Public Insurance against Idiosyncratic and Aggregate Risk: The Case of Social Security and Progressive Income Taxation

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Abstract

In this paper I discuss the role a progressive income tax system and a redistributive pay as you go (PAYGO) social security system can play in insuring and reallocating idiosyncratic as well as aggregate risk. I also argue that the underlying source of market failures generating such a role for government intervention may be crucial when determining the normative consequences of such social insurance.

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1 Introduction

In many industrialized countries, mayor reforms of the social insurance system are currently being discussed. Fundamental reforms of the social security system, the (financing of the) health care system, the public unemployment insurance programs as well as far-reaching reforms of the progressive income taxes are on the political agenda in many European countries as well as in the U.S. Scientifically informing this debate is an important task for researchers in the field of public finance.

Why do modern societies have implemented these social insurance schemes? Because an individual household faces substantial risk over her lifetime. This risk may take the form of aggregate risk or idiosyncratic risk, that is, it may affect the entire economy or it may be specific to the individual household.[1] Examples of important idiosyncratic risk include mortality risk, labor income risk (both through unemployment shocks as well as shocks to relative wages) as well as health risk. Aggregate shocks change economy-wide wages and returns to capital, sometimes dramatically, as in the great depression in the early 1930's.

If private financial markets provide imperfect insurance against this risk there is potential room for government intervention. In this article I will discuss, without attempting to provide a comprehensive survey, the role of two important policies that my own research has identified as quantitatively important in providing social insurance against risk, namely unfunded social security and progressive income taxation. Special emphasis will be devoted to the role that imperfect *private* insurance markets play for the analysis, as well as to a discussion of different approaches to model and justify incomplete financial markets.

This paper is organized as follows. In the next section I will attempt to make the case that a pure pay as you go social security system (in subsection 2.4) and progressive income taxes (in subsection 2.5) may play a quantitatively important role in insuring idiosyncratic risk, in the absence of private insurance markets that can attain the same role. I will first describe the class of models that I think are useful to make this point (in subsection 2.1), then briefly discuss the policy thought experiments carried out (in subsection 2.2), and then outline the basic effects of the policies under consideration (in

[1] Of course idiosyncratic shocks may be correlated with aggregate shocks; for example, the size of individual income shocks may increase in recession. I chose to present the arguments in this paper in this dichotomy for ease of exposition purely.

subsection 2.3), before turning to the substantive results.

I then argue in subsection 2.6, for the example of progressive income taxes, that the reason for why private insurance markets against idiosyncratic income risk are absent or imperfect may play a crucial role for an evaluation of the desirability of public insurance against this risk. In particular I demonstrate that, if the sources of market incompleteness are modeled explicitly and the structure of private financial markets responds endogenously to changes in tax policy it may be possible that an increase in the provision of public insurance crowds out private insurance, potentially more than one for one.

Finally, in section 3 I will demonstrate that an appropriately designed social security system can help to efficiently reallocate the consequences of aggregate shocks, if these shocks affect wages and interest rates differentially and the world is populated by agents of different ages. Again, if these agents could trade a full set of private financial contracts whose payoffs are contingent on the realization of the aggregate uncertainty, then the role of social security to provide an improved allocation of risk across generations would be greatly diminished. Section 4 concludes the paper with an outlook on open research questions in the field identified by the research discussed in this survey.

Before delving into my analysis a word of caution is in order. I am not attempting here to provide a comprehensive survey of the literature, this is excellently done elsewhere.[2] I am merely giving a progress report on my own research about the role of social insurance policies in general, and social security as well as progressive income taxation in particular, in insuring idiosyncratic as well as aggregate shocks. As such this survey is necessarily biased by my own views and towards my own work; my apologies for this in advance.

2 Government Insurance against Idiosyncratic Risk

Idiosyncratic risk is large. The conditional variance of household-level income in the U.S. is an order of magnitude bigger than the conditional variance of

[2] See, e.g. Atkinson (1987), Chari and Kehoe (1999), Salanie (2003) or Feldstein and Liebman (2006).

aggregate income (GDP). There are a variety of mechanisms a household has access to in order to insulate consumption from random individual income fluctuations, from formal market insurance, self-insurance through precautionary saving to informal risk sharing arrangements among extended family members and friends.

While some papers with more empirical focus have attempted to assess how effective these mechanisms are in helping households to smooth consumption in the light of idiosyncratic shocks and to quantify the welfare losses from imperfectly being able to do so,[3] this section focuses on the role public insurance, in the form of social security and a progressive income tax system, can play.

Specifically, I want to ask and answer the following questions. How important are the welfare gains of improved insurance due to these programs quantitatively, relative to the potentially adverse distortionary impact these programs have on labor supply and capital accumulation? Who are the winners and losers from potential tax and social security reforms, both in the short and in the long run? How does an optimal policy that balances incentive effects, insurance and redistribution look like?

In order to answer the question posed in the previous paragraph one needs a quantitative model with at least the following elements a) idiosyncratic risk that is at least partially uninsurable on private financial markets b) endogenous capital formation c) a nontrivial life cycle structure and d) a government that administers social insurance programs that have the potential to provide a partial substitute for missing private insurance markets. The pioneering work by Auerbach and Kotlikoff (1987) developed an OLG model with many generations and a neoclassical production sector that employs capital as a factor that can be accumulated to study, using numerical methods, the impact of fiscal policy (taxation, social security). Since then many papers have incorporated idiosyncratic risk, mainly with respect to longevity and labor earnings, into the original Auerbach and Kotlikoff model, typically assuming that these risks, especially labor income risks, are uninsurable on financial markets. Imrohoroglu et al. (1999) and Rios-Rull (1999) provide excellent surveys of the literature, both in terms of the substantive findings as well as the methods used to derive them.

[3] See, e.g. Dynarski and Gruber (1997) or Krueger and Perri (2004, 2005a).

2.1 Key Model Elements[4]

On the production side the model used to answer the policy questions is the standard one-sector neoclassical growth model in which capital and labor is used to produce a single output good that can be used for both consumption and investment purposes. Capital depreciates at a constant rate δ and there is labor-augmenting technological progress at constant rate g, consistent with the existence of a balanced growth path.

Households in our artificial economy face the most important idiosyncratic risks that actual households in the real world are confronted with. First, while there is a maximum number of years a household can survive (say, until age 100) at each age there is a certain (age-specific) conditional probability that the household will die at that age. In the light of this longevity risk, and assuming that the household has a precautionary motive and no access to actuarially fair annuity markets, she will decide to accumulate more assets than under complete lifetime certainty, with the risk of leaving unintended bequests should she die prematurely.

Second, households face idiosyncratic income risk (or wage risk, if labor supply is modeled as being a choice variable, as in most of the analysis below).[5] Again, absent explicit private insurance markets for this risks households will attempt to self-insure by building up precautionary savings that can be used to stabilize consumption. Given these idiosyncratic risks, and given government policies that define the general income tax code, social security taxes and benefits, in every period a household makes three decisions, namely how much to work, how much to save using a one-period risk free bond and how much to consume.

Therefore the households maximize lifetime utility

$$E\left\{\sum_{j=0}^{J}\beta^{j}\frac{\left(c_j^{\omega}(1-l_j)^{1-\omega}\right)^{1-\sigma}}{1-\sigma}\right\},$$

with respect to streams of consumption and leisure, $\{c_j, 1-l_j\}$. Here β is the time discount factor, σ is the coefficient of relative risk aversion and E

[4] In order to keep this paper nontechnical only a verbal description of the model economy follows. For a formal set-up of the model and definition of equilibrium see Conesa and Krueger (2005).

[5] For the quantitative properties of the model the exact specification of the stochastic income process is important. The analysis discussed below uses the estimates of Storesletten et al. (2004) from the PSID for the persistence and variability of these shocks.

the expectations operator. Idiosyncratic, age-dependent conditional survival probabilities ψ_j introduce lifetime uncertainty into the household's decision problem.

In a typical period the household faces a budget constraint of the

$$c + a' = (1 - \tau_{ss}) w \varepsilon_j \theta \eta l + (1 + r)(a + Tr) - T[y]$$

for nonretired households and

$$c + a' = SS + (1 + r)(a + Tr) - T[y]$$

for retired households. Here c is consumption in the current period, and a' are the purchases of one period real risk free bonds. Income is generated from bonds purchased yesterday, a, from accidental bequests of households that died prematurely and whose assets are redistributed in a lump-sum fashion. Furthermore the household works l hours, for a wage per efficiency unit w, and labor productivity is given by $\varepsilon_j \theta \eta$, further explained below. Labor income is subject to a social security payroll tax. Finally the household pays taxes according to the tax schedule T, which may be levied on consumption, labor and capital income, depending on the context. The vector y describes the relevant tax base. The budget constraint of a retired household looks similar, but the household earns lump-sum social security benefits SS rather than labor income. Consumption, labor supply and bond holdings are required to be nonnegative (i.e. households face borrowing constraints, and the constraint $l \leq 1$ captures the restriction that households cannot work more than 100% of their time.

A detailed comment on labor productivity $\theta \varepsilon_j \eta$ is in order. labor productivity. The term ε_j is a deterministic age component and assures that in the model wages are hump-shaped over the life cycle, as observed in the data. The component θ is a fixed effect, standing in for unmodeled heterogeneity with sources before labor market entry (such as education, innate ability etc.). The presence of this component induces a potential motive of the policy maker for redistribution among different θ-types, depending on the social welfare function. Finally, the term η is a stochastic shock to labor productivity, and follows a Markov chain with transition matrix

$$\pi(\eta' | \eta) > 0$$

It is this model element that introduces idiosyncratic income risk into a households life, and thus generates a potential role for government social insurance policies to help households hedge against this labor income risk.

In our model a continuum of households interact in general equilibrium, as in Bewley (1986), Huggett (1993) and Aiyagari (1994). The key market clearing conditions that determine real wages and real returns to capital (real interest rates) are the labor market and the capital market clearing condition. The former equates labor demand by firms to labor supplied by households, the later equates the capital stock used in production (plus potentially the supply of government bond) to total desired asset holdings by households. The government administers a pure PAYGO social security system whose budget is balanced. In addition, it finances government consumption through tax revenues in order to balance the budget in every period as well.

2.2 Thought Experiments

For a fixed policy a stationary equilibrium is given by distribution of households by age, wealth levels and income (or labor productivity) levels that remains constant over time. While individuals age, change their position in the income and wealth distribution due to idiosyncratic income shocks, the distribution itself is stationary. A policy reform which is assumed to be unexpected[6] then sends the economy on a transition path to a new stationary equilibrium associated with the new policy. As we will argue below, an explicit consideration of the transition path is often crucial for evaluating the aggregate and welfare consequences of a policy reform; simply comparing steady states may give very misleading results.[7]

2.3 Trade-offs in the Policies under Consideration

The two government policies under investigation, a PAYGO social security system and (potentially progressive) income taxation affect the household's after tax income profile over the person's life cycle, possibly distorting consumption, labor supply and saving decisions.

On the other hand these policies may play an important role in insuring idiosyncratic shocks, by in part providing explicit substitutes for missing

[6] If the policy reform is expected in advance the economy enters the transition path the moment the reform is announced or becomes known, and not only when it is executed.

[7] It is the explicit calculation of a transition path which changing cross-sectional wealth distributions, however, that leads to a considerable additional computational burden; for the technical details see Rios-Rull (1999), for a detailed algorithm for a particular example involving social security reform, see Conesa and Krueger (1999).

private insurance markets (e.g. social security for mortality risk), in part by reducing the income risk faced by individuals via progressive income taxation or a social security system where benefits are imperfectly linked to contributions. Exactly because these risks are big for individual households, but are idiosyncratic in that they average out in the aggregate, they suit themselves very well for the provision of social insurance, again in the absence of private insurance that may serve the same function.

Finally, to the extent that an equitable distribution of welfare is deemed desirable by the policy makers, progressive income taxation and a redistributive social security system may serve an important function towards realizing this goal.[8] All three effects of fiscal policy are present in our analysis, and thus quantitative dynamic general equilibrium analysis attempts to uncover their relative importance for allocations and welfare.[9]

2.4 Mortality Risk, Income Risk and Social Security Reform

In the presence of idiosyncratic mortality and labor income risk and absence of explicit insurance markets (annuity markets and private unemployment or wage insurance) against these risks a social security system may provide a partial substitute. This is obvious for mortality risk, since social security pays benefits as long as one lives, and thus insures households against the risk of living too long. With respect to income risk the argument for social security is more subtle. If benefits are not (or only imperfectly) linked to one's own tax contributions and if social security taxes take the form of proportional labor income taxes, then the social security system partially

[8]Often what is insurance from an ex-ante perspective is redistribution ex post. For example, in a world with agents that differ by their permanent level of labor productivity, behind the Rawlsian veil of ignorance a progressive income tax system provides insurance against being born a low-productivity agent, while ex post it redistributes between permanently labor-income poor and labor-income rich households.

Whenever needed we use the (somewhat arbitrary) convention that characteristics realized before economic birth (i.e. labor market entry in our model) fall under the heading redistribution whereas household characteristics realized during the household's lifetime (such as labor income or mortality shocks) fall under the heading insurance.

[9]Many papers, most of them using static models, have studied the trade-off between either equity and efficient labor supply (see e.g. the seminal paper by Mirrlees (1971)) or efficient labor supply and social insurance stemming from progressive taxation (see e.g. Mirrlees (1974) and Varian (1980)).

insures households against income risk, by providing those that had bad income realizations with higher pension benefits than justified based on their own past contributions. From an ex-ante perspective and absent any other private or public mechanisms (such as a progressive income tax code) that provide insurance against random income fluctuations over a households' lifetime this income insurance aspect of social security is beneficial. On the other hand, the less benefits are tied to own contributions, the more is the social security payroll tax perceived as a pure and distorting labor income tax. In addition, the unfunded nature of most social security taxes may reduce national saving and thus the aggregate capital stock.

In the discussion about reforming PAYGO social security system towards systems that rely more on private, funded pension accounts (the Riesterrente in Germany, President Bush's social security reform proposal) it has gone relatively unnoticed[10] that with a partial privatization some of the positive income insurance effects from social security may be lost, at least in countries that have social security systems in which benefits are only very imperfectly linked to contributions, such as the U.S. or the UK.[11]

In Conesa and Krueger (1999) we use the model described above to simulate transitions of the U.S. economy with a PAYGO, redistributive social security system towards a privatized system that does not include any explicit or implicit insurance component against idiosyncratic income risk. First, comparing steady states we find that the welfare gains from privatization are substantial, in the order of 12% of consumption per period for a newborn agent. These gains are mainly due to a substantial increase in the aggregate capital stock driven by stronger private incentives to save for retirement. However, the welfare gains are substantially smaller than the increase in per capita consumption (which increases by about 13%) because the PAYGO social security system provided welcome consumption insurance against idiosyncratic income shocks.

Even more important is the insurance role for social security when taking explicitly into account the fact that a transition to the new steady state requires time and resources to build up the higher capital stock. Our method-

[10] In a recent paper Fehr and Habermann (2005) highlight the potential welfare gains from introducing a social security system with a progressive benefit schedule in Germany which has better insurance properties than the current system in which benefits are tightly linked to contributions.

[11] Usually these plans come with some form of annuitization of retirement wealth to deal with the mortality risk.

ology allows us to calculate the welfare consequences of a social security reform for all agents currently alive, to document who are the winners and the losers of the reform, and to provide a head count for the share of winners. Depending on the exact assumptions about the timing of the phase-out of PAYGO social security the number of winners differs somewhat. In all our experiments it includes young households, and middle aged households with relatively few assets which are not affected severely by the decline in interest rates due to increased private saving. In stark contrast to the steady state welfare results, only a minority of households currently alive benefit from the reform, the share ranging from $20 - 30\%$. Finally, the share of winners decreases substantially in a world with, relative to a world without labor earnings uncertainty, indicating that the loss of insurance due to the abolition of the PAYGO social security system tilts the welfare balance for many households. For our benchmark scenario that analyzes a rapid phasing-out the fraction of reform supporters (judging by the welfare consequences of the reform) falls from 40% without income risk to 20% with severe (that is, realistic) idiosyncratic income risk.

These results paint a bleak picture for the political feasibility of social security reforms towards more funded systems; despite potentially large long-run welfare gains. The transition costs and the loss of insurance costs may generate too many losers of the reform in the short run. At least two qualifying remarks about this conclusion are in order. First, the hypothetical reforms envisioned in Conesa and Krueger (1999) were by no means optimal. Recently Conesa and Garriga (2005) have documented that in a realistically calibrated large scale OLG model (in which idiosyncratic income and mortality risk, and thus the insurance of social security is absent) a Pareto improving social security reform towards a fully funded system can be implemented if the policy maker uses the reform to cleverly reduce distortions of the (social security) tax system.[12]

Secondly, the main problems leading to the pessimistic conclusions of Conesa and Krueger (1999) are that the welfare gains from the reform lie too far in the future for currently alive households to matter, and that these households lose income insurance from social security. However, Fuster et al. (2006) demonstrate that if household members are altruistically linked with each other they may be able to compensate for the loss of insurance by using

[12] The theoretical possibility of this result was documented already by Homburg (1990) in a simple two-period OLG model.

private transfers among members of different generations. And, of course, agents alive today may now value the welfare gains their children may enjoy from the reform in the future.[13] For reforms similar to the ones for which Conesa and Krueger found support of about $20 - 30\%$ of the population, Fuster et al. (2006) document support of more than 50%.

2.5 Optimal Progressive Income Taxation

While a redistributive social security system may play a useful role in insuring households against idiosyncratic income risk, there are of course more direct ways for the government to achieve this goal. By implementing a progressive income tax code the government reduces the variance of after-tax incomes, relative to pre-tax incomes, something that may be welcomed public insurance for households from an ex-ante point of view. In addition progressive taxes enhances a more equal distribution of income and thus welfare among ex-ante different households, an effect that may increase social welfare, depending on the social welfare function used to aggregate expected lifetime utilities of these different households.

However, progressive taxation has the undesirable effect that it distorts incentives for labor supply and saving (capital accumulation) decisions of private households and firms. The policy maker thus faces nontrivial trade-offs when designing the income tax code, especially in dynamic settings where household incomes are changing over time.[14] In Conesa and Krueger (2005) we therefore ask the simple question how progressive (if at all) the optimal income tax code is, in a realistically calibrated large scale OLG model described above where all three effects (insurance, redistribution, labor supply and savings incentives) are present.[15]

[13] They also stress the importance of endogenous labor supply responses to the policy reform in their paper.

[14] There is a large literature on optimal taxation in a static context which, while providing many useful results and intuition for the findings to be reviewed here, cannot be discussed here because of space constraints. Chari and Kehoe (1999) and Salanie (2005) provide excellent surveys of this literature.

[15] There is a sizeable literature studying the allocative and welfare consequences of a given tax reform in dynamic models similar to ours, without studying the *optimal* tax system. Examples include Castañeda et al. (1999) and Ventura (1999), Altig et al. (2001), Domeij and Heathcote (2004) and Nishiyama and Smetters (2005). Saez (2002) analytically characterizing the optimal progressivity of capital income taxes alone, specifically focusing on the tax treatment of households at the upper tail of the wealth distribution.

In our model the government has to finance a fixed exogenous amount of government spending via proportional consumption taxes, taken as given in the analysis, and income taxes, whose optimal design we want to study. In order to make our question operational (that is, computable) we need to make two crucial, and by no means noncontroversial choices. First we need to define what we mean by optimal. We call the income tax system optimal that maximizes the steady state ex-ante expected utility of a newborn agent, before it is known with which ability level (and thus earnings potential) that agent will be born (i.e. looking upon her future life from behind the Rawlsian veil of ignorance). Second, we need to determine a class of tax functions that is flexible enough not to impose too many restrictions on how an optimal income tax code can look like, but is tractable enough that one can maximize over this set.

Letting $T(y)$ denote total taxes paid by an individual with pre-tax income y, the tax code is therefore restricted to the functional form

$$T(y) = a_0 \left(y - \left(y^{-a_1} + a_2 \right)^{-\frac{1}{a_1}} \right) \tag{1}$$

where (a_0, a_1, a_2) are parameters. This functional form nests a poll tax ($a_1 = -1$), a purely proportional system ($a_1 \to 0$) and a wide range of progressive tax systems (for all $a_1 > 0$). As argued by Gouveia and Strauss (1994) for the right choices of parameters this tax code provides a good approximation to the effective (as opposed to statutory) income tax code in the U.S. It also allows us to search over a wide range of potential tax codes by simply maximizing over two parameters (the third is determined by budget balance of the government).[16]

We find that the optimal income tax code is well approximated by a proportional income tax with a constant marginal tax rate of roughly 17%

Reiter (2004) focuses on optimal nonlinear capital taxation as well.

One serious omission in our dynamic analysis that may bias our results in favor of more tax progression is the exogeneity of the human capital accumulation decision. If human capital accumulation is an engine of growth as in Benabou (2002) and Caucutt et al. (2003), and progressive taxation slows that engine down, then such a policy may be uncalled for, given that policies that adversely affect (long run) growth rates tend to have severe welfare consequences.

[16]This functional form also has theoretical appeal, as has its foundation in the equal sacrifice approach (see Berliant and Gouveia (1993)), where taxes are set such that every taxpayer loses the same (proportion of) utility from the reduction of income.

and a fixed deduction of roughly $9,400.[17] Relative to the actual U.S. income tax code as approximated by Gouveia and Strauss (1994) with the optimal tax system aggregate labor supply is 0.54% higher and aggregate output is 0.64% higher than in the benchmark tax system, even though average hours worked decline by about 1%, reflecting a shift of labor supply from low-productivity to high-productivity individuals. In terms of the distributional consequences we find that households with annual income below around $18,200 and above $65,000 receive a tax cut in the optimal system whereas the middle class faces substantially higher income taxes. Evidently, since the optimal tax code maximizes steady state welfare of a newborn this tax code generates welfare gains, relative to the status quo. These amount to a significant 1.7% uniform increase in consumption across all periods and states of the world of a newborn's life.

Where do these welfare gains come from? Reducing marginal tax rates for high earnings (potential) households increase labor supply and savings incentives for these agents, and the deduction efficiently implements the desired amount of redistribution and insurance. That these motives are important for the government is demonstrated by the result that a pure flat tax, without deduction, leads to a *reduction* in welfare by close to 1%, even relative to the U.S. benchmark, even though aggregate output rises by 9.0%.[18]

2.5.1 A Remark on Labor versus Capital Income Taxes

So far the income tax code was restricted to not discriminate between the sources of income. However, since the seminal papers by Chamley (1986) and Judd (1985) the result that the optimal capital income tax, at least in the long run, is equal to zero, was shown to be very robust (for a recent survey, see Atkeson et al., 1999). So could it have been that the reason a flat tax plus deduction was found to be optimal in the previous section was that such a tax code best mimics the zero capital income tax result? One can address this issue by simply repeating the analysis, but allowing for

[17] As such it comes relatively close to the flat tax reform advocated by Hall and Rabushka (1995).

[18] In contrast to the previous section where substantial steady state welfare gains were wiped out along the transition, explicitly computing the transition path and the welfare consequences for agents living through the transition shows that a majority of 62% of all agents currently alive would obtain welfare gains from such a reform. The main group losing out, and hence most likely opposed to the reform is, consistent with our steady state findings, the middle class (defined median labor earnings and wealth).

separate tax functions being applied to labor and capital income. In ongoing work with Juan Carlos Conesa and Sagiri Kitao we found that the answer to this conjecture is negative. Optimizing over a progressive labor income tax code and a proportional capital income tax code we find that not only are optimal capital income taxes positive, but they are substantially positive, in the order of 36%, thereby exceeding marginal labor income taxes at any income level. The labor income tax schedule is roughly a proportional tax code with a tax rate of 23% and a deduction of about $\$6,000$, or about 17% of average household income. The fact that the deduction now is somewhat smaller than in the previous analysis suggests that capital income taxation plays some role in providing redistribution. It is also the high capital income tax that, by reducing capital accumulation and thus output, is responsible for driving average tax rates higher than in our previous study where the tax code could not discriminate between the source of income.

What is the intuition for this result. First, in an OLG model with an explicit life cycle structure Erosa and Gervais (2002) and Garriga (2003) show *theoretically* that if the tax code is restricted to be anonymous (that is, taxes paid only depend on taxable income, but not on household characteristics such as age) then the capital income taxes should not be equal to zero.[19] But this does not explain why capital income taxes are substantially different from zero, and even higher than labor income taxes. We conjecture that crucial for this result is how elastic capital accumulation and labor supply are with respect to their corresponding marginal tax rate. Those contributing most to the tax revenue of the government in our life cycle economy are middle-aged individuals which are both highly productive in their jobs (and hence have high labor income) and are in the process of accumulating savings for retirement. The crucial question in determining the optimal mix of taxes is then how elastic is labor supply and savings of this group of the population to labor and capital income taxes, respectively. As a matter of fact these agents supply labor quite elastically, whereas (life-cycle) savings are quite inelastic with respect to the after-tax interest rate. Consequently the capital income tax is substantial, a finding that seems robust to a wide range of preference specifications that imply labor supply elasticities of magnitudes estimated in

[19] Hubbard and Judd (1986) first demonstrated, via simulation results, that in a life cycle model with borrowing constraints the optimal capital income tax may be positive, because a shift to labor income taxes reduces after-tax labor income and thus tightens the constraint. Even in the infinite horizon model with idiosyncratic uninsurable income uncertainty Aiyagari (1995) argues that capital income ought to be positive.

the empirical labor literature.

Aiyagari (1995) shows that the presence of uninsurable idiosyncratic labor productivity risk may lead to capital income taxes that are positive. In order to evaluate the importance of this model element we characterize the optimal tax code in the absence of idiosyncratic uncertainty, and also eliminate ex-ante permanent heterogeneity in labor productivity. First results indicate that the optimal labor income tax schedule not progressive anymore, and that capital income taxes are even higher.[20] Hence the presence of idiosyncratic risk *reduces* the optimal capital income tax. How does this result square with Aiyagari's (1995) findings? He compares the market equilibrium to what a social planner would choose which is not bound by the restriction on allocations that missing insurance markets against idiosyncratic risk imposes. If even the social planner cannot change the condition that any allocation chosen has to be implementable with the given (incomplete) market structure, then Davila et al. (2005) show that the social planner would likely opt for a *higher* capital stock than arising in the market equilibrium without taxes. In this sense, there is *under*accumulation in the market equilibrium with uninsurable idiosyncratic risk, As a consequence, the presence of this risk calls for lower capital income taxes, and reversely, abstracting fro this risk drives optimal capital income taxes up.

Finally, it is fairly easy to generate optimal capital income taxes close to zero in our model. This requires, however, that government has accumulated so much negative debt (that is, it owns assets) that it can finance almost all government outlays by interest earned on these assets. Then there is little need to tax, and thus little need to raise revenue from capital income taxes.

2.6 Public versus Private Insurance

In the previous two subsections the insurance role of a redistributive social security system and the progressive income tax system arose from the incompleteness of private insurance markets which was exogenously assumed, rather than derived as an equilibrium outcome. While there are many reasons for imperfect private insurance markets, the reasons most frequently given center around private information/moral hazard problems (see e.g. Golosov et al. (2003)) and limited enforcement of private insurance contracts. I

[20] While the optimal marginal (and average) labor income tax rate is 11.4% the corresponding capital income tax rate is 41.8%.

now demonstrate that if one models the frictions that lead to incomplete risk sharing explicitly, then the public provision of insurance may adversely affect the way private insurance markets work. Borrowing from work with Fabrizio Perri (Krueger and Perri, 2005b), I show that if private income insurance is limited because private insurance contracts can only be enforced through exclusion from participating in financial markets in the future, then the provision of public insurance crowds out the provision of private insurance against idiosyncratic uncertainty, potentially more than one for one.[21] In contrast to the results in the previous subsections, now by attempting to provide better public insurance against idiosyncratic income risk the government may achieve exactly the opposite, namely a worse risk allocation of private consumption.

This result confirms Stiglitz' (1981) concern about the lack of modelling the underlying frictions that are the source of market incompleteness: "Without a clear specification of the information/transactions technology, there is always a danger that any intervention in the economy designed, say, to alleviate problems arising from an absence of risk markets will be either infeasible or so costly to implement that it would not, in fact, constitute a Pareto improvement, for precisely the same reasons that the markets were absent in the first place." This concern should always be kept in mind when interpreting the positive insurance role of public insurance programs pointed out in previous subsections.

While in Krueger and Perri (2005b) we quantify the size of the crowding out effect in a realistically calibrated stochastic dynamic general equilibrium model of the sort used in the previous subsections[22], here I contain my exposition to a simple model to make the conceptual point.

2.6.1 A Simple Model with Two Agents[23]

The economy is populated by two agents that live forever and have risky income y that can take either of two values $\{y_l, y_h\} = \{1-\varepsilon, 1+\varepsilon\}$ with equal probability $p = 0.5$. Here $\varepsilon \in [0, 1)$ measures the amount of income risk

[21] Attanasio and Rios-Rull (2000) arrive at a similar conclusion, in a model where a small number of agents engage in private insurance arrangements. Andolfatto (2002) uses the same ideas to construct a theory of inalienable property rights.

[22] We ignore the life cycle dimension of the model used previously, though.

[23] Equilibria in models with a continuum of agents and enforcement frictions are analyzed analytically in Thomas and Worrall (2004) and Krueger and Perri (2005b).

each agent faces. We assume that income is perfectly negatively correlated between the two agents, so that while per capita income in the economy is always constant at 1, which of the two agents is rich is random.

Agents have standard time-separable preferences over consumption streams given by

$$U(c^i) = (1-\beta)E\sum_{t=0}^{\infty}\beta^t u(c_t)$$

where u satisfies the usual properties[24] and expectations E are taken with respect to the stochastic process governing individual income.

I model the tax system as a simple linear tax system with marginal tax rate τ and deduction d, so that total taxes paid as a function of current income y are given by

$$T(y) = \tau y - d$$

Assuming that the government balances the budget in every period we obtain, using the fact that per capita income is equal to 1 in every period, that

$$d = \tau * 1 = \tau$$

Consequently an agents' after tax income can take two values,

$$\begin{aligned} e_l &= 1-(1-\tau)\varepsilon \\ e_h &= 1+(1-\tau)\varepsilon \end{aligned}$$

which depend both on the extent of income risk ε and the progressivity of the income tax code, as measured by τ. For $\tau > 0$ the tax system is progressive, for $\tau = 0$ it is proportional and for $\tau < 0$ it is regressive.

2.6.2 Private Insurance as a Function of the Tax System

The variance of after tax income in this simple world is easily calculated as

$$Var(e) = (1-\tau)^2\varepsilon^2$$

so an increase in τ (making the tax system more progressive) evidently reduces the variance of after-tax income. If households have no access to private

[24] That is, u is continuous, twice differentiable, strictly increasing and strictly concave on $(0,\infty)$ and satisfies the Inada conditions. Furthermore the discount factor β is positive and less than 1.

financial markets at all, then they have to consume the autarchic allocation $c_t = e_t$ in all periods, and evidently a more progressive tax system, by providing social insurance against income shocks, is preferred to a less progressive tax system by all agents from an ex-ante point of view (e.g. before income uncertainty is revealed). While the model with incomplete financial markets used in the previous subsection was a great deal more complicated, at the heart of the positive insurance role of public policy was this reduction in after-tax incomes of households.

Now I want to investigate what happens in a world where the extent to which private insurance operates depends endogenously on the tax system. To that affect I assume that the two households can potentially enter arbitrary insurance contracts with each other. The only friction that prevents perfect insurance (which is the ex ante desired outcome for both agents) is that both households cannot commit to honor the insurance contract ex post. In particular, at each time and after every possible income realization both households have the option to default on the mutual insurance contract, the consequence of being excluded from future insurance.

Consumption allocations that are not subject to the incentive to default therefore have to satisfy the incentive constraints

$$\begin{aligned} u(c_t) + E_t \sum_{s=t+1}^{\infty} \beta^{s-t} u(c_t) &\geq u(e_t) + E_t \sum_{s=t+1}^{\infty} \beta^{s-t} u(e_t) \\ &\equiv V^{Aut}(e_t) \end{aligned} \tag{2}$$

These constraints simply say that at every point of time both agents are weakly better off remaining in the insurance contract with each other than defaulting and living in financial autarchy from that point on.[25]

Crucially, the consequences of default depend on the after-tax income process and thus are affected by the tax system. In economic terms, while agents can be excluded from financial markets for bad behavior, they cannot be excluded from social insurance by the government.

Given a tax system and letting the two households trade insurance contract that satisfy the no default constraints (2) results in a consumption allocation that provides maximal insurance, subject to the constraint that

[25] Krueger and Uhlig (2006) model the outside option as being determined endogenously by perfect competition of insurance companies for households, rather than as financial autarchy. Kletzer and Wright (2000), in the context of the sovereign debt literature allow for collusion among insurance companies (or banks, in their context).

none of the two agents is ever better off in autarchy.[26] [27] At every point of time one of the two agents has the higher after-tax income e_h, and it is that agent that has the incentive to default in the current period, since if she does not, the private insurance contract stipulates her to share some of her income with the other agent. Therefore it is not surprising that the equilibrium consumption allocation is given by the following rule: the agent with the currently high income e_h consumes consumption $c_h \geq 1$ and the currently poor agent consumes $c_l = 2 - c_h$. One may interpret the excess consumption of the currently rich $c_h - 1$ as the bribe it takes to keep that agent from defaulting. This bribe is determined as follows. Let $V(c_h)$ denote the *lifetime* utility of the agent who consumes c_h today and any time in the future her income is equal to e_h, and who consumes c_l whenever income is low, e_l. The number c_h is then given as the smallest solution to the equation

$$V(c_h) = V^{Aut}(e_h), \tag{3}$$

that is, it is the smallest bribe that makes the currently rich agent indifferent between defaulting or not.[28]

For the purpose of this paper the crucial aspect is that the degree of consumption insurance that can be attained through private contracts is

[26] We will focus our discussion on symmetric and stationary allocations. Symmetry simply means that both agents have consumption allocations that simply depend on their income history, but not their name in addition. Kehoe and Levine (2001) show that the first time an incentive constraint binds for any of the agent, the continuing allocation is stationary.

[27] There are several market arrangements that implement the allocation to be described; it arises as equilibrium outcome in an Arrow-Debreu world with the incentive constraints placed in the individual consumption sets (see Kehoe and Levine, 1993), it comes about in a model where both agents trade Arrow securities subject to state contingent solvency constraints (see Alvarez and Jermann, 2000) or it can be implemented as a subgame perfect equilibrium in a repeated game (see Kocherlakota, 1996).

[28] This result is established in Kehoe and Levine (2001) and used by Krueger and Perri (2006) in their study of consumption inequality in the U.S.

$>$From the definition of $V(c_h)$ and $V^{Aut}(e_h)$, it is easy to see that $c_h = e_h$ (that is, autarchy) is a solution to this equation, but not necessarily the smallest one. It is also easy to see that autarchy can be the only solution; if for example $\beta = 0$ and agents only care about present consumption, then the rich agent does not value future insurance and is unwilling to share income today to any extent.

I am implicitly assuming that perfect consumption insurance is not possible since it violates the incentive constraint. If $u(1) \geq V^{Aut}(e_h)$, then the incentive constraints are not binding and the equilibrium allocation is given by perfect consumption insurance. It is easy to show that for β big enough this situation arises.

affected by the tightness of constraint (3). A change in the progressivity of the tax system not only changes the riskiness of after-tax income, and thus the need for private insurance, but also the possibility of private insurance. If a change in τ makes it more attractive to live in financial autarchy, then less private insurance is implementable with contracts that will not be defaulted on. We now want to investigate the extent to which this happens.

It is easy to solve for the utility from consuming the autarchic allocation of the agent with the currently high income,

$$V_h^{Aut} = V^{Aut}(e_h) = \left(1 - \frac{\beta}{2}\right) u(1 + \varepsilon(1-\tau)) + \frac{\beta}{2} u(1 - \varepsilon(1-\tau))$$

that is, it is a weighted average of utility from high and low after-tax income. Consequently an increase in tax progression τ reduces consumption risk in autarchy, but also reduces current consumption of the rich agent in autarchy. Because of these two counteracting effects the overall impact of τ on lifetime utility from autarchy is ambiguous.

However, close inspection of the expression for $V^{Aut}(e_h)$ shows that there is a range of tax rates τ such that an increase in tax progression τ increases $V^{Aut}(e_h)$. Therefore if the government chooses to attempt to provide more social insurance, it makes the incentives to default on private insurance contracts stronger for the currently rich agent.[29] As a consequence c_h increases;

[29] The details are as follows. Define the range of relevant tax rates to be $\tau \in [-\frac{1-\varepsilon}{\varepsilon}, 1] \equiv \mathcal{T}(\varepsilon)$. At the lower bound of this range after tax income of the income-poor agent equals 0, at the upper bound of tax progressivity after tax incomes are equalized.

Holding fixed income risk ε, straightforward calculations show that $V^{Aut}(e_h)$ is strictly concave in τ, strictly increasing at $\tau = -\frac{1-\varepsilon}{\varepsilon}$ and strictly decreasing at $\tau = 1$. It therefore has a unique maximum at τ^*. There are three regions for τ, as shown in figure 1. For very regressive tax systems $\tau \in [-\frac{1-\varepsilon}{\varepsilon}, \hat{\tau}]$ the utility from autarchy is so low (because of the high consumption risk in autarchy) that the incentive constraint even for the rich agent is not binding. The equilibrium allocation is given by perfect consumption insurance, and a marginal change in tax progression does not have any impact on realized consumption risk.

For very high tax progressivity $\tau \in [\tau^*, 1]$ the resulting equilibrium allocation is autarchy itself, since, due to the generous provision of public insurance autarchy is not a bad thing for the currently rich household. Thus the incentive constraint is very tight, allowing no further privately administered risk sharing among the agents. Evidently in this range an increase in the progressivity of the tax code reduces the variance of after-tax income and thus consumption (since the equilibrium allocation is autarchy).

But finally, in an intermediate range $\tau \in (\hat{\tau}, \tau^*)$ we observe that the value of autarchy is increasing in tax progression τ, tightening the constraint. In this range a tighter constraint individual agents' consumption is more risky with a more progressive tax system. In other words, the provision of more public insurance crowds out private insurance more than one for one. Since the way private insurance markets work respond endogenously to the tax system, in contrast to a world where markets are incomplete for reasons exogenous to the model now the provision of social insurance may be counterproductive for social welfare. Note that this result is obtained in a model in which progressive taxes, in contrast to the previous section, have no adverse effects on labor supply and capital accumulation by construction. This result should serve as warning that when making the case for publicly provided insurance against idiosyncratic shocks one may need to be explicit about why private insurance markets are inoperative.

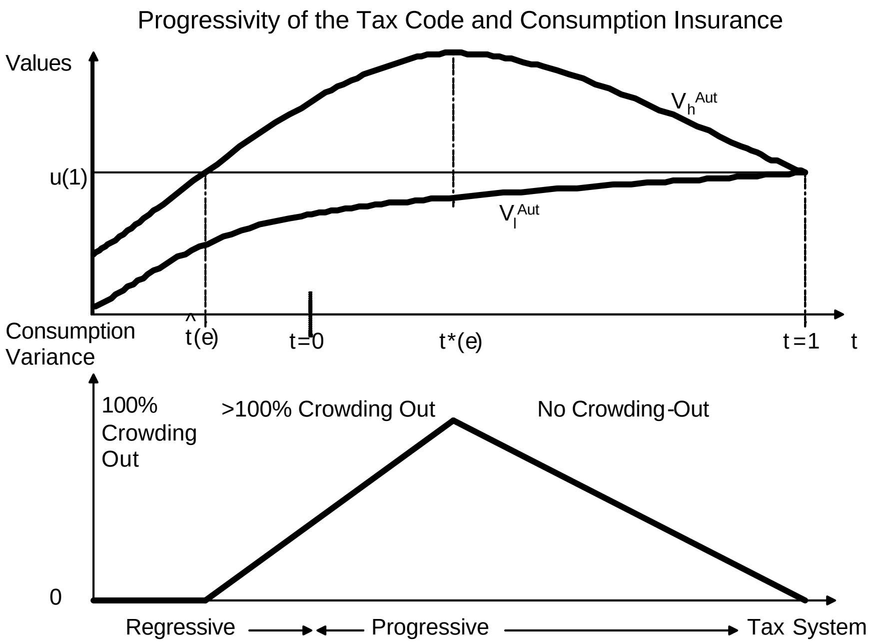

Figure 1:

requires that the consumption bribe for the currently rich agent, c_h, has to increase (in this range $c_h < e_h$). Thus the provision of more public income insurance leads to larger consumption variability: public provision of insurance crowds out private consumption insurance more than 100%.

In Krueger and Perri (2005b) we argue that the effect demonstrated here in a very simple model with two agents may be quantitatively important. We do so by calibrating a model with a continuum of agents that face idiosyncratic income shocks of realistic magnitude and a tax system that resembles the income tax code for the U.S. Reversing the argument above we calculate that by making the tax system less progressive, starting from the current status quo, the model with endogenously incomplete markets indeed predicts private consumption to be less risky than before, suggesting a more than 100% crowding-in from the reduction of publicly provided income insurance.[30]

While I do not necessarily want to push the idea that in reality one needs to expect a more than one for one crowding-out effect from public insurance programs, our results should serve as reminder that the assumption of an (incomplete) financial market structure that is independent of public policy is by no means innocuous. Nevertheless, I now show that in the presence of incomplete markets with respect to *aggregate* shocks, social insurance in the form of a PAYGO social security system may improve the allocation of aggregate risk across generations.

3 Government Reallocation of Aggregate Risk

An unfunded, redistributive social security system may not only provide social beneficial insurance against idiosyncratic mortality and income risk, but may also help to efficiently reallocate the economic impact of aggregate shocks across different generations. I will call this positive effect *intergenerational risk sharing*. But how can a social security system lead to enhanced intergenerational risk sharing? The reasoning, recently stressed in the literature by Shiller (1999) and Bohn (1998, 1999) goes as follows.[31] Suppose that returns to capital (i.e. interest rates or stock market returns) and wages

[30] Cutler and Gruber (1996) as well as Reil-Held (2004) provide some empirical evidence that the crowding-out effect on private insurance from public insurance programs, while likely not be more than 100%, can be quite sizeable. Krueger and Perri (2005a) use household consumption data from the U.S. to directly test the empirical implications of the model described above, against the alternative of self-insurance as envisioned by the standard life cycle-permanent income theory.

[31] The argument that in the presence of incomplete financial markets may provide a normative justification for a PAYGO social security system dates has been advanced already by Diamond (1977) and Merton (1983).

are imperfectly correlated and driven by a common aggregate shock, then a government program that enables generations to effectively pool their labor and capital income can lead to a reduction in the consumption variance of all generations. A pure PAYGO social security system that endows retired households with a claim to labor income may serve as such risk sharing tool between generations, in the (assumed) absence of private financial markets that achieve the same goal. If, on the other hand, a full set of state-contingent claims is traded on these markets, then social security can serve no further role as risk allocation device.

The potentially positive intergenerational risk sharing role of social security need to be traded off against the standard crowding-out effect that unfunded social security has on private savings and thus capital formation, leading to lower wages for future generations. With Felix Kubler I try to assess which of the two effects dominate *quantitatively* (see Krueger and Kubler (2002, 2006)) In this section I will use a simple model to provide a back of the envelope calculation for the relative magnitude of the two effects, before summarizing the key results from our quantitative analysis.

3.1 A Model for a Back of The Envelope Calculation

Consider an agent that lives for two periods, earns wage w in the first period on which she pays a social security payroll tax τ. She only values consumption in the second period of her life, and thus saves the remainder of her wages, at a stochastic gross return R. Her consumption in the second period is given by

$$c = (1-\tau)wR + \tau wG \tag{4}$$

where τwG are the social security benefits she receives, with G being the stochastic gross return of the social security system. Assume that the agent values consumption The agent values consumption in the second period of her live according to the utility function $v(c)$. Therefore her lifetime utility is given by

$$U(\tau) = Ev\left[(1-\tau)wR + \tau wG\right] \tag{5}$$

where $E(.)$ is the expectation with respect to uncertainty realized in the second period of the households' life. Obviously this lifetime utility depends on the size of the social security system, as measured by its tax rate τ.

In this simple model one can derive, under additional assumptions, an intuitive condition under which the introduction of a (small) social security system is welfare-improving. Formally, we seek a condition under which

$$U'(\tau = 0) > 0.$$

If one assumes that agents have log-utility, $v(c) = \ln(c)$ and that the returns on social security and private savings G and R are jointly lognormally distributed, then this condition can be written as (after some tedious algebra, see the appendix in Krueger and Kubler (2006)),

$$E\left\{\frac{G}{R}\right\} = \frac{E(G)}{E(R)} \cdot \frac{[cv(R)^2 + 1]}{[\rho_{G,R} \cdot cv(G) \cdot cv(R) + 1]} > 1 \tag{6}$$

where

$$\rho_{G,R} = \frac{Cov(G,R)}{Std(G)Std(R)}$$

is the correlation coefficient between G and R and

$$cv(R) = \frac{Std(R)}{E(R)} \text{ and } cv(G) = \frac{Std(G)}{E(G)}$$

are the coefficients of variation of R and G, respectively.

Equation (6) has an intuitive interpretation. First, the introduction of a (small) social security system increases the agents' welfare if the implicit expected return to social security, $E(G)$, exceeds the return on private saving, $E(R)$. If one approximates $E(G)$ and $E(R)$ by historical averages, as we will do below, then privates returns are substantially higher than the implicit returns of the social security system, at least if the private asset under considerations are stocks. Nevertheless, the condition may still be satisfied if private returns are very volatile (that is, $cv(R)$ is big) or the correlation between private saving returns and returns to social security is small. It is exactly this last aspect that provides a simply proxy for the intergenerational risk sharing effect. By endowing old agents with an additional asset that pays out conditional on aggregate labor income and whose return is imperfectly correlated with private capital returns R, social security reduces the variance of old-age consumption, of course possibly at the expense of mean consumption, if $E(G) < E(R)$.

Since the normative evaluation of the trade-off between mean consumption and consumption variance depends on the attitudes of agents about risk it is instructive to derive a condition similar to (6) for arbitrary risk aversion. Assuming a constant relative risk aversion utility function one obtains (without any distributional assumptions on (G, R))

$$E\left(\frac{G}{R^{\sigma}}\right) - E\left(R^{1-\sigma}\right) > 0 \tag{7}$$

In order to provide a back of the envelope calculation about whether the risk allocation effect could provide a normative justification for social security in a somewhat realistically calibrated model, I now use data on private returns to saving R and returns to the social security system G, as well as the condition (7) to check whether for reasonable degrees of risk aversion the introduction of a (small) social security system is justified on welfare grounds.

Figure 2 plots the left hand side of (7), as a function of risk aversion σ, when private returns are approximated by stock market returns and the returns to social security are approximated by the (gross) growth rate of aggregate real wages. I show results both for the case when a model period is thought of as roughly 20 years (which seems more appropriate in a two-period model) and for annual data.[32]

One finds that condition (7) is satisfied for all $\sigma \geq 1.34$ if one uses annual data, and for all $\sigma \geq 1.54$ if one uses 17 year intervals. Therefore the cutoff risk aversion above which social security provides a welfare improvement is at the lower end of values commonly used in macroeconomics and public finance. Of course this result is derived in a simple model where intertemporal choices of agents (in fact any choices) were absent and in which the general equilibrium crowding out effect from social security were abstracted from. In the next section I will document how the inclusion of these features in a full-blown DSGE model affects the normative conclusions of social security as an intergenerational risk sharing device.

[32]Details of the data used are contained in the appendix of Krueger and Kubler (2006). Gross returns R are constructed from a NYSE/AMEX value weighted portfolio, as reported in John Campbell (2003). The gross return to social security G is computed as the gross growth rate of real total compensation of employees from NIPA, provided by the Bureau of Economic Analysis (BEA). The 17-year frequency is justified by the fact that it gives me four observations for the 1926-1998 data used.

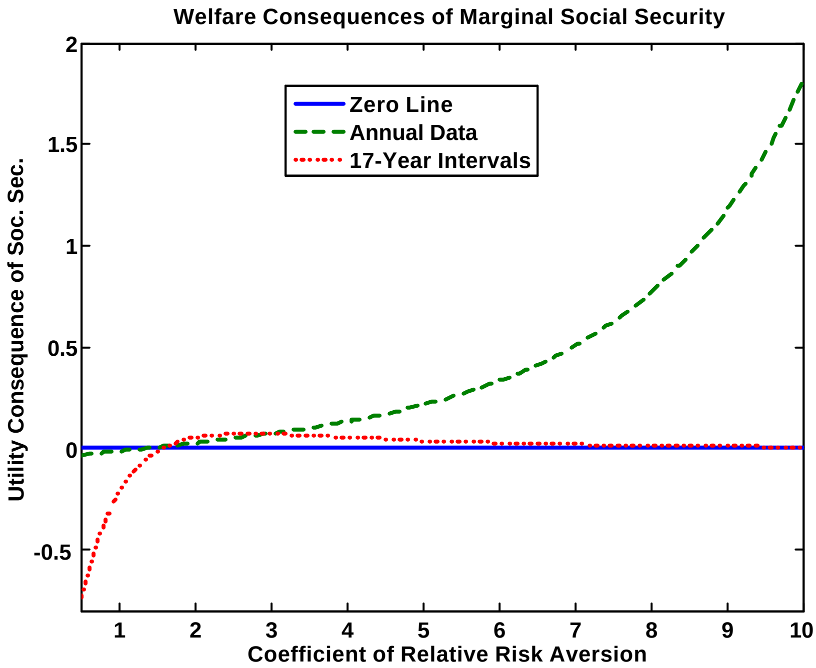

Figure 2:

3.2 A Quantitative Evaluation of Intergenerational Risk Sharing via Social Security

As in the case of idiosyncratic uncertainty the appropriate quantitative tool for evaluating the welfare consequences of social security is an expanded version of the large-scale overlapping generations model pioneered by Auerbach and Kotlikoff (1987), enriched by the presence of aggregate uncertainty that affects both returns to capital and wages. It is well-known since Samuelson (1957) and Diamond (1965) that equilibria in OLG models may be socially suboptimal, but not because of inefficient intergenerational risk sharing, but rather because of an overaccumulation of capital or an efficient allocation of average consumption across generations.

If one wants to make the normative case for social security as risk sharing device, one therefore needs to make sure (by providing a theoretical condition that can be checked in applications) that market equilibria without social security are not production inefficient (do not suffer from overaccumulation of capital) and not dynamically inefficient (do not suffer from misallocation of average consumption across generations).[33] The only source of inefficiency of market outcomes that remains is then the inefficient allocation of risk across generations in the presence of incomplete financial markets. Figure 3 therefore summaries the quantitative question at hand: is there a scope for social security as a welfare improving policy innovation in a realistically calibrated economy that is production-efficient and dynamically efficient?

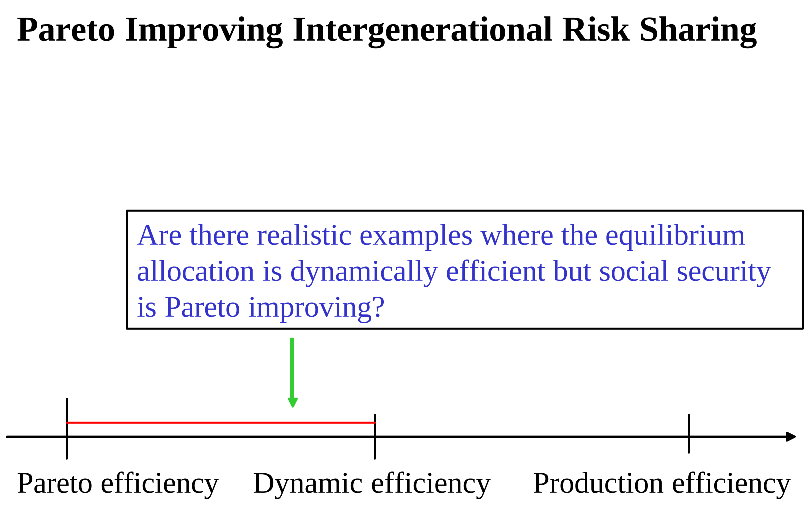

Figure 3:

Adopting arguments from Demange (2002) we show in Krueger and Kubler a sufficient condition for dynamic efficiency in an OLG economy with aggregate risk is that, loosely speaking, that is sufficiently likely that interest rates

[33] Abel et al. (1989) argue that, empirically, it is likely that the U.S. economy is dynamically efficient. Furthermore Demange (2002) shows that in every economy that includes land as an asset the market equilibrium is dynamically efficient. For an example where social security can generate a Pareto improvement in an economy with land see Krueger and Kubler (2002).

in the economy exceed the growth rate of the population plus the growth rate of technological progress.

Following the Auerbach and Kotlikoff (1987) tradition and building on earlier work by Smetters (2002) a quantitative model with nine overlapping generations and aggregate fluctuations is constructed and calibrated to U.S. data on wages and interest rates.[34] As the simple model in the previous section suggests crucial for the importance of the risk sharing effect are the relative size of mean returns of private assets (as proxied by returns to capital) and social security (as proxied by wage growth), their relative variability and their correlation. Thus our calibration makes sure that a model equilibrium reproduces these statistics from the data, and it also verifies that the theoretical condition for dynamic efficiency is satisfied. Therefore the model is suitable to answer the questions whether the welfare gains from enhanced intergenerational risk sharing via social security are sufficiently big in a realistic model to overcompensate the negative effects from forcing agents to save at lower returns and from the general equilibrium capital crowding-out effect.

When we introduce a PAYGO social security system into our artificial economy we find the following. First, abstracting from the capital crowding-out effect of social security in general equilibrium, the introduction of social security does indeed represent a mutually beneficial (that is, Pareto improving) reform, even though the equilibrium without social security is dynamically efficient.[35] Especially, this result is obtained in a world where private capital pays a return that is on average about 4 percentage points above the implicit returns to the social security system, indicating a strong positive effect of social security on the intergenerational allocation of risk. However, the capital crowding-out effect in general equilibrium is substantial and overturns these gains, at least if the economy is parameterized as is standard in

[34] The computation of such a model poses substantial difficulties since in the presence of aggregate shocks the wealth distribution across different generation changes over time, depending on the aggregate shock. Technically speaking one either has to solve for a recursive competitive equilibrium with nine continuous state variables (which we do, using the techniques developed in Krueger and Kubler (2004)), or to approximate the wealth distribution with a small set of its moments, a technique pioneered by Krusell and Smith (1998) and applied to a large scale OLG model with aggregate and idiosyncratic shocks by Storesletten et al. (2001).

[35] With aggregate uncertainty one has to take a stand on whether to distinguish agents only by the time of birth or also by the stochastic shock at birth. We opted for the latter, and therefore used so-called ex-interim Pareto efficiency as our welfare criterion.

the macroeconomic and public finance literature, that is, if households are only moderately risk averse. Finally, even if one allows social security to have adverse effects on capital accumulation (that is, considering a general equilibrium model) the introduction of social security is a Pareto-improving reform if households are highly risk averse and, in addition, have a fairly high intertemporal elasticity of substitution and physical capital is not too important in the production function. High risk aversion makes households value intergenerational insurance a lot, a high willingness to intertemporally substitute consumption keeps the welfare consequences of distorting the life cycle profile of consumption in check, and a low capital share means that the impact of capital crowding-out on the availability of aggregate resources is mitigated.[36]

Despite this last result the overall conclusion from our quantitative analysis has been that, at least for degrees of risk aversion commonly used in macroeconomics, the positive risk allocation role of social security is insufficient to render the introduction of a stylized social security system a Pareto improvement. Of these results do not establish that there cannot be a better designed intergenerational transfer scheme that leads to welfare gains. Recently, Olovsson (2004) characterized, within a general class of tax-benefit-schemes, the social security system that maximizes expected lifetime utility of an unborn agent in the long run, that is, ignoring transitional dynamics. He finds that the welfare gains from an optimal social security system, relative to a stylized U.S. system that Krueger and Kubler attempt to model and that has fairly safe benefits, can be substantial, in the order of 15% of per-period consumption. It is achieved by a system of social insecurity, with benefits that are highly volatile and procyclical. First, this system generates tax rates for the young that are low in recessions and high in expansions, and thus shifts aggregate risks towards the elderly. Second, the volatile benefits encourage precautionary savings, and thus increase the capital stock in the economy. Consistent with the findings of Krueger and Kubler (2006) the welfare consequences of the general equilibrium effect on the capital stock are dominant. But Olovsson (2004) also finds that even an optimally designed unfunded social security system leads to substantial long-run welfare losses,

[36] In order to be able to vary risk aversion and intertemporal elasticity of substitution separately in the utility function we employ a recursive utility formulation, developed by Kreps and Porteus (1978) and Epstein and Zin (1981). This class of utility functions is particularly useful for studies of policies such as social security that affect both the allocation of consumption risk as well as the timing of consumption

relative to the free market outcome.[37]

4 Conclusion

If financial markets on which households can insure against idiosyncratic and aggregate risks can insure are incomplete, the government may provide a beneficial partial substitute by administering a (redistributive) social security system or a progressive income tax. This paper has summarized my own attempts to quantify these benefits. It has also provided a warning that the approach taken in this paper to incomplete markets, namely to leave the reasons for market incompleteness unmodeled and the structure of these markets to be invariant to changes in public policy, may ignore important interactions between public policy and market structure that changes the welfare conclusions about policy reforms.

This problem is related to a fundamental critique that Narayana Kocherlakota (2005) has recently and forcefully voiced against the "Old Public Finance" literature, by which he labels work that exogenously restricts the set of fiscal instruments the government (and by implication, private households) have access to. By "exogenous" he means that the restrictions do not follow as consequences from the underlying informational and institutional structure of the model, but are rather imposed by the model builder in an ad hoc fashion, like market incompleteness and the forms of the tax and social security system were imposed by me in the current paper. Instead he advocates a new research agenda, the "New Dynamic Optimal Finance" which is the dynamic counterpart to the Mirrlees (1971) approach to optimal taxation, and proceeds in three steps. First, the model builder is explicit about the informational and enforcement frictions that the government and individual agents face. Second, given these frictions one derives the consumption and labor allocations that are socially optimal, given these frictions. Third one searches for government policies that implement these constrained-optimal allocations as a market equilibrium. This new literature so far has focused on private information. It takes the view that the major risk households face is their ability to generate income. If this ability is private information, then the otherwise optimal complete insurance is not incentive compatible, since

[37] As discussed above, because of the transition issue these findings obviously do not imply that a policy reform abolishing an already existing PAYGO social security system is Pareto improving.

high-ability agents would claim to be low-ability agents, severely limiting the government's ability to generate revenue to implement social insurance.

In Golosov et al. (2003) and Albanesi and Sleet (2006) the optimal income tax code, given these informational frictions, is characterized. In contrast to the work advocated in this paper the resulting optimal tax code may, in general, be very complex, depend on past income or may be a joint tax schedule on income and wealth, as in Albanesi and Sleet (2006). While this new approach to dynamic public finance provides a clear intellectual alternative to the work advocated in much of this paper, it remains to be seen whether the quantitative conclusions from that work are robust, qualitatively and quantitatively, to the new approach advanced by Kocherlakota.

What are the lessons policy makers should, in my view, draw from the work discussed in this paper? The most obvious conclusion is that reform debates of social insurance systems should not focus exclusively on providing good incentives for labor supply and capital accumulation, but should also acknowledge that such reform can dramatically change the exposure of households to risk, which, from an ex-ante perspective, households would like to be insured against. Second, to what extent the government should provide public insurance depends crucially on how well private insurance markets are developed. Therefore the answer to this question is likely country-dependent; simply adopting reforms that have worked elsewhere may not necessarily be the right way to go.

On specific issues, our work indicates that a flat tax system with sizeable deduction generates efficiency gains without compromising the ability of the government to provide income insurance and redistribution via the tax system. Recently, flat taxes have enjoyed wide popularity in Eastern Europe, whereas in Western Europe political attempts to move towards such a tax system have been largely unsuccessful. In light of our results these facts could be interpreted as indicating that whenever a powerful middle class has a lot to lose from such fundamental tax reform, it is hard to implement it politically. Without this status quo problem, in newly capitalist societies, such reform may be more feasible from a political economic point of view.

I have also argued that, in the case of social security reform potentially large long-run welfare gains from moving towards a funded system have to traded off against welfare losses of a large number of generations in the short run. Currently, it has become clear that due to the severe aging of the population the current social security system will become infeasible very soon, especially in Germany, France and Italy. Taxes will have to raised, benefits cut, or people will have to work longer. Using the need for reform to move towards a more funded system, is, according to our work neither politically feasible nor desirable from a normative point of view, unless one ignores the transition analysis from one steady state to the next.

Finally, and more generally, I hope to have convinced the reader that economic theory has many important insights to offer for these policy discussions; it is furthermore hoped that these insights are given serious thought by those how make far-reaching policy decisions for us and future generations.

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