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Families and Social Security

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Abstract

The present paper quantifies the importance of family insurance for the analysis of social security. We therefore augment the standard overlapping generations model with idiosyncratic labor productivity and longevity risk in that we account for gender and marital status. We simulate the abolition of pay-as-you-go pension payments, calculate the resulting intergenerational welfare changes and isolates aggregate efficiency effects for singles and families by means of compensating transfers. In accordance with previous studies that take into account transitional dynamics, we find that abolishing social security creates significant efficiency losses. Most importantly, however, we show that singles are substantially worse off from a shut-down of old-age payments compared to married couples. A decomposition of the efficiency loss reveals that this difference can be almost exclusively attributed to the insurance role of the family with respect to longevity risk. Since a married individual inherits her spouse's wealth after his death and the likelihood that both partners reach a very old age is relatively small, marriage serves as an insurance device against longevity risk for the surviving partner.

JEL-Codes: J120, J220.

Keywords: stochastic general equilibrium, home production, family insurance.

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1 Introduction

Public expenditure on social security has been rising steadily in the last decades in almost all Western economies. In the year 2009, expenditure on old-age and survivor benefits amounted to roughly 7 percent of GDP in the US and more than 15 percent in Italy, see OECD (2013). Under the current demographic projections and in the absence of major reforms, we expect this expenditure to rise even further in the future. Seeing this growing importance of social security expenditure for fiscal budgets, numerous papers have analyzed the importance of existing social security systems and tried to quantify their redistributive and efficiency consequences. The majority of these studies have in common that they derive their results within a standard overlapping generations framework, in which a household is essentially an unspecified unisex entity that supplies labor to the market, consumes and saves. In reality, however, the majority of men and women are married or live together in a cohabitation arrangement. Decisions about labor supply, consumption and savings are therefore often made within a family context where husband and wife have to come up with a mutual agreement. Modeling family structures is therefore important when studying the role of social security for various reasons. First, couples realize economies of scale in consumption and benefit from specialization in market and home labor, so that life-cycle labor supply and savings as well as liquidity constraints may differ substantially from their single counterparts. Second, as already discussed by Attanasio et al. (2005), Ortigueira and Siassi (2013), Kotlikoff and Spivak (1981) and Brown and Poterba (2000), marriage can provide insurance against labor market and longevity risk and therefore substitute (at least partly) for social security. Third, specific features of the social security system such as survivors benefits or supplementary benefits to one-earner couples may redistribute resources from singles towards couples. As a consequence, internal rates of return typically differ for singles and married couples.

In the present paper, we augment the standard overlapping generations model with idiosyncratic labor productivity and longevity risk in that we account for gender and marital status. We assume that when women and men enter the economy at young age they learn about their family status (which is drawn from a Bernoulli distribution) and that this status remains unchanged over their entire life cycle. In order to paint a most accurate picture of the differences in labor supply and savings of men and women as well as single and couple households, we allow for labor supply decisions (at the intensive margin), home work as well as (exogenous) childbearing. We assume that couples maximize the sum of both partners' utilities, meaning that a couple's decision is always efficient. We calibrate our model to the German economy using both macroeconomic data as well as microeconomic evidence on time use and wealth for different types of households. From the point of view of this paper, the advantage of looking at the German pay-as-you-go (PAYG) social security system is that it features a (almost pure) Bismarckian design with a very tight tax-benefit linkage.[1] This allows us to focus on the labor supply distortions, longevity insurance and liquidity ef-

[1] In contrast the system in the US is highly progressive and therefore redistributes resources from households with high to those with low labor earnings.

fects of social security, without losing ourselves in a long discussion about the redistributive role of the government.

Using our calibrated model economy, we study the role of social security for different household types. Specifically, our counterfactual is a scenario in which the government suddenly and unexpectedly prevents the accumulation of new pension claims for households. Yet, all acquired pension rights – especially those of current retirees – remain untouched and need to be financed by current and future generations. As we simulate a full transition path, we are able to study different financing schemes for these existing claims. In accordance with previous studies that take into account transitional dynamics, we find that in terms of aggregate efficiency – i.e. after all effects of pure intergenerational redistribution have been smoothed out – abolishing social security creates substantial losses. The reason for this is a combination of changing labor supply distortions and the loss in longevity insurance. Most importantly, however, we show that singles are substantially worse off from abolishing PAYG old-age payments compared to married couples, in fact their efficiency loss is almost four times as large. A decomposition reveals that this difference can be almost exclusively attributed to the insurance role of the family with respect to longevity risk. Since a married individual inherits her spouse's wealth after his death and the likelihood that both partners reach a very old age is relatively small, marriage serves as an insurance device against longevity risk for the surviving partner. Consequently, married couples are much less reliant upon governmental provided longevity insurance.

The remainder of the paper is organized as follows: The next section briefly discusses previous results regarding the privatization of social security and the importance of the pension system for singles and couple households. Section 3 describes the structure of the simulation model, while section 4 explains the calibration and simulation approach. Finally, Section 5 presents the simulation results and the last section offers some concluding remarks.

2 Relationship to the existing literature

The study of the effects of social security has quite some tradition in the literature that dates back to Hubbard and Judd (1987) and İmrohoroğlu et al. (1995, 1999). In dynamically efficient economies, the introduction of unfunded social security systems redistributes towards currently existing generations. On the one hand, retirees at the time of the introduction get a free lunch, as they have never contributed to the system but receive old-age benefits. On the other hand, with a declining capital stock, the economy moves further away from the golden rule. Therefore it is not surprising that most studies find a negative impact of the introduction of social security on long run welfare, and in turn a long run welfare gain from its abolition.

As soon as the welfare effects of transitional generations are taken into account, things are not so clear-cut anymore. Studies like Nishiyama and Smetters (2007) and Fehr, Habermann and Kindermann (2008) show that when intergenerational redistribution is neutralized via compensating transfers, the insurance benefits of social security dominate the cost arising from labor supply distortions and stronger liquidity constraints both in the US and in Germany. Consequently, moving towards a fully funded system induces efficiency losses. The questions that remain then rather relate to the optimal size and/or design of the existing paygo system.[2]

More recent studies analyzing issues of social security have already introduced family structures in OLG models. Kaygusuz (2015) explicitly distinguishes between single individuals and married partners of both sexes. He finds that the current US social security system especially discourages labor market participation of married women and favors traditional single-earner couples. Sanchez-Martin and Sanchez-Marcos (2010) quantify the consequences of recent pension reforms in Spain for single-earner and double-earner households of different educational backgrounds. Simulating a transition path that features realistic population aging in Spain, they show that when survival pensions are neglected, one might significantly underestimate future financial burdens of the Spanish pension system. While both of these studies assume a deterministic income process for individuals, Nishiyama (2010) quantifies the consequences of an elimination of spousal and survivor benefits in the US system using a model with stochastic labor productivity. He includes a transition path but only considers married households who decide jointly on their intensive labor supply. The removal of spousal and survivor benefits induces a strong increase in market work hours for women in the long run which could be transformed into a welfare gain for all current and future cohorts.

Domeij and Klein (2002) as well as Hong and Rios-Rull (2007) model marriage, divorce and remarriage as idiosyncratic shocks over the life cycle. They compare long-run equilibria of economies with and without a social security system. The results of Domeij and Klein (2002) support the view that the redistributive pension system in Sweden is to a large extend responsible for the unequal distribution of wealth in the economy. Hong and Rios-Rull (2007) find that the positive effect of longevity insurance through old-age payments is dominated by the negative effect of a decrease in the capital stock. Therefore they conclude that the role of the pension system in providing longevity insurance is very limited.

Beneath studies that include family structures in an OLG model, our paper is also related to a strand of literature that quantifies the importance of home production for the labor supply decision of singles or married couples. Olivetti (2006) and Greenwood et al. (2005) are popular representatives of this line of research. The paper that is most closely related to ours is probably Dotsey, Li and Yang (2015), who simulate social security reforms in a standard stochastic overlapping generation model (without families) that incorporates home production.

[2] See e.g. Fehr, Kallweit and Kindermann (2013b) who analyze the optimal progressivity of the German pension system.

3 The model economy

In the following we describe the overlapping generations model we use to quantify the importance of social security for singles and families. We thereby draw heavily on Fehr, Kallweit and Kindermann (2013a), who use the same model to analyze reforms of the family taxation system in Germany.

3.1 Demographics

At any point in time our economy is populated by J overlapping generations. At each date t a new generation is born. The size of generations grows over time at the constant rate n. Upon entering the economy, the members of the newborn cohort learn about their gender g, where being a woman F or a men M is equally likely. In addition, they draw a realization of a skill level $s \in \{1, \dots, S\}$ and a marital status $m \in \{0, 1, \dots, S\}$. $m = 0$ means that the individual is single and $m > 0$ that she is married to a spouse of skill class $m = s^*$.[3] There is a probability distribution π_g^s that defines the likelihood of being of skill level s conditional on gender g and a probability π^m of getting married. Conditional on getting married, individuals of a gender g and skill level s are assigned to a s^* spouse with probabilities $\pi_{g,s}^{s^*}$. All of these characteristics – gender, skill and martial status – are assumed to be invariant over the life cycle.

In addition to these permanent characteristics there are two transitory risk factors regarding demographics:

(i) *The number of children:* Childbirth is due to exogenous probabilities and can only take place at age J_c. Specifically we assume that at J_c fractions π_m^c and π_s^c of married and single households give birth to exactly 2 children. The kids then live with their parents until they reach adulthood. Children can either be born into a marriage or out of wedlock. In the latter case they stay with their mother and the father has to pay alimonies.

(ii) *Survival to the next period:* Individuals only survive from age $j - 1$ to age j with a certain probability ψ_j^g conditional on their gender. For married partners we assume these probabilities to be independent, so it may happen that only one of the two partners dies. In this case, the surviving spouse inherits all the assets of the partner. If both partners die at once or if a single agent dies, they leave accidental bequests to their children's generation.

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3 Variables referring to a partner are denoted by an asterisk.

3.2 Endowments and preferences

Individuals are endowed with a gender, skill and age specific labor productivity $e_{g,s,j}$. At the exogenous retirement age J_R they become unproductive and therefore stop working. In addition labor productivity is due to uninsurable idiosyncratic shocks η_j, where $\pi^{\eta}_{g,s}(\eta_{j+1}|\eta_j)$ is the distribution of tomorrows labor productivity conditional on today's realization of η.

Individuals have preferences over stochastic streams of consumption c_j and leisure ℓ_j, which they value according to the standard discounted expected utility function

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

β is a time discount factor. In order to smooth consumption over time and self-insure against idiosyncratic productivity shocks, agents can save in a risk free asset a_j with a tight borrowing constraint $a_j \geq 0$. Upon retirement, they start receiving pension benefits. We denote by p_j the current amount of already accumulated pension rights. Finally, since our model abstracts from annuity markets, individuals that die before the maximum age of J may either leave their savings to their remaining spouse or (in case of singles or married partners that both die at the same age) leave accidental bequests. The sum of accidental bequests Q_t in period t is distributed according to the age-specific scheme Γ_j in a lump-sum fashion, i.e.

$$b_j = \Gamma_j Q_t. \tag{2}$$

We can summarize the state of an age-j agent as

$$z_j = (g, s, m, k_j, \eta_j, \eta^*_j, a_j, p_j), \tag{3}$$

where $k_j \in \{0, 2\}$ indicates the number of children and η^*_j the current labor productivity shock of the (potential) partner. In the following, we will for the sake of simplicity omit the indices t and z_j wherever possible.

3.3 The single household's decision problem

Due to additive separability in time, we can formulate the decision problem recursively so that

$$V(z_j) = \max_{x_j, h_j, \ell_j} \quad u(c_j, \ell_j) + \beta\psi^g_{j+1} E\left[V(z_{j+1})\right]. \tag{4}$$

Individual consumption $c_j = c_j(x_j, h_j, 0)$ is produced within the household by means of market goods x_j and home labor h_j. Since lifespan is uncertain, future utility is weighted with the gender-specific survival probability ψ^g_{j+1}. Future utility is computed over the distribution of future states of productivity η_{j+1} as well as the number of children k_{j+1}. Singles maximize (4) subject to the budget constraint

$$a_{j+1} = (1 + r)a_j + y_j + \tilde{p}_j + cb_j + al_j + b_j - \tau \min[y_j; 2\bar{y}] - T(y_j, \tilde{p}_j, ra_j) - (1 + \tau_x)x_j. \tag{5}$$

At the beginning of life households are endowed with zero assets $a_1 = 0$ and they do not value bequests, i.e. $a_{J+1} = 0$. In addition to interest income from savings ra_j, they receive gross income from supplying labor to the market $y_j = we_j\eta_j l_j$ during their working period as well as public pensions $\tilde{p}_j$ during retirement. Labor income y_j is the product of the wage rate for effective labor w, gender- and skill-specific productivity at age j, $e_{g,s,j}\eta_j$ and time spent working in the market l_j. Besides working at home and in the market, all women have to spend time φ_j on educating their children when those are living in the household. Consequently, market labor is given by $l_j = 1 - h_j - \ell_j - \varphi_j$. The government pays child benefits cb_j to mothers. If children are born out of wedlock, fathers have to pay income dependent alimonies ($al_j < 0$) which are received by the children's mother as a lump-sum payment ($al_j > 0$). Households contribute at a rate τ to the public pension system up to a ceiling which amounts to the double of average income $\bar{y}$. Taxes on labor income, pensions and asset income are paid according to the progressive schedule $T(\cdot, \cdot, \cdot)$. Finally, the price of market goods x_j includes consumption taxes τ_x.

Pension claims are fully earnings related. Specifically, for a single household they evolve according to

$$p_{j+1} = p_j + \kappa \min[y_j; 2\bar{y}], \tag{6}$$

where κ denotes the accrual rate and $p_1 = 0$.[4] Our model takes a contribution ceiling into account which fixes the maximum contribution and pension accrual base.

3.4 The married household decision problem

Following Nishiyama (2010) or Kaygusuz (2015), we assume a collective model of household decision making. Married couples of skill groups s and s^* at age j maximize a joint welfare function with equal weights in order to obtain efficient outcomes

$$\max_{x_j, h_j, h_j^*, \ell_j, \ell_j^*} \left\{ u(c_j, \ell_j) + \beta\psi_{j+1}^{g} E[V(z_{j+1})] \right\} + \left\{ u(c_j, \ell_j^*) + \beta\psi_{j+1}^{g^*} E[V(z_{j+1}^*)] \right\} \tag{7}$$

with $c_j = c_j(x_j, h_j, h_j^*)$. The respective household budget constraint reflects the fact that both assets and pension claims are pooled within a marriage.[5] In addition, the income splitting method of family taxation is applied in the benchmark economy. The household budget constraint reads

$$\begin{aligned} a_{j+1} = {} & (1+r)a_j + y_j + y_j^* + 2\tilde{p}_j + b_j + b_j^* + cb_j \\ & - \tau \left(\min[y_j; 2\bar{y}] + \min[y_j^*; 2\bar{y}] \right) - 2T\left(\frac{y_j + y_j^*}{2}, \tilde{p}_j, ra_j \right) - (1+\tau_x)x_j. \end{aligned} \tag{8}$$

Note again that married couples in our benchmark are not altruistic and don't derive direct utility from being married. Consequently, they still value consumption and leisure according to the function (1).

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4 Note that $\tilde{p}_j = p_j$, if $j \geq J_R$ and $\tilde{p}_j = 0$ otherwise.

5 The pooling of pension claims approximates the German widow's pension benefit.

Pension claims now evolve according to

$$p_{j+1} = p_j + \kappa \frac{\min[y_j; 2\bar{y}] + \min[y_j^*; 2\bar{y}]}{2}. \tag{9}$$

Beneath the productivity processes for both partners, married agents take into account the possibility that one of the spouses dies. In this case the surviving partner of gender g completely inherits the assets of the partner and receives her (pooled) old-age pension. Her state turns into $z_{j+1} = \left(g, s, 0, k_j, \eta_{j+1}, 0, a_{j+1}, p_{j+1}\right)$. The surviving spouse then behaves identical to a single household. Consequently, couples' assets are only passed on to younger cohorts if both partners die at the end of the same period.

3.5 Instantaneous utility, scale effects and home production

The period utility function is defined as

$$u(c_j, \ell_j) = \frac{1}{1-\frac{1}{\gamma}} \left(c_j^{1-\frac{1}{\rho}} + \alpha \ell_j^{1-\frac{1}{\rho}} \right)^{\frac{1-\frac{1}{\gamma}}{1-\frac{1}{\rho}}}, \tag{10}$$

where γ is the intertemporal elasticity of substitution between consumption at different ages, ρ is the intratemporal elasticity of substitution between consumption and leisure at each age j and α is an age-independent leisure preference parameter.

The needs of a household generally do not grow in proportion to the number of household members. We therefore model scale effects in household consumption. Let $n_j \in \{1, 2\}$ denote the number of adult household members. Consumption for each adult family member is then derived from

$$c_j(x_j, h_j, h_j^*) = \underbrace{\left(\frac{1}{n_j + \phi \hat{k}_j}\right)^{\omega}}_{\text{scale effect}} \cdot \underbrace{\left\{ v x_j^{1-\frac{1}{\chi}} + (1-v)\Phi \left(h^{\text{agg}}\right)^{1-\frac{1}{\chi}} \right\}^{\frac{1}{1-\frac{1}{\chi}}}}_{\text{home production}} \tag{11}$$

with

$$h^{\text{agg}} = \begin{cases} \left[(h_j)^{1-\frac{1}{\sigma}} + (h_j^*)^{1-\frac{1}{\sigma}} \right]^{\frac{1}{1-\frac{1}{\sigma}}}, & \text{if married} \\ h_j, & \text{if single.} \end{cases} \tag{12}$$

The production of the consumption good within the household follows a CES home production technology combining market goods x_j and aggregate home labor h^{agg}. The latter itself is again derived using a CES production function, where σ measures the elasticity of substitution between the respective time spent in home production by the two partners. v is a share parameter for market goods x_j, Φ is a scale parameter and χ defines the elasticity of substitution between market goods x_j and effective working time in home production. The scale effect translates household consumption into consumption realized by each adult family member. Scale effects in household consumption are captured by the parameters ϕ and ω. With $0 < \phi, \omega < 1$ a child costs less than an adult and the second adult and each additional child are cheaper to feed and clothe than the older sibling. Since children always stay with the mother, single men who have children do not realize child costs in consumption, i.e. $\hat{k}_j = 0$.

3.6 Technology

Firms in this economy use capital and labor to produce a single good according to a Cobb-Douglas production technology. Capital depreciates at rate δ. Firms maximize profits renting capital and hiring labor from households under perfect competition, i.e.

$$\max_{K_t, L_t} \left\{ \theta K_t^{\varepsilon} L_t^{1-\varepsilon} - wL_t - (r + \delta)K_t \right\} \tag{13}$$

where K_t and L_t are aggregate capital and labor, respectively, ε is the capital share in production and θ defines a technology parameter. As a result the net marginal product of capital equals the interest rate for capital r and the marginal product of labor equals the wage rate for effective labor w.

3.7 The government sector

Our model distinguishes between the tax- and the social security system. In each period t, the government collects taxes from households in order to finance general government consumption G as well as aggregate child benefits CB_t, i.e.

$$T_{I,t} + T_{X,t} = G + CB_t, \tag{14}$$

where $T_{I,t}$ and $T_{X,t}$ define income and consumption tax revenues, respectively. We assume that government consumption remains fixed over time and that the budget is balanced through adjustments of the consumption tax.

The sole role of the social security system in our model is to provide old-age benefits. Benefits are financed on a pay-as-you-go basis through payroll contributions from labor income below the contribution ceiling of $2\bar{y}$. Budget balance of the system is achieved by adjustments of the contribution rate.

3.8 Equilibrium conditions

Given a specific fiscal policy, an equilibrium path of the economy is an allocation that solves the household decision problem, reflects competitive factor prices, and balances aggregate inheritances with unintended bequests. Furthermore aggregation must hold and the consumption tax as well as the pension contribution rate have to balance the tax and pension system's budgets. Since we assume a closed economy setting, output has to be completely utilized for private consumption, public consumption G and investment purposes, i.e.

$$Y_t = X_t + G + (1+n)K_{t+1} - (1-\delta)K_t. \tag{15}$$

Aggregate savings have to balance capital demand of firms and the government and aggregate labor supply has to be employed by firms.

4 Calibration of the initial equilibrium

4.1 Demographic structure

Table 1 reports the central parameters of the model. In order to reduce computational time, each model period covers five years. Agents reach adulthood at age 20 ($j = 1$) and may give birth to two children at age 25 ($J_c = 2$). Since children stay in the household for twenty years, we have $k_1 = k_6 = k_7 = \ldots = 0$. Individuals retire mandatorily at age 60 ($J_R = 9$) and face a maximum possible life span of 100 years ($J = 16$). In order to generate the German average of 1.4 children per mother and the unequal distribution of children out of wedlock and in families, we set the childbirth probability of married females to $\pi_m^c = 0.9$ and of single females to $\pi_s^c = 0.45$. We assume that 53 percent of all males/females who enter the labor market are married. This reflects the average fraction of married households among working cohorts in Germany, see Statistical Yearbook of the Statistisches Bundesamt (2007, 33). Consequently, on average 70 percent of households have two children, but more than two thirds of mothers are married.

We assume a population growth rate of $n = 0.05$, resulting in an annual rate of 1 percent. Since population growth is currently close to zero in Germany, this number mainly reflects labor productivity growth. Conditional survival probabilities ψ_j^g are computed from the year 2000 Life Tables for Germany reported in Bomsdorf (2002). However, in order to simplify the demographic transition, we restrict uncertain survival to retirement years, i.e. $\psi_j^f = \psi_j^m = 1, j < j_R$. We distinguish high-skilled and low-skilled or regular individuals (i.e. $S = 2$) and assume that 24 percent of men and 15 percent of women are high-skilled. While 83 percent of high-skilled women marry a high-skilled men, only 54 percent of high-skilled men marry a women from the same skill level. The skill distribution as well as mating probabilities were estimated from German Socio-Economic Panel (SOEP) data of the years 1995-2007.[6]

4.2 Preference parameters, labor market participation and time use

Most microeconomic estimates of the intertemporal elasticity of substitution fall between zero and one, see the discussion in Auerbach and Kotlikoff (1987) or İmrohoroğlu and Kitao

[6] The SOEP data base is described in Wagner et al. (2007).

Table 1: Parameter selection

Demographic parameters		*Preference parameters*	
(Adult) Life span (J)	16	Intertemporal elasticity of substitution (γ)	0.50
Retirement period (J_R)	9	Intratemporal elasticity of substitution between	
Child birth period (J_c)	2	... consumption and leisure (ρ)	0.60
Childhood periods	4	... market goods and home work (χ)	2.00
Skill levels (S)	2	... male and female home work (σ)	1.67
Childbirth probability (π^c_m)	0.90	Coefficient of leisure preference (α)	0.70
Childbirth probability (π^c_s)	0.45	Share parameter for market goods (v)	0.48
Population growth rate (n)	0.05	Scaling factor consumption (ω)	0.50
		Scaling factor children (ϕ)	0.30
		Discount factor (β)	0.995
Technology/Budget parameters		*Government parameters*	
Factor productivity (θ)	1.45	Consumption tax rate (τ_x)	0.20
Capital share (ε)	0.33	Contribution rate (τ)	0.199
Depreciation rate (δ)	0.29		
Education time male (φ^m)	0.00		
Education time female (φ^f)	0.15		

(2009). We use $\gamma = 0.5$ in our benchmark. The intratemporal elasticity of substitution between consumption of goods and leisure is set to $\rho = 0.6$, which yields an uncompensated labor supply elasticity of 0.16 for men and of 0.36 for women. Table 2 also illustrates that while single men and women have quite similar labor supply elasticities, married women's labor supply is significantly more elastic than that of men. The latter reflects the fact that labor supply at the extensive margin is more flexible than at the intensive margin for married women. In order to account for the elasticities in the model, male labor supply at the market is restricted to be at least 25% of their time endowment. This leads to a compensated cross elasticity of male labor supply of 0.038. Bargain et al. (2014) report compensated cross-wage elasticities for German married men close to zero.

Table 2: Labor supply elasticities in the initial equilibrium

	Total		*Single*		*Married*	
	Men	Women	Men	Women	Men	Women
uncompensated	0.16	0.36	0.25	0.30	0.09	0.45
compensated	0.35	0.82	0.56	0.67	0.19	1.02

In order to calibrate the participation rates and the split-up of time use, we assume $\chi = 2$. Rogerson (2009, p. 596) surveys the literature and concludes that typical estimates of the substitution elasticity between market goods and home work ranges between 1.6 and 2.5. In addition, we take $\phi = 0.3$ and $\omega = 0.5$ from Greenwood et al. (2003) to capture the scale effects in household consumption. Then we calibrate the leisure preference parameter

$\alpha = 0.7$ and the share parameter for market goods $v = 0.48$ in order to match realistic overall time use shares for Germany. Burda et al. (2008) report that on average men and women spend about 43.2, 25.5 and 31.2 percent of their time endowment as leisure time, market work and home work, respectively. Next, the intratemporal elasticity of substitution between male and female home work $\sigma = 1.67$ is calibrated such that we obtain a time difference in home labor for married men and women similar to those reported in Burda et al. (2008). We choose a scaling factor Φ in order to make sure that aggregate household home labor never exceeds two. Finally, time costs of males and females for the education of children φ_j are chosen in order to match gender-specific time use data for mothers and fathers reported in Statistisches Bundesamt (2003). Table 3 compares the fractions of market work, home work and leisure for married couples of different genders generated by the model with those from the data. The first block in the upper part reveals that even without children men and women are quite different with respect to their shares of market work and home work. In the model this is mainly generated by the gender productivity gap which is especially pronounced for the high-skilled, see Fehr, Kallweit and Kindermann (2013a). Specialization increases significantly during the years of child rearing. Note that independent of their number of children men and women roughly spend the same time on leisure consumption. Finally, time spent in home production increases after retirement. On average, retirees devote about 40 percent of their time to home production and 60 percent to leisure consumption.

*Table 3: Time use for married households: model vs. data**

		Men			Women		
		market work	home work	leisure	market work	home work	leisure
no children	Model[b]	38.0	22.0	40.0	21.3	34.0	44.7
	Data[a]	31.6	25.3	43.1	23.4	34.4	42.3
children	Model[b]	38.6	23.8	37.6	16.6	42.0	41.4
	Data[a]	37.5	24.3	38.2	15.6	47.5	36.8
retired	Model	0.0	35.2	64.8	0.0	45.4	54.6
	Data[a]	0.0	36.9	63.1	0.0	47.1	52.9

* In percent of time endowment. [a] Burda et al. (2008), Statistisches Bundesamt (2003).
[b] Education time included in homework.

Finally, in order to calibrate a realistic aggregate net wealth to output ratio of about 3.8, the discount factor β is set at 0.995 which implies an annual discount rate of about 0.1 percent. For information on the estimation of productivity profiles and the income process see Fehr, Kallweit and Kindermann (2013a).

4.3 Technology and government parameters

On the production side we let the capital share in production be $\varepsilon = 0.33$ reflecting the average share of capital income in Germany. The annual depreciation rate for capital is set at 6.6 percent (i.e. the periodic depreciation rate is $\delta = 0.29$) which yields a realistic interest rate of 3 percent. Finally we specify the general factor productivity $\theta = 1.45$ in order to normalize the initial wage rate to unity.

We set the pension contribution rate to 19.9 percent, which yields a net replacement rate of about 70 percent for the pension system. The progressive income tax schedule is oriented towards German tax practice. Specifically, we let pension contributions be exempt from tax and assume pension benefits to be fully taxed. Taxable labor income consists of gross labor earnings minus a fixed allowance of 2400 € per person and an additional deduction of 10 percent of y_j.[7] The sum of labor and pension income is taxed according to the German tax schedule introduced in 2005. After a basic allowance of 7800 € per person, the marginal tax rate increases from 15.8 to 44.3 percent when taxable income exceeds 52000 €. Capital income is taxed at a rate of 26.4 percent after a basic allowance of 9000 €. Child benefits cb_j roughly reflect current German law which states states that for the first two children in total 4416 € per year are paid as transfers per child ('Kindergeld') by the government. Finally, if parents are not married, the father has to pay an alimony al_j which amounts to 10 percent of his net income per child. In the initial long-run equilibrium, we fix the consumption tax rate at 20 percent in order to generate a realistic public consumption ratio G/Y.

4.4 The initial equilibrium

Table 4 reports the calibrated benchmark equilibrium and the respective figures for Germany. Since men have lower survival probabilities than women, their life expectancy (at age 20) is 76.8 years, while women on average become 4.3 years older. As one can see, the initial equilibrium reflects the current macroeconomic situation in Germany quite realistically.

Aggregate pension benefits are slightly too high and aggregate tax revenues are a bit too low. Note that about one third of tax revenues are generated from progressive labor income taxation. Child benefits account for 2.2 percent of GDP, so that public consumption amounts to 16.9 percent of GDP. The fraction of bequest in GDP seems to be too low, but one has to keep in mind that our model only accounts for unintended bequest.

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[7] These deductions reflects the diverse possibilities in the German tax system to reduce taxable income (e.g. deductions of income-related expenses or household-related services). The chosen values guarantees a realistic income tax revenue to output share.

Table 4: The initial equilibrium

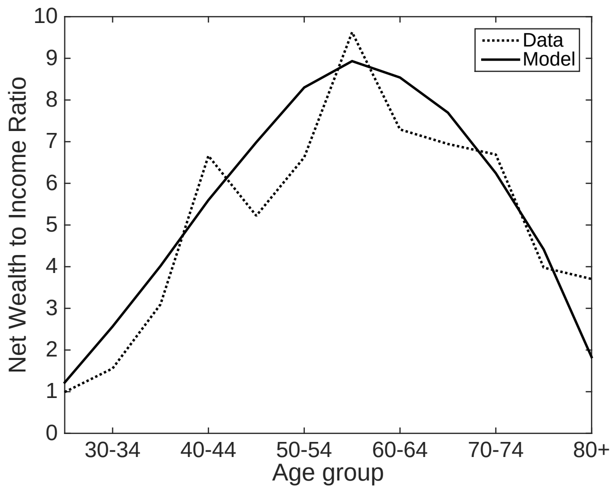
	Model solution	Germany[a]
Calibration targets		
Life expectancy (women) (in years)	81.1	82.8
Life expectancy (men) (in years)	76.8	77.7
Pension benefits (% of GDP)	12.4	11.6
Tax revenues (in % of GDP)	19.1	22.7
Aggregate Net Wealth (in % of GDP)	3.7	3.8
Other benchmark coefficients		
Interest rate p.a. (in %)	3.0	–
Bequests (in % of GDP)	3.6	7.1[b]
from which are intergenerational	2.2	–
Gini-coefficient for net income	29.2	28.2[c]

Source: [a]IdW (2015), [b]Schinke (2012), [c]SVR (2009).

4.5 Wealth profiles: Data vs. model

To test how accurately our model predicts the savings behavior of different household types, we use data from the European Household Finance and Consumption Survey (HFCS) provided by the ECB for Germany. The HFCS is currently available as cross section. The data was collected between 2010 and 2011. The dataset contains household level information on real and financial asset holdings, i.e. the amount and value of houses, liabilities, deposits, mutual funds, bonds, stocks, managed accounts, voluntary pension contributions and life insurances. From this we can construct the net wealth of each household. In addition, we have information on age, family status as well as total household income. We group households using 5 year age bins and classify them as either married or non-married (single, divorced, widowed). The dotted line in the left part of Figure 1 reports the average net wealth profile by age group divided by average household labor income. We can see that the average wealth profile exhibits the typical life cycle savings hump-shape with savings peaking around the date of retirement. On the right hand side of the figure we report the ratio between the net wealth of married and non-married household. Married households on average hold about 2 to 3 times as much wealth as a same age non-married household. The solid lines in Figure 1 show the model predicted counterparts to the data. Overall we find that our model paints a quite accurate picture of the saving behavior of households. If at all it might slightly understate the savings behavior of married households in relation to non-married households. Fehr, Kallweit and Kindermann (2013a) provide further information on the life cycle behavior of men and women with and without children in the initial equilibrium and in the data.

Figure 1: Wealth profiles over the life cycle



5 Simulation results

We now want to study the consequences of an abolition of the social security system in our model. Our thought experiment is as follows: Let $t = 0$ denote the initial equilibrium of our economy. In the reform year $t = 1$ the government unexpectedly announces and implements that households cannot accumulate any further pension rights. All pension entitlements that were already derived in the initial equilibrium remain untouched. Consequently, social security will still pay old-age benefits until the last generation that was already economically active in the initial equilibrium has reached the maximum age. We simulate two different scenarios for financing these remaining benefits.

1. *The traditional view:* In the traditional view scenario, we assume that payroll tax rates adjust in each period so that payroll contributions exactly cover instantaneous expenditure. As a result, payroll tax rates decline rapidly throughout the transition and ultimately turn zero.

2. *The tax-smoothing view:* An alternative scenario is one in which the government wants to achieve tax smoothing. This obviously leads to a more equal distribution of the burden of financing existing pension claims. Specifically we assume that the government reduces the payroll tax rate to a level that guarantees that the present value of payroll contributions equals the present value of remaining social security payments. This results in a shortage of funds for social security in the early periods of the transition. In order to close the budget we allow social security to issue debt in the short run. This leads to interest payment which it can later on finance through payroll tax revenue. In this simulation scenario, we also assume that the consumption tax is adjusted in a sustainable way and that government debt balances short-run fluctuations in the tax system's budget.

For each of these scenarios, we compute a full transition path and report the macroeconomic consequences. More importantly we also want to evaluate the reforms in terms of the welfare effects for different generations and in terms of aggregate efficiency. We therefore first describe how we evaluate welfare and efficiency. We then report the results from our two reform scenarios and decompose the efficiency effect into components driven by labor supply distortions, longevity insurance and liquidity effects. Finally, we discuss moderate reforms which either slightly increase or reduce the level of future old-age benefits in order to find the optimal size of the pension system for different household types.

5.1 Computation of welfare and efficiency effects

We use the concept of compensating variation à la Hicks to quantify welfare effects. Owing to the homogeneity of our utility function we have

$$u\big[(1+\phi)c_j,(1+\phi)\ell_j\big] = (1+\phi)^{1-\frac{1}{\gamma}}u\big[c_j,\ell_j\big] \tag{16}$$

for any x_j, ℓ_j and ϕ. Since utility is additively separable with respect to time, a simultaneous increase in consumption and leisure by the factor $1+\phi$ at any age increases life time utility by the factor $(1+\phi)^{1-\frac{1}{\gamma}}$.

With these considerations in mind we can compute a simple welfare measure in our simulation model. Lets first look at an individual that has already made economic decisions in the initial equilibrium and is hit by the reform of social security at some point in her life cycle. We call generation for which this happens *current generations*. Assume that this individual had the state z_j at time $t=1$ which is associated with a utility level $V_1(z_j)$. We can now compare this utility level with the respective initial equilibrium counterpart $V_0(z_j)$ and find that the compensating variation is

$$\phi(z_j) = \left(\frac{V_1(z_j)}{V_0(z_j)}\right)^{\frac{1}{1-\frac{1}{\gamma}}} - 1. \tag{17}$$

ϕ indicates the percentage change in both consumption and leisure the individual would require in the initial equilibrium in order to be as well off as in the reform scenario. We may alternatively say that an individual is ϕ better (or worse) off in terms of resources after the reform. If $\phi > 0$, the reform is welfare improving for this individual and vice versa. For current generations we report a simple average of the compensating variation by age and household types, i.e. for singles and married.

Generations that first enter the economy after the reform was announced and implemented by the government are called *future generations*. For future generations we compute an ex ante welfare measure, i.e. we evaluate their utility behind the Rawlsian veil of ignorance where we assume that only their marital status but not their gender, skill level or any labor market shock has been revealed. For the generation that first enters the economy at time t we therefore calculate

$$EV_t^s = E\left[V_t(z_1)|m=0\right] \quad \text{and} \quad EV_t^m = E\left[V_t(z_1)|m>0\right].$$

From these welfare measures we can again calculate the compensating variation for singles and married partners between living in the reform scenario and living in the initial equilibrium.

Naturally, when implementing such a drastic reform like the abolition of pension payments, welfare effects for different cohorts will not only result from changes in the efficiency of the economic environment (like changes in labor supply distortions, the degree of longevity insurance, etc.) but also from intergenerational redistribution. This redistribution can e.g. arise from factor price changes or changes in tax burdens over time. One goal of the tax smoothing scenario we simulate is to minimize the degree of intergenerational redistribution by smoothing the burden of our reform across generations. Nevertheless we still find substantially different welfare effects for different cohorts, pointing to the fact that even then there is a lot of intergenerational redistribution going on. In order to isolate the efficiency effect of our reform from the effects of intergenerational redistribution we have to make some further assumptions. We therefore run as separate simulation and assume that the government can observe the individual state z_j and pay lump-sum transfers or levy lump-sum taxes from each individual.[8] The transfers are designed in the following way: to all single households from current generations we pay lump-sum transfers such that they are as well off after the reform as in the initial equilibrium. Consequently their compensating variation $\phi(z_j)$ amounts to zero. This procedure is certainly not a zero sum game but will either produce some surplus or deficit. This surplus or deficit is redistributed across all future singles in a way that they all face the same compensating variation. This procedure is repeated for married couples. As a result of this, all members of current generations experience a welfare effect of zero and all singles and married individuals from future generations face exactly one welfare level, respectively.[9] The unique compensating variation of singles and married partners can be interpreted as a measure of efficiency. Consequently, if the variation is greater than zero, the reform is Pareto improving after compensation for these household types and vice versa. In addition, the difference in the compensating variation between singles and married couples reflects differences in the efficiency consequences between household types.

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8 This concept was was introduced under the name Lump-Sum Redistribution Authority by Auerbach and Kotlikoff (1987, 62f.) and has been applied by Nishiyama and Smetters (2007) as well as Fehr, Habermann and Kindermann (2008) or Fehr, Kallweit and Kindermann (2013) in similar stochastic frameworks. Fehr and Kindermann (2015) show how the design of such lump-sum transfers translate into different social welfare functions with different objectives for a social planner.

9 Note that we are basically applying the second welfare theorem, which tells us that the government can implement any distribution of utilities with lump-sum transfers that are targeted towards individual endowments. Since the non-exogenous parts of the state z_j of a household (i.e. savings and pension claims) are determined in the previous period, we can interpret z_j as the endowment of a member of a current generation. Furthermore note that marriage is exogenous in our model, so that targeting transfers to singles and married partners does not distort a marital decision. The difference to the second welfare theorem is that the government doesn't move utility distributions on the Pareto frontier, but with a given distance thereof.

5.2 Privatization of social security without debt: The traditional view

The majority of studies that are concerned with the consequences of a complete or partial privatization of pensions abstract from public debt and balance the budget with payroll taxes that decrease over time.[10] We can simulate such a scenario in our model by setting the accrual rate $\kappa_t = 0.0$ for $t \geq 1$ in equations (6) and (9) so that individuals keep their pension claims, but do accumulate no additional claims in the future. The contribution rate τ is adjusted in each period in order to balance the budget of social security and the consumption tax rate is adjusted to balance the government budget (14).

Table 5 reports the macroeconomic effects of such a reform. Abolishing the pension system has two major consequences for households in our economy. First, as social security stops paying old-age benefits, individuals have to provide for resources in retirement years on their own. This induces a massive increase in private savings and therefore productive capital which causes the economy to significantly expand. As capital becomes abundant, its return declines substantially along the transition. In the new long-run equilibrium the capital stock has increased by about 50 percent which leads to an interest rate that per year is about 2 percentage points lower than in the initial equilibrium. With the long-run growth rate of the economy being equal to 1 percent, the economy consequently moves (almost) to golden rule capital accumulation. Second, payroll taxes that are used to finance remaining old-age benefit payments distort labor supply in the short-run, but ultimately these taxes fall to zero.[11] This leads labor supply to decline in the short-run and increase in the long-run. Note that men and women react quite differently to the changes in payroll tax rates. Not surprisingly, given the elasticity calculations in Table 2 men are much less elastic towards wage changes than women. In addition the fact that men are (usually) the primary earners in families and work quite hard regardless of their wage leads to a very small reaction in married mens labor supply which is compensated by a larger change in labor hours by their female partners. Note that when households reduce their market labor hours, they do not consume the additional time as leisure but substitute (at least mostly) with home work in order to sustain a certain level of consumption. The reduction in labor input increases wages in the short-run. The long-run increase in wages of 13.7 percent is a result of the substantial increase in productive capital. With the expansion of the economy aggregate consumption rises by 6.2 percent. Paired with the substantial increase in labor and capital income and therefore income tax revenue, this induces the government to reduce the consumption tax rate by 9.0 percentage points.

With these effect in mind we can now turn to the welfare consequences of our reform for

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[10] Examples of this approach are İmrohoroğlu et al. (1995, 1999), Nishiyama and Smetters (2007), Nishiyama (2010), Dotsey, Li and Yang (2015) or Kaygusuz (2015).

[11] In the initial equilibrium in reward for the contribution to the pension system, an individual receives pension benefits at old age. Consequently, the contribution to social security is not perceived as a pure tax, but can be split into an implicit savings and an implicit tax component, see Sinn (2000) and Fehr, Habermann and Kindermann (2008). When no more pension claims can be accumulated after the reform, however, the full payroll tax is actually a tax which results in an additional distortion of labor supply.

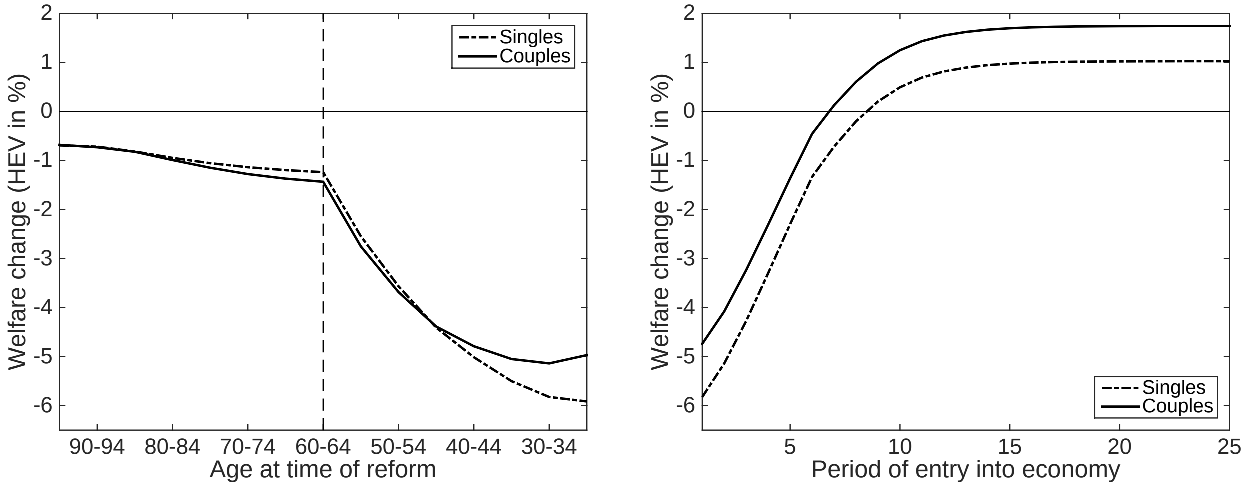
Table 5: Macroeconomic effects with variable tax rates[a]

Period	1	3	5	7	∞
Capital market:					
Private assets	0.0	2.1	9.9	21.0	51.0
Capital stock	0.0	2.1	9.9	21.0	51.0
Bequests	–2.0	–6.7	–5.8	8.0	98.2
Interest rate (in pp p.a.)	–0.4	–0.5	–0.7	–1.1	–1.9
Labor market:					
Labor input	–7.7	–6.2	–3.9	–1.6	2.4
– single men	–6.9	–5.4	–3.5	–1.6	2.6
– married men	–0.8	–1.0	–1.0	–0.7	0.1
– single women	–14.6	–11.4	–6.9	–2.8	3.1
– married women	–16.6	–13.1	–8.0	–1.8	6.3
Homework	5.9	5.8	4.8	3.1	–1.1
Wage rate	2.7	2.8	4.6	7.1	13.7
Goods market:					
GDP	–5.3	–3.5	0.4	5.4	16.4
Consumption	–9.4	–11.4	–10.6	–7.5	6.2
Government:					
Consumption tax rate (in pp)	3.6	3.6	1.6	–1.4	–9.0
Social security tax rate (in pp)	1.4	–1.0	–5.8	–11.4	–19.9

[a]If not indicated otherwise, values are reported as changes in percent over initial equilibrium values. pp - percentage points

different cohorts and household types. The left part of Figure 2 reports the (average) compensating variation of current generation by age and household type while the right part shows the same for future cohorts. The vertical line in the left part separates retirees from working generations. A lower interest rate and a higher consumption tax rate explains a uniform welfare loss for all generation of retirees in the reform year. Since they have to pay payroll taxes but don't accumulate anymore pension claims in reward, current workers experience substantial welfare losses as well. The same is true for early future generations in the right part of Figure 2. As the economy keeps expanding and aggregate consumption increases, future generations realize welfare gains which rise up to 1.5 percent of initial resources in the long run. Note that married couples seem to be systematically better off than singles (at least for younger and future generations). We will see below that this is due to better self insurance possibilities for married couples against longevity risk.

Figure 2: Welfare effects (current and future cohorts)



5.3 Privatization of social security with tax smoothing

In the previous subsection the phase-out of the pension system was completely financed by transitional cohorts while future cohorts are relieved of any burdens from the past. This has two problematic consequences. First, long run welfare gains are mostly due to intergenerational redistribution and do not indicate the efficiency implications of the existing pension system. Second, consumption and payroll tax rates vary enormously during the transition inducing additional intertemporal distortions of labor supply and savings in turn. As we want to isolate the efficiency consequences of the abolition of old-age payments from its impact on intergenerational redistribution, this is hardly a desirable outcome. So the first step we want to take to circumvent this problem is to introduce tax smoothing. As already stated above, we finance the privatization of social security by a constant payroll tax that persists throughout the transition and in the new long-run equilibrium.[12] The same is true for the consumption tax rate, so that periodical budgets of social security and the tax system may include deficits or surpluses that increase or reduce public debt. The government budget constraint consequently reads

$$(1+n)B_{G,t+1} - B_{G,t} + T_{I,t} + T_{X,t} = G + r_t B_{G,t} + CB_t, \tag{18}$$

with $B_{G,t}$ denoting general government debt and the initial condition being $B_{G,0} = 0$. The same adjustment has to be made to the budget of social security, as the two systems are allowed to issue debt separately.

This reform experiment is identical to the one studied in Fehr, Habermann and Kindermann (2008) and closely related to the one in Fehr and Kindermann (2010), with the difference being that we account for different genders, household types and home production. Nev-

[12] On average, this payroll tax rate reflects implicit taxes of the former PAYG-system, while the reduction reflects the average savings share, see Sinn (2000).

ertheless it is useful to summarize the main finding of these related paper, as many of their results will (at least qualitatively) also show up here. When privatizing social security with tax smoothing, these papers essentially identify three effects:

1. *Labor supply distortions:* The reform creates additional distortions on labor supply, especially on older workers. The reason for this is twofold. First, a pay-as-you-go financed pension system as the one we study here has an implicit tax structure with tax rates declining with age, see Fehr and Kindermann (2010). When we turn the implicit tax of the pension system into an explicit payroll tax, the tax structure becomes flat over the working life. So essentially we move labor tax burdens from young to old workers. As the latter tend to be more elastic than the former, this induces a negative effect on overall labor supply. In addition, payroll taxes to social security are tax deductible and pension payments are fully taxed in the initial equilibrium. When as a result of the reform we lower payroll taxes this means that a larger fraction of labor income will be taxable during the working phase.[13] As our tax code is highly progressive, this induces additional negative incentives on labor supply. In terms of aggregate efficiency, both effects create an efficiency loss.

2. *Longevity insurance:* The social security system pays an old-age transfer as long as a person lives and therefore insures individuals against the risk of becoming super old. When this longevity insurance is abolished, consumers experience a substantial welfare loss.

3. *Liquidity constaints:* As we lower the payroll tax rate the amount of available resources to households in the working years increases. This reduces the importance of liquidity constraints which results in an efficiency gain.

With these results in mind, lets turn to the macroeconomic effects of our reform experiment with tax smoothing reported in Table 6. The constant payroll tax that is needed to finance the burden of existing pension rights equals $(19.9 - 11.6 =)$ 8.3 percent.[14] The fact that more labor income will be taxed under the progressive tax code and that households generate more capital income leads to more tax revenue from factor income taxation and in turn to a 1.5 percentage point decline in the consumption tax rate. The effect our reform has on the accumulation of savings has hardly changed. Yet, the impact on aggregate capital is substantially different. The reason is that the government now heavily issues public debt to finance shortages in the budget of social security and therefore absorbs almost all additional savings. In fact a remarkable 269.7% debt to GDP ratio is needed for this to work. The capital stock therefore hardly moves along the transition, which results in only minor changes in the interest rate. With the above remarks about changes in labor supply distortions it is not surprising that we find aggregate labor supply to drop from period 1 of the transition. As

[13] Essentially we are moving from a front- to a back-loaded taxation scheme.

[14] This implicit tax rate is strongly related to the difference between the interest rate and the growth rate of the economy, which amounts to 2 percent in annual terms.

Table 6: Macroeconomic effects with sustainable tax rates[a]

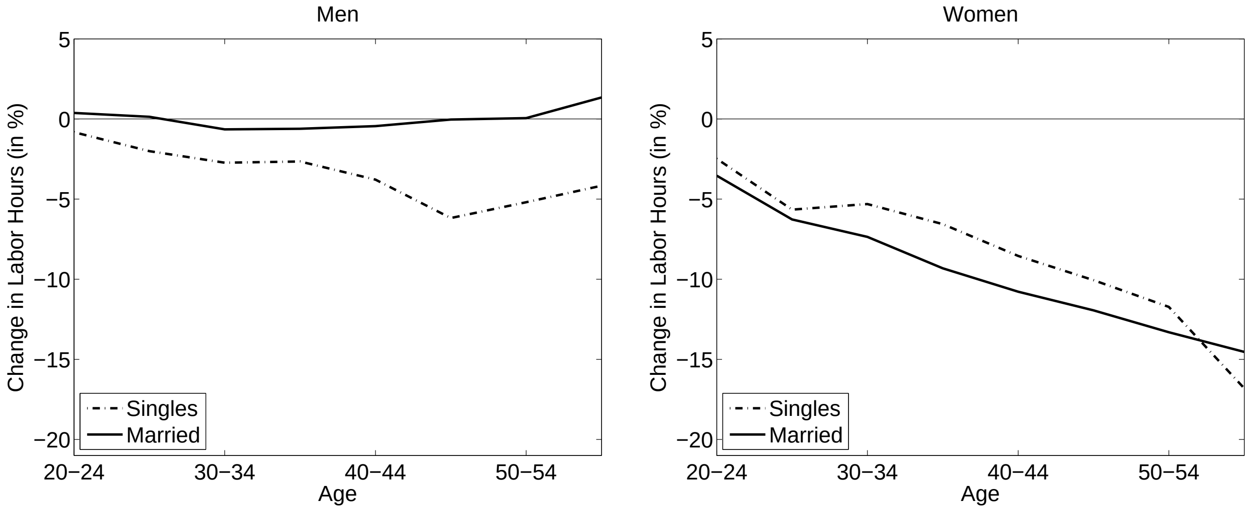
Period	1	3	5	7	∞
Capital market:					
Private assets	0.0	16.5	34.6	50.5	68.9
Capital stock	0.0	–1.5	–1.8	–1.4	0.6
Govt. Debt/GDP (in %)	0.0	–5.3	–9.6	–12.2	–13.8
Pension Debt/GDP (in %)	0.0	73.0	146.3	207.0	269.7
Bequests	–0.7	1.7	14.4	42.4	160.5
Interest rate (in pp p.a.)	–0.1	–0.1	0.0	–0.1	–0.2
Labor market:					
Labor input	–2.5	–2.4	–2.6	–3.0	–3.5
– single men	–1.8	–1.4	–1.6	–2.1	–2.6
– married men	0.1	0.3	0.4	0.3	–0.1
– single women	–6.2	–6.1	–6.4	–6.6	–7.2
– married women	–5.5	–6.0	–6.8	–7.6	–8.3
Homework	1.3	1.5	2.0	2.4	3.1
Wage rate	0.9	0.3	0.3	0.5	1.4
Goods market:					
GDP	–1.7	–2.1	–2.3	–2.5	–2.2
Consumption	–1.7	–2.7	–3.5	–4.0	–4.0
Government:					
Consumption tax rate (in pp)	–1.5	–1.5	–1.5	–1.5	–1.5
Social security tax rate (in pp)	–11.6	–11.6	–11.6	–11.6	–11.6

[a]If not indicated otherwise, values are reported as changes in percent over initial equilibrium values. pp - percentage points

future cohorts receive higher bequest, a positive income effect reduces labor supply even further throughout the transition. Again it is married men who respond the least to changes in (net) wages and women who are much more elastic than men. To illustrate the reaction in labor supply of different genders and household types, Figure 3 plots the percentage change in labor hours over the life cycle for single and married men and women. Not surprisingly we see that the drop in labor hours is especially strong at later ages of working life reflecting the change in the (implicit) tax structure described above. Note that married women reduce their labor supply further than singles during child rearing years. In order to compensate for this and for the fact that children are costly, both partners of a marriage have to work more at later periods of working life. The drop in labor supply leads to a simultaneous increase in home work hours as well as to a 1.4 percent rise in wages. As capital hardly moves throughout the transition, the economy contracts by 2.2 percent and aggregate consumption falls even more.

The left part of Figure 4 shows the welfare effects of this reform for current and future co-

Figure 3: Labor supply along the life cycle (men and women)

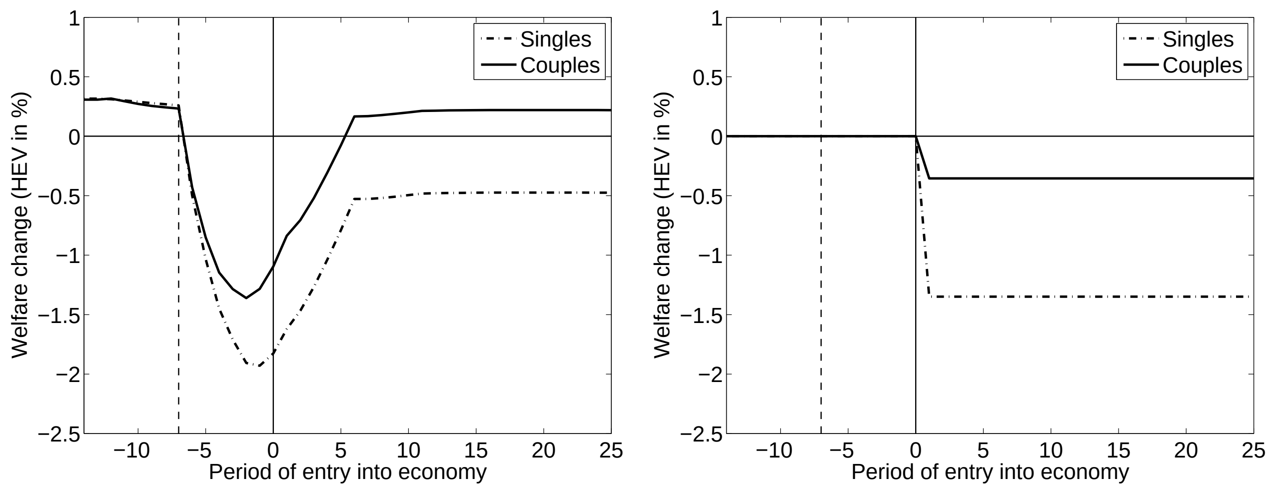


horts.[15] The first thing that sticks out is that welfare consequences are much more evenly distributed across different generations. This was exactly the intention of our tax smoothing exercise. As consumption taxes fall by about 1.5 percentage points from year 1 of the transition, already retired households now experience a slight welfare gain. Older and middle-aged workers in the reform year lose significantly more than younger cohorts, which is because of the worsened labor supply incentives for these people and due to the fact that these households have fewer remaining working years to make up for the loss in retirement income. Young workers and future generations yet gain from a substantial increase in bequests and the rise in wages. Consequently, married couples in future cohorts can realize welfare gains which amount to 0.22 percent of initial equilibrium resources. Singles in the long-run, however, suffer from a welfare loss of -0.48 percent. Summing up, intergenerational redistribution effects more than compensate the cost from higher labor supply distortions and the elimination of the longevity insurance for couples but not for singles.

By running our reform with tax smoothing, we already managed to balance some of the substantial intergeneration redistribution. However we still find remarkable differences in welfare effects across generations. Consequently, the reported long run welfare effects in the left part of Figure 4 still mix up income redistribution across cohorts and efficiency effects. In order to isolate the pure effects on aggregate efficiency, we re-run our simulation under the assumption that the government is able to compensate all intergenerational redistribution by means of individual lump-sum taxes. The resulting welfare effects for singles and couples are shown in the right part of Figure 4. As discussed above, the government makes all existing singles and couples as well off as in the initial equilibrium. Then the cost for singles are redistributed to future singles so that they all face the same welfare changes. The same procedure is repeated for couples so that the difference in the welfare effects of future cohorts reflects how singles and couples are differently affected in efficiency terms by the reform.

[15] Current cohorts are now described by their year of birth.

Figure 4: Welfare effects of singles and couples (before and after compensation)



We find that the elimination of social security induces efficiency losses for both singles and married couples. However, the efficiency loss of 1.34 percent for singles is substantially larger than the one for couples (0.35 percent). The question is how to explain this.

5.4 Disaggregation of efficiency effects

Recalling the discussion of the effects of social security privatization on aggregate efficiency derived from previous papers, it is not surprising that our reform generates efficiency losses. Both worsened labor supply incentives as well as the loss in longevity insurance weigh negatively in terms of efficiency, and it would be hard to believe that improved liquidity conditions can overcompensate these negative effects. However it remains to be identified which of the three effects on aggregate efficiency is so different for married couples compared to singles. In order to isolate the impact of the different components on aggregate efficiency, we simulate our privatization experiment with alternative assumptions about labor supply and lifespan uncertainty and report the results in Table 7.

Table 7: Disaggregation of efficiency effects

	Efficiency	
Scenario	Singles	Couples
Fixed labor and life span	0.27	0.19
+ life span uncertainty	-0.55	0.42
+ variable labor supply	-0.92	0.18
+ homework (Baseline)	-1.34	-0.35

First of all, we want to determine the role of liquidity constraints. We therefore simulate a version of our economy in which life span is assumed to be certain and equal to 80 years for all individuals. In addition, we let both home production and labor supply decisions be fixed at initial equilibrium levels, i.e. households can only respond with their savings decision to the reform of the pension system. The efficiency results of this simulation are shown in the first line of Table 7.[16] We find that when we abolish social security in such an environment, both singles and couples experience an efficiency gain. This gain is a direct consequence of relaxed liquidity constraints for all households. In the initial equilibrium, singles (and especially single moms) tend to be liquidity constraint more often, so that the positive liquidity effect is slightly higher for these households.

Next we want to quantify the importance of longevity insurance provision for singles and couples. Consequently, we re-introduce lifespan uncertainty into the model. Yet, households are still not allowed to adjust home production nor labor supply along the transition. The difference in the efficiency effects between the second and the first line in Table 7 then reflects how much households suffer from losing longevity insurance provided by social security. We find that this value is negative ($-0.55 - 0.27 = -0.82$) for singles, but positive $0.42 - 0.19 = 0.23$ for married couples. This means that from the perspective of a couple, self-insurance against longevity risk is actually more attractive than longevity insurance provided by the government, so that couples prefer a situation without social security. In contrast, singles have a hard time self-insuring against the risk of reaching very old ages, so that they would rather rely on governmental insurance schemes.

In the third simulation, we allow households to adjust their labor hours, but still assume home production to be fixed at initial equilibrium values. As already discussed above, worsened labor supply conditions towards the end of the working career now generate an additional efficiency loss when social security is shut down. For singles this loss amounts to $-0.92 - (-0.55) = -0.37$ percent, while for couples it is -0.24 percent.

Finally, we allow households to also adjust their home production effort, so that we are back in our baseline scenario. The efficiency numbers reported in the last line of Table 7 are therefore the same as in the right panel of Figure 4. We find that, under variable home production, efficiency effects from privatizing the pension system substantially fall both for singles (-0.42) as well as for couples (-0.53). When households are allowed to adjust home labor effort, they react more elastically to changes in labor supply incentives (which is especially true for couples). As our reform clearly worsens labor supply conditions, it leads to larger efficiency losses when labor supply is more elastic.

Dotsey, Li and Yang (2015) report that the privatization of social security leads to higher long-run welfare levels in a model with home production compared to a model without. Note that this result is not at all in conflict with ours. In fact, when we compare the long-run welfare levels from simulations with fixed and variable home production and time variable social security taxes, we come to the very same conclusion. Yet, when looking at the transitional dynamics, the higher long-run welfare level is due to substantial intergenerational

[16] Besides bequest now being zero, the initial equilibrium doesn't look very different from the one reported in Table 4.

redistribution. When home labor is flexible, households are able to exploit the rise in long-run wages that results from capital abundance and decreasing labor tax rates way more effectively. At the same time, however, they suffer much more from short-run declines in (net) wages due to high social security taxes. In a simulation with tax smoothing, the burdens from privatizing social security are much more evenly distributed between generations. In such a setup, we also find long-run welfare to fall when home production is endogenous.

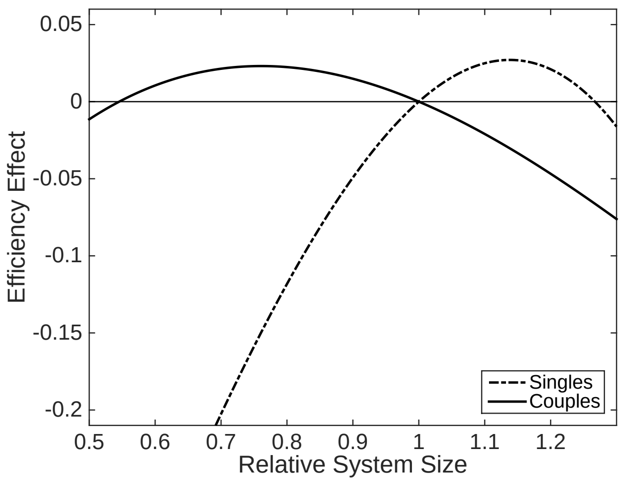
Finally, note that the overall efficiency loss that can be attributed to worsened labor supply conditions is $-0.55 - (-1.34) = 0.79$ for singles and $0.42 - (-0.35) = 0.77$ for couples. Consequently, the substantial difference in efficiency effects of our pension funding reform can almost exclusively be attributed to households of different composition valuing governmentally provided longevity insurance differently.

5.5 Moderate reforms: Should we downsize or increase the pension system?

A complete elimination of social security is certainly not a viable policy option especially in times when capital markets seem to be flooded. However, it might be useful to ask whether a moderate reform of social security can be recommended from an efficiency point of view and who would benefit from such a policy. Especially in times of demographic change in which the costs associated with aging and low fertility rates force most countries to reduce the generosity of future pension benefits, it is important to understand to what extent social security reforms enhance or deteriorate the efficiency of the economy as a whole and to what extent singles and couples are differently affected.

Figure 5 reports the efficiency impact for singles and couples when we reduce or increase the accrual rate κ. First of all, we find that couples would benefit from a moderate decline in the

Figure 5: Efficiency effects of moderate reforms for singles and couples



size of social security, while singles would actually prefer the system to be expanded. This is a direct consequence of couples having access to better self-insurance technologies than singles. In a sense, the pension system redistributes from couples towards singles, as both types of households pay the same (percentage) amount of contribution, but singles build more heavily on governmentally provided longevity insurance. In addition, the efficiency effect is much less responsive to variations in system size for couples than for singles. In fact, when the system size is reduced, singles quickly incur substantial efficiency losses, while couples are only mildly negatively affected by a system expansion. This again is a result of couples being able to adjust more flexible to the economic environment and especially the degree of risk sharing that is provided through social security.

Summing up, our results indicate that there is a tension between the needs of singles and couples when it comes to the size of the pension system. While couples generally would be in favor of smaller system sizes, singles prefer the government to provide substantial social insurance. Recent reforms that aim at reducing the importance of pay-as-you-go social security systems therefore may create an imbalance between couples and singles, where the share of the latter in the population is steadily rising.

6 Conclusions and future extensions

In this paper we disentangle the efficiency consequences of social security for singles and families. We therefore augment the standard overlapping generations model with idiosyncratic labor productivity and longevity risk in that we account for gender and marital status. Our results indicate that both singles and married couples would loose substantially from an abolition of the German social security system. After a proper compensation of the effects of intergenerational redistribution, the efficiency loss is about four times as large for singles than for couples. Welfare effects from privatizing the pension system are due to (i) worsened labor supply conditions especially for older workers, (ii) a loss in longevity insurance provided by the government and (iii) improved liquidity conditions. Our decomposition exercise reveals that while the labor supply and liquidity effects are very similar for singles and married couples, the longevity effect is not. Since a married individual inherits her spouse's wealth after his death and the likelihood that both partners reach a very old age is relatively small, marriage serves as an insurance device against longevity risk for the surviving partner. Consequently, married couples are much less reliant upon governmental provided longevity insurance. In fact, in the absence of any labor supply decision, married couples would prefer a situation without social security system, while singles would like to stay in the status quo. Finally, we show that there is a tension between the needs of singles and couples when it comes to the optimal size of the pension system. While couples generally would be in favor of smaller system sizes, singles prefer the government to provide substantial social insurance.

It is interesting that although the complexity of the present model differs quite substantially from our previous studies such as Fehr, Habermann and Kindermann (2008) or Fehr and Kindermann (2010), the present findings still confirm our previous results. They are also in line with other papers that highlight the insurance role of families such as Brown and Poterba (2000) or Ortigueira and Siassi (2013). It also sheds more light on the role of home production an issue which has just recently deserved increasing attention, see Guler and Taskin (2013) or Dotsey, Lin and Yang (2015). However, our simulation approach indicates a novel way to isolate the importance of all these effects for different household types.

Of course, our analysis is based on various assumptions which might affect our qualitative results. First, the German pension system features a Bismarck design so that labor supply distortions are low and the insurance provision against income risk is limited. It could be that the effects of home production are quite different in a more progressive pension system. Second, bequest motives may play an important role especially in a family context, but this is completely neglected here. Including bequest motives for families with children might affect the intergenerational redistribution pattern but it is unlikely that it changes the family insurance provision. A third issue for further study concerns the preference structure of the family household. On the one side it might be interesting to change the weights assigned to husband and wife in the decision problem of families or even move from a cooperative to a non-cooperative family decision modeling. On the other side there is some evidence that women are more risk avers than men which indicates to modify the assumption that men and women have the same preferences. Finally, in real life marital status changes constantly throughout the whole life cycle. In principle we could follow Domeij and Klein (2002) or Hong and Ríos-Rull (2007) who analyze social security in a model that features marriage, divorce and remarriage as idiosyncratic shocks over the life cycle. Alternatively, since social security may as well affect household formation, it might be interesting to endogenize marriage and divorce probabilities along the lines of Chade and Ventura (2002). However, if the marital status changes over the life cycle the clear distinction of singles and couples is not possible any more.

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