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Abstract

The present paper quantifies the economic consequences of eliminating the system of income splitting in Germany. We apply a dynamic simulation model with overlapping generations where single and married agents have to decide on labor supply and homework facing income and lifespan risk. The numerical exercise computes the resulting welfare changes across households and isolates aggregate efficiency effects of a move towards either individual taxation or family splitting.

Our results indicate strongly that a switch towards individual taxation performs best in terms of economic efficiency due to reduced labor market distortions and improved insurance provision. In our benchmark calibration the efficiency gain amounts to roughly 0.4 percent of aggregate resources. Excluding home production significantly reduces aggregate efficiency gains while including marital risk slightly improves the efficiency of individual taxation.

JEL-Code: H210, H240, J120, J220.

Keywords: stochastic general equilibrium, home production, female labor supply, tax unit choice, insurance provision.

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1 Introduction

For many years the reform of family taxation has been an important issue in the policy debate in Germany. In contrast to most other European countries which have introduced a system of individual taxation in the past, Germany still runs a joint taxation system with income splitting for married households. Under this system half of the joint income of both spouses is taxed according to the progressive tax schedule and the resulting tax burden is doubled for the household. As a consequence, both spouses face the same marginal tax rate independent of the distribution of labor income within the marriage. The existing system is criticized both on distributional as well as on efficiency grounds. Compared to a non-married couple with the same joint income, the tax savings of the married couple – the so-called splitting advantage – increase up to a maximum level both with the difference and the level of income. Therefore, the system does not support families with children but subsidizes one-earner households with high incomes. The system also heavily distorts the labor supply decision of the married couple. Since the secondary earner faces the high marginal tax rate of the primary earner, it is not surprising that in Germany the labor market participation rate of married women is fairly low compared to other countries. This is particularly inefficient since the labor supply of the secondary earner is typically considered more elastic than the one of the primary earner.

Depending on whether they put more weight on distributional or efficiency objectives, the proposed reform alternatives point in completely opposite directions. Those who focus on the distributional implications of the current system favor a system of family splitting with children increasing the income splitting factor in addition to the spouses. Raising the splitting factor while keeping the current tax schedule would reduce income tax revenues so that the budget has to be balanced by higher tax rates and/or lower transfers. Those who emphasize the labor market distortions and female labor supply incentives propose a move towards a system of individual taxation. Of course, a system of individual taxation would increase income tax revenues so that the budget allows for lower tax rates and/or higher transfers.

The present study attempts to quantify the macroeconomic implications of alternative reforms of family taxation for the German economy as well as the distributional and efficiency consequences for different households. We apply a dynamic general equilibrium model with overlapping generations, where the different married or single agents within a cohort consume leisure, work in the market and at home. During the employment phase each individual faces a risky labor market opportunity and the lifespan is uncertain. For every simulated policy reform we compute the macroeconomic transition path, the resulting welfare changes across and within cohorts and isolate aggregate efficiency effects due to changing labor supply distortions and insurance provision.

Our numerical exercises indicate the following major results. First, as expected, individual taxation and family splitting both increase labor supply of married women, in the former case even up to 10 percent (in hours). The main difference between both reforms is the impact on aggregate savings and capital accumulation. While individual taxation dampens aggregate savings and capital accumulation, the opposite holds for family splitting. Second, a switch towards individual taxation performs better in terms of economic efficiency. The resulting gains amount to roughly 0.4 percent of aggregate resources and are due to improved labor supply incentives and an implicit insurance provision against wage risk. Efficiency gains would even further increase, if individual taxation was combined with the introduction of a child splitting factor. Third, efficiency gains are much smaller without flexible home production due to lower labor supply elasticities. The explicit consideration of marital risk dampens the redistribution between singles and married and slightly increases efficiency gains from individual taxation. Efficiency losses due to reduced insurance provision can be generated only for very special model assumptions.

Given this focus, our paper is related to at least three different research strands. The first is concerned with the optimal taxation of couples. Boskin and Sheshinski (1983) were among the first to point out the efficiency gains from a separate taxation of men and women within a household. Their central argument rests on the fact that when two partners in a marriage decide simultaneously about the allocation of time worked in the market and the distribution of resources for individual consumption, labor supply of the secondary income earner is more elastic than that of the first. This reasoning was undisputed for quite a long time, until Piggott and Whalley (1996) thought to have found an efficiency oriented reasoning for joint taxation. They introduced home production into the cooperative household model and showed that individual taxation might distort the optimal time allocation with respect to home work. However, as the following discussion in Gottfried and Richter (1999) as well as Apps and Rees (1999) showed, even in their model in which home production is distorted by taxes, individual taxation is still the optimal choice from an efficiency point of view. Yet, Apps and Rees (2011) show that the case for individual taxation becomes even more convincing, if one assumes the productivity levels of both spouses to converge in the wake of assortative mating. Therefore, the so-called conventional wisdom (Apps and Rees, 2011) proposes individual taxation of married couples from an efficiency point of view. However, the conventional wisdom focuses only on labor supply incentives in models without earnings risk. When labor earnings are uncertain, progressive income taxation might provide an insurance benefit which compensates the induced labor supply distortions. Indeed, Corneo (2013) has recently argued that joint taxation with income splitting provides couples with more insurance against earnings risk. Since this result is derived in a model with exogenous labor supply, a comprehensive analysis has to include labor market distortions and insurance effects.

A second strand of literature refers to various micro simulation approaches which quantify the resulting labor market and distributional consequences of a reform of family taxation in Germany. Typically these studies are based on the discrete choice approach proposed by van Soest (1995), in which household members choose their hours worked in the labor market out of a discrete set, e.g. 0, 10, 20 or 40 hours for the female and 0 or 40 hours for the male spouse. Most importantly, these decisions are made on a joint basis, so that interactions between labor effort and wage levels of the two partners can be taken into account. On this basis, Steiner and Wrohlich (2004) find that a revenue-neutral move from joint to individual taxation in Germany would increase participation rates of married women by almost 5 percentage points and female labor supply in hours by 11.4 percent. More recent studies by Bach et al. (2011) as well as Decoster and Haan (2011) confirm these figures while the results of Eichhorst et al. (2012) indicate much smaller effects. The introduction of different family splitting rules in Germany are simulated by Beblo et al. (2004), Bergs et al. (2007) as well as Steiner and Wrohlich (2008). Typically they find a significant fall in tax revenues and a modest increase in labor supply. Consequently, microeconomic studies typically favor a move towards individual taxation due to the stronger positive effects on individual labor supply.

Finally, our study is also related to recent calibrated overlapping generation models where married and single households decide on the time allocation for home work and market work as well as savings. Among others, Olivetti (2006) and Greenwood et al. (2005) study the rising labor market participation of women in the past in such macro-economic set-ups. Their results indicate that changes in the returns to experience as well as the introduction of labor-saving consumer durables may have had an important impact. Rogerson (2009), Olovsson (2009) and Ragan (2013) are examples of studies which argue that home production is also important in reconciling the effects of tax and transfer systems for the observed cross-country differences in market labor supply. The focus of the present study however is more connected to Guner et al. (2012a, b) who analyze the impact of U.S. income tax reforms on female labor supply in such a dynamic economy populated with single and married households, where the latter comprise one or two earners.

Typically, simulation studies with overlapping generations quantify steady state effects of policy reforms or technology improvements. Instead, we compute the transition path towards the long-run equilibrium, derive the short and long-run welfare consequences for for different household types within a cohort and isolate the aggregate efficiency consequences of the considered reforms by means of a compensation mechanism. In this sense, our approach combines the merits of the three different strands of literature. The next section provides a description of the simulation model we use to derive our results. Section three explains the calibration of the model parameters and section four reports the simulation results in detail. Section five concludes with some ideas for future research.

2 The model economy

2.1 Overview

Our model consists of up to three interacting sectors: households, firms and the government.

At any point in time the household sector distinguishes overlapping generations of both genders. At each successive age individuals decide about how much to consume and save. They are endowed with one unit of time, which they can either supply to the market, use for home production or consume as leisure. Beyond a mandatory retirement age agents are not allowed to work at the market anymore. Individuals make their choices under a series of risks. Specifically, there is uncertainty about:

(i) *marital status:* When they enter the labor market, individuals are assigned to a marital status which they keep until death. They are either single or they are married to an individual of the other gender. In the latter case, the married couple constitutes a decision unit with pooled resources, i.e. the two partners make a joint decision about the allocation of consumption, assets, labor supply, home production and leisure consumption.

(ii) *the number of children:* Children are another "risk factor" in our model, meaning that their birth is due to an exogenous probability π^c. Childbirth only takes place at the age J_c. 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 will stay with their mother and the father will have to pay alimonies.

(iii) *individual labor productivity:* Beneath following a trend dependent on gender, age and education, individual labor productivity is affected by idiosyncratic transitory shocks.

(iv) *survival to the next period:* Individuals will only survive to the next period with a certain probability ψ_j^g depending on their gender. Married couples thereby constitute a special case, as it might be that only one of the two partners dies. In this case, the surviving spouse will inherit 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.

Firms produce a single good under perfect competition employing labor and capital from households, the latter of which depreciates at a constant rate. The government runs two systems with separate budgets. The tax system collects taxes on individual labor and asset income as well as consumption in order to finance the provision of a public good, child benefit payments and interest payments on existing debt. In addition, a pay-as-you-go pension system collects contributions from working agents and pays old-age benefits depending on individuals' earnings history to retirees.

After this very general description of our model, we now define the behavior of all actors in a more technical way.

2.2 Demographics and intracohort heterogeneity

Our model economy is populated by J overlapping generations. At any discrete point t in time, a new generation – populated in equal size by men M and women F – is born. Individuals face gender-specific lifespan uncertainty, where $\psi_j^g \leq 1$ denotes the conditional survival probability of gender $g \in \mathcal{G} = \{M, F\}$ from age $j-1$ to age j with $\psi_{J+1}^g = 0$. When they enter the labor market, agents belong to different skill classes $s \in \mathcal{S} = \{1, \ldots, S\}$

and are either married to a spouse or singles. As the skill level, marital status remains stable throughout lifetime, i.e. we abstract from divorce and remarriage at this stage. The individual state vector of an age-j agent is then defined by

$$z_j = (g, s, m, k_j, \eta_j, \eta_j^*, a_j, p_j). \tag{1}$$

The first four state variables denote the demographic structure of the household. Besides gender and skill level, the marital status $m \in \mathcal{M} = \{0, 1, \ldots, S\}$ indicates whether the individual is single ($m = 0$) or married to a spouse from skill class $m \in \mathcal{S}$. Fertility is exogenous and $k_j \in \{0, 2\}$ indicates the number of children. At age J_c, a fraction π_m^c (π_s^c) of married (single) men and women are assigned two children (i.e. $k_j = 2$) who remain in the household until reaching adulthood, afterwards the household status returns to $k_j = 0$. The two following entries η_j and η_j^* describe an idiosyncratic shock to labor income of the individual and his potential spouse.[1] In case the individual is a single we set $\eta_j^* = 0$. Finally, $a_j \in \mathcal{A} = [0, \infty[$ and $p_j \in [0, \infty[$ are an agent's asset holdings and pension claims at the beginning of the period. While assets and pension claims are influenced by individual decisions, the other state variables are determined exogenously. Gender, skill level and marital status can be interpreted as one-time persistent shocks, the realization of which is revealed at the beginning of the life-cycle. While the two realizations of gender occur with equal probability, there is a probability distribution π_g^s which assigns the skill level s conditional on gender g. Conditional on getting married, individuals of a gender g and skill level s are assigned to a s^* spouse with probabilities $\pi_{g,s}^{s^*}$ before they enter the life cycle. With respect to fertility we assume that on average singles have less children than married households so that the probability of having two children is smaller for singles than for married couples: $\pi_s^c < \pi_m^c$. Labor productivity is transitory and by assumption follows a first-order Markov process. Therefore the probability distribution of future labor productivity η_{j+1} only depends on the current productivity η_j, i.e. there exists a probability distribution $\pi_{g,s}^{\eta}(\eta_{j+1}|\eta_j)$ which by assumption depends on gender and skill level.

Agents retire at age J_R and start to receive pension benefits which are financed by proportional payroll taxes payed up to a contribution ceiling of the double of average labor income. 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 where both partners die at the same age) leave accidental bequests $b_j(z_j)$ that will be distributed according to the age-specific scheme Γ_j in a lump-sum fashion across all working individuals, i.e.

$$b(z_j) = \Gamma_j Q_t \tag{2}$$

where Q_t defines aggregate unintended bequests in period t. In the following, we will for the sake of simplicity omit the indices t and z_j wherever possible.

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[1] Variables pertaining to a partner are denoted by an asterisk. In particular, if s = male, then s^* = female and vice versa.

2.3 The single households decision problem

All agents value streams of consumption c_j and leisure ℓ_j according to the standard expected utility function

$$E\left[\sum_{j=1}^{J}\beta^{j-1}u(c_j,\ell_j)\right], \tag{3}$$

where β is a time discount factor. Due to additive separability over time, we can formulate the decision problem recursively so that

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

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

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

At the beginning of life households are endowed with zero assets $a_1 = 0$. Throughout the whole life cycle assets are restricted to be greater or equal to zero, i.e. agents might be liquidity constrained and 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 generated by wages for effective labor w, gender- and skill-specific productivity at age j, $e_j\eta_j$ 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 were 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 may also inherit accidental bequests b_j from their parent's generation. They may pay a lump-sum tax tr_j (or receive a subsidy) during working years and 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 payed 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 $p_1 = 0$.[2] Our model takes a contribution ceiling into account which fixes the maximum contribution and pension accrual base to the double of average income per year $\bar{y}$.

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

2.4 The married household decision problem

Following Hong and Rios-Rull (2007), we assume a collective model of household decision making. Consequently, 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.[3] In addition, the income splitting method of family taxation is applied in the benchmark economy. Consequently, the household budget constraint reads

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

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 (3).

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 the possibility that one of the spouses dies into account. In this case the surviving partner, e.g. the partner of gender g, completely inherits the assets of the partner and his state turns into $z_{j+1} = (g, s, \eta_{j+1}, 0, 0, 2a_{j+1}, p_{j+1})$. Consequently, couples' assets are only passed on to younger cohorts if both partners die at the end of the same period.

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

[3] The pooling of pension claims approximates the German widow's pension benefit.

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

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

with

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

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. $\hat{k}_j = 0$.

2.6 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 such that 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, i.e.

$$\max_{K_t, L_t} \; \left\{ \theta K_t^{\varepsilon} L_t^{1-\varepsilon} - w L_t - (r + \delta) K_t \right\} \tag{11}$$

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.

2.7 The government sector

Our model distinguishes between the tax- and the pension system. In each period t, the government issues new debt $B_{G,t+1} - B_{G,t}$ and collects taxes from households in order to finance general government expenditure G which is fixed per capita as well as interest payments on existing debt,[4] i.e.

$$B_{G,t+1} - B_{G,t} + T_{I,t} + T_{X,t} + T_{T,t} = G + r_t B_{G,t} + CB_t, \tag{12}$$

where $T_{I,t}$ and $T_{X,t}$ define income and consumption tax revenues, respectively, and CB_t denotes aggregate child benefits. A uniform lump-sum tax $T_{T,t}$ for adult individuals who are not retired balances the government's budget.

In each period, the pension system pays old-age benefits and collects payroll contributions from labor income below the contribution ceiling of $2\bar{y}$. The pension budget is balanced in every period by means of the contribution rate.

2.8 Equilibrium conditions

Given a specific fiscal policy, an equilibrium path of the economy has to solve the household decision problem, reflect competitive factor prices, and balance aggregate inheritances with unintended bequests. Furthermore aggregation must hold and the lump-sum 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.

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

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

3 Calibration of the initial equilibrium

3.1 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 in wedlock and in families, we set the childbirth probability of married females to $\pi^c_m = 0.9$ and of single females to $\pi^c_s = 0.45$. We assume that 53 percent of all males/females who enter the labor

[4] Since we assume a population growth rate of zero, the government cannot issue new debt in a long-run equilibrium.

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.

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_m^c)	0.9	Coefficient of leisure preference (α)	0.60
Childbirth probability (π_s^c)	0.45	Share parameter for market goods (υ)	0.52
		Scaling factor consumption (ω)	0.50
		Scaling factor children (ϕ)	0.30
		Discount factor (β)	0.93
Technology/Budget parameters		*Government parameters*	
Factor productivity (θ)	1.52	Debt-to-output (B_G/Y)	0.80
Capital share (ε)	0.35	Consumption tax rate (τ_x)	0.20
Depreciation rate (δ)	0.26	Contribution rate (τ)	0.199
Education time male (φ^m)	0.00		
Education time female (φ^f)	0.15		

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 low-skilled or regular and high-skilled individuals (i.e. $S = 2$) and assume that the initial distribution of men and women over these two groups follows the one reported in the appendix. Mating probabilities $\pi_{g,s}^{s^*}$ were estimated from German Socio-Economic Panel (SOEP) data of the years 1995-2007 and are reported in the appendix as well.[5]

3.2 Preference parameters, labor market participation and time use

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

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

labor supply elasticity of 0.17 for men and of 0.47 for women. Evers et al. (2008) survey labor supply estimates from 30 different studies and find a mean elasticity of 0.07 for men and of 0.34 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. (2012) 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	0.17	0.47	0.20	0.38	0.15	0.60
compensated	0.40	0.93	0.54	0.73	0.27	1.17

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 $\alpha = 0.6$ and the share parameter for market goods $v = 0.52$ 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 wage gap described below. 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]	38.9	21.5	39.6	22.6	32.0	45.4
	Data[a]	31.6	25.3	43.1	23.4	34.4	42.3
children	Model[b]	39.6	23.6	36.8	17.9	40.3	41.8
	Data[a]	37.5	24.3	38.2	15.6	47.5	36.8
retired	Model	0.0	34.0	66.0	0.0	44.9	55.1
	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 capital to output ratio of 3.4, the discount factor β is set at 0.93 which implies an annual discount rate of about 1.6 percent.

3.3 Technology and government parameters

On the production side we let the capital share in production be $\varepsilon = 0.35$ reflecting the average share of capital income in Germany. The annual depreciation rate for capital is set at 4.75 percent (i.e. the periodic depreciation rate is $\delta = 0.26$) which yields a realistic investment share in output. Finally we specify the general factor productivity $\theta = 1.52$ in order to normalize the initial wage rate to unity.

We choose an accrual rate κ such that the replacement rate of net income amounts to 50 percent, which yields a realistic pension contribution rate for Germany. 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 is due to gross labor earnings minus a fixed allowance of 2400 € per person and an additional deduction of 10 percent of y_j. 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 reflect current German law which states that on average 2400 € 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 assume a debt-to-output ratio of 80 percent and fix the consumption tax rate at 20 percent in order to generate a realistic public consumption ratio G/Y.

3.4 Estimation of productivity profiles and income uncertainty

We estimate productivity profiles for men and women of different skill classes using inflated hourly wages w_{ijt} of primary household earners from the German SOEP. Our unbalanced panel data set covers full-time workers between ages 20 and 60 of the years 1984 to 2008 who were divided into secondary and tertiary educated subgroups according to the International Standard Classification of Education (ISCED) of the UNESCO of 1997. This approach leads to a total of 130 693 observations with 61 798 low-skilled males, 49 438 low-skilled females, 10 636 high-skilled men and 8 821 high-skilled women.

With this data, we estimate a simplified version of the Storesletten et al. (2004) model. Specifically, we assume log wages to follow a gender, skill group and age dependent trend and let shocks to individual wages be of AR(1) type. In addition we estimate time fixed effects to rule out business cycle components and technical change. Consequently we estimate the equations

$$\log(w_{ijt}) = \log(e_j) + \text{time}_t + \log(\eta_{ij})$$

with

$$\log(\eta_{ij}) = \varrho \log(\eta_{ij-1}) + \epsilon_{ij} \quad , \quad \epsilon_{ij} \sim N(0, \sigma_\epsilon^2).$$

We specify the time trend to

$$\log(e_j) = \beta_0 + \beta_1 \cdot j + \beta_2 \cdot j^2/100$$

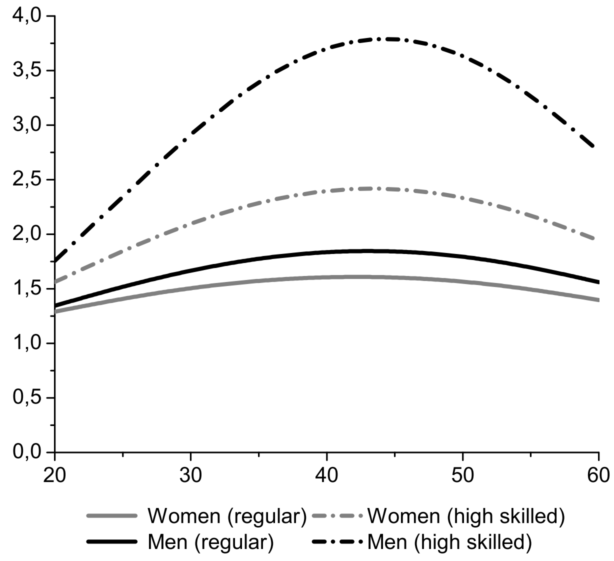
and estimate four separate equations, one for each gender and skill combination. Our parameter estimates are shown in Table 4 (standard errors are reported in parentheses).

Table 4: Parameter estimates for individual productivity

	Men		*Women*	
	low-skilled	*high-skilled*	*low-skilled*	*high-skilled*
Intercept β_0	1.4256	06894	1.7944	1.4152
	(0.0351)	(0.1384)	(0.0397)	(0.1426)
age term β_1	0.0671	0.1225	0.0405	0.0735
	(0.0018)	(0.0067)	(0.0021)	(0.0072)
age^2 term β_2	-0.0721	-0.1324	-0.0459	-0.0810
	(0.0023)	(0.0079)	(0.0027)	(0.0088)
AR(1) correlation ϱ	0.8665	0.9187	0.8044	0.8637
	(0.0016)	(0.0026)	(0.0023)	(0.0042)
transitory variance σ_ϵ^2	0.0396	0.0380	0.0648	0.0556
	(0.0017)	(0.0070)	(0.0020)	(0.0062)

Note that we find a strong AR(1) correlation of around $0.8 - 0.9$ for the error term. Bayer and Juessen (2012) document similar values using SOEP data. The estimated wage profiles can be seen in Figure 1. While the gender productivity gap for high-skilled is quite drastic, the difference between low-skilled men and women is fairly small.

Figure 1: Estimated productivity profiles



For computational reasons, we finally approximate the shock η by a first order discrete Markov process with three nodes using a discretization algorithm as described in Tauchen and Hussey (1991).[6]

3.5 The initial equilibrium

Table 5 reports the calibrated benchmark equilibrium and the respective figures for Germany in 2010. 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.

We consider a closed economy, so that the private consumption share in output also includes net exports. Aggregate pension benefits are slightly too high and aggregate tax revenues are slightly too low. Quite realistically, about one third of tax revenues are due to progressive labor income taxation. Given the debt-to-output ratio of 80 percent, interest payments are roughly 3.8 percent of GDP, child benefits account for 2.2 percent of GDP, so that public consumption amounts to 15.5 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.

Next we compare the life cycle behavior of men and women in the initial benchmark equilibrium. Since married households equally split their assets and consumption of market goods, the differences in Figure 2 are due to the gender wage gap which induces single women to consume less and save more than single men. The latter also induces women to work more

[6] We have also used a Markov process with five nodes. This approximation yields almost the identical equilibrium but increases computational time dramatically.

Table 5: The initial equilibrium

	Model solution	*Germany 2010*[a]
Calibration targets		
Life expectancy (women) (in years)	81.1	81.9
Life expectancy (men) (in years)	76.8	76.8
Pension benefits (% of GDP)	12.0	11.6
Tax revenues (in % of GDP)	21.4	22.2
Capital-output ratio	3.4	3.5
Other benchmark coefficients		
Interest rate p.a. (in %)	4.7	–
Bequests (in % of GDP)	6.2	7.1[b]
from which are intergenerational	4.0	–
Gini-coefficient for net income	29.3	28.2[c]

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

at home on average than men as shown in Figure 2. The labor supply drop in child rearing years is also significant in the upper part. Note that these figures reflect averages and the difference in labor supply is even more significant when only couples with children are considered.

Finally, Figure 3 compares the fractions of full-time employed men and women with and without children in the model with the data from Statistisches Bundesamt (2007). Of course, since the model does not explicitly account for years of higher education, the full-time employment fraction initially is much too high in the model. However, education only delays the full-time employment of women to later years. Our model captures the initial fraction of full-time employed women quite well and reflects the employment decline of women without children afterwards. In addition, the model also captures the full-time employment fraction of women with children in comparison with the data.

4 Simulation results

The remainder of this paper focusses on the macroeconomic, welfare and efficiency consequences of alternative reforms of family taxation. More specifically, we substitute the existing income splitting system by either individual taxation or family splitting. For each policy reform considered we balance the annual budget of the government by a uniform lump-sum tax or subsidy for adult individuals who are not retired. In addition the pension budget is balanced by the endogenous contribution rate.

In the first subsection we explain how welfare and efficiency effects are computed. The

Figure 2: Life cycle behavior of men and women

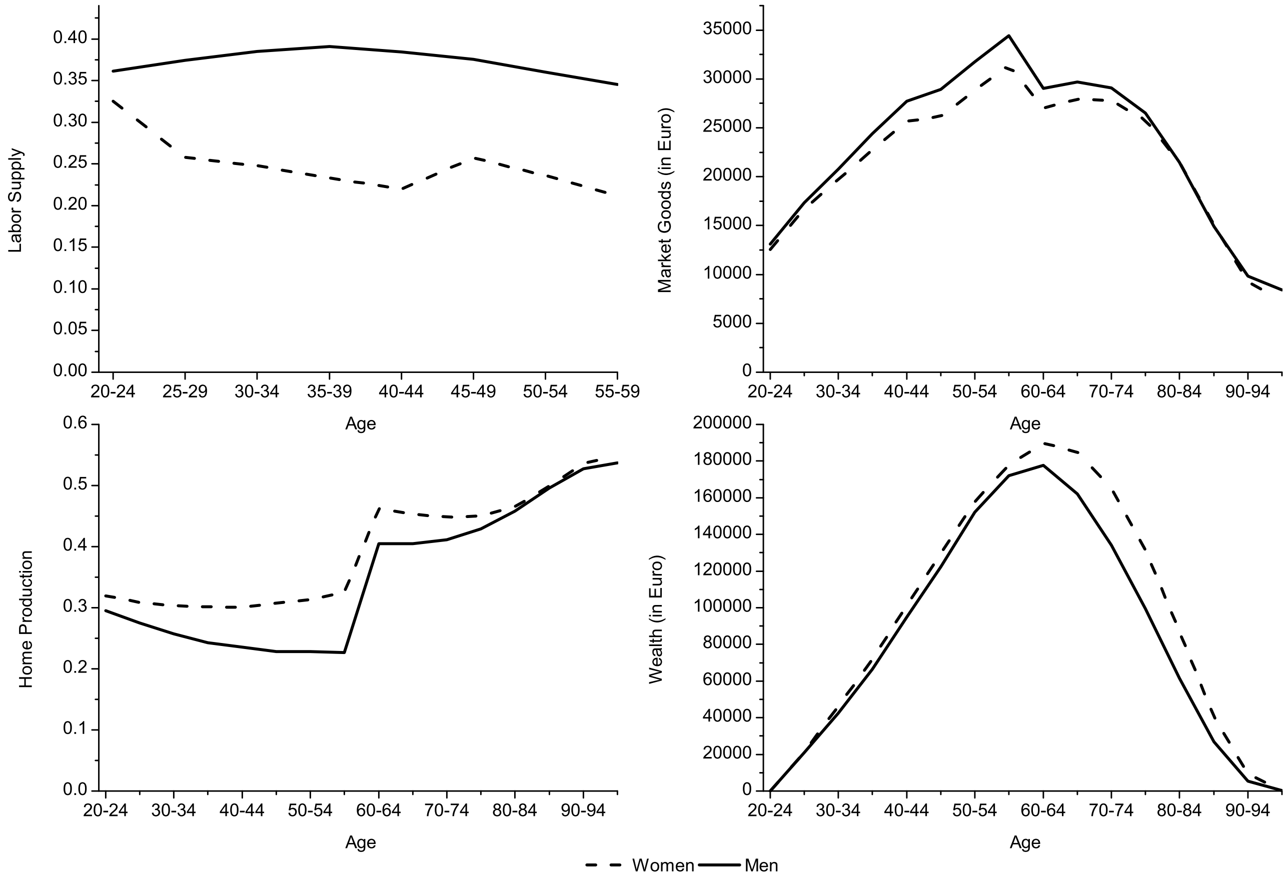
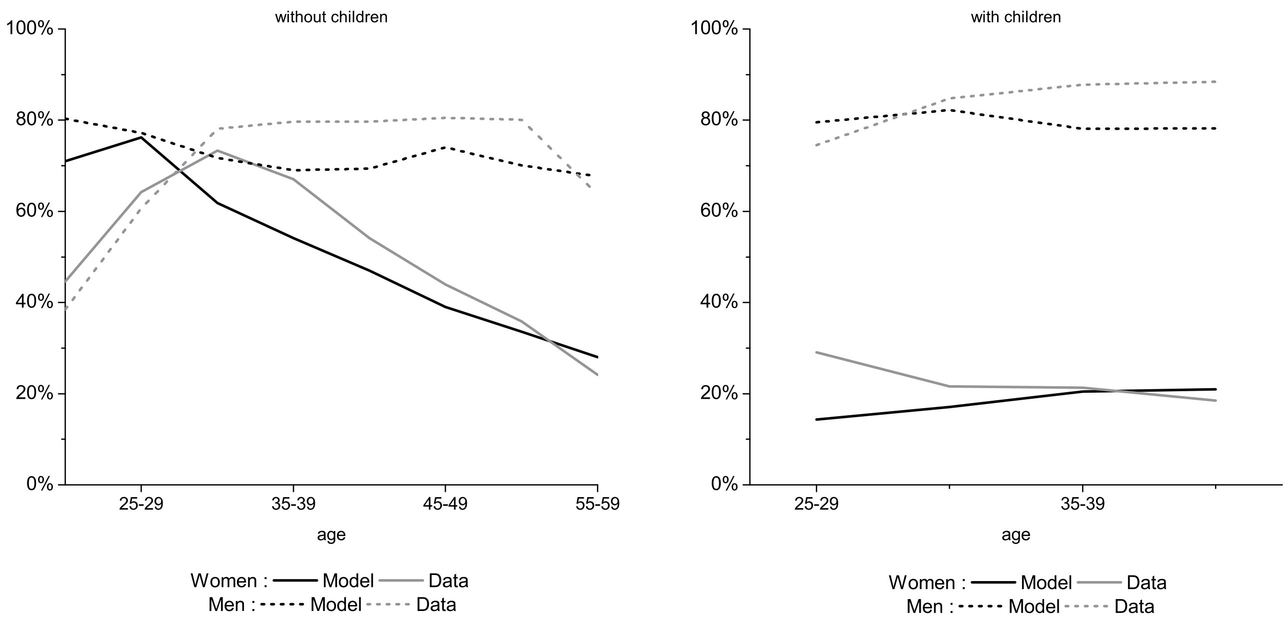


Figure 3: Fraction of full-time employed by gender



subsequent part considers the three policy reforms in the benchmark version of the model discussed above. The following sensitivity analysis isolates the impact of the home production technology and allows for divorce risk and remarriage.

4.1 Computation of welfare and efficiency effects

We apply compensating variation à la Hicks to quantify welfare effects. Due to the homogeneity of our utility function,

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

holds for any x_j, ℓ_j and ϕ. In consequence, since utility is additively separable with respect to time, if consumption and leisure were simultaneously increased by the factor $1+\phi$ at any age, life-time utility would increase by the same factor. With these considerations in mind let's again turn to our simulation model. Assume an individual at state z_j had utility $V^b(z_j)$ in the initial long-run equilibrium path and $V^r(z_j)$ after the policy reform. The compensating variation between the baseline and the reform scenario for the individual characterized by z_j is then given as

$$\phi = \left(\frac{V^r(z_j)}{V^b(z_j)}\right)^{\frac{1}{1-\frac{1}{\gamma}}} - 1.$$

ϕ then indicates the percentage change in both consumption and leisure individual z_j would require in the initial equilibrium in order to be as well off as after the policy reform. We may also say that an individual is ϕ better (or worse) off in terms of resources after the reform. If $\phi > 0$, the reform is therefore welfare improving for this individual and vice versa.

A special rule applies to individuals not having entered their economically relevant phase of life in the year before we conduct our policy reforms (the so-called future generations). We evaluate their utility behind the Rawlsian veil of ignorance, i.e. from an ex-ante perspective where their gender but neither their skill level nor any labor market shock has been revealed. The concept of compensating variation thereby applies likewise.

In order to isolate the pure efficiency effects of the reform, we apply the hypothetical concept of a Lump-Sum Redistribution Authority (LSRA) in a separate simulation.[7] The LSRA thereby proceeds as follows: to all generations already economically active before the reform it pays lump-sum transfers or levies lump-sum taxes in order to make them as well off after the reform as in the initial equilibrium. Consequently their compensating variation amounts to zero.[8] Having done that, the LSRA may have run into debt or built up assets. It now redistributes this debt or assets across all future generations in a way that they all face the same compensating variation. This variation can be interpreted as a measure of efficiency. Consequently, if the variation is greater than zero, the reform is Pareto improving after compensation and vice versa. With this concept in hand, we can now proceed to our simulation results.

[7] The LSRA was introduced by Auerbach and Kotlikoff (1987, 62f.).

[8] Couples are compensated likewise.

4.2 Policy reforms in the benchmark model

This subsection compares the economic effects of a move towards alternative systems of family taxation. Since in our model income splitting only matters for non-retired couples, we can define the splitting advantage (SA) in the benchmark equilibrium as the difference between the aggregate labor income tax burden under the individual and the joint taxation system:[9]

$$SA = T(y_j) + T(y_j^*) - 2T\left(\frac{y_j + y_j^*}{2}\right).$$

A move towards individual taxation eliminates this splitting advantage and changes labor supply incentives for husband and wife since the marginal tax rate increases for the primary earner and decreases for the secondary earner. The tax advantage in the model totals to 1.1% of GDP, which is exactly the value calculated recently by Bach et al. (2011). In order to better understand the economic forces at work, we simulate the move towards individual taxation in two steps: First we keep the joint filing system (i.e. identical marginal tax rates for both partners), but eliminate the splitting advantage via compensating lump-sum payments. Then we simulate a complete introduction of the pure individual taxation system.

The second reform considers a move towards family taxation as practiced for example in France. In addition to the splitting factor of one for husband and wife we introduce an additional splitting factor of 0.5 per child so that the tax burden for a couple with two children changes to

$$3T\left(\frac{y_j + y_j^*}{3}\right).$$

Of course, if a single woman has two children, she will also benefit from the reform since her tax burden changes to $2T(y_j/2)$. Since we assume that all children live with their respective mothers, single fathers are not directly affected by the reform.

The last reform considered combines the merits of individual taxation and family splitting.[10] Here we introduce individual taxation in combination with a child splitting factor of 1.0 per child. We assume that the two partners in a marriage have to share the child splitting factor, so that husband and wife with two children face a tax burden of $2T(y_j/2)$ each after the reform. Single mothers with two children can apply both child factors, so that their tax burden is computed from $3T(y_j/3)$.

Macroeconomic implications Table 6 reports the short and long-run macroeconomic effects of all four considered reforms. When we eliminate the splitting advantage but keep the

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9 Remember that asset income is taxed at a flat rate separately from labor income and that retired couples always receive the same pension benefit.

10 It is not currently discussed in the German political debate but seems to be a natural alternative.

joint filing system in reform (1), the government generates revenues from the splitting advantage and uses these revenues to finance a uniform subsidy to all working individuals. Since the splitting advantage is mainly beneficial for rich couples with a large difference in income between primary and secondary earner, the considered reform consists of an income transfer from rich couples towards all other non-retired households. Due to scaling effects couples save more in our model. Consequently, asset accumulation is dampened and the capital stock decreases during the transition. Labor supply and labor input also fall on aggregate, but disaggregation clearly shows that married couples work more (due to the negative income effect) while singles work significantly less (due to the positive income effect). Those who work less (more) on the market partly substitute towards (out of) homework which slightly increases. Overall, GDP and wages slightly decrease throughout the transition. Changes in labor input reduce the splitting advantage. In addition, revenues from consumption taxation decline so that the lump-sum transfer falls from 438 € to 367 € in the long run. Interest rates and contribution rates are not altered significantly (not reported).

Table 6: Macroeconomic effects of abolishing income splitting[a]

Policy reform	(1)			(2)			(3)			(4)		
Period	1	3	∞	1	3	∞	1	3	∞	1	3	∞
Capital stock	0.0	-0.4	-0.9	0.0	0.1	-1.3	0.0	0.6	1.2	0.0	1.3	1.8
Labor supply	-0.3	-0.3	-0.3	0.8	0.7	0.5	0.8	0.8	0.7	2.1	2.0	1.8
men	-0.2	-0.2	-0.2	-1.0	-1.1	-1.1	0.3	0.3	0.3	-0.3	-0.3	-0.2
single	-0.8	-0.9	-0.9	-0.6	-0.7	-0.8	0.0	0.1	0.1	-0.2	-0.1	0.0
married	0.3	0.4	0.3	-1.4	-1.4	-1.4	0.5	0.5	0.5	-0.4	-0.4	-0.3
women	-0.5	-0.5	-0.5	4.0	3.9	3.5	1.8	1.6	1.4	6.5	6.1	5.4
single	-0.9	-1.2	-1.3	-0.8	-1.1	-1.5	1.5	1.3	1.2	1.8	1.6	1.2
married	0.2	0.4	0.6	10.3	10.2	9.8	2.2	1.9	1.7	12.6	11.8	10.8
Homework	0.2	0.2	0.3	-0.6	-0.6	-0.4	-0.5	-0.5	-0.5	-1.3	-1.4	-1.4
Consumption	0.0	-0.2	-0.5	0.6	0.7	0.2	0.4	0.7	1.0	1.3	1.9	2.2
GDP	-0.2	-0.3	-0.5	0.5	0.5	-0.1	0.5	0.7	0.9	1.4	1.7	1.8
Wage rate	0.1	-0.1	-0.2	-0.3	-0.2	-0.6	-0.3	0.0	0.2	-0.7	-0.2	0.0
Lump-sum tax[b]	-438	-406	-367	-400	-406	-305	100	66	36	-210	-350	-400

[a]Changes in percent over value in initial equilibrium. [b]In Euro

Reform (2) of Table 6 shows the full implementation of individual taxation. Of course, now marginal tax rates for primary earners of couples increase while marginal tax rates for secondary earners fall. As a consequence, aggregate labor supply immediately increases significantly. Disaggregation clearly shows that married men (i.e. primary earners) significantly decrease their labor supply (in hours) by 1.4 percent while married women (i.e. secondary earners) dramatically increase labor input by more than 10 percent. This is very much in line with the figures reported in Steiner and Wrohlich (2004) or Bach et al. (2011). Since married women work more on the market, homework now decreases. Note that the labor supply effects for single men and women are almost identical in both experiments, i.e. they are both affected by income effects only. Higher labor input has a small positive effect on capital accumulation in the short run. In the long run however, the income redistribution away from rich households dominates so that the long-run capital stock falls. The increase of aggregate labor supply explains the initial output increase, while the subsequent drop is due to the reduction of the capital stock. Higher labor input and lower capital stock lead to a fall in wages and a slight increase of the interest rate. The uniform lump-sum transfer for working individuals is now slightly lower than before. Again, it falls significantly in the long run due to the decline of consumption tax revenues. Since married couples receive higher pension benefits, the long-run contribution rate increases by 0.9 percentage points.

Reform (3) shows the macroeconomic consequences of introducing family splitting. Couples and single mothers with children now experience a significant reduction of their tax burden and their marginal tax rate. Consequently, the government receives lower revenues from the progressive income tax so that the budget has to be balanced by a uniform lump-sum tax of initially 100 €. Higher family resources and lower marginal tax rates increase capital accumulation and aggregate labor supply. Note that single men show almost no labor supply reaction since they are only indirectly affected by the reform (i.e. via higher lump-sum taxes). On the other hand, married women react stronger than single women, since they have children more often. Higher employment of mothers reduces homework but increases GDP throughout the transition. Higher employment reduces wages slightly in the short run, but long-run wages rise again due to the higher capital stock. Higher income and consumption tax revenues allow to reduce the lump-sum tax during the transition.

The final reform (4) which combines individual taxation with a specific child splitting factor of 1.0 has the strongest macroeconomic effects. Labor supply incentives are improved further and income is redistributed towards singles and couples with children. As a result, capital accumulation increases as well as labor input by 1.8 percentage points in the long run. Consumption and GDP both increase quite similarly. As a consequence, the initial lump-sum transfer of 210 €, which is significantly lower than in the second reform, almost doubles throughout the transition.

Welfare and efficiency With the above discussion in mind, we can now turn to the welfare effects of the four policy reforms considered. Table 7 summarizes welfare consequences measured in compensating variation for different households and cohorts. Agents are grouped by their gender and marital status. With respect to married couples we also distinguish couples where both partners are low skilled and high skilled and a mixed couple where the husband is high skilled and the wife is low skilled (hi/lo) or vice versa. Finally, we also calculate the welfare change for the aggregate of all married couples. The first column indicates the age of the respective cohort in the reform year or cohorts living in the new long-run equilibrium (denoted by "∞”). It should be clear that all our reform experiments only marginally and indirectly affect existing retirees via the very small initial changes in interest rates. Therefore we do not report their welfare effects in the following.

When we eliminate the splitting advantage, welfare effects in the reform year are clear-cut for working cohorts . First, singles benefit due to lump-sum transfers which balance the budget. Since all individuals receive the same transfer, high-skilled experience a relatively lower welfare gain than low-skilled singles (not reported). Since married couples lose the splitting advantage, they are all worse off. However, the splitting advantage is small for a couple where the husband is low skilled (lo/lo and lo/hi) and the splitting advantage is significantly higher for a couple where the husband is high skilled (hi/lo and hi/hi). Quite intuitively the splitting advantage reaches its maximum when the husband is high skilled and the wife is low skilled. Welfare losses also increase slightly for married couples with children compared to those without children. Of course, this reflects the fact that differences in labor supply of a couple are especially high during child rearing years. Note that losses slightly decrease with rising age of initial cohorts. Those aged around fifty have most employment years (years with splitting advantage) already behind them while those around thirty will still experience those years. The welfare gains decrease and the losses increase slightly for future cohorts which reflects the long-run fall in wages and the decline of the lump-sum transfer shown in the left part of Table 6. Comparing males and females of the same type, women always experience slightly higher gains and losses than the respective men. Due to the gender productivity gap shown in Figure 1, remaining lifetime resources for women are always lower than for (respective) men so that relative welfare changes are higher for the former.

Finally, let's turn to welfare effects after LSRA compensation payments. As mentioned above, the LSRA makes all existing cohorts as well off as in the initial equilibrium and redistributes resources across future generations to make them all face the same welfare changes. The efficiency effects of the policy reform are depicted in the column "with LSRA" of Table 7. Although the considered reform does not affect labor supply incentives, it generates an aggregate efficiency gain of 0.17 percent of initial resources. This is mainly due to the fact that the redistribution from married towards single households improves the insurance provision against labor income risk. Due to variable labor supply, married households can better hedge against income shocks than single households. In addition, uniform lump-sum transfers effectively redistribute from rich households towards poorer households so that the reform strengthens the progressivity of the labor income tax system.[11] Note that the positive insurance effect is not in contrast to Corneo (2013), since the latter study abstracts from variable labor supply (and self insurance) and applies income-dependent transfers in order to exclude redistribution across income classes. Nevertheless our result at least indicates that the insurance provision of the joint taxation system with income splitting is fairly weak and does not survive in a model with variable labor supply.

The second block of Table 7 reports the welfare consequences when the complete move towards individual taxation is implemented. Working singles experience quite similar income effects as in the previous simulation. The significantly lower gains for singles in the long run are due to reduced lump-sum transfers and wages. With respect to married couples

[11] We also simulate the elimination of the splitting advantage with lump-sum transfers are only paid to married households. In this case the aggregate efficiency gain almost disappears.

Table 7: Welfare effects of alternative reforms of family taxation*

	Male					Female					
	single	married				single	married				with
Age		lo/lo	hi/lo	hi/hi	all		lo/lo	lo/hi	hi/hi	all	LSRA
						(1) Joint filing without splitting advantage					
Current Workers											
45-49	0.40	-0.20	-0.88	-0.63	-0.33	0.43	-0.23	-0.16	-0.76	-0.38	0.00
25-29[a]	0.71	-0.29	-1.41	-1.02	-0.50	0.69	-0.34	-0.19	-1.19	-0.56	0.00
25-29[b]	0.68	-0.25	-1.37	-0.92	-0.45	0.76	-0.30	-0.22	-1.10	-0.52	0.00
Future Generations											
15-19	0.76	-0.25	-1.31	-0.99	-0.44	0.83	-0.28	-0.19	-1.12	-0.48	0.17
∞	0.71	-0.30	-1.36	-1.04	-0.48	0.74	-0.34	-0.24	-1.17	-0.52	0.17
						(2) Individual taxation					
Current Workers											
45-49	0.50	0.17	-0.32	-0.21	0.07	0.55	-0.21	0.07	-0.64	-0.36	0.00
25-29[a]	0.78	0.35	-0.48	-0.31	0.17	0.76	-0.52	0.09	-1.13	-0.74	0.00
25-29[b]	0.75	0.32	-0.31	-0.37	0.15	0.84	-0.35	0.05	-0.94	-0.58	0.00
Future Generations											
15-19	0.81	0.39	-0.36	-0.27	0.23	0.85	-0.46	0.14	-1.05	-0.65	0.43
∞	0.39	0.06	-0.69	-0.59	-0.12	0.49	-0.84	-0.24	-1.40	-1.05	0.43
						(3) Family splitting					
Current Workers											
45-49	-0.06	-0.05	-0.05	-0.04	-0.05	-0.06	-0.08	-0.07	-0.06	-0.07	0.00
25-29[a]	-0.12	0.29	0.34	0.43	0.32	0.43	0.12	0.25	0.57	0.23	0.00
25-29[b]	-0.12	-0.10	-0.08	-0.07	-0.09	-0.14	-0.15	-0.13	-0.11	-0.14	0.00
Future Generations											
15-19	-0.10	0.22	0.25	0.33	0.23	0.09	0.05	0.17	0.43	0.15	0.18
∞	-0.06	0.25	0.28	0.35	0.27	0.13	0.08	0.20	0.46	0.19	0.18
						(4) Individual taxation with child splitting					
Current Workers											
45-49	0.12	0.06	-0.42	-0.31	-0.05	0.14	-0.37	-0.08	-0.77	-0.51	0.00
25-29[a]	0.06	1.10	0.65	1.25	1.08	0.88	0.42	1.01	0.34	0.37	0.00
25-29[b]	0.06	0.20	-0.42	-0.48	0.04	0.06	-0.55	-0.13	-1.10	-0.78	0.00
Future Generations											
15-19	0.06	1.04	0.55	0.99	0.99	0.35	0.33	0.91	0.13	0.25	0.60
∞	-0.08	0.96	0.46	0.90	0.90	0.23	0.24	0.81	0.04	0.16	0.60

*In percent of initial resources. [a]With children. [b]Without children.

we have to distinguish between primary and secondary earner. Both partners share the reduction in consumption after the introduction of individual taxation. However, since the primary earner (typically the husband) now consumes more leisure (i.e. works less) and the secondary earner (typically the wife) consumes less leisure (i.e. works more) than in the previous simulation, most females are slightly worse off or slightly better off while husbands are all significantly better off than in the previous simulation. As already discussed above, since labor supply elasticities differ significantly across genders, it is efficiency enhancing to increase the marginal tax rate for the husband while lowering it for the respective wife.[12] The aggregate efficiency gains due to reduced labor market distortions are shown in the last column of Table 7 where the welfare gains with LSRA compensations increase from 0.17 (in the previous simulation) to now 0.43 percent of initial resources.

Next, consider the welfare effects of a move towards family splitting. This system mainly redistributes from families and singles without children towards those with children. Consequently, all single males as well as those working-age cohorts where the children have already left the house (i.e. age 45-49) lose. For cohorts in the child-rearing ages 25-44, single mothers and couples with children will benefit while those without children will lose. Table 7 also clearly shows that – due to the progressive tax schedule – family splitting is especially beneficial for high-skilled couples. The increase in capital accumulation and wages during the transition explains the rising welfare gains for future cohorts. The last column shows a significant efficiency gain of 0.18 percent of remaining resources. This figure reflects the lower labor supply distortions for households with children on the one hand and the reduced insurance provision against income risk due to the uniform lump-sum tax on the other hand.

Finally, when individual taxation is introduced in combination with a child splitting factor, labor supply incentives improve even stronger than before. Compared to the reform without a child splitting factor there is hardly any redistribution towards singles without children. At the same time families with children are much better off compared to reform (2). The latter also explains why future couples are now better off than before. The lower labor market distortions also explain the higher efficiency gains reported in the last column.

Summing up, Table 7 documents that individual taxation performs much better in terms of economic efficiency than family splitting. There is hardly any evidence that the current system of joint taxation offers significant insurance benefits. In the next section we test whether these conclusions also hold in other model set-ups.

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[12] Apps and Rees (1999) showed in a theoretical framework that welfare only increases if

$$\sigma_1 + \frac{w_2 l_2}{w_1 l_1}\sigma_{21} < \sigma_2 + \frac{w_1 l_1}{w_2 l_2}\sigma_{12},$$

where the indices denote the primary and secondary earner, σ_i the uncompensated elasticity and σ_{ij} the uncompensated cross elasticity of labor supply.

4.3 Sensitivity analysis

In order to get a feeling for the robustness of the above numerical results, this subsection presents some sensitivity analysis for the introduction of individual taxation and family splitting. In the first instance we start from the same initial equilibrium as in the previous section. However, in the first scenario we keep the time spent in both home production and leisure fixed at the initial individual levels while in the second scenario we only keep the initial time spent in home production fixed. In the last sensitivity scenario we extend the baseline model with flexible home production and allow for divorce and remarriage during the life cycle. Of course, in this case we also have to recalibrate the initial equilibrium slightly.

Exogenous labor supply Since a central objective of the reform of family taxation is to improve labor supply incentives, a natural starting point for sensitivity analysis is to simulate the above reforms in a model with exogenous labor supply. In this case there are hardly any macroeconomic repercussions when individual taxation is introduced. Only lump-sum transfers increase significantly (from 305 to 428 € in the long run) since now tax revenues rise stronger than before. The upper part of Table 8 reveals that singles are hardly affected compared to the respective benchmark simulation in the middle part of Table 7. Married women are slightly better off while married males are worse off (due to higher/lower leisure consumption). Note that future cohorts now realize almost identical welfare changes as current cohorts, since they are not hurt by lower wages any more. As one would expect, without (efficiency enhancing) labor supply reactions efficiency gains decrease. However they are still significantly positive, which is again due to the improved insurance provision against labor income risk by the uniform lump-sum transfers. As Corneo (2013) we assume that labor supply is exogenous, but the latter study applies budget balancing transfers which do not redistribute across income classes. Our model is more complicated (and realistic) since we allow for marriages across income classes and typically observe two-earner households with different incomes. In such a model set-up the insurance gains from joint taxation seem to be very small.[13] As soon as we allow for variable labor supply they completely disappear since adjustment of labor input due to positive or negative productivity shocks also provides an implicit insurance.

The lower part of Table 8 reports the consequences when family splitting is introduced in the model with exogenous labor supply. Now the lump-sum tax increases from 36 to 168 € in the long run (compared to the benchmark in Table 6). Consequently, all singles are now worse off than before. In addition, the substitution of the progressive income tax by a higher uniform lump-sum tax redistributes from poorer towards richer married households and reduces the insurance provision against labor income risk. Therefore, without positive labor supply incentives aggregate efficiency effects are now negative.

[13] In principle, we are able to generate an efficiency loss with exogenous labor supply when the transfers depend on individual labor income. In this case the redistribution across income classes is dampened and the insurance provision within an income class (between lucky ones and unlucky ones) is highlighted.

Age	Male					Female					with LSRA
	single	married				single	married				
		lo/lo	hi/lo	hi/hi	all		lo/lo	lo/hi	hi/hi	all	
Individual taxation											
Current Workers											
45-49	0.43	-0.21	-0.93	-0.68	-0.34	0.46	-0.21	-0.13	-0.70	-0.35	0.00
25-29[a]	0.75	-0.28	-1.35	-1.04	-0.49	0.72	-0.28	-0.13	-1.08	-0.50	0.00
25-29[b]	0.72	-0.21	-1.32	-0.92	-0.42	0.81	-0.21	-0.16	-0.96	-0.44	0.00
Future Generations											
15-19	0.82	-0.19	-1.24	-0.96	-0.39	0.86	-0.19	-0.10	-0.99	-0.35	0.25
∞	0.81	-0.20	-1.25	-0.97	-0.40	0.85	-0.20	-0.11	-1.00	-0.36	0.25
Family splitting											
Current Workers											
45-49	-0.20	-0.21	-0.15	-0.14	-0.19	-0.22	-0.21	-0.17	-0.14	-0.19	0.00
25-29[a]	-0.36	0.17	0.69	0.79	0.31	0.14	0.17	0.45	0.82	0.32	0.00
25-29[b]	-0.34	-0.34	-0.26	-0.23	-0.32	-0.39	-0.35	-0.29	-0.24	-0.32	0.00
Future Generations											
15-19	-0.38	0.01	0.43	0.52	0.10	-0.22	0.01	0.24	0.53	0.11	-0.15
∞	-0.33	0.07	0.47	0.56	0.18	-0.16	0.06	0.29	0.57	0.15	-0.15

Table 8: Welfare effects with exogenous labor supply*

*In percent of initial resources. [a]With children. [b]Without children.

No flexibility in home production Next we start again from the benchmark equilibrium but disregard home production so that households can only choose between working at the market and leisure consumption after the reform. Table 9 documents that compared to the benchmark model with home production in Table 2 labor supply elasticities especially of women are now reduced significantly.

Table 9: Labor supply elasticities in the model without flexibility in home production

	Total		*Single*		*Married*	
	Men	*Women*	*Men*	*Women*	*Men*	*Women*
uncompensated	0.12	0.12	0.05	0.08	0.20	0.18
compensated	0.41	0.40	0.33	0.32	0.48	0.51

The introduction of individual taxation still eliminates the splitting advantage but now married women only increase their labor supply by roughly 5 percent (instead of 10 percent presented above in the fully-fledged model). Married men now reduce their labor supply by a higher amount. As a consequence, aggregate employment falls slightly after the reform.

The upper part of Table 10 shows that the reduced flexibility is bad for married females (since they have to reduce their leisure consumption much stronger in order to work more) and good for married males (since they can now increase their leisure consumption stronger than before). There is only one exception from this rule with couples where women are the primary earners (female, married, lo/hi). In this case the couple is better off when the labor supply flexibility is lower. Lower tax revenues reduce lump-sum transfers from 305 to 266 € in the long run (compared to the benchmark simulation). Consequently, single households experience lower welfare gains than in the benchmark and the insurance provision against labor income risk is reduced. Not surprisingly, aggregate efficiency gains of the reform decrease to 0.05 percent of remaining resources due to lower insurance provision and labor market effects. When family splitting is introduced in the model without home production,

Table 10: Welfare effects without flexible home production*

	Male					Female					
	single	married				single	married				with
Age		lo/lo	hi/lo	hi/hi	all		lo/lo	lo/hi	hi/hi	all	LSRA
					Individual taxation						
Current Workers											
45-49	0.36	0.33	-0.01	-0.01	0.23	0.38	-0.53	0.25	-0.99	-0.70	0.00
25-29[a]	0.58	0.74	-0.12	0.02	0.51	0.55	-1.26	0.21	-1.78	-1.44	0.00
25-29[b]	0.55	0.46	0.03	-0.12	0.31	0.62	-0.86	0.27	-1.49	-1.11	0.00
Future Generations											
15-19	0.59	0.64	-0.01	-0.06	0.46	0.62	-1.16	0.33	-1.67	-1.27	0.05
∞	0.35	0.43	-0.23	-0.27	0.24	0.41	-1.37	0.14	-1.85	-1.48	0.05
					Family splitting						
Current Workers											
45-49	-0.11	-0.11	-0.10	-0.09	-0.11	-0.12	-0.13	-0.12	-0.10	-0.12	0.00
25-29[a]	-0.18	0.14	0.35	0.47	0.21	0.37	0.16	0.18	0.48	0.23	0.00
25-29[b]	-0.17	-0.17	-0.16	-0.13	-0.16	-0.20	-0.21	-0.18	-0.14	-0.19	0.00
Future Generations											
15-19	-0.16	0.07	0.25	0.34	0.13	0.02	0.08	0.08	0.35	0.13	0.06
∞	-0.08	0.14	0.32	0.41	0.18	0.09	0.14	0.15	0.41	0.20	0.06

*In percent of initial resources. [a]With children. [b]Without children.

labor supply increases only by 0.3 percent in the long run so that capital accumulation is dampened slightly compared to Table 6. In order to balance the budget, lump-sum taxes have to increase from 36 to 63 € in the long run. The lower part of Table 10 shows that now all singles and married couples without children are worse off compared to the respective benchmark simulation in Table 7. Reduced labor supply elasticities dampen the efficiency gains on the labor market and higher lump-sum taxes provide less insurance. Consequently, aggregate efficiency gains decline from 0.18 to 0.06 percent of aggregate resources.

Introducing marital risk Finally, we keep home production flexible as before but introduce demographic dynamics similar to those of Hong and Rios-Rull (2007).[14] Singles now can get married at any age j with probability π_j^m and married couples can get divorced with probability π_j^d. We restrict (for computational reasons) marriage, divorce and re-marriage to working periods. After retirement, single individuals remain single until death while married couples could only become widows/widowers.

Single agents still solve the problem (4), but now future utility is computed over the distribution of future states of own productivity η_{j+1}, marital status m_{j+1} and productivity of the partner η^*_{j+1}. If the agent stayed single with probability $1 - \pi^m_{j+1}$, his state would move to $z_{j+1} = (g, s, \eta_{j+1}, 0, 0, a_{j+1}, p_{j+1})$. However, if he was to get married to an agent of same age with probability π^m_{j+1}, his future state would change to

$$z_{j+1} = \left(g, s, \eta_{j+1}, s^*, \eta^*_{j+1}, \frac{a_{j+1} + a^*_{j+1}}{2}, \frac{p_{j+1} + p^*_{j+1}}{2} \right). \tag{13}$$

Single agents take the mating probabilities $\pi^{s^*}_{g,s}$ into account and form expectations over future spouses' productivity η^*_{j+1}, assets a^*_{j+1} and pension claims p^*_{j+1} according to the distribution of singles of gender g^* and skill group s^* over the state space at age j.

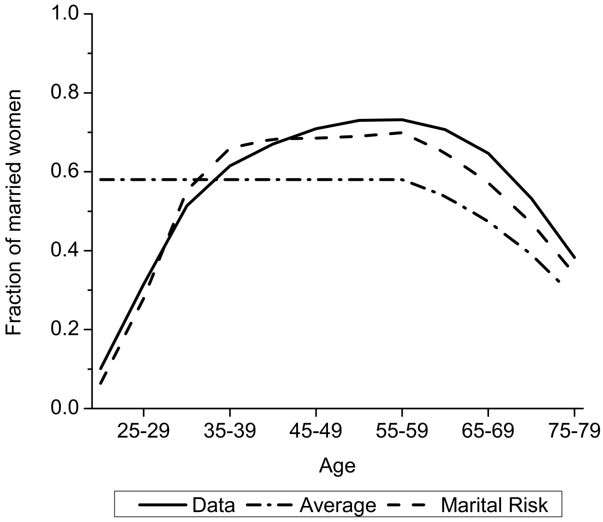
Married agents also maximize (7) as before but beneath the productivity processes for both partners, they take three different scenarios into account: The first reflects the situation when the marriage continues with probability $1 - \pi^d_{j+1}$ in the next period and the spouse survives. The second case covers the situation when one of the spouses dies. Finally, the third case describes the situation when the marriage is divorced. Here, the individual status changes to $z_{j+1} = (g, s, \eta_{j+1}, 0, 0, a_{j+1}, p_{j+1})$.

Age-specific marriage and divorce probabilities π_j^m and π_j^d are derived from cohort data reported in the Statistical Yearbook of the Statistisches Bundesamt (2007). Specifically we adjust actual marriage and divorce rates in order to match existing cohort-specific fractions of married couples. Figure 4 shows the fraction of married women in each cohort we obtain when applying our estimated marriage and divorce probabilities to the model. We see an increase of married couples in the early years of life until age 35 due to high marital risk. Passing age 35, the number of married couples stays roughly constant. With survival probabilities being lower than one at retirement, the fraction of married women again declines as the number of widows increases. Figure 4 also shows the fraction of married women we obtain when applying the actual data on married couples in Germany computed from Statistisches Bundesamt (2007) and reports the respective fractions with the constant share from the previous section without marital risk.

In order to realize a capital-output ratio of 3.4 we (slightly) recalibrate the discount rate to $\beta = 0.95$. Note from Figure 4 that the fraction of couples is now higher at retirement than in the previous model. Consequently, more widowers receive bequests from the previous spouse so that average consumption of singles now peaks after retirement and aggregate

[14] Fehr, Kallweit and Kindermann (2013) also provide a detailed formal description of this model set-up.

Figure 4: Fraction of married women



bequests now rise to 7.3 percent of GDP. Since 3.1 percent of GDP are transfers to the surviving spouse, the redistribution towards younger cohorts is hardly changed compared to the benchmark.

Quite surprisingly, despite the introduction of marital risk the macroeconomic adjustment after the policy reforms is quite similar as reported in Table 6 for the benchmark economy. Individual adjustment of labor supply and savings is dampened but not qualitatively changed. The resulting welfare and efficiency effects of the two considered policy reforms in the model with marital risk are reported in Table 11. Remember that in the benchmark model with constant marital status singles are better off than couples with individual taxation, especially when they are females. In the model with marital risk single younger workers may become married and younger married couples may now become singles in the future. Consequently, welfare gains of younger single workers are reduced compared to the benchmark model and vice versa for younger couples. The efficiency gains in the right column of Table 11 rise slightly from 0.43 to 0.50 percent of remaining resources. The latter might be due to the improved insurance provision due to the a higher lump-sum transfer (which rise from 309 to 355 € in the long run).

Similarly, the lower part of Table 11 shows that a move towards family splitting makes singles slightly better off, while especially married men are typically worse off compared to the benchmark without changing marital status. On aggregate, efficiency gains are slightly reduced compared to the benchmark from 0.18 to 0.14 percent of aggregate resources. Since long-run lump-sum taxes fall slightly compared to the respective benchmark simulation from 36 to 16 €, this can be only due to reduced labor market effects.

Of course, it would be no problem to further analyze the sensitivity of our results with respect to other technology, preference or tax parameters. For example, we have simulated alternative lump-sum budget balancing mechanisms and the impact of risk neutral preferences. Alternative transfer schemes change the resulting distributional effects within and

Table 11: Welfare effects with marital risk*

Age	Male single	Male married lo/lo	Male married hi/lo	Male married hi/hi	Male married all	Female single	Female married lo/lo	Female married lo/hi	Female married hi/hi	Female married all	with LSRA
					Individual taxation						
Current Workers											
45-49	0.61	0.27	-0.25	-0.14	0.16	0.66	-0.09	0.17	-0.54	-0.24	0.00
25-29[a]	0.64	0.56	-0.20	-0.11	0.38	0.27	-0.20	0.22	-0.77	-0.39	0.00
25-29[b]	0.61	0.51	-0.10	-0.17	0.35	0.38	-0.03	0.18	-0.58	-0.23	0.00
Future Generations											
15-19	0.66	0.56	-0.07	-0.04	0.42	0.33	-0.04	0.21	-0.59	-0.19	0.50
∞	0.26	0.22	-0.43	-0.38	0.08	-0.06	-0.41	-0.16	-0.93	-0.55	0.50
					Family splitting						
Current Workers											
45-49	-0.06	-0.05	-0.04	-0.04	-0.05	-0.06	-0.07	-0.06	-0.05	-0.07	0.00
25-29[a]	0.14	0.27	0.35	0.43	0.30	0.37	0.23	0.37	0.67	0.32	0.00
25-29[b]	-0.08	-0.08	-0.06	-0.05	-0.07	-0.11	-0.12	-0.11	-0.09	-0.12	0.00
Future Generations											
15-19	0.04	0.17	0.24	0.28	0.20	0.09	0.14	0.31	0.50	0.17	0.14
∞	0.08	0.21	0.27	0.32	0.23	0.14	0.18	0.35	0.53	0.21	0.14

*In percent of initial resources. [a]With children. [b]Without children.

across cohorts, but the basic advantage of individual taxation compared to family splitting in terms of economic efficiency turned out to be very robust.[15] Similarly, Kallweit (2013) applies the above model with marital risk and compares a move towards individual taxation in combination with either an endogenous consumption or an endogenous labor income tax. In this case the selected budget balancing mechanisms itself generate welfare and efficiency effects which can hardly be distinguished from the original one. Lower consumption taxes are directly beneficial for already retired cohorts while a lower labor tax progressivity partly neutralizes the implied intragenerational redistribution. In addition, aggregate efficiency further rises especially when the marginal labor income tax is reduced. This should suffice to indicate the sensitivity of the results in the present framework. Some extensions of the model are discussed in the final section.

[15] Of course, results are available upon request.

5 Conclusions and future extensions

The simulation section clearly shows the main advantages of our approach. While microsimulation studies which are typically based on a similar microeconomic structure analyze distributional effects at a very detailed individual level, our approach offers results at an aggregate level which only distinguishes according to marital status, gender, skills and age. This allows us to consider the impact of employment changes on macroeconomic aggregates such as savings and capital accumulation and to isolate the efficiency consequences of the considered policy reforms arising from changing labor market distortions and insurance provision.

Our simulation results indicate that individual taxation and family splitting both increase aggregate labor supply, but completely differ with respect to their impact on aggregate savings. Whereas a move towards individual taxation dampens capital accumulation, the opposite holds for the introduction of family splitting. Both reforms induce a positive aggregate efficiency effect, but a switch towards individual taxation clearly performs better in terms of economic efficiency. Individual taxation improves labor supply incentives and the insurance provision against income risk. Family splitting performs significantly worse in terms of economic efficiency because it affects a smaller fraction of households and induces a reverse redistribution pattern which lowers the insurance provision. Consequently, individual taxation also outperforms family taxation if we abstract from labor supply reactions. The introduction of individual taxation increases economic efficiency even without household production. However, the efficiency gains are much smaller due to lower labor supply elasticities. Finally, the explicit consideration of marital risk dampens the redistribution between singles and married and slightly increases the optimality of individual taxation compared to family splitting.

Of course, the present model could be extended in various directions. For example, Meier and Wrede (2013) as well as Fehr and Ujhelyiova (2013) analyze a move from joint to individual taxation in a model with endogenous fertility. Not surprisingly, if higher income tax revenues are used to finance child care facilities in such a set-up, it is possible to increase female labor supply and fertility jointly. The following issues seem to be even more interesting for future research: Kleven and Kreiner (2007) consider various utility generating activities that use both market goods and homework as inputs. If selective commodity taxation can be applied in this framework, then joint income taxation rather than individual taxation is optimal from an efficiency point of view. Meier and Rainer (2012a, b) show that with a non-cooperative bargaining approach for family decision making, the optimality of individual taxation vs. joint taxation is far from clear. Finally, a move towards individual taxation may also affect household formation so that a comprehensive analysis may require endogenous marriage and divorce probabilities as in Chade and Ventura (2002). Therefore, the present paper is not a terminal point, it may rather serve as a fruitful starting point for future research projects on the optimality of individual vs. joint taxation of couples.

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