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Fertility, Female Labor Supply, and Family Policy

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Abstract

The present paper develops a general equilibrium model with overlapping generations and endogenous fertility in order to analyze the interaction between public policy and household labor supply and fertility decisions. The model's benchmark equilibrium reflects the current family policy consisting of joint taxation of married couples, monetary transfers and in-kind benefits which reduce the time cost of children. Then we simulate alternative reforms of the tax and the child benefit system and analyze the long-run impact on fertility and female labor supply. Our simulations indicate three central results: First, policies which simply increase the family budget either via higher transfers (direct or in-kind) or via family splitting increase fertility but reduce female employment. Second, increasing tax revenues due to the introduction of individual taxation would increase female employment but reduce fertility. Third, revenue neutral policies such as a reform of the benefit structure or a move towards individual taxation combined with an increase in in-kind benefits may achieve both goals and therefore yield significant welfare gains.

JEL-Code: J120, J220.

Keywords: stochastic fertility, general equilibrium life cycle model.

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1 Introduction

During the past decades most industrialized countries of the Western world have experienced declining fertility rates combined with an increase in female labor market participation (FLMP). Within OECD countries total fertility rates[1] (TFR) decreased from above 2.6 children per woman in 1970 to 1.6 children in 2006, see OECD (2009a). In Germany this negative trend was even stronger. In the old West German states the TFR decreased from its peak of 2.5 children per woman in the mid-1960s to 1.3 children in the mid-1980s (StaBu, 2007). The decline did not turn out to be so significant in the former German Democratic Republic, so that the TFR has stayed at about 1.4 children per woman since the German reunification. During the last three decades, the mean age of mothers at first childbirth increased, on average from 23.8 to 27.7 years. Although the postponement of first childbirth is very significant with an increase of over one year per decade, cohort fertility data indicates that recuperation is only partial at higher ages. Since women give fewer birth to children and later in life, it seems natural that they would increase their share in the labor force at the same time. As documented by OECD (1995, 2009b) participation rates of prime-age women rose significantly within OECD countries from 48.3 percent in 1974 to 61.3 percent in 2008. The inverse relationship between fertility and FLMP can also be observed in the cross-section data with respect to the individual skill level. For example, in 2007 low-skilled women in Germany had a participation rate of 57 percent and on average 1.9 children, whereas high-skilled women had a higher participation rate (85 percent) and on average only 1.1 children (StaBu, 2009b,c).

At first sight, both trends could be explained quite well by Becker's (1965) seminal work on household time allocation. According to this model the rising female earnings power has induced a fertility decline and an increase in female employment because the positive income effects on fertility and leisure demand were dominated by negative substitution effects due to the increased opportunity cost of child bearing and leisure. This preference-based theory fits quite well with empirical studies that document the positive correlation between women's education and their labor market participation (OECD, 2009b), postponed maternity (Gustafsson and Kalwij, 2006) and childlessness (Hoem, Neyer and Andersson, 2006). However, the Beckerian theory requires a specific preference structure that assures that the substitution effect dominates as income rises. For example, if preferences are homothetic, the income effect and the substitution effect cancel one another. Becker's argument also generates testable predictions that appear inconsistent with the empirical evidence. As pointed out by Galor (2010), the demographic transition across Western Europe in the 19th century does not support a negative correlation between income and fertility. In addition, recent time series data of OECD countries indicates

[1] The average number of children that would be born alive to a woman during her lifetime if she were to pass through her childbearing years conforming to the age-specific fertility rates of a given year.

a much more complex relationship between women's fertility and labor supply decisions. First, the trend that women give birth to fewer children and later in life is not uniform among all OECD countries. In countries such as Belgium, France, the Scandinavian countries and the United States the TFR has either remained at or has recently recovered to above 1.8 children per woman, while in countries such as Germany, Italy or Spain fertility rates have remained constant below 1.4 children for many years. Second, several recent studies (Ahn and Mira, 2002; Del Boca, Pasqua and Pronzato, 2009) have stressed that across many OECD countries the relationship between female employment and fertility has changed over the last 25 years. While in 1980 there was a clear negative correlation between female employment and total fertility rates, in 2005 some OECD countries with higher rates of female employment also had relatively high birth rates, so that the correlation in these countries is now positive. Finally, the relation between education and fertility has changed its sign recently as well. In the past, OECD countries with higher rates of women's enrollment in tertiary education were also those featuring lower fertility rates. In the 1990s, however, countries with higher women's education also reported higher fertility rates (d'Addio and d'Ercola, 2005).

Since many industrialized countries are facing an enormous pressure due to the ageing population and the decline in population size, increasing TFRs *and* FLMPs jointly is extremely important for future labor markets and social security systems. Not surprisingly, family policy is attracting increasing public attention while at the same time a substantial amount of both theoretical and empirical research aims to uncover the central determinants of a woman's joint childbearing and labor supply decisions. Extending the overlapping generations model of Galor and Weil (1996), Martinez and Iza (2004) focus on labor market conditions, technological change and private child care provisions in order to explain the interaction between differential birth rates and women's labor supply in a growing economy. On the other hand, Apps and Rees (2004) discuss differences in the public child care systems and family taxation in order to explain the described heterogeneity in fertility rates and labor market outcomes across countries. Recent empirical studies by Björklund (2006), Del Boca et al. (2009), Kalwij (2009), Laroque and Salanie (2004) and Lalive and Zweimüller (2009) indicate that various policies that reduced the opportunity cost of children were indeed successful in increasing fertility rates and labor market participation for women. Another strand of the literature has focussed on the differential fertility of different educational groups. Since intergenerational educational mobility is fairly low (Woessmann, 2008), de la Croix and Doepke (2003) develop a model in which persistent intragenerational fertility differences worsen the income distribution and reduce future economic growth.

The present study is related to the recent literature of calibrated models on the economics of the family. In this context, Caucutt, Guner and Knowles (2002), Greenwood, Guner and Knowles (2003) or Guner and Knowles (2009) distinguish two sexes and analyze the interaction between marital status, employment, childbearing and human capital investment in a three-stage decision process. In these models women's fertility declines in their educational level since children are time intensive and thus more costly for women with high productivity. The models are applied to analyze the impact of changes in women's productivity or of different government policies on marriage, fertility, employment, education and the overall income distribution. Erosa, Fuster and Restuccia (2002) abstract from the marital decision in order to study the impact of fertility and labor market decisions on human capital accumulation in a search theoretic framework with job mobility and different job qualities. The study finds that fertility decisions, which generate long lasting employment and wage effects, mainly explain the observed gender wage gap in the U.S. while tenure capital plays only a minor role. Da Rocha and Fuster (2006) apply a similar search model but they consider an overlapping generations economy where only adult females make childbirth and labor market decisions. Due to labor market frictions the model is able to generate the observed positive correlation between fertility and employment among OECD countries mentioned above. All studies discussed so far are partial equilibria since they mainly consider the household side, abstract from capital accumulation, public budgets and endogenous factor price repercussions. In contrast, the present study builds on Conesa (2000) or Doepke, Hazan and Maoz (2008) who abstract from labor market search and analyze the household's fertility and women's labor supply decisions within a dynamic general equilibrium framework. Conesa (2000) focusses on intragenerational differences in fertility behavior and replicates the delayed childbirth and lower birth rates of higher educated women. Doepke et al. (2008) consider only one representative household per cohort and generate a baby boom by restricting labor market access for women. However, both studies mostly neglect the government sector. This is where the present study steps in. In particular, we analyze reform options for child benefits and family taxation in Germany, since this country has an extremely negative past record regarding TFRs and FLMPs. Our simulation results show that it is possible to increase fertility and female employment rates simultaneously if the government increases the supply of child care facilities for children of all ages. The paper also highlights the positive effects of a move towards individual taxation. Although such a reform is currently precluded by German constitutional law, it is important to understand and quantify the adverse consequences of the present system of joint taxation.

The next section motivates the quantitative approach by considering a simple static model of fertility choice. Section 3 describes the structure of the simulation model. Section 4 explains the calibration and simulation design. Finally, section 5 presents the numerical results and section 6 offers some concluding remarks.

2 The static model of fertility choice

In order to discuss some central mechanisms that motivate our quantitative approach, this section introduces the most basic model of fertility choice in which children provide direct utility benefits.[2] Households maximize utility subject to a budget constraint where women divide their time endowment (normalized to unity) into working and child-rearing. Assuming separable utilities and the CES case we have

$$\max_{c,n} \; U(c,n) = \alpha_c \frac{c^{1-\frac{1}{\rho}}}{1-\frac{1}{\rho}} + \alpha_n \frac{n^{1-\frac{1}{\rho}}}{1-\frac{1}{\rho}} \qquad \text{s.t.} \quad c + b_0 n = w(1 - b_1 n)$$

where c and n denote consumption and the number of children, respectively. The parameters α_c and α_n as well as the substitution elasticity ρ determine the preference structure, w defines the wage and b_0, b_1 the costs of children in terms of money and time. Note that family policy intends to reduce the costs of children either via b_0 (for example by direct transfers per child) or indirectly via b_1 (for example by providing subsidized child care). The explicit solution for the number of children is given by

$$n = \frac{w}{\left[\frac{\alpha_c}{\alpha_n}(b_0 + w b_1)\right]^{\rho} + b_0 + w b_1}.$$

As it turns out, a clearly negative relationship between income and fertility could be generated by ignoring monetary costs of children ($b_0 = 0$) and setting $\rho > 1$. If only time costs of children matter then high-wage families face higher opportunity costs of having children. With a high elasticity of substitution between children and consumption, the substitution effect dominates so that $n(w)$ decreases, as in the data. It is also obvious that family policy which reduces b_0 and/or b_1 is able to increase the fertility rate.

However, one has to keep in mind that financing of family policy reduces net income which may either counteract or strengthen the effects on fertility of the policy instruments. In addition, changes in the cost parameters may affect fertility decisions of various income classes differently. While direct payments per child may have a strong income effect on low-skilled households, they have only a negligible impact on high-skilled parents. Quite the opposite applies to family policy instruments that reduce the time costs of children. The simple static model also neglects leisure demand and the interaction between the fertility choice and female labor supply decision. Although the utility from leisure consumption could also be considered in the static model, the labor supply decision in the present context has to account for the timing of births and the

[2] See Jones, Schoonbroodt and Tertilt (2010) for a discussion of such static fertility models. Alternatively, children may also be viewed as an investment providing old-age security, see Boldrin and Jones (2002).

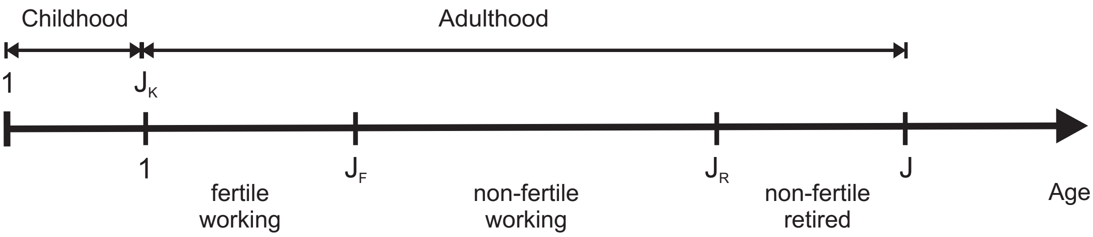
accumulation and depreciation of female human capital during child rearing. Consequently, the joint fertility and labor supply decision has to be analyzed in a dynamic framework. In such a setup it is also possible to quantify the macroeconomic growth effects resulting from the adjusted fertility pattern. The next section discusses the structure of such a simulation model.

3 The dynamic model economy

3.1 Demographics and intracohort heterogeneity

We consider an economy populated by overlapping generations of married couples who live for J periods indexed by adult ages $j \in \mathcal{J} = \{1, \ldots, J\}$. The life cycle of a representative household is described in Figure 1. We assume that both adult members of the household belong to the same skill level $s \in \mathcal{S} = \{1, \ldots, S\}$. Men work continuously until age $J_R - 1$, afterwards they retire. All woman retire at the same age as men, but they can choose in every period before retirement how much they work. Apart from the labor supply and savings decision, couples face the decision about the number and timing of their children. Women can give birth to children until age J_F. We abstract from twins, triplets etc., so that only one child per period can be born. Consequently, the total number of children of the age-j household is $n_j \in \mathcal{N} = \{0, \ldots, J_F\}$. Parents raise their children for J_K periods, so that $k_i \in \mathcal{J}$ indicates the age of the i-indexed child of the household. After birth, all children of a cohort are identical until they reach adulthood.

Figure 1: The child-household life cycle



Our model only considers long-run equilibria so that we can omit a time index for all variables. It is solved recursively and an age-j household faces the state vector

$$z_j = (s, \mathrm{a}_j, D_j), \tag{1}$$

where $\mathrm{a}_j \in \mathcal{A} = [0, \infty)$ defines the household's assets held at the beginning of age j. The vector $D_j = (k_1, \ldots, k_{n_j}) \in \mathcal{N}^J$ with $0 \leq k_1 \leq k_{n_j}$ contains the demographic characteristics of all children of the household. More specifically, k_1 and k_{n_j} denote the age of the youngest and the oldest child of the age-j household, respectively. Given D_j we can compute the number of children currently living in the household $m_j \leq n_j$ (i.e. those children where $k_i \leq J_K$) or the number of children with ages equal to or less than 6 years (m_{6j}). Finally, $m_{1j} \in \{0, 1\}$ indicates whether the age-j household currently has a newborn child or not.

Each age-j cohort is fragmented into subgroups $\xi(z_j)$, according to the initial distribution (i.e. at $j = 1$), the fertility process and optimal individual decisions. Let $X(z_j)$ be the corresponding cumulated measure to $\xi(z_j)$. Hence,

$$\int_{\mathcal{C}} \mathrm{d}X(z_j) = 1, \quad \text{for all} \quad j \in \mathcal{J}$$

must hold, as $\xi(z_j)$ is not affected by cohort sizes but only gives densities within cohorts. For the sake of simplification, we define $\mathcal{C} = \mathcal{S} \times \mathcal{A} \times \mathcal{N}^{\mathcal{J}}$ as the set of states. Let N_j denote the number of (2-person-)households in the age-j cohort, then

$$M = \sum_j N_j \int_{\mathcal{C}} m_j(z_j)\mathrm{d}X(z_j) \tag{2}$$

measures the aggregate number of children living in households while the endogenous (native) population growth rate η can be computed from

$$(1 + \eta)^{J_K} = \frac{1}{2} \sum_j N_j \int_{\mathcal{C}} m_{1j}(z_j)\mathrm{d}X(z_j) \tag{3}$$

where we have normalized the number of the youngest households to unity, i.e. $N_1 = 1$. In order to have zero or positive population growth, we add an exogenous population growth rate from immigration $\bar{\eta}$ so that in equilibrium cohort numbers can be computed from

$$N_j = (1 + \eta + \bar{\eta})N_{j-1}. \tag{4}$$

In the following, we will omit the state indices z_j for every variable whenever possible. Agents are then only distinguished according to their age j.

3.2 The households' problem

Since we consider the steady state, households maximize utility at the initial age choosing a contingent plan for consumption, labor supply, the number of children and the timing of births. Following Conesa (2000), in every period during the fertile years the household decides whether to have an additional child in the subsequent period or not. Conditional on having decided to have a newborn next period, this event will only happen with a certain probability. Our model assumes a preference structure that is represented by a time-separable, nested CES utility function. Consequently, the problem can be written recursively so that the household at age j and state z_j solves

$$V(z_j) = \max_{c_j,\ell_j,\hat{n}_j} \left\{ u\left(c_j, \ell_j, \hat{n}_j\right) + \beta E\left[V(z_{j+1}|z_j)^{1-\frac{1}{\gamma}} \right] \right\}^{\frac{1}{1-\frac{1}{\gamma}}} \tag{5}$$

by choosing per capita consumption of goods c_j, leisure consumption of the mother ℓ_j and the family size $\hat{n}_j$. With n_j being the number of children, we define $\hat{n}_j = 2 + n_j$. Expected utility in future periods is discounted by β and the intertemporal elasticity of substitution is defined by γ. The expectation operator E in (5) indicates that future utilities are computed over the distribution of D_{j+1}.

Households maximize (5) subject to the budget constraint (6),

$$\mathrm{a}_{j+1} = (1+r)\mathrm{a}_j + (1-\tau)w_j + m_j b^c - m_{6j} p_c l_j^f + p_j - T(y_j) - (1+\tau_c) f(m_j) c_j \tag{6}$$

with $\mathrm{a}_1 = \mathrm{a}_{J+1} = 0$. The constraint (6) reflects how children affect resources of the family in the model. In addition to interest income from savings $r\mathrm{a}_j$, households receive gross labor income

$$w_j = we_j(l^h + e_j^f l_j^f) \quad \text{with} \quad e_j^f = \begin{cases} 1 & n_j = m_j = 0 \\ (1-\delta_c)e_{j-1}^f & n_j, m_j > 0 \\ e_{j-1}^f & n_j > 0, m_j = 0 \end{cases}$$

during their working periods. Given the wage rate for effective labor w and e_j as the age-j productivity, labor supply of the husband l^h is exogenously predetermined[3] while the working time of the mother l_j^f is endogenously chosen given the husband's income, and the number of children in the household. We assume that children in the household reduce productivity of the mother where δ_c measures the depreciation rate which determines the depreciation factor e_j^f. The time endowment of the mother is normalized to one and allocated to working, childcare and leisure consumption.

$$1 = l_j^f + \Psi(D_j) + \ell_j \tag{7}$$

The time required for childcare measured by the function $\Psi(\cdot)$ depends on the age structure of children since we assume – following Da Rocha and Fuster (2006) or Doepke et al. (2008) – that younger children are more time intensive than older children. Depending on the number of children, households may also receive direct monetary support b^c such as child benefits or parental leave benefits per child. In addition, they have to pay a fee of p_c per (younger than six year) child for external child care during the time the mother is working.[4] Households have to

[3] We do not consider this as a strong assumption given the large body of empirical evidence suggesting very limited reaction of men's labor supply to tax changes, see Heckman (1993) or Eissa and Hoynes (2004).

[4] Of course, public policy instruments are oversimplified. In Germany, the price paid for non-parental child care may vary significantly with the income level of households and the value of parental leave benefits depends on the mother's income from working previous to the child's birth.

pay social security contributions at a rate τ on gross family income, income taxes that depend on (family-size related) taxable income y_j, and receive public pensions p_j during retirement. Finally, the price of consumption goods c_j includes consumption taxes τ_c and total consumption of the household is given by multiplying per capita consumption with $f(m_j) = 1.7 + 0.5m_j$, see Conesa (2000).

3.3 Instantaneous utility and the decision to have children

Similarly to Conesa (2000) or Doepke et al. (2008) we define the period utility function by

$$u(c_j, \ell_j, \hat{n}_j) = \left\{ \left[c_j^{\alpha_1} \ell_j^{1-\alpha_1} \right]^{1-\frac{1}{\rho}} + \alpha_2 \hat{n}_j^{1-\frac{1}{\rho}} \right\}^{\frac{1-\frac{1}{\gamma}}{1-\frac{1}{\rho}}}. \tag{8}$$

where α_1 denotes the coefficient of consumption in the sub-utility function and ρ defines the intratemporal elasticity of substitution between consumption and leisure on the one hand and family size on the other hand, while α_2 defines the age-independent preference parameter for family size.

The fertility decision is modeled similarly to the college choice in Heckman, Lochner and Taber (1998). In every period during fertile years $j < J_F$ each household has to decide whether to have one additional child in the subsequent period or not. The welfare change of having an additional child for household z_j measured by the equivalent variation can be written as

$$\frac{V(z_j^1)}{V(z_j^0)} - 1 - \epsilon_z$$

where $V(z_j^1)$ and $V(z_j^0)$ measure utilities from having an additional child or not, respectively. Additional non-pecuniary (i.e. psychological) gains or costs from additional children, which are not observed by the model, are captured by $\epsilon_z \sim N(0, \sigma^2)$. We assume that the latter are normally distributed within each skill class with mean zero and variance σ^2. Due to the law of large numbers, we can now compute the fraction of households that decide to have an additional child from

$$P\left(\left\{\frac{V(z_j^1)}{V(z_j^0)} - 1 - \epsilon_z\right\}\right) = \Phi_{0,\sigma^2}\left[\frac{V(z_j^1)}{V(z_j^0)} - 1\right],$$

where Φ_{0,σ^2} defines the cumulative normal distribution function with mean zero and variance σ^2. Conditional on having decided to have a baby next period, this event will happen with probability $0 \leq \pi \leq 1$. Following Conesa (2000), we assume that fertility uncertainty is independent of age and skill classes during fertile ages. Note that there is no uncertainty if the household decides not to have a newborn.

3.4 The production side

Firms in this economy use capital and labor to produce a single good according to a Cobb-Douglas production technology $Y = \theta K^{\varepsilon} L^{1-\varepsilon}$ where Y, K and L are aggregate output, capital and labor, respectively, ε is capital's share in production and θ defines a technology parameter. Capital depreciates at a rate δ_k. Firms maximize profits, renting capital and hiring labor from households such that net marginal products equal r, the interest rate for capital, and w, the wage rate for effective labor.

3.5 The government sector

Our model distinguishes between the general government budget and the pension system. In each period of the long-run equilibrium, the government issues new debt $(\eta + \bar{\eta})B_G$ and collects taxes from households in order to finance general government expenditure G (which is fixed per capita), in-kind benefits or services for families G_c and direct monetary support Mb^c to families, as well as interest payments on its debt, i.e.

$$(\eta + \bar{\eta})B_G + T = G + G_c + Mb^c + rB_G, \tag{9}$$

where T defines tax revenues from income and consumption taxation

$$T = \tau_c C + \sum_j N_j \int_{\mathcal{C}} T(y_j) \mathrm{d}X(z_j) \tag{10}$$

with C as aggregate consumption. We assume that contributions to public pensions are exempted from income tax while benefits are fully taxed. Consequently, taxable income y_j is computed from gross labor income net of pension contributions, capital income and – after retirement – public pensions, i.e.

$$y_j = (1 - \tau)w_j + ra_j + p_j. \tag{11}$$

Given taxable income, we apply the German progressive tax code of the year 2005. In-kind benefits for families are modeled as a a fixed cost per child κ that covers childcare institutions and the provision of schools and universities minus payments of parents for public childcare, i.e.

$$G_c = \kappa M - p_c \sum_j N_j \int_{\mathcal{C}} m_{6j}(z_j) l_j^f(z_j) \mathrm{d}X(z_j). \tag{12}$$

In each period, we assume a fixed debt to output ratio and balance the public budget by adjusting the consumption tax rate.

Finally, the pension system pays old-age benefits and collects payroll contributions from wage income. Pension benefits p_j of a retiree household at age $j \geq J_R$ in a specific year are uniform across age and skill classes and computed as a fixed replacement rate of average income $\bar{w}$. Since the budget of the pension system must be balanced in every period by payroll contributions, we have

$$\tau w L = p \sum_{j=J_R}^{J} N_j \int_{\mathcal{C}} \mathrm{d}X(z_j), \tag{13}$$

where L denotes aggregate labor supply defined in (15) below.

3.6 Equilibrium conditions

Our initial long-run equilibrium is computed in a closed economy so that factor prices are endogenous and the trade balance is zero. Then we implement a policy reform and compute the resulting long-run equilibrium where we keep the factor prices of the initial steady state constant.

In addition to factor prices being equal to marginal products, we need households to maximize (5) with respect to the respective constraints (6) and (7), an invariant measure of households ξ over the whole state space and market clearance for the capital, labor and goods market in the closed or small open economy:

$$K + B_G + B_F = \sum_j N_j \int_{\mathcal{C}} a_j(z_j)\mathrm{d}X(z_j) \tag{14}$$

$$L = \sum_j N_j \int_{\mathcal{C}} \left[\, e_j l^h + e_j^f l_j^f(z_j) \,\right] \mathrm{d}X(z_j) \tag{15}$$

$$Y = C + G + (\eta + \bar{\eta} + \delta_k)K + TB, \tag{16}$$

where B_F measures foreign debt and TB denotes the trade balance.

4 Calibration of the initial equilibrium

4.1 Parameterizing the model

Table 1 reports the central parameters of the model. In order to reduce computational time, each model period covers two years. Therefore, children are at home until age 19 ($J_K = 10$), then they start adult life at age 20 ($j = 1$), women can have children until age 36 ($J_F = 8$), households are forced to retire at age 66 ($J_R = 23$) and face a life span of 80 years ($J = 30$).

Since we adjust in our initial equilibrium the exogenous growth rate of households in order to have zero growth (i.e. $\bar{\eta} = -\eta$), this cohort structure yields a quite realistic dependency ratio between pensioners and working cohorts of 36.4 percent.

Table 1: Parameter selection

Demographic parameters	Preference parameters	Technology/ Budget parameters	Government parameters
$J = 30$	$\gamma = 0.5$	$\theta = 1.17$	$B_G/Y = 0.6$
$J_R = 23$	$\alpha_1 = 0.5$	$\varepsilon = 0.3$	$T(y)$ see text
$J_F = 8$	$\rho = 0.65$	$\delta_k = 0.122$	$p_c = 0.2$
$J_K = 10$	$\alpha_2 = 0.35$	$l^h = 0.4$	$\kappa = 0.065\bar{w}$
$S = 3$	$\beta = 1.0$	δ_c see text	$b^c = 0.065\bar{w}$
$\pi = 0.8$		$\Psi(D_j)$ see text	$p = 0.55\bar{w}$
		e_j see text	

We distinguish $S = 3$ educational classes and assume that households only marry within the same skill-class. Based on data estimated from German Socio-Economic Panel (SOEP) of the years 1995-2007 we assume that 25, 55 and 20 percent of the cohort are low-, middle- and high-skilled, respectively. These shares also fit in quite well with the shares reported in StaBu (2009a, 26). SOEP data is also used to compute the efficiency profiles e_j for skill classes across the life-cycle.[5] Finally, following Conesa (2000) we assume that 80 percent of those households that wish to have a child will receive one.

With respect to the preference parameters, we set the intertemporal elasticity of substitution γ as well as the consumption preference in the Cobb-Douglas sub-utility function α_1 to 0.5. The chosen value for the intertemporal elasticity of substitution is within the range of commonly used estimates, see the discussion in İmrohoroğlu and Kitao (2009, p.871). The consumption preference parameter yields quite realistic female labor force participation rates, see Table 3 below. The fertility choice parameters ρ and α_2 are calibrated such that the model is consistent with completed fertility and timing of fertility as observed in the data. As explained above, the higher the intratemporal elasticity of substitution between ordinary utility (from goods and leisure consumption) and family size ρ, the larger is the difference in completed fertility between the high-skilled and the low-skilled class. The preference for family size α_2 determines the level of completed fertility. We set ρ at 0.65 and α_2 at 0.35, which yields both the negative relationship between income and children and the target level for the total fertility rate in the initial equilibrium. Finally, in order to calibrate a realistic capital to output ratio, the discount

[5]The SOEP data base is described in Wagner, Frick and Schupp (2007). See Fehr, Kallweit and Kindermann (2009) for detailed explanations of the estimation procedure and results.

factor is set at 1.0.

With respect to technology parameters we specify the general factor productivity $\theta = 1.17$ in order to normalize labor income and set the capital share in production ε at 0.3. The annual depreciation rate for capital is set at 5.9 percent which yields a periodic depreciation rate of $\delta_k = 0.122$. Husbands are assumed to work 40 percent of their time endowment which is typically assumed in quantitative studies, see Auerbach and Kotlikoff (1987). The depreciation of women's productivity depends on the respective skill level. We assume a one percent depreciation for low-skilled mothers and a two percent depreciation for middle- and high-skilled mothers. These figures are somewhere between the depreciation rates applied by Da Rocha and Fuster (2006) and Doepke et al. (2008). Finally, we assume that the time costs $\Psi(D_j)$ decrease linearly with age of children. Every mother spends 25 percent of the time endowment with a newborn, 8 percent with every child below school age and 5 percent with every remaining child. These figures are in line with Da Rocha and Fuster (2006).

With respect to the government sector we assume a debt-to-output ratio of 60 percent and that taxation of gross income (from labor, capital and pensions) is close to the current German income tax code and the marginal tax rate schedule $T05$ which was introduced in 2005. Consequently, given taxable income y_j of the household and applying the income splitting method, the marginal tax rate rises linearly after the basic allowance of 16.600 € from 15 percent to a maximum of 42 percent when y_j passes 104.000 €. In addition, we also account for the solidarity surcharge of 5.2 percent so that we get

$$T(y_j) = 1.052 \times 2 \times T05(y_j/2).$$

In the initial equilibrium we set $p_c = 0.2$, which yields a realistic revenue of private fees to public childcare and is also close to the figures used by Da Rocha and Fuster (2006). In addition, we assume that 6.5 percent of average income is transferred as child benefits. This figure is quite realistic for Germany, where roughly 2.000 € is paid per child per annum and average income amounts to roughly 30.000 €. The same figure is also assumed for in-kind benefits per capita. Finally, we assume that pensions of each household amount to 55 percent of average wages and fix the per capita costs of general public consumption (G) in order to get realistic figures in our benchmark.

4.2 The initial equilibrium

Table 2 and Figure 2 report some central indices of the calibrated benchmark equilibrium and the respective figures for Germany in 2007/2008. The upper part of Table 2 shows that the model's total fertility rate and mean age at childbirth match the German situation quite well.

However, first child birth is too late in the model compared to reality. Figure 2 compares the actual and the model's distribution of family sizes at age 36-38 (i.e. when childbirth is completed). Our model replicates the fact that about 50 percent of German families have either one or no child. However, the fraction of families without children is higher in reality compared to the model. Families with more than one child are captured by the model quite well. With respect to the different skill classes our model reflects the fact that fertility rates decrease with income (i.e. skill level). As one can see in Figure 2 the shares of childless families increase and the shares of families with three or more children decrease with the skill level. As shown by Table 2, the skill-specific fertility rates are realistic.

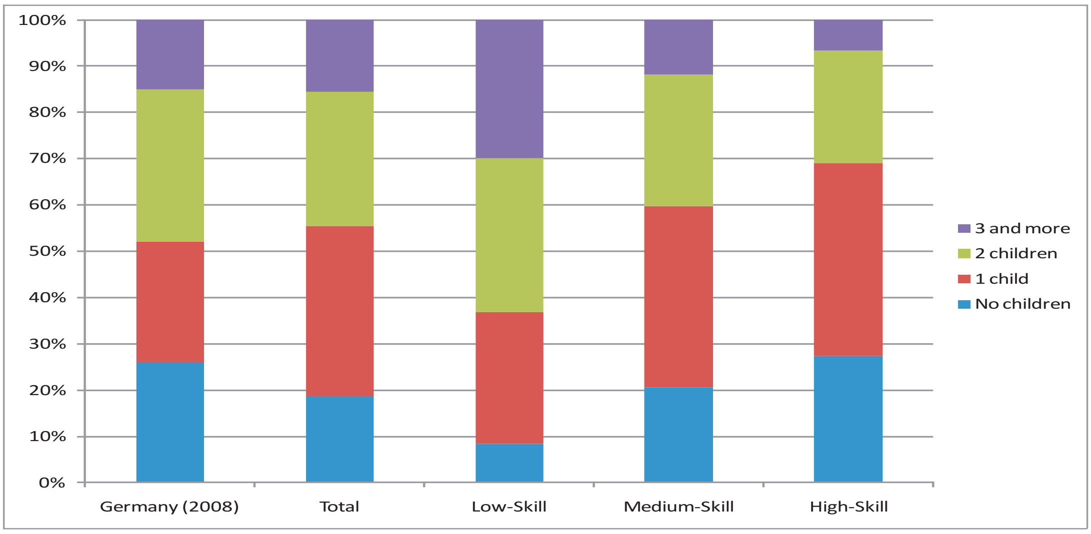
Table 2: The initial equilibrium

	Model solution	Germany 2007/2008[a]
Calibration targets		
Total fertility rate (TFR)	1.46	1.38[b]
Total mean age at childbirth (in years)	29.9	29.8[b]
Total mean age at first child (in years)	27.9	26.1[c]
Skill-specific fertility rates	1.96/1.34/1.11	1.94/1.35/1.14[c]
Skill-specific share of childless (in %)	8/21/27	11/16/26[c]
Government indicators (% of GDP)		
In-kind benefits and services	3.0	3.0[d]
Direct monetary support	3.0	3.0[d]
General government expenditure	15.1	15.0
Interest payments	3.1	2.7
Tax revenues	24.2	22.5
Pension benefits	13.5	11.5
Pension contribution rate (in %)	19.9	19.9
Consumption tax rate (in %)	19.0	–
Other benchmark coefficients		
Skill-specific mean age at first child (in years)	27.4/28.2/27.9	–
Capital-output ratio	2.8	3.3
Interest rate p.a. (in %)	5.2	–
(Native) Population growth rate p.a. (in %)	-1.5	–

Source: [a]IdW (2009), [b]StaBu(2009a), [c]StaBu (2009b), [d]Rosenschon (2006).

With respect to the calibration of family policy measures, we follow the comprehensive study of Rosenschon (2006), where overall public expenditures for family in Germany accumulate to 10.7 percent of GDP. However, many family transfer instruments, which are listed there, are not taken into account by the model. With respect to in-kind transfers such as public childcare services and schools, Rosenschon (2006) reports a figure of roughly 3 percent of GDP. In addition, direct transfers to families including child benefits and parental leave benefits also

Figure 2: Aggregate and skill-specific family structures



Source: StaBu (2009b).

add up to roughly 3 percent of GDP. The remaining figures are calibrated in order to arrive at a realistic government tax structure and macroeconomic situation. We fix public debt to 60 percent of GDP, so that annual interest payments amount to 3.1 percent of GDP. Since we abstract from growth and deficit financing, tax revenues add up to 24.2 percent of GDP. Private consumption amounts to 64.7 percent of GDP and the endogenous consumption tax rate is 19 percent, so that consumption tax revenues are slightly higher than income tax revenues. The average and marginal tax rate of the latter across the total population are 8.9 and 22.6 percent, respectively. However, skill-specific average income tax rates increase from 2.1 to 9.1 and 17.4 percent and marginal income tax rates increase from 13.3 to 23.7 and 32.0 percent. We also match the current pension contribution rate in Germany, but pension benefits are too high in the model. Note that due to the low fertility rate we end up with a negative native population growth rate of 1.5 percent. In the initial equilibrium we assume that immigration completely neutralizes this effect so that total population growth is zero.

Table 3 reports the participation rates of women in the model and in the German labor force. We assume that women are participating in the labor market when they work more than five percent of their time endowment. Given this definition, our model replicates the situation of women in the German labor market quite well. First, we match the average participation rate of 69.7 percent almost perfectly. Second, as in reality, participation rates increase with skill level. Third, the model also yields a close approximation of the life-cycle behavior of female labor supply, which increases in the years when children attend school and decreases sharply before retirement. This pattern is similar in all skill classes but the profile is very steep in the low-skill class while it is fairly flat in the high-skill class. Of course, this reflects the differences in the numbers of children.

Table 3: Female labor market participation rates (FLMP)

	20-33	34-53	54-64	Total	Germany 2007[a]
Low-skill ($s = 1$)	54.1	64.1	26.9	51.4	56.7
Medium-skill ($s = 2$)	67.8	87.0	58.4	73.7	75.1
High-skill ($s = 3$)	76.5	96.5	78.1	85.6	84.4
Total	65.9	82.8	53.9	70.5	69.7
Germany 2006[b]	61.0	73.0	45.0	–	–

Source: [a]OECD(2009c), [b]StaBu (2009c).

5 Simulation results

This section presents our simulation results for the small open economy.[6] The first subsection discusses alternative reforms of the family benefit structure whereas the second subsection concentrates on reforms of the tax system. In order to quantify the impact of a changing family policy on macroeconomic variables and welfare, we compute a new long-run equilibrium after the introduction of alternative policy reforms and compare it to the initial equilibrium discussed in Tables 2 and 3. In all simulations we assume a constant general government expenditure per capita, a constant debt-to-output ratio and balance the public budget by adjusting the consumption tax rate.

In order to separate the short-run (i.e. where the adult population structure is constant) from the long-run consequences when the population structure has adjusted, we split each reform simulation into two scenarios. In the first scenario we adjust the immigration rate $\bar{\eta}$ in order to keep the aggregate population growth rate of the economy constant. Then we simulate the same reform with an unaltered immigration rate. In this scenario a change in native fertility affects the aggregate population growth rate of the economy so that the long-run population structure changes. The latter has a direct impact on pay-as-you-go financed social security and also on the structure of public consumption and tax revenues.

5.1 Reform scenarios for family benefits

With respect to direct and indirect family benefits we consider three different policy reforms. First we increase the direct monetary transfers b^c by roughly 25 percent. We compare this reform with an alternative policy that increases the per capita outlays for in-kind benefits by the

[6]We have also simulated the reforms in a closed economy, but the resulting repercussion effects from changing factor prices are not significant. Simulation results are available upon request.

same amount. If public care facilities for pre-school age children and schoolchildren increase, children stay at home less so that time costs for their mothers decrease. Consequently, we assume in this scenario that the time costs for a pre-school child fall from 8 to 4 percent and the time costs for a pupil decrease from 5 to 2.5 percent of the available time. While both initial reforms imply an increase of per capita transfers to families, the third experiment keeps the aggregate benefits per child constant but changes their structure. In this case the increase of in-kind benefits from the second policy reform is combined with an equivalent reduction in direct transfers per child. Table 4 reports the changes of some central variables.

Table 4: Fertility, macro and welfare effects of child and in-kind benefit reforms

	Child benefit increase		In-kind benefit increase		Benefit structure reform	
	short-run	long-run	short-run	long-run	short-run	long-run
Fertility rates						
TFR	1.82	1.79	1.92	1.88	1.52	1.52
TFR(1)	2.58	2.50 (28)	2.54	2.46 (26)	1.83	1.82 (-7)
TFR(2)	1.66	1.62 (21)	1.77	1.74 (30)	1.44	1.43 (7)
TFR(3)	1.24	1.26 (14)	1.47	1.49 (34)	1.33	1.33 (20)
Macroeconomic effects[a]						
$\eta + \bar{\eta}$	0.0	0.7	0.0	0.9	0.0	0.1
$b^c M/Y$	1.8	1.8	1.1	1.2	-0.6	-0.5
G_c/Y	0.9	0.9	2.0	2.0	0.8	0.8
τ_c	4.1	3.1	5.3	4.2	0.8	0.6
τ	0.0	-3.9	0.0	-4.8	0.0	-0.8
A (p.c.)	3.0	0.1	0.9	-2.7	-1.8	-2.2
L^f (p.c.)	-10.8	-5.0	-8.9	-1.7	1.7	2.9
$L^f(1)$(p.c)	-31.0	-21.4	-16.5	-4.2	17.6	19.6
$L^f(2)$(p.c)	-13.6	-5.0	-10.0	0.1	2.6	4.3
$L^f(3)$(p.c)	-4.6	-2.2	-6.4	-3.2	-2.0	-1.4
L^m (p.c.)	0.0	3.3	0.0	4.1	0.0	0.7
Y, L (p.c.)	-3.1	0.9	-2.6	2.4	0.5	1.3
Welfare effects[b]						
$W(1)$	-0.63	0.99	-1.32	0.67	-0.43	-0.03
$W(2)$	-1.73	-0.05	-2.00	0.00	-0.24	0.14
$W(3)$	-1.82	-0.15	-2.14	-0.14	-0.30	0.08

[a]Change in percentage points. [b]As a percentage of the present value of remaining resources. p.c. per capita

When we increase child benefits in the left part of Table 4, the total fertility rate rises significantly from 1.46 to 1.82 in the short-run. However, this increase differs substantially in the three skill classes. As one would expect, child benefits have a very strong impact on low-skilled households whose total fertility rate TFR(1) increases from 1.96 to 2.58 children (i.e. by 28 percent). At the same time, high-skilled families increase fertility only slightly from 1.11 to

1.24 children (i.e. by 14 percent). Child benefits rise due to the reform from 3.0 to 4.8 percent of GDP. About half of this increase is due to the direct effect of higher benefits (with a constant number of children) and the other half is due to the increase in the number of children. Of course, when the number of children rises, in-kind benefits have to increase as well. Due to higher outlays on children the consumption tax rate has to increase by 4.1 percentage points. At the same time, social security contributions remain constant in the short-run, since the population structure is not altered. Implicitly, the reform transfers resources from old age, when consumption is high, towards younger ages when households have children. Therefore, savings per capita increase, which (at least) partly neutralizes government policy. Due to higher fertility, aggregate female labor supply (measured in hours worked) falls by almost 11 percent. Of course, the reduction in hours worked depends on age and skill level. While high-skilled women reduce their labor supply by only 4.6 percent, low-skilled women reduce labor supply by 31 percent. Similarly, Table 5 reveals that participation rates of young women in the low-skill class fall by 8.4 percentage points from 54.1 to 45.7 percent, while they decrease for the elderly in the top-skill class only by 0.7 percentage points from 78.1 to 77.4 percent. The reduction in female employment induces an outflow of capital so that output decreases by about 3 percent. Not surprisingly, higher taxes and the reduction of per capita output induce a welfare loss for all households. Note, however, that high-skilled households are hurt the most due to their lower fertility.

The next column displays the long-run effects where we keep immigration constant so that the aggregate population growth rate increases after the reform. Consequently, the dependency ratio decreases from 36.4 to 29.3 percent, which in turn reduces the social security contribution rate by 3.9 percentage points. The change in the population structure reduces the consumption share of GDP and increases the investment share. Nevertheless, the long-run consumption tax rate is lower than the one in the short-run for two reasons. First, now the government has to run a deficit in order to keep the debt-to-output ratio fixed. Second, the share of general public consumption in GDP falls since output per capita increases while the government consumption per capita remains constant. The output per capita increases due to higher male and female employment per capita.[7] Lower tax and contribution rates have a positive impact on welfare. Consequently, long-run welfare for low-skilled households increases by roughly one percent of resources, while middle-skilled and high-skilled households lose slightly.

The middle part of Table 4 reports the consequences of an equivalent increase in in-kind benefits which reduces child-related costs for mothers. Consequently, in-kind benefits relative to GDP now increase by 2.0 percentage points while direct monetary transfers to households only increase by 1.1 percentage points due to the rise in the number of children. In our calibration,

[7]Male labor supply is fixed but the change in the population structure increases per capita male employment.

this reform increases aggregate fertility rates even more strongly compared to the previous simulation. In contrast to the last reform, the fertility rate of the high-skilled class increases even more strongly than that of the low skilled class (i.e. 34 percent vs. 26 percent). Note that aggregate female labor supply falls by a lesser amount in both the short- and the long-run. Only high-skilled women work significantly less than before since they have more children. As shown in Table 5, participation rates of women are now significantly higher than in the previous simulation. Especially middle-aged women with children attending school work more than before. Due to higher fertility, consumption taxes have to increase compared to the previous simulation, so that welfare losses in the short-run are higher in all skill-classes.

Considering the long-run effects in the fourth column of Table 4, the aggregate population growth rate now amounts to 0.9 percent. Again, the increase in consumption taxes is more than balanced by the fall in social security contribution rates. The labor supply now increases much more strongly so that the output per capita rises by 2.4 percentage points. Finally, low-skilled families benefit from such a reform while the high-skilled lose slightly in the long run.

In the right part of Table 4 we combine an increase of in-kind benefits with an identical reduction of direct child benefits per child. As a consequence, child benefits decrease now by roughly 0.5 percentage points, while in-kind benefits increase from 3 percent to 3.8 percent of GDP. Not surprisingly, the rise in total fertility is only modest, since now especially high-skilled women increase childbirth while low-skilled families even reduce childbirth compared to the benchmark situation in Table 2. Therefore, aggregate population growth in the last column only rises by 0.1 percentage points. Since changes in tax and contribution rates are only small, government policy now mainly transfers resources within younger cohorts. As a consequence of the increased available time, female labor supply rises in the short and the long run quite significantly by 1.7 and 2.9 percent, respectively. As shown in Table 5, female participation rates at middle ages increase in all skill classes but especially for low-skilled women who have fewer children. The higher employment reduces aggregate savings so that capital inflows increase while long-run output per capita rises by 0.5 and 1.3 percent. Therefore, similar as in Apps and Rees (2004) or in Da Rocha and Fuster (2006), our model allows to generate a joint increase in fertility and female employment by adjusting the family benefit structure. However, as one can see in the lower part of Table 4, such a policy may have some distributional costs. In the long run, mainly middle- and high-skilled families benefit from such a reform while low-skilled households are slightly hurt.

Table 5: Changes in long-run female labor market participation rates (FLMP)

	Child benefit increase				In-kind benefit increase			
	20-33	34-53	54-64	Total	20-33	34-53	54-64	Total
Low-skill ($s = 1$)	-8.4	-17.9	-9.7	-12.0	-6.1	-6.1	-6.5	-5.3
Medium-skill ($s = 2$)	-6.0	-4.5	-2.4	-4.3	-3.4	-2.2	-2.0	-2.4
High-skill ($s = 3$)	-4.4	-0.9	-0.7	-2.2	-0.6	-0.2	-1.4	-0.8
Total	-6.3	-7.3	-4.0	-5.9	-3.6	-2.9	-3.1	-2.9
	Benefit structure reform				Family taxation			
	20-33	34-53	54-64	Total	20-33	34-53	54-64	Total
Low-skill ($s = 1$)	3.3	9.6	4.4	6.5	0.8	3.5	-8.7	0.4
Medium-skill ($s = 2$)	1.7	1.1	-0.3	1.0	0.4	-3.5	-9.5	-3.4
High-skill ($s = 3$)	1.9	0.6	-0.7	0.7	-1.9	-1.3	-4.0	-2.2
Total	2.2	3.2	0.8	2.4	0.0	-1.3	-8.2	-2.2
	Individual taxation				Individual taxation/ In-kind benefit increase			
	20-33	34-53	54-64	Total	20-33	34-53	54-64	Total
Low-skill ($s = 1$)	1.5	16.1	17.4	11.7	-5.4	14.7	21.1	10.1
Medium-skill ($s = 2$)	7.4	9.2	7.4	8.0	9.0	8.9	10.2	9.4
High-skill ($s = 3$)	11.8	2.3	3.7	5.4	7.9	1.5	4.8	4.3
Total	6.6	9.7	9.3	8.5	5.0	9.0	12.0	8.6

All changes in percentage points.

5.2 Tax reform scenarios

The existing system of jointly taxing married couples in Germany has been under critique for quite some time. First, it has strong negative incentive effects for the second earner, since marginal income tax rates are identical for both partners in marriage. In this view there is a direct link between the income tax system and the low labor force participation rate of married women in Germany. Second, the system is not an adequate means of family policy since it subsidizes married couples and not families with children. For both political and constitutional reasons it seems very unlikely that Germany introduces a system of individual taxation in the near future. Nevertheless, various reform proposals with respect to family taxation have been put forward recently. This section compares two alternatives. More specifically, we consider a system of "Family taxation" such as practiced in France, which comprises splitting factors for each spouse equal to 1 (as in Germany) and additional splitting factors of 0.5 per child for the first and the second child and 1 for each additional child. We contrast the reform towards the French tax system with two alternatives which yield significantly higher income tax revenues. In the scenario "Individual taxation" both family members are taxed separately, while in the scenario "Individual taxation/In-kind benefit increase" the higher tax revenues from individual taxation are used to increase in-kind benefits for children as described in the previous section. Table 6 reports the simulation results of the experiments with alternative family taxation reforms.

Table 6: Fertility, macro and welfare effects of family tax reforms

	Family taxation		Individual taxation		Individual taxation/ In-kind benefit increase	
	short-run	long-run	short-run	long-run	short-run	long-run
Fertility rates						
TFR	1.76	1.76	1.23	1.26	1.69	1.67
TFR(1)	2.00	1.97 (0)	1.77	1.84 (-6)	2.39	2.32 (19)
TFR(2)	1.72	1.72 (28)	1.09	1.10 (-18)	1.50	1.49 (11)
TFR(3)	1.56	1.58 (42)	0.91	0.89 (-20)	1.26	1.27 (14)
Macroeconomic effects[a]						
$\eta + \bar{\eta}$	0.0	0.7	0.0	-0.5	0.0	0.5
$b^c M/Y$	0.8	0.9	-0.6	-0.6	0.4	0.4
G_c/Y	0.8	0.9	-0.6	-0.6	1.0	1.0
τ_c	3.6	3.0	-3.9	-2.6	0.4	-0.5
τ	0.0	-3.6	0.0	3.4	0.0	-2.7
A^c	8.4	6.2	1.6	2.1	2.1	0.6
L^f (p.c.)	-12.4	-7.4	22.1	16.3	13.1	17.7
$L^f(1)$ (p.c.)	4.3	12.9	42.9	29.9	25.3	34.8
$L^f(2)$ (p.c.)	-14.5	-7.6	22.9	15.8	13.1	18.9
$L^f(3)$ (p.c.)	-13.0	-10.6	17.7	14.6	11.2	13.5
L^m (p.c.)	0.0	3.1	0.0	-2.9	0.0	2.3
Y, L (p.c.)	-3.6	0.1	6.4	2.7	3.8	6.7
Welfare effects[b]						
W(1)	-1.45	0.08	1.68	-0.22	0.47	1.78
W(2)	-1.45	-0.02	2.17	0.38	0.21	1.49
W(3)	-1.64	-0.20	2.15	0.39	0.08	1.35

[a]Change in percentage points. [b]As a percentage of the present value of remaining resources.
p.c. per capita

The introduction of child splitting factors as in the French income tax system reduces income tax revenues significantly, so that the consumption tax rate has to be increased by 3.6 percentage points in the short run. However, such a tax system also generates higher fertility. Since income tax reductions rise with income, especially high-skilled families increase the number of children. Higher fertility rates now result in direct child benefits and in-kind benefits to increase by the same amount. Compared to the previous subsection, aggregate savings now increase much more strongly since mainly high-skilled families benefit from the redistribution towards younger cohorts. As before, aggregate employment and output fall due to the reduction in female labor supply. Note that adjustment is asymmetric across skill classes. Low-skilled women with two children increase labor supply in young ages since their marginal tax rate may fall to zero due to the reform. Medium- and high-skilled women increase fertility and reduce their hours worked and participation rates significantly. Surprisingly, families from the high-skilled class are hurt the most despite the fact that they benefit the most per child. Since this class has the highest fraction of childless families, their total (average) tax benefit might be still smaller than that for low-skilled families. The latter even gain slightly in the long run, when the higher fertility rate affects the whole economy. In this case the social security contribution rate decreases by 3.6 percentage points and per capita output rises slightly. For high-skilled families the negative effects from higher consumption taxes still dominate so that they experience a welfare loss even in the long run.

The introduction of individual taxation shifts the tax burden from elastic female labor supply towards the inelastic male labor supply. As a consequence, aggregate female labor supply increases by more than 22 percent in the short run. Again, the three skill classes react quite differently. Low-skilled women hardly change their fertility behavior. They increase their labor supply the most, especially when the children are older or have already left the house, see Table 5. Medium- and high-skilled women significantly reduce the number of their offspring so that they can work more especially at younger ages. Due to higher tax revenues, the consumption tax rate could be reduced by almost 4 percentage points. This already takes into account the reduction in fertility rates which in turn reduces benefits for families significantly. The rise in employment induces capital inflows so that output increases in the short run by 6.4 percent. The reduced labor market distortions increase welfare roughly by 1.7 percent of resources in the short run. Of course, the fall in fertility increases the contribution rate of the pension system in the long run. Consequently, employment is reduced again in all skill classes.[8] The low-skilled now experience a welfare loss while the medium- and high-skilled realize significant long-run welfare gains.

In the last simulation of Table 6 we combine the introduction of the individual tax system with an increase in in-kind benefits as in the previous section. Since the additional income tax revenues are not sufficient to cover the cost increase, the consumption tax rate has to rise by 0.4 percentage points in the short run. This combination yields a simultaneous increase in fertility *and* female employment. In the short run female labor supply increases by more than 13 percent and the fertility rate increases to almost 1.7 children per woman. Note that especially low-skilled women work more and have more children. Table 5 shows that their

[8] The long run changes in participation rates and hours worked of 8.5 (in percentage points) and 16.3 (in percent), respectively, are roughly in line with the 4.85 percentage points and 11.4 percent computed in Steiner and Wrohlich (2004). However, the latter study applies a partial equilibrium microsimulation model and allows for a joint labor supply reaction of both spouses after a switch towards individual taxation.

participation rates at young ages fall but increase significantly at older ages. Medium- and high-skilled women also have more children, but they also work significantly more at young ages. Due to the reduced contribution rate, the long-run increase in female employment is even higher than the short run effect. Finally, all skill classes experience welfare gains. In the long run they amount to roughly 1.5 percent of aggregate resources. Low-skilled families are significantly better off since they benefit the most from the fall in tax rates and the increase in family benefits. Consequently, our simulation results confirm the theoretical analysis of Apps and Rees (2004) who also find a simultaneous increase of female employment and fertility after a revenue neutral switch towards individual taxation.

6 Summary and discussion

The present paper attempts to introduce a simulation model that captures the central elements of the joint decision of female labor supply and fertility. In a dynamic framework, adult couples decide each period on consumption, female labor supply and, during fertile years, whether or not to have an additional child in the following period. We apply the so-called "male chauvinist" assumption, i.e. the wife is assumed to adjust her labor supply to that of the husband. According to our model, the diversion of time away from the labor market into child care within the household results in a loss of job-related human capital for the woman. At the same time there is an option for families to raise children in government provided child care facilities in order to alleviate the joint labor supply and fertility choice.

With respect to family policy our simulations indicate three central results. First, higher direct or indirect transfers to families may increase the total fertility rate, but they also reduce female labor supply. Main beneficiaries are low-skilled families since they have many children. Second, the introduction of individual taxation significantly increases female employment by more than 16 percent, but it further reduces fertility rates especially of medium- and high-skilled women. As a consequence, long-run welfare of low-skilled households deteriorates while medium- and high-skilled experience welfare gains of almost 0.4 percentage points. Finally, a joint increase in female employment and fertility is possible if the government provides additional child care facilities. If the latter are financed by a reduction of direct family transfers, the fertility increase is extremely modest and it may hurt especially low-skilled households. If additional outlays are financed by the introduction of individual taxation, fertility and employment increase significantly, all households realize long-run welfare gains which amount to more than one percent of available resources. Due to having more children, low-skilled households benefit significantly more than high-skilled.

Of course, one has to be careful to take the model too serious and draw too many policy conclusions from the reported quantitative results. Despite its complexity the model structure still abstracts from many real world features that are very important for fertility and female labor supply decisions. We consider uncertainty only with respect to childbirth whereas employment is always certain. In future work we plan to follow Da Rocha and Fuster (2006) and model labor market search and uncertainty of future employment opportunities. In addition, we will follow Fehr, Kallweit and Kindermann (2009) and disaggregate the family structure in order to distinguish between families and singles and couples with different skill-combinations. As in Fehr et al. (2009) it might also be interesting to derive the joint labor supply of both spouses and to consider a home production technology. Finally, it is important to consider the transition between steady states in order to quantify the initial impacts of the considered policies in the right way. All these extensions would make the model structure more realistic. Most likely they would dampen our quantitative results but hardly change our qualitative findings.

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