Taxing Women: A Macroeconomic Analysis

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Abstract

Based on well-known evidence on labor supply elasticities, several authors have concluded that women should be taxed at lower rates than men. In this paper, we evaluate the quantitative implications of this conclusion in a model able to capture key cross-sectional observations for the analysis. We present a life-cycle setup with heterogeneous married and single households, costly childbearing and an operative extensive margin in the labor supply of married females. We find that relative to the current structure of taxation, setting a proportional tax rate on married females equal to 4% (8%) increases output and female labor force participation by about 3.9% (3.4%) and 6.9% (4.0%), respectively. We also find that gender-based proportional taxes improve welfare and are preferred by a majority of people. Nevertheless, welfare gains are higher when the U.S. tax system is replaced by a proportional, gender-neutral income tax.

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1 Introduction

Two observations are central to this paper. First, it is well known that the labor supply elasticities of women are larger than those of men, especially when the extensive margin is considered.[1] Second, the current U.S. tax system is biased against women's work in the marketplace. Since the US system taxes the income of households and not the income of individuals, for a married woman who considers entering the labor force, her marginal tax rate depends on her husband's income. Given the current levels of marginal tax rates, this is arguably a substantial impediment to labor force participation.

These observations have motivated work in the theory of optimal taxation. From standard public-finance principles, the higher labor supply elasticities of women suggest that they should be taxed at lower rates than men. Boskin and Sheshinski (1983) were possibly the first to establish this insight. They focused on the optimal linear-income taxation of two-earner households with exogenously given differences in labor supply elasticities between men and women.[2] More recently, Alesina, Ichino, and Karabarbounis (2010) put forward more forcefully the idea of differential taxation of men and women within a model in which gender differences in labor supply elasticities emerge endogenously. Under parametric restrictions, they conclude that married women should be taxed at lower rates than married men.[3]

Although the above results are attractive for their policy implications, work in this area has been almost exclusively theoretical, and a quantitative evaluation of the relative merits of differential taxation by gender is still missing. It is an open question what are the expected, quantitative effects associated to changing the current structure of taxation in this direction. In this paper, we fill this void. We ask: what are the aggregate effects of taxing married females at lower rates? What are the welfare implications of these lower tax rates? To answer these questions, we use a model able to capture key cross-sectional observations for the problems at hand. We build a life-cycle model populated by heterogeneous single and married agents. Individuals differ in terms of their labor endowments, which differ both

[1] See Blundell and McCurdy (1999) for a survey of estimates. With growing labor force participation of females, the labor supply elasticity of men and women recently became more similar (see Blau and Kahn, 2007; Heim, 2007). There still exist, however, substantial differences.

[2] In an earlier paper, Rosen (1975) hints at the same issue. Apps and Rees (1988) reach a similar conclusion within a model with home production. See Apps and Rees (2010) for an excellent summary and discussion of these results.

[3] Kleven, Kreiner, and Saez (2009), following Mirelees (1971), study the optimal taxation of couples in a model economy where the planner does not observe the ability of primary earner or the cost of participation for the secondary earner. As a result, the government faces a multidimensional screening problem. They show that if the participation of the secondary earner is a signal of the couple being better off, the secondary earner faces a tax and this tax is declining in the primary earner's earnings.

initially and how they evolve over the life cycle. In particular, the labor market productivities of females are endogenous and depend on their labor market histories: not working is *costly* for females since if they do not work their human capital depreciates. Married households decide if both or only one members should work, in the presence or absence of (costly) children and the structure of the tax system. In this context, changes in the structure of taxation lead to changes in participation rates and aggregate labor supply, and can have large welfare consequences.

We calibrate our model to the U.S. economy under the current tax system, taking into account observed heterogeneity in skill endowments, marital segregation by skill, labor-force participation rates as well as the presence of children and their cost. We then proceed to study the effects of a tax system that imposes different *proportional taxes* on the labor earnings of married females. Following Alesina et al (2010), we will refer to these as *gender-based* taxes, albeit their particular implementation will be connected to marital status as we explain below. Gender-based taxes that we consider nest as special cases the equal tax rates on men and women. Hence, a virtue of our analysis is that it allows us to separate the effects of differential taxation of married females, from the effects associated to the elimination or reduction of tax progressivity.

We consider two implementations of gender-based taxes. First, we consider replacing the U.S. tax system by proportional tax rates on labor earnings of married females that are lower than for the rest (married males, singles). We refer to this case as the *broad-base* case, as the reduction in tax rates on married females is financed by all other agents. In our second scenario, we first calculate a revenue-neutral proportional tax applied to all agents independent of their gender. We then assign this tax rate to singles, and reduce the tax rates on the labor earnings of married females increasing only the tax rates on married males. We refer to this case as the *narrow-base* case, as only tax rates on married males are used to achieve revenue neutrality.

We find that a shift to proportional tax rates has substantial effects. Replacing the current tax structure by a proportional income tax at a 10.2% rate increases aggregate hours worked by 3.2% and aggregate output by 3.2% across steady states. As marginal tax rates are reduced for majority of households, married females increase their labor market participation by 2.8%. Taking into account changes in labor supply along the extensive as well the intensive margin, the overall contribution of married females to changes in hours is substantial and amounts to 48.9%.

The effects of proportional taxes outlined above are amplified when married females are taxed at proportionally lower rates. When shifting to gender-based taxes in our narrow-base case, a reduction in the tax rate on labor income to 4% (8%) increases output by 4.0% (3.5%) and aggregate hours by 4.2% (3.6%) across steady states. These findings are driven by the much stronger responses of married females; they increase their participation by 6.9% (4.2%), and contribute 65.8% (56.1%) to the overall changes in hours. Similar results hold under our broad-base case. This is all not surprising, as tax rates are reduced on the group that reacts the most to tax changes.

To assess welfare effects from our experiments, we compute transitions between steady states under the assumption of a small-open economy. We find that gender-based taxes lead to a welfare improvement to a majority of households alive at the date when the structure of taxes change. Nevertheless, we find that proportional income tax at a uniform rate dominates gender-based taxes in terms of aggregate welfare gains. While a proportional income tax on all delivers aggregate welfare gains of about 1.8% in consumption terms, a differential tax rate of 4% (8%) on married females implies gains of about 0.7% (1.1%). As we explain in section 7.1, this result is driven by the effects associated to taxing married men at higher rates as in revenue-neutral tax reforms lower taxes on married females have to be financed by higher taxes on married males. While households where married women have a higher initial labor endowment tend to gain from the shift to gender-based taxes, most married households in our model are those where males have *higher* labor productivity. This is due to the observed marital sorting by skill, and initial wage gaps. Hence, the higher tax rates on males that accompany the lower rates on females have a net detrimental consequence on the welfare of most married households, and thus on aggregate welfare.

Our paper is organized as follows. Section 2 presents a simple example that highlights the effects of differential tax rates on females on labor supply and participation decisions. Sections 3 and 4 present the model economy. Sections 3 and 10 discuss calibration choices. In section 6 we explain in detail the nature of the quantitative experiments that we conduct. Section 7 contains the main findings of the paper. Finally, section 8 concludes.

1.1 Current U.S. Taxes

It is well known that the current U.S. tax system is biased against women's work.[4] As we mentioned earlier, this bias originates from the fact that the U.S. tax system taxes the income of *households*, not the income of individuals. As a result, for a woman who considers entering the labor force, her marginal tax rate depends on her husbands' income. In addition, given the progressivity built in the system, the tax rate on her first dollar of income increases with the household's income (inframarginal income).

[4] See McCaffery (1999) for a comprehensive description.

In related work (Guner, Kaygusuz and Ventura, 2011), we examine in detail the relationship between taxes effectively paid by households and their income in a large cross-sectional data from the U.S. Internal Revenue Service for the year 2000. Using this data, we estimate effective average tax rates. In Figure 1, we present the average tax rates and corresponding marginal rates, for a married couple with 2 children in the year 2000.[5] To illustrate the bias against women's work, imagine a married couple in which only the husband works and earns about the mean household income in the U.S. (about $ 58,375 in the 2000 IRS data). The average and marginal tax rates of this household are about 7.9% and 15.5%, respectively. Hence, the marginal tax rate that the household faces is 15.5% for woman's first hour of work. Combined with payroll taxes and the additional child care expenses that the family might face, the combined reduction on the additional income that the female generates can be substantial, leading to disincentives for labor market participation. For higher income households, as Figure 1 indicates, the disincentives can be much stronger. For a household at twice the level of mean income, the marginal tax rate is about 20.8%, whereas for a household at five times mean income, the marginal tax rate amounts to about 27.8%.

Table 1 presents more detailed information about marginal tax rates faced by married households. The table shows marginal tax rates at different levels of household's income, that changes according to different hypothetical earnings for married female (secondary earner). Using our estimates, this is done for when she is about to enter the labor force, at low earnings (one- half mean income), or at higher earnings (mean income).

As we note in Guner et al (2011), the aforementioned marginal tax rates are lower bounds on the marginal rates faced by married households. These follows from the fact that the marginal tax rates reported are calculated from average tax rates, and take into account all the *inframarginal* deductions that households have access to. Effective marginal tax rates are good approximations at low levels of income. At high levels of income, reported marginal tax rates are non-trivially higher than effective marginal rates.[6]

2 Taxing Married Women Differently

In this section, we present a simple static, decision-problem example that illustrates how differential taxation of married females affects labor supply decisions in two earner households, at the intensive and extensive margins.

[5] See section 5 for details.

[6] For instance, the average recorded marginal rate at five times mean income is about 34.0%, more than six percentage points above the marginal rate computed from our effective tax function.

A one-earner household Consider a married couple. The household decides whether only one or both members should work and if so, how much. Let x and z denote the labor market productivities (wage rates) of males and females, respectively. Let τ_H be a proportional tax on the labor income of the male, and let τ_L be a proportional tax on the labor income of the female.

Consider first the problem if only one member (husband) works. The household problem is given by

$$\max_{l_{m,1}}\{2[\underbrace{\log((1-\tau_H)zl_{m,1})}_{=\log(c)}]-W(l_{m,1})\},$$

where $l_{m,1}$ is the labor choice of the primary earner (husband). The subscript 1 represents the choices of a one-earner household. The function $W(.)$ stands for the instantaneous disutility associated to work time. The function $W(.)$ is differentiable and strictly convex.

Household utility when only one member works is given by

$$V_1(\tau)=2[\log((1-\tau_H)zl^*_{m,1})]-W(l^*_{m,1}),$$

where a $'*'$ denotes an optimal choice.

A two-earner household When both members work, the household incurs a utility cost q, drawn from a distribution with cumulative distribution function $\zeta(q)$. Then the problem is given by

$$\begin{aligned}\max_{l_{m,2},l_{f,2}} \quad & \{2[\underbrace{\log((1-\tau_H)zl_{m,2}+(1-\tau_L)xl_{f,2})}_{=\log(c)}] \\ & -W(l_{m,2})-W(l_{f,2})-q\},\end{aligned}$$

where the subscript 2 represents the choices of a two-earner household. Let the solutions to this problem be denoted by $l^*_{m,2}$ and $l^*_{f,2}$. Household utility in this case equals

$$\begin{aligned}V_2(\tau_H,\tau_L)-q \quad = \quad & 2[\log((1-\tau_H)zl^*_{m,2}+(1-\tau_L)xl^*_{f,2})] \\ & -W(l^*_{m,2})-W(l^*_{f,2})-q.\end{aligned}$$

Letting the function $W(.)$ adopt the functional form that we will use later, $\varphi l^{1+\frac{1}{\gamma}}$, it is easy to find that relative labor supplies depend on relative productivities, the relative tax wedge and the Frisch elasticity γ, and is given by

$$\frac{l_{f,2}^*}{l_{m,2}^*} = \left(\frac{x}{z}\right)^{\gamma} \left(\frac{1-\tau_L}{1-\tau_H}\right)^{\gamma}$$

It follows that a higher relative productivity of the female, or a lower relative tax distortion on her, increases her labor supply relative to her partner.

The extensive margin in labor supply A married household is indifferent between having one and two earners for a sufficiently high value of the utility cost. Hence, there exists a q^* that satisfies $q^* = V_2(\tau_H, \tau_L) - V_1(\tau_H)$. For households with a q higher than the corresponding threshold value, it is optimal to have only one earner, while for those with a q lower than the threshold it is optimal to be a two-earner household.

From the above expressions, it is clear that the thresholds will change as either τ_H or τ_L change. In order to determine how exactly they will change with taxes, we appeal to the envelope theorem. It follows that

$$\frac{\partial q^*}{\partial \tau_L} = \frac{\partial V_2(\tau_H, \tau_L)}{\partial \tau_L} = -2\, \frac{x l_{f,2}^*}{(1-\tau_H) z l_{m,2}^* + (1-\tau_L) x l_{f,2}^*} < 0 \tag{1}$$

and

$$\begin{aligned} \frac{\partial q^*}{\partial \tau_H} &= \frac{\partial V_2(\tau_H, \tau_L)}{\partial \tau_H} - \frac{\partial V_1(\tau_H)}{\partial \tau_H} \\ &= -2\, \frac{z l_{m,2}^*}{(1-\tau_H) z l_{m,2}^* + (1-\tau_L) x l_{f,2}^*} + 2\, \frac{z l_{m,1}^*}{(1-\tau_H) z l_{m,1}^*} > 0. \end{aligned} \tag{2}$$

Note that (2) holds if $l_{m,1}^* > l_{m,2}^*$ and

$$(1-\tau_H) z l_{m,1}^* < (1-\tau_H) z l_{m,2}^* + (1-\tau_L) x l_{f,2}^*.$$

Both conditions are quite intuitive and satisfied in the current set-up. Hence, q^* and as a result, the labor force participation of married females, will be higher when taxes on married females are lower. Similarly, q^* and the the labor force participation of married females, will be higher when taxes on married males are higher. Changes in either tax rates affect the threshold values for the utility cost, and change labor force participation.

Welfare Note that for given labor productivities, we can write welfare as

$$
\begin{aligned}
V &= \int_0^{q^*} (V_2(\tau_H, \tau_L) - q) d\zeta(q) + \int_{q^*} V_1(\tau_H) d\zeta(q) \\
&= \zeta(q^*) V_2(\tau_H, \tau_L) + (1 - \zeta(q^*)) V_1(\tau_H) - \int_0^{q^*} q d\zeta(q) \qquad (3)
\end{aligned}
$$

From this expression, some intuition regarding the welfare changes driven by changes in tax rates follow. First, for fixed participation decisions, an increase in τ_H reduces the welfare of one and two-earners households. Similarly, a reduction in τ_L increases the welfare of two-earner households. Hence, for fixed participation decisions, a reduction in τ_L accompanied by an increase in τ_H to balance the budget *may* increase welfare if τ_H does not have to be increased too much. This would be the case if the labor supply elasticity of married females is high enough, and participation rates are high. With variable participation decisions, there are further reasons for a reduction in τ_L accompanied by an increase in τ_H to increase welfare. This would occur as with an increase in participation, the required increase in τ_H to finance a given reduction in τ_L will be smaller.

Note also that the wage gap between the spouses can play a central role in welfare changes. If z is much higher than x, say, a reduction in τ_L accompanied by an increase in τ_H may reduce welfare: one-earner households will be worse off, and inframarginal two-earner households may be worse off as well.

3 Model

Our model economy follows the model we use in Guner, Kaygusuz and Ventura (2010). We study a stationary overlapping generations economy populated by a continuum of males (m) and a continuum of females (f). We denote by $j \in \{1, 2, ..., J\}$ the age of each individual. Individuals differ in terms of their marital status: they are born as either single or married, and their marital status does not change over time. Population grows at rate n.

Married households and single females also differ in the number of children attached to them. These households can be childless or endowed with two children. Children appear either *early* or *late* in the life-cycle exogenously, and affect the resources available to households for three periods. Children do not provide any utility.

The life-cycle of agents is split into two parts. Agents start life as workers and at age J_R, they retire and collect pension benefits until they die at age J. Spouses are assumed to be of the same age, and as a result experience identical life-cycle dynamics.

Each period, working households (married or single) make labor supply, consumption and savings decisions. If a female with children, married or single, works, then the household has to pay child care costs. Children also imply a fixed time cost for females. Not working for a female is *costly*; if she does not work, she experiences losses of labor efficiency units for next period. If the *female* member of a married household supplies positive amounts of market work, then the two-earner household incurs a utility cost. As a result of these assumptions, married males always work in this economy, while there is a labor-force participation decision for married females.

3.1 Heterogeneity and Demographics

Individuals are different in terms of their labor efficiency units. At the start of life, each *male* is endowed with an exogenous type z, where $z \in Z$ and $Z \subset R_{++}$ is a finite set, which remains constant over his life cycle. Let the age-j productivity of a type-z agent be denoted by the function $\varpi_m(z, j)$. Let $\Omega_j(z)$ denote the fraction of age-j, type-z males in male population, with $\sum_{z \in Z} \Omega_j(z) = 1$.

Each female starts her working life with a particular intrinsic type. As males, this type is fixed over time and is denoted by $x \in X$, where $X \subset R_{++}$ is a finite set. Let $\Phi_j(x)$ denote the fractions of age-j, type-x females in female population, with $\sum_{x \in X} \Phi_j(x) = 1$.

In contrast to men, as women enter and leave the labor market, their labor market productivity levels evolve *endogenously*. Each female starts life with an initial productivity level that depends on her intrinsic type, denoted by $h_1 = \eta(x) \in H$. After age-1, the next period's productivity level (h') depends on the female's intrinsic type x, her age, the current level of h and current labor supply (l). We assume that for $j \geq 1$,

$$h' = G(x, h, l, j) = \exp\left[\ln h + \alpha_j^x \chi(l) - \delta(1 - \chi(l))\right]. \tag{4}$$

all $h \in H$. In this formulation α_j^x represents age and type specific growth factors associated to female labor supply while δ is the depreciation rate associated to non-participation.[7] The function G is increasing in h and x and non-decreasing in l. It captures the combined effects of a female intrinsic type, age and labor supply decisions on her labor market productivity growth.

Let $M_j(x, z)$ denote the fraction of marriages between an age-j, type-x female and an age-j type-z male, and let $\omega_j(z)$ and $\phi_j(x)$ be the fraction of single type-z males and the

[7]Our formulation of the human capital accumulation process follows Attanasio, Low and Sánchez Marcos (2008).

fraction of single type-x females, respectively. Then, the following accounting identity must hold

$$\Omega_j(z) = \sum_{x \in X} M_j(x, z) + \omega_j(z). \tag{5}$$

Furthermore, since the marital status does not change, $M_j(x, z) = M(x, z)$ and $\omega_j(z) = \omega(z)$ for all j, which implies $\Omega_j(z) = \Omega(z)$. Similarly, for age-j females, we have

$$\Phi_j(x) = \sum_{z \in Z} M_j(x, z) + \phi_j(x). \tag{6}$$

Since marital status does not change $\phi_j(x) = \phi(x)$ and $\Phi_j(x) = \Phi(x)$ for all j

We assume that each cohort is $1 + n$ bigger than the previous one. The demographic structure is stationary so that age j agents are a fraction μ_j of the population at any point in time. The weights are normalized to add up to one, and obey the recursion, $\mu_{j+1} = \mu_j/(1+n)$.

3.2 Children

Children are assigned exogenously to married couples and single females at the start of life, depending on the intrinsic type of parents. Each married couple and single female can be of three types: *early* child bearers, *late* child bearers, and those *without* any children. Early and late child bearers have *two* children for three periods. Early child bearers have these children in ages $j = 1, 2, 3$ while late child bearers have children attached to them in ages $j = 2, 3, 4$.

We assume that if a female with children works, married or single, then the household has to pay for child care costs. Child care costs depend on the age of the child (s). For a female with children of age $s \in \{1, 2, 3\}$, the household needs to purchase $d(s)$ units of (child care) labor services for their two children. Since the competitive price of child care services is the wage rate w, the total cost of child care services for two children equals $wd(s)$. Each young, $s = 1$, child also implies a time cost for the mother, whether she is working or not.

3.3 Preferences and Technology

The momentary utility function for a single female is given by

$$U_f^S(c, l, k_y) = \log(c) - \varphi(l + k_y \varkappa)^{1+\frac{1}{\gamma}},$$

where c is consumption, l is time devoted to market work, and $\varkappa$ is fixed time cost having two age-1 (young) children for a female. Here $k_y = 0$ stands for the absence of age-1 (young) children in the household, whereas $k_y = 1$ stands for young children being present. Since a single male does not have any children, his utility function is simply given by

$$U_m^S(c,l) = \log(c) - \varphi(l)^{1+\frac{1}{\gamma}}.$$

Married households maximize the sum of their members utilities. We assume that when the female member of a married household works, the household incurs a utility cost q. Then, the utility function for a married female is given by

$$U_f^M(c,l_f,q,k_y) = \log(c) - \varphi(l_f + k_y\varkappa)^{1+\frac{1}{\gamma}} - \frac{1}{2}\chi\{l_f\}q,$$

while the one for a married male reads as

$$U_m^M(c,l_m,l_f,q) = \log(c) - \varphi l_m^{1+\frac{1}{\gamma}} - \frac{1}{2}\chi\{l_f\}q,$$

where $\chi\{.\}$ denote the indicator function. Note that consumption is a public good within the household. Note also that the parameter $\gamma > 0$, the intertemporal elasticity of labor supply, and φ, the weight on disutility of work, are independent of gender and marital status.

We assume that at the start of their lives married households draw a $q \in Q$, where $Q \subset R_{++}$ is a finite set. For a given household, the initial draw of a utility cost depends on the intrinsic type of the husband. Let $\zeta(q|z)$ denote the probability that the cost of joint work is q, with $\sum_{q\in Q}\zeta(q|z) = 1$.

There is an aggregate firm that operates a constant returns to scale technology. The firm rents capital and labor services from households at the rate R and w, respectively. Using K units of capital and L_g units of labor, firms produce $F(K,L_g) = K^\alpha L_g^{1-\alpha}$ units of consumption (investment) goods. We assume that capital depreciates at rate δ_k. Households save in the form of a risk-free asset that pays the competitive rate of return $r = R - \delta_k$.

3.4 Incomes, Taxation and Social Security

Let a stand for household's assets. Then, the total pre-tax resources of a single working male of age j and a single female worker of age j without any children are given by $a + ra + w\varpi_m(z,j)l_m$ and $a + ra + whl_f$, respectively. For a single female worker with children, they amount to $a + ra + whl - wd(s)\chi\{l_f\}$. The pre-tax total resources for a married working couple with children are given by $a + ra + w\varpi_m(z,j)l_m + whl_f - wd(s)\chi\{l_f\}$, while they are $a + ra + w\varpi_m(z,j)l_m + whl_f$ for those without children.

Retired households have access to social security benefits. We assume that social security payments depend on households' intrinsic types, i.e. initially more productive households receive larger social security benefits. This allows us to capture in a parsimonious way the positive relation between lifetime earnings and social security transfers, as well as the intra-cohort redistribution built into the system. Let $p_f^S(x)$, $p_m^S(z)$, and $p^M(x,z)$ indicate the level of social security benefits for a single female of type x, a single male of type z and a married retired household of type (x,z), respectively. Hence, retired households pre-tax resources are simply $a+ra+p_f^S(x)$ and $a+ra+p_m^S(z)$ for singles, and $a+ra+p^M(x,z)$ for married ones.

Income for tax purposes, I, is defined as total labor and capital income. Hence, for a single male worker, it equals $I = ra + w\varpi_m(z,j)l_m$, while for a single female worker, it reads as $I = ra + whl_f$. For a married working household, taxable income equals $I = ra + w\varpi_m(z,j)l_m + whl_f$. We assume that social security benefits are not taxed, so income for tax purposes is simply given by ra for retired households. The total income tax liabilities of married and single households are affected by the presence of children in the household, and are represented by tax functions $T^M(I,k)$ and $T^S(I,k)$, respectively, where $k = 0$ stands for the absence of children in the household, whereas $k = 1$ stands for children of any age being present. These functions are continuous in I, increasing and convex. This representation captures the actual variation in tax liabilities associated to the presence of children in households.

There is also a (flat) payroll tax that taxes individual labor incomes, represented by τ_p, to fund social security transfers. Besides the income and payroll taxes, each household pays an additional flat capital income tax for the returns from his/her asset holdings, denoted by τ_k.

4 Decisions and Equilibrium

We now present the decision problem for different types of households in the recursive language. For single males, the individual state is (a,z,j). For single females, the individual state is given by (a,h,x,b,j). For married couples, the state is given by (a,h,x,z,q,b,j). Note that the dependency of taxes on the presence of children in the household (k) is summarized by age (j) and childbearing status (b): (i) $k = 1$ if $b = \{1,2\}$ and $j = \{b, b+1, b+2\}$, and (ii) $k = 0$ if $b = 2$ and $j = 1$, or $b = \{1,2\}$ for all $j > b+2$, or $b = 0$ for all j. Similarly, the presence of age-1 (young) children (k_y) depends on b and j.

The Problem of a Single Male Household Consider now the problem of a single male worker of type (a,z,j). A single worker of type-(a,z,j) decides how much to work and how much to save. His problem is given by

$$V_m^S(a,z,j) = \max_{a',l}\{U_m^S(c,l) + \beta V_m^S(a',z,j+1)\} \tag{7}$$

subject to

$$c+a' = \begin{cases} a(1+r(1-\tau_k)) + w\varpi_m(z,j)l(1-\tau_p) - T^S(w\varpi_m(z,j)(j)l + ra, 0) & \text{if } j < J_R \\ a(1+r(1-\tau_k)) + p_m^S(z) - T^S(ra), \text{ otherwise} & \end{cases},$$

and

$$l \geq 0,\ a' \geq 0 \text{ (with strict equality if } j = J)$$

The Problem of a Single Female Household In contrast to a single male, a single female's decisions also depends on her current human capital h and her child bearing status b. Hence, given her current state, (a,x,h,b,j), the problem of a single female is

$$V_f^S(a,h,x,b,j) = \max_{a',l}\{U_f^S(c,l,k_y) + \beta V_f^S(a',h',x,b,j+1)\},$$

subject to
(i) With kids: if $b = \{1,2\}$, $j \in \{b, b+1, b+2\}$, then $k = 1$, and

$$c + a' = a(1+r(1-\tau_k)) + whl(1-\tau_p) - T^S(whl + ra, 1) - wd(j+1-b)\chi(l).$$

Furthermore, if $b = j$, then $k_y = 1$.
(ii) Without kids but not retired: if $b = 0$, or $b = \{1,2\}$ and $b+2 < j < J_R$, or $b = 2$ and $j = 1$, then $k = 0$ and

$$c + a' = a(1+r(1-\tau_k)) + whl(1-\tau_p) - T^S(whl + ra, 0)$$

(ii) Retired: if $j \geq J_R$, $k = 0$ and

$$c + a' = a(1+r(1-\tau_k)) + p_f^S(x) - T^S(ra, 0).$$

In addition,

$$h' = G(x,h,l,j),$$

$$l \geq 0,\ a' \geq 0 \text{ (with strict equality if } j = J)$$

Note how the cost of children depends on the age of children. If $b = 1$, the household has children at ages 1, 2 and 3, then $wd(j+1-b)$ denote cost for ages 1, 2 and 3 with $j = \{1, 2, 3\}$. If $b = 2$, the household has children at ages 2, 3 and 4, then $wd(j + 1 - b)$ denotes the cost for children of ages 1, 2 and 3 with $j = \{2, 3, 4\}$. A female only incurs the time cost of children if her kids are 1 year old, and this happens if $b = j = 1$ or $b = j = 2$.

The Problem of Married Households Like singles, married couples decide how much to consume, how much to save, and how much to work. They also decide whether the female member of the household should work. Their problem is given by

$$\begin{aligned} V^M(a, h, x, z, q, b, j) &= \max_{a',\, l_f,\, l_m} \{[U_f^M(c, l_f, q, k_y) + U_m^M(c, l_m, l_f, q)] \\ &+ \beta V^M(a', h', x, z, q, b, j + 1)\}, \end{aligned}$$

subject to
(i) <u>With kids:</u> if $b = \{1, 2\}$, $j \in \{b, b + 1, b + 2\}$, then $k = 1$ and

$$\begin{aligned} c + a' &= a(1 + r(1 - \tau_k)) + w(\varpi_m(z, j)l_m + hl_f)(1 - \tau_p) \\ &- T^M(w\varpi_m(z, j)l_m + whl_f + ra, 1) - wd(j + 1 - b)\chi(l_f) \end{aligned}$$

Furthermore, if $b = j$, then $k_y = 1$.
(ii) <u>Without kids but not retired:</u> if $b = 0$, or $b = \{1, 2\}$ and $b + 2 < j < J_R$, or $b = 2$, $j = 1$, then $k = 0$ and

$$\begin{aligned} c + a' &= a(1 + r(1 - \tau_k)) + w(\varpi_m(z, j)l_m + hl_f)(1 - \tau_p) \\ &- T^M(w\varpi_m(z, j)l_m + whl_f + ra, 0) \end{aligned}$$

(ii) <u>Retired:</u> if $j \geq J_R$, then $k = 0$ and

$$c + a' = a(1 + r(1 - \tau_k)) + p^M(x, z) - T^M(ra, 0).$$

In addition,

$$h' = G(x, h, l_f, j)$$

$$l_m \geq 0,\ \ l_f \geq 0, a' \geq 0 \text{ (with strict equality if } j = J)$$

4.1 Stationary Equilibrium

The aggregate state of this economy consists of distribution of households over their types, asset and human capital levels. Suppose $a \in A = [0, \overline{a}]$. By construction, H is a bounded set. Let $\mathcal{A}$ be the class of Borel subsets of A and $\mathcal{B}$ be the class of Borel subsets of $A \times H$. Let $\psi_j^M(B, x, z, q, b)$ be the number (measure) of age j married households of type (x, z, q, b), with assets and female human capital level in $B \in \mathcal{B}$. Similarly, let $\psi_{f,j}^S(B, x, b)$ be the number of age j single females of type (x, b) with assets and human capital level in $B \in \mathcal{B}$. Finally, let $\psi_{m,j}^S(B, z)$ be the number of single males of type (z), with assets in $B \in \mathcal{A}$.

By construction, $M(x, z)$, the number married households of type (x, z), must satisfy for all ages

$$M(x, z) = \sum_{q,b} \int_H \int_A \psi_j^M(a, h, x, z, q, b) dhda.$$

Similarly, the fraction of single females and males must be consistent with the corresponding measures $\psi_{f,j}^S$ and $\psi_{m,j}^S$. For all ages,

$$\phi(x) = \sum_b \int_H \int_A \psi_{f,j}^S(a, h, x, b) dhda,$$

and

$$\omega(z) = \int_A \psi_{m,j}^S(a, z) da.$$

In stationary equilibrium, factor markets clear. Aggregate capital (K) and aggregate labor (L) are given by

$$\begin{aligned} K &= \sum_j \mu_j [\sum_{x,z,q,b} \int_H \int_A a\psi_j^M(a, h, x, z, q, b) dhda + \sum_z \int_A a\psi_{m,j}^S(a, z) da \\ &+ \sum_{x,b} \int_H \int_A a\psi_{f,j}^S(a, h, x, b) dhda] \end{aligned} \tag{8}$$

and

$$\begin{aligned} L &= \sum_j \mu_j [\sum_{x,z,q,b} \int_H \int_A (hl_f^M(a, h, x, z, q, b, j) + \varpi_m(z, j) l_m^M(a, h, x, z, q, b, j)) \psi_j^M(a, h, x, z, q, b) dhda \\ &+ \sum_z \int_A \varpi_m(z, j) l_m^S(a, z, j) \psi_m^S(a, z) da + \sum_{x,b} \int_H \int_A hl_f^S(a, h, x, b, j) \psi_{f,j}^S(a, x, b) dhda] \end{aligned} \tag{9}$$

Furthermore, labor used in the production of goods, L_g, equals

$$
\begin{aligned}
L_g &= L - [\sum_{x,z,q}\sum_{b=1,2}\sum_{j=b,b+2}\mu_j \int_H \int_A \chi\{l_f^M\} d(j+1-b)\psi_j^M(a,h,x,z,q,b) dh da \\
&+ \sum_{x}\sum_{b=1,2}\sum_{j=b,b+2}\mu_j \int_H \int_A \chi\{l_f^S\} d(j+1-b)\psi_{f,j}^S(a,h,x,b) dh da], \qquad (10)
\end{aligned}
$$

where the term in brackets is the measure of labor used in child care services.

In addition, factor prices are competitive so $w = F_2(K, L_g)$, $R = F_1(K, L_g)$, and $r = R - \delta_k$. In the Appendix I, we provide a formal definition of equilibria.

5 Parameter Values

To assign parameter values, we use aggregate and cross-sectional data from different sources. The model period is five years. Except for the choice of income tax functions (see below), details regarding the choice of parameters are contained in Appendix II.

To construct income tax functions for married and single individuals, we use our estimates contained in Guner et al (2011) of *effective tax rates* as a function of reported income, marital status and children. The underlying data is tax-return, micro-data from Internal Revenue Service for the year 2000 (Statistics of Income Public Use Tax File). For married households, the estimated tax functions correspond to the legal category *married filing jointly.* For singles without children, tax functions correspond to the legal category of *single* households; for singles with children, tax functions correspond to the legal category *head of household.*[8] To estimate the tax functions for a household with children, married or not, the sample is restricted to households in which there are two dependent children for tax purposes.

In Guner et al (2011) we posit

$$t(\tilde{y}) = \eta_1 + \eta_2 \ \log(\tilde{y}),$$

where t is the average tax rate, and the variable $\tilde{y}$ stands for multiples of mean household income in the data. That is, a value of $\tilde{y}$ equal to 2.0 implies an average tax rate corresponding to an actual level of income that is twice the magnitude of mean household income in the data. Given these estimates, we impose these tax functions in our model using the model

[8] We use the 'head of household' category for singles with children, since in practice it is clearly advantageous for most unmarried individuals with dependent children to file under this category. For instance, the standard deduction is larger than for the 'single' category, and a larger portion of income is subject to lower marginal tax rates.

counterpart of $\tilde{y}$ and mean income. That is, total tax liabilities amount to $t(\tilde{y}) \times \tilde{y} \times$ *mean household income*.

Estimates for η_1 and η_2 are contained in Table 2. Figure 1 displays estimated average and marginal tax rates for different multiples of household income for a married household with two children. Our estimates imply that such a household type at around mean income faces an average tax rate of about 7.9% and marginal tax rate of 15.5%. At twice the mean income level, the average and marginal rates amount to 13.2% and 20.8%, respectively.

Table 3 summarizes our parameter choices. Table 4 shows the performance of the benchmark model in terms of the targets we impose. The table also shows how well the benchmark calibration reproduces the labor force participation of married females. The model has no problem in reproducing jointly these observations as the table demonstrates.

6 The Quantitative Experiments

We study the effects of moving from the current U.S. tax system to a tax system where different proportional tax rates on labor earnings coexist, τ_L an τ_H. All households pay a common additional proportional tax rate on capital income, τ_k^*. In all cases considered, the experiments are revenue neutral. Naturally, our formulation incorporates a trade off: if lower tax rates τ_L are chosen, a higher tax rate τ_H becomes necessary to achieve budget balance.

We first implement a revenue-neutral proportional income tax reform and compute the common proportional income tax τ such that $\tau_L = \tau_H = \tau$. We then consider two cases of differential taxation of married females, depending on the tax base used to balance the budget. Let E_m and E_f be the labor income of males and females, respectively. In our *narrow-base* case, under differential tax rates for married females, we assume that the after-tax labor income of a single male is simply $E_m(1-\tau)$, while for single females it is given by $E_f(1-\tau)$. For married males and females, respectively, the after-tax labor income is given by $E_m(1-\tau_H)$ and $E_f(1-\tau_L)$. Hence, the narrow case taxes married females at a lower rate and achieves revenue-neutrality by applying higher taxes *only* on married males.

In our *broad-base* case, married females face τ_L and everyone else (married or single) face τ_H. Hence, the after-tax labor income of a single male is simply $E_m(1-\tau_H)$, while for single females it is given by $E_f(1-\tau_H)$. For married males and females, respectively, the after-tax labor income is given by $E_m(1-\tau_H)$ and $E_f(1-\tau_L)$.

In both cases, the capital income tax rate equals $\tau_k^* = \tau_k + \tau$. That is, capital income of all households is taxed at the rate original rate τ_k plus the marginal rate τ from proportional taxation. It follows that when we make τ_L and τ_H different from each other, the tax rates on capital are *unchanged*. Therefore, our results capture the consequences of taxing different people differently in terms of their labor earnings, without changes in the tax rate on capital income.

All our experiments are conducted under the assumption of a small-open economy: the rate of return to capital and the wage rate are unchanged across steady states. To achieve revenue neutrality, we balance the budget period by period via adjusting τ for the proportional income tax experiment, or τ_H for gender-based taxation experiments.

7 Findings

We report first in this section steady-state comparisons of economies in relation to the benchmark. Table 5 reports key aggregate findings for the case of a proportional income tax ($\tau = \tau_H = \tau_L$), and for two levels of tax rates for females, ($\tau_L = 8\%$) and ($\tau_L = 4\%$), under broad and narrow tax-base cases.

We start by discussing the results from a shift to a proportional income tax. In this case, by construction, marginal and average tax rates on capital and labor income become equal for all households, eliminating in this way the non-linearities of the current system discussed earlier. In the new steady state, the uniform tax rate that balances the budget equals 10.2%. As Table 5 demonstrates, the introduction of a proportional income tax leads to substantial effects on output and factor inputs. Total labor supply (hours adjusted by efficiency units) increases by 3.0%. Aggregate capital increases by 3.6%. As a result of these changes, aggregate output increases substantially by about 3.2% across steady states.

Table 5 also shows more disaggregated responses in labor supply to a proportional tax, that take place at the intensive margin for both males and females, as well as at the *extensive* margin for married females. Recall that in the benchmark economy, the tax structure generates non-trivial disincentives to savings and work since average and marginal tax rates increase with incomes. In addition, married females who decide to enter the labor force are taxed at their partner's current marginal tax rate. With the elimination of these disincentives, the changes in hours worked by married females are much larger than the aggregate change in hours. The introduction of a flat-rate income tax implies that the labor force participation of married females increases by about 2.8%, while hours per worker rise by about 2.9% for females, and about 2.6% for males. Taking stock of intensive and the extensive margins, total hours for married females increases by about 5.8%.

Differential taxation of married females amplifies the effects discussed above. As τ_L becomes lower than τ_H, married households find optimal to shift hours worked from males to females and thus, participation rates increase. The level of τ_H that achieves revenue neutrality ranges from 10.95% (for $\tau_L = 8\%$ with broad tax base) to 13.45% (for $\tau_L = 4\%$ with narrow tax base). The change in labor force participation sharply increases as τ_L is reduced: this change goes from 2.8% under a proportional tax to about 6.5% and 6.9% under a tax rate on married females of 4%. These effects are reflected in the resulting increases in output; while output increases by about 3.2% under a proportional income tax, the increases are *larger* as the tax rate on married females is reduced.

Two aspects of the findings so far are worth mentioning here. First, as Table 5 shows, the aggregate effects of gender-based taxes are largely independent of the tax base under consideration. The effects on participation rates and labor supply are slightly higher under the narrow-tax base, as the gap between tax rates on married females and married males is larger there, but the differences between the cases are rather small. Hence, for the effects on aggregates, whether taxes to balance the budget are raised on married males or everyone else is of second-order importance. Second, the bulk of aggregate gains in output and labor supply emerge under a proportional tax. Gender-based taxes add relatively little to output and aggregate labor supply: a simple proportional tax accounts for about 80% (77%) of the output (labor) gains under $\tau_L = 4\%$ (with the narrow tax base).

The Importance of Married Females How large is the contribution of married females to changes in hours and labor supply? The bottom panel of Table 5 sheds light on this question. We calculate the fraction of total hours and labor changes, accounted for by the responses of married females. About 48.9% (48.2%) of the total changes in hours (labor) are accounted for the responses of married females under a simple proportional tax. With $\tau_L = 8\%$, this fraction raises to 56.1% (55.8%), whereas for $\tau_L = 4\%$ it becomes 65.8% (65.5%). These results are striking, and lead to the conclusion that the majority of gains in hours worked upon tax changes are connected to the behavior of married females. Furthermore, as tax rates on married females are reduced, they account for a larger share of the changes associated to tax changes.

Who changes participation? We concentrate now on the identity of married females who change their behavior along the extensive margin, and the consequent effects on their human capital. Table 6 shows the participation changes for different skill levels and child-bearing status, for the case of the proportional tax and narrow-tax base under $\tau_L = 8\%$ and $\tau_L = 4\%$.

The results clearly indicate that less-skilled married females and those with children respond more to the tax changes. Note, for instance, that at the lowest value for the tax rate on married females, 4%, married females with a high school degree or less increase their participation by about 11%. Meanwhile, married females with a college degree or more, increase participation by much less, 4.2%. Given this behavior, it should be expected that females with children would react more than those without children to tax changes: lower types are more likely to have children as well as to have them early. In addition, as we elaborated in Guner et al (2010), income effects lead females with children to react more strongly to tax changes.

Multiple factors account for the asymmetry in participation responses by skill. First, notice that the labor force participation of high-type married females is quite large in the benchmark economy to begin with, leaving relatively little room to react to tax changes. Second, marginal tax rates on women's drop even for low types, and drop drastically with the lower values of τ_L. Recall that in the benchmark economy, the marginal tax rate on a household with an income equal to one-half average income is about 10.2% while the marginal rate amounts to about 15.5% for those with a mean income level. The corresponding marginal rates are now 10.2%, 8% and 4%, and in the case of gender-based taxes, their effect is compounded by the correspondingly higher marginal rates on married males. Finally, since our benchmark is forced to account for the participation patterns in our parameterization, the shape of the distributions (cdf) of utility costs differ non-trivially according to the husband's type. This leads to a typically larger slope in the cdf for married households with less-skilled females. It follows that changes in participation decisions rules result in larger effects for the group of less-skilled females than for high-skilled ones.

7.1 Welfare Analysis

We now discuss the welfare implications of the tax changes discussed so far. Given our findings on the similarities between the broad-base scenario and the narrow-base one, we focus our attention on the latter in conjunction with the case of a proportional income tax. We compute transitions between steady states and report multiple welfare findings for individuals alive at the date when the tax system is changed. To achieve budget neutrality, we find in each period either the proportional tax rate τ or the tax rate τ_H, that generate the same amount of tax collections as in the benchmark economy.

In order to quantify gains/losses relative to the benchmark economy, we compute the common, percentage change in consumption in the benchmark economy, that keeps households indifferent between the benchmark steady state and transition path driven by the alternative regime. We do this for all households, as well as for different groups of them, and discuss how their welfare is impacted upon tax changes.

Table 7 reports the consumption compensation for different age groups, the common compensation for all households alive at the start of the change in the tax regime, and the fraction of households who experience a welfare gain. Table 7 shows that about 57% of households benefit from the shift to proportional income taxation. The Table also reveals that the aggregate welfare gain is substantial, which amounts to about 1.8% increase in consumption. It is important to note here that welfare gains display an inverted U-shape as a function of age; younger households lose from the shift to a proportional income tax whereas middle-age households gain, and gain substantially. The old households also gain but their gains are lower than those of middle-aged households. This reflects the fact that young and old households, who have lower incomes than middle-aged ones, pay relatively lower taxes under the current (progressive) U.S. tax system than under a proportional income tax.

As the tax rate on married females is reduced from the proportional tax level, the aggregate fraction of winners remains relatively constant. Moving from the current U.S. tax system to gender-based taxes generate aggregate welfare gains; they amount to 1.1% under a tax rate on married females of 8%, and about 0.7% under a tax rate of 4%.[9] As it was the case with proportional taxes, welfare gains display an inverted U-shape since younger households are negatively affected as a group whereas middle-age ones gain.

A central implication from these findings is that, even when there are non-trivial gains in taxing married women at proportionally lower rates than married males, the gains associated to moving to a simple proportional income tax are *larger*. This also holds in experiments (not reported) for the broad-base case. Since in the narrow-base case, tax rates on singles are not affected by the comparison (recall that by design these tax rates are fixed at the proportional tax levels), the findings suggest that there are effects on married households that operate differently as we move in the direction of gender-based taxes. We focus on these effects below.

Married Households Gender-based taxes, with a narrow tax base, effectively reduce taxes on married females and increase taxes on married males. As a result, the aggregate welfare gains and losses that we report in Table 7 mainly reflect gains and losses for married households. In order to highlight the welfare effects on them, we present results in Tables 8 and 9 for different types of married households born at the date when the tax changes are

[9] Under $\tau_L = 8\%$, the tax rate on married males amounts to 13.8% in the first period of the transition, declining monotonically to about 11.6% after ten model periods. Under $\tau_L = 4\%$, the tax rate on married males is about 15.9% in the first period, declining to about 13.5% after ten model periods.

implemented, organized by the skills of each of the spouses and their childbearing status. Tables 8 presents results for the case of a proportional income tax, and Table 9 does the same for $\tau_L = 4\%$.

For the proportional income tax case, the results reveal large differences in welfare gains and losses. Households with spouses with high labor productivity gain, whereas those with relatively low initial productivity lose. The differences in welfare changes between types can be substantial; whereas childless couples in which both members have post-college education gain about 11%, their counterparts with high school education or less lose by about 3.3%. The presence of children does not affect this conclusion at the qualitative level, but clearly affects the magnitude of resulting welfare gains/losses. As households with children are less likely to be two-earner households, they are less likely to benefit from lower taxes on females and more likely to suffer from the higher taxes on males. As a result, the presence of children mitigate welfare gains and enhance welfare losses. Not surprisingly, households with children early in their life cycle tend to have lower gains and larger losses relative to households where children appear late.

How will different types of married households be affected by a shift from a gender-neutral proportional tax to gender-based taxes? Intuitively, there are three different types of married households to consider. First, there are households where even at lower rates, wives do not participate in the labor market. Second, there are households where both members work before and after a move to gender-based taxes. In these households, whether they gain or not relative to a gender-neutral proportional tax depends mainly on the wage-gender gap between the spouses. If the husband is earning substantially more than the wife, they stand to lose from a move to differential taxation, as the household has to pay higher taxes in exchange. On the other hand, if the wife has higher wages than the husband, the household will gain. Finally, there is the third group where female will enter the labor force after a move to gender-based taxes. How would these three groups fare under a such a policy shift? The first group (non-working wives) will be better off with gender-neutral proportional income taxes as this will imply lower taxes on husbands. The second (working wives) group is also likely to prefer gender-neutral taxes as for *most* of these households, females face lower wages than males. Finally, it is an open question if the third group (wives who start working), will prefer gender-neutral or gender-based taxes. This will depend on changes in the tax liability of females versus males associated with the shift to gender-based taxes.

Consider now the results for gender-based taxes in Table 9. To fix ideas, consider first those households in which both spouses have the same types (along the diagonal). For these cases, welfare gains (losses) are uniformly *lower (higher)* under $\tau_L = 4\%$ relative to the case of the proportional income tax.[10] In particular, among households with low-type husbands and wives, gender-based taxation generates large welfare losses as these households consist mainly of working husband and non-working wives and they are clearly hurt by higher taxes on husbands. As we start moving in the direction of higher labor endowments for females or lower labor endowments for males, welfare losses are reduced and welfare gains start emerging or increase relative to the proportional income tax case. Indeed, independent of their child bearing status, only for households in which the wife has more than college education and the husband has some college education or less, the welfare numbers are better under $\tau_L = 4\%$ than under proportional taxes. As we argued above, these households gain more in relation to a uniform proportional tax as taxes on the relatively more productive spouse are reduced, while in all other cases the opposite is true. Altogether, it follows that a crucial reason for the lower welfare gains under gender-based taxes is the wage differences between spouses. For households in which spouses have the same type (about half of married households in our economy), there is an initial wage-gender gap that continues over the life cycle. For households in which females are lower types than males, wage differences are further amplified by differences in skills. As a result, for majority of households in our economy, husbands have higher wages than their wives. Therefore, the higher tax rates on males have a large impact on welfare that dominates the effects resulting from lower tax rates on females.

Summing up, the message of our results is clear. Differential taxation of married males and females at proportional rates improves welfare in aggregate terms relative to the benchmark economy, and a majority of households are better off. Nevertheless, due to sorting and the presence of wage-gender gaps, the resulting gains are smaller than those emerging under a proportional income tax.

8 Concluding Remarks

A central result from this paper is that, on a measure of aggregate welfare, a shift to gender-based taxes delivers welfare gains, and that a majority of households would support such a change. Nevertheless, these gender-based taxes are dominated by the replacement of the current structure of taxes by a uniform, proportional tax system on all households. Put differently, we found mixed support for gender-based proportional taxes in our model economy.

It is worth emphasizing at this point that a central concern in the current paper is the

[10] We obtain similar results with $\tau_L = 8\%$.

detailed consideration of the female labor supply decision, in order to capture the heterogeneity observed in the data. In doing so, we admittedly have abstracted from some factors that may lead to the optimality of differential taxation by gender, as considered by Alesina et al (2010). Our results highlight one reason why lower taxes on married females might not improve welfare relative to a simple proportional tax: lower taxes on females have to be financed by higher taxes on married males and taxing high earners in married couples at higher rates can be costly.

Since our welfare results stand in contrast with results on the optimality of gender-based taxes, we conclude by relating our model with the model in the aforementioned paper. In both papers, the elasticity of female labor supply is *endogenous*; in Alesina et al (2010) it is driven by comparative advantage in home production and career investments, whereas in our model is affected by the participation decision of married females. There are income effects in labor supply in our model, while in their paper, home and market consumption goods enter linearly in preferences. Their model is effectively a static setup, amenable for theoretical analysis, while ours incorporates life-cycle behavior and capital accumulation.

A central difference between Alesina et al (2010) and our paper relates to marriage and the modeling of household decisions. All individuals are married in equilibrium in Alesina et al (2010), while we explicitly consider married and single people. In particular, we assume that (i) marital status and marital sorting is exogenous to the model, and unlike Alesina et al (2010), (ii) there is no bargaining affecting household decisions as there is nothing to disagree on. Endogenous marriage coupled with bargaining over the gains from marriage would clearly affect the identity of winners and losers from the shift to gender-based taxes and therefore, the scope and magnitude of welfare gains. Gender-based taxes can also affect incentives to acquire education, which in our model is exogenously given to individuals at the start of the life cycle. Future research should determine whether these features are important enough to overcome our welfare findings.

9 Appendix I: Definition of Equilibrium

For married couples, let $\lambda_b^M(x,z)$ be the fraction of type-(x,z) couples who have childbearing type b, where $b \in \{0,1,2\}$ denotes no children, early childbearing and late childbearing, respectively, and $\sum_b \lambda_b^M(x,z) = 1$. Similarly, let $\lambda_b^S(x)$ be the fraction of type-x single females who have childbearing type b, with $\sum_b \lambda_b^S(x) = 1$. Let $\mathcal{A}$ be the class of Borel subsets of $A = [0, \overline{a}]$,and $\mathcal{B}$ be the class of Borel subsets of $A \times H$. Let $\psi_j^M(B,x,z,q,b)$ denote the number of married individuals of age j with (a,h) pair in set B, when the female is of type x, the male is of type z, the household faces a utility cost q of joint work, and is of child bearing type b. This function (measure) is defined for $B \in \mathcal{B}$, all $x,z,q,b \in X \times Z \times Q \times \{0,1,2\}$. The measure $\psi_{f,j}^S(B,x,h,b)$, for single females, is defined similarly. Finally, $\psi_{m,j}^S(B,z)$, for single males, is defined over sets $B \in \mathcal{A}$ and all $z \in Z$.

Let $\chi\{.\}$ denote the indicator function. Let the functions $g^S(a,h,x,b,j)$ and $g^M(a,h,x,z,q,b,j)$ describe the evolution of the female human capital over the life cycle. For $j > 1$,

$$g^M(a,h,x,z,q,b,j) = G(x,h,l_f^M(a,h,x,z,q,b,j-1),j-1)$$

$$g^S(a,h,x,b,j) = G(x,h,l_f^S(a,h,x,b,j-1),j-1)$$

The measures defined above obey the following recursions:

Married households

$$\psi_j^M(B,x,z,q,b) = \int_H \int_A \psi_{j-1}^M(a,h,x,z,q,b)\chi\{(a^M(.\ ,\ j-1),\ g^M(.\ ,\ j-1)) \in B\}dhda,$$

for $j > 1$, and

$$\psi_1^M(B,x,z,q,b) = \begin{cases} M(x,z)\lambda_b^M(x,z)\zeta(q|z) \text{ if } (0,\eta(x)) \in B, \\ 0, \text{ otherwise} \end{cases}$$

Single female households

$$\psi_{f,j}^S(B,x,b) = \int_H \int_A \psi_{f,j-1}^S(a,h,x,b)\chi\{(a_f^S(.\ ,\ j-1), g^S(.\ ,\ j-1)) \in B\}dhda,$$

for $j > 1$, and

$$\psi_{f,1}^S(B,x,b) = \begin{cases} \phi(x)\lambda_b^S(x) \text{ if } (0,\eta(x)) \in B, \\ 0, \text{ otherwise} \end{cases} .$$

Single male households

$$\psi^S_{m,j}(B,z) = \int_A \psi^S_{m,j-1}(a,z)\chi\{a^S_m(.\ ,\ j-1) \in B\}da,$$

for $j > 1$, and

$$\psi^S_{m,1}(B,z) = \begin{cases} \omega(z) \text{ if } 0 \in B \\ 0, \text{ otherwise} \end{cases}.$$

Equilibrium Definition For a given government consumption level G, social security tax benefits $p^M(x,z)$, $p^S_f(x)$ and $p^S_m(z)$, tax functions $T^S(.)$, $T^M(.)$, a payroll tax rate τ_p, a capital tax rate τ_k, and an exogenous demographic structure represented by $\Omega(z)$, $\Phi(x)$, $M(x,z)$, and μ_j, a *stationary equilibrium* consists of prices r and w, aggregate capital (K), aggregate labor (L), labor used in the production of goods (L_g), household decision rules $l^M_f(a,h,x,z,q,b,j)$, $l^M_m(a,h,x,z,q,b,j)$, $l^S_m(a,z,j)$, $l^S_f(a,h,x,b,j)$, $a^M(a,h,x,z,q,b,j)$, $a^S_m(a,z,j)$ and $a^S_f(a,h,x,b,j)$, measures ψ^M_j, $\psi^S_{f,j}$, and $\psi^S_{m,j}$, such that

1. Given tax rules and factor prices, the decision rules of households are optimal.

2. Factor prices are competitively determined; i.e. $w = F_2(K, L_g)$, and $r = F_1(K, L_g) - \delta_k$.

3. Factor markets clear; i.e. equations (8), (9) and (10) in the text hold.

4. The measures ψ^M_j, $\psi^S_{f,j}$, and $\psi^S_{m,j}$ are consistent with individual decisions.

5. The Government Budget and Social Security Budgets are Balanced; i.e.,

$$\begin{aligned} G &= \sum_j \mu_j[\sum_{x,z,q,b} \int_H \int_A T^M(.)\psi^M_j(a,h,x,z,q,b)dhda + \sum_z \int_A T^S(.)\psi^S_{m,j}(a,z)da \\ &+ \sum_{x,b} \int_H \int_A T^S(.)\psi^S_{f,j}(a,h,x,b)dhda + \tau_k rK], \end{aligned}$$

and

$$\begin{aligned} &\sum_{j \geq J_R} \mu_j[\sum_{x,z,q,b} \int_H \int_A p^M(x,z)\psi^M_j(a,h,x,z,q,b)dhda + \sum_{x,b} \int_H \int_A p^S_f(x)\psi^S_{f,j}(a,h,x,b)dhda \\ &+ \sum_z \int_A p^S_m(z)\psi^S_{m,j}(a,z)da] \\ = \ &\tau_p wL \end{aligned}$$

10 Appendix II: Calibration

10.1 Demographics and Endowments

Agents start their life at age 25 as workers and work for forty years, corresponding to ages 25 to 64. The first model period ($j = 1$) corresponds to ages 25-29, while the first model period of retirement ($j = J_R$) corresponds to ages 65-69. After working 8 periods, agents retire at age 65 and live until age 80 ($J = 11$). The population grows at the annual rate of 1.1%, the average values for the U.S. economy between 1960-2000.

There are four types of males. Each type corresponds to an educational attainment level: *less than or equal to high school* (hs), *some college* (sc), *college* (col) and *post-college* education (col+). We use data from the 2008 U.S. Census to calculate age-efficiency profiles for each male type. Within an education group, efficiency levels correspond to mean weekly wage rates, which we construct using annual wage and salary income and weeks worked. We normalize wages by the mean weekly wages for all males and females between ages 25 and 64.[11] Figure 2 shows the second degree polynomials that we fit to the raw wage data. In our quantitative exercises, we calibrate the male efficiency units, $\varpi_m(z, j)$, using these fitted values.

There are also four intrinsic female types, which corresponds to four education levels. Table 10 reports the initial (ages 25-29) efficiency levels for females (together with the initial male efficiency levels and the corresponding gender wage gap). We use the initial efficiency levels for females to calibrate their initial human capital levels, $h_1 = \eta(x)$. After ages 25-29, the human capital level of females evolves endogenously according to

$$h' = G(x, h, l, j) = \exp\left[\ln h + \alpha_j^x \chi(l) - \delta(1 - \chi(l))\right].$$

We calibrate the values for α_j^x and δ as follows: First, we choose δ such that annual wage loss associated to non-participation is 2%, a figure calculated by Mincer and Olfek (1982). Then, we select α_j^x so that if a female of a particular type works in every period, her wage profile has exactly the same shape as a male of the same type. This procedure takes the initial gender differences as given, and assumes that the wage growth rate for a female who works full time will be the same as for a male worker; hence, it sets α_j^x values equal to the growth rates of male wages at each age. Table 11 shows the calibrated values for α_j^x.

We determine the distribution of individuals by productivity types for each gender, i.e.

[11] We include in the sample the civilian adult population who worked as full time workers last year, and exclude those who are self-employed or unpaid workers or make less than half of the minimum wage. Our sample restrictions are standard in the literature and follow Katz and Murphy (1992).

$\Omega(z)$ and $\Phi(x)$, using data from the 2008 U.S. Census. For this purpose, we consider all household heads or spouses who are between ages 30 and 39 and for each gender calculate the fraction of population in each education cell. For the same age group, we also construct $M(x, z)$, the distribution of married working couples, as shown in Table 12. Given the fractions of individuals in each education group, $\Phi(x)$ and $\Omega(z)$, and the fractions of married households, $M(x, z)$, in the data, we calculate the implied fractions of single households, $\omega(z)$ and $\phi(x)$, from accounting identities (5) and (6). The resulting values are reported in Table 13: about 77% of households in the benchmark economy consists of married households, while the rest (about 23%) are single. Since we assume that the distribution of individuals by marital status is independent of age, we use the 30-39 age group for our calibration purposes. This age group captures the marital status of recent cohorts during their prime-working years, while being at the same time representative of older age groups.

10.2 Children

In the model each single female and each married couple belong to one of three groups: *childless*, *early child bearer* and *late child bearer*. The early child bearers have two children at ages 1, 2 and 3, corresponding to ages 25-29, 30-34 and 35-39, while late child bearers have their two children at ages 2, 3, and 4, corresponding to ages 30-34, 35-39, 40-44. This particular structure captures two features of the data from the 2008 CPS June supplement.[12] First, conditional on having a child, married couples tend to have two children. Second, these two births occur within a short time interval, mainly between ages 25 and 29 for households with low education and between ages 30 and 34 for households with high education.

For singles, we use data from the 2008 CPS June supplement and calculate the fraction of 40 to 44 years old single (never married or divorced) females with zero live births. This provides us with a measure of lifetime childlessness. Then we calculate the fraction of all single women above age 25 with a total number of two live births who were below age 30 at their last birth. This fraction gives us those who are early child bearers, and the remaining fraction of assigned as late child bearers. The resulting distribution is shown in Tables 14.

We follow a similar procedure for married couples, combining data from the CPS June Supplement and the U.S. Census. For childlessness, we use the larger sample from the U.S. Census.[13] The Census does not provide data on total number of live births but the total

[12] The CPS June Supplement provides data on the total number of live births and the age at last birth for females, which are not available in the U.S. Census.

[13] The CPS June Supplement is not particularly useful for the calculation of childlessness in married couples. The sample size is too small for some married household types for the calculation of the fraction of married females, aged 40-44, with no live births.

number of children in the household is available. Therefore, as a measure of childlessness we use the fraction of married couples between ages 35-39 who have no children at home.[14] Then, using the CPS June supplement we look at all couples above age 25 in which the female had a total of two live births and was below age 30 at her last birth. This gives us the fraction of couples who are early child bearers, with the remaining married couples labeled as the late ones. Table 15 shows the resulting distributions.

We use the U.S. Bureau of Census data from the Survey of Income and Program Participation (SIPP) to calibrate child care costs we use.[15] The total yearly cost for employed mothers, who have children between 0 and 5 and who make child care payments, was about \$6,414.5 in 2005. This is about 10% of average household income in 2005, which we take as the total child care cost of two children. The Census estimates of total child care costs for children between 5 and 14 is about \$4851, which amounts to about 7.7% of average household income in 2005. We set $d(1) = d_1$ and $d(2) = d(3) = d_2$ and select d_1 and d_2 so that families with child care expenditures spend about 10% and 7.7% of average household income for young (0-5) and older (5-14) children, respectively.

10.3 Social Security and Capital Taxation

We calculate $\tau_p = 0.086$, as the average value of the social security contributions as a fraction of aggregate labor income for 1990-2000 period.[16] Using the 2008 U.S. Census we calculate total Social Security income for all single and married households.[17] Tables 16 and 17 show Social Security incomes, normalized by the level corresponding to single males of the lowest type. Given τ_p, the value of the benefit for a single retired male of the lowest type, $p_m^S(x_1)$, is chosen to balance the budget for the social security system. The implied value of $p_m^S(x_1)$ for the benchmark economy is about 18.1% of the average household income in the economy.

We use τ_k to proxy the U.S. corporate income tax. We estimate this tax rate as the one that reproduces the observed level of tax collections out of corporate income taxes after the major reforms of 1986. such tax collections averaged about 1.92% of GDP for 1987-2000

[14] Since we use children at home as a proxy for childlessness, we use age 35-39 rather than 40-44. Using ages 40-44 generates more childlessness among less educated people. This is counterfactual, and simply results from the fact that less educated people are more likely to have kids younger, and hence these kids are less likely to be at home when their parents are between ages 40-44.

[15] See Table 6 in http://www.census.gov/population/www/socdemo/child/tables-2006.html

[16] The contributions considered are those from the Old Age, Survivors and DI programs. The Data comes from the Social Security Bulletin, Annual Statistical Supplement, 2005, Tables 4.A.3.

[17] Social Security income is all pre-tax income from Social Security pensions, survivors benefits, or permanent disability insurance. Since Social Security payments are reduced for those with earnings, we restrict our sample to those above age 70. For married couples we sum the social security payments of husbands and wives.

period. Using the technology parameters we calibrate in conjunction with our notion of output (business GDP), we obtain $\tau_k = 0.097$.

10.4 Preferences and Technology

There are three utility functions parameters to be determined: the intertemporal elasticity of labor supply (γ), the parameter governing the disutility of market work (φ), and fixed time cost of young children ($\varkappa$). We set γ to 0.4. This value is contained in the range of recent estimates by Domeij and Floden (2006, Table 5).[18] Given γ, we select the parameter φ to reproduce average market hours per worker observed in the data, about 40.1% of available time in 2008.[19] We set $\varkappa = 0.132$ to match the labor force participation of married females with young, 0 to 5 years old, children. From the 2008 U.S. Census, we calculate the labor force participation of females between ages 25 to 39 who have two children and whose oldest child is less than 5 as 55.6%. We select the fixed cost such that the labor force participation of married females with children less than 5 years (i.e. early child bearers between ages 25 and 29 and late child bearers between ages 30 and 34), has the same value. Finally, we choose the discount factor β, so that the steady-state capital to output ratio matches the value in the data consistent with our choice of the technology parameters (2.93 in annual terms).

We assume that the utility cost parameter is distributed according to a (flexible) gamma distribution, with parameters k_z and θ_z. Thus, conditional on the husband's type z,

$$q \sim \zeta(q|z) \equiv q^{k_z - 1} \frac{\exp(-q/\theta_z)}{\Gamma(k_z)\theta_z^{k_z}},$$

where $\Gamma(.)$ is the Gamma function, which we approximate on a discrete grid. This procedure allows us to exploit the information contained in the *differences* in the labor force participation of married females as their own wage rate differ with education (for a given husband type). This way we control the slope of the distribution of utility costs, which is potentially important in assessing the effects of tax changes on labor force participation.

Using Census data, we calculate that the employment-population ratio of married females between ages 25 and 54, for each of the educational categories defined earlier.[20] Table 18

[18] Rupert, Rogerson and Wright (2000) provide estimates within a similar range in the presence of a home production margin.

[19] The numbers are for people between ages 25 and 54 and are based on data from the Census. We find mean yearly hours worked by all males and females by multiplying usual hours worked in a week and number of weeks worked. We assume that each person has an available time of 5000 hours per year. Our target for hours corresponds to 2005 hours in the year 2003.

[20] We consider all individuals who are *not* in armed forces.

shows the resulting distribution of the labor force participation of married females by the productivities of husbands and wives for married households. The aggregate labor force participation for this group is 72.2%, and it increases from 61.8% for the lowest education group to 81.9% for the highest. Our strategy is then to select the two parameters governing the gamma distribution, for every husband type, so as to reproduce each of the rows (five entries) in Table 18 as closely as possible. This process requires estimating 10 parameters (i.e. a pair (θ, k) for each husband educational category).

Finally, we specify the production function as Cobb-Douglas, and calibrate the capital share and the depreciation rate using a notion of capital that includes fixed private capital, land, inventories and consumer durables. For the period 1960-2000, the resulting capital to output ratio averages 2.93 at the annual level. The capital share equals 0.343 and the (annual) depreciation rate amounts to 0.055.[21]

[21] We estimate the capital share and the capital to output ratio following the standard methodology; see Cooley and Prescott (1995). The data for capital and land are from Bureau of Economic Analysis (Fixed Asset Account Tables) and Bureau of Labor Statistics (Multifactor Productivity Program Data).

Table 1: Marginal Tax Rates: Married Household with Two Children

Household Income	Wife's Earnings (additional income)	Marginal Tax Rate (%)
Panel A: Initial Income = 0.5 × Mean Income		
0.5× Mean Income	0	10.2
Mean Income	0.5 × Mean income	15.5
2 × Mean Income	Mean Income	20.8
Panel B: Initial Income = 3.0 × Mean Income		
3 × Mean Income	0	23.9
3.5 × Mean Income	0.5 × Mean income	25.1
4.5 × Mean Income	Mean Income	27.0

Note: Entries show the marginal tax rates for a married household with two dependent children, at different income levels driven by additional wife's earnings

Table 2: Tax Function Estimates

Estimates	Married (no children)	Married (two children)	Single (no children)	Single (two children)
η_1	0.1028	0.0789	0.1392	0.090
η_2	0.0582	0.0763	0.0481	0.0819
St. Errors				
η_1	0.0002	0.0003	0.0003	0.0011
η_2	0.0002	0.0003	0.0003	0.0020

Note: Entries show the parameter estimates for the postulated function relating average tax rates and household income.

Table 3: Parameter Values

Parameter	Value	Comments
Population Growth Rate (n)	1.1	U.S. Data - see text.
Discount Factor (β)	0.972	Calibrated - matches K/Y
Intertemporal Elasticity (Labor Supply) (γ)	0.4	Literature estimates.
Disutility of Market Work (φ)	8.03	Calibrated - matches hours per worker
Time cost of Children ($\varkappa$)	0.132	Calibrated – matches LFP of married females with young children
Dep. of human capital, females (δ)	0.02	Mincer and Olfek (1982)
Growth of human capital, females (α_j^x)	-	Calibrated - see text.
Capital Share (α)	0.343	Calibrated - see text.
Depreciation Rate (δ_k)	0.055	Calibrated - see text.
Payroll Tax Rate (τ_p)	0.086	U.S. Data - see text.
Social Security Income ($p_m^S(x_1)$) (lowest type single male)	18.1%	% household income - balances budget
Capital Income Tax Rate (τ_k)	0.097	Calibrated - matches corporate tax collections
Distribution of utility costs $\zeta(.\|z)$	–	Gamma Distribution - matches LFP by education conditional on husband's type

Table 4: Model and Data

Statistic	Data	Model
Capital Output Ratio	2.93	2.92
Labor Hours Per-Worker	0.40	0.40
Labor Force Participation of Married Females with Young Children (%)	62.6	62.1
Participation rate of Married Females (%), 25-54		
Less than High School	61.8	61.7
Some College	74.0	73.5
College	74.9	75.0
More than College	81.9	80.8
Total	72.2	71.9
With Children	68.3	67.1
Without Children	85.9	81.4

Table 5: Aggregate Effects (%)

	Proportional Income	Broad Tax Base		Narrow Tax Base	
		$\tau_L = 0.08$	$\tau_L = 0.04$	$\tau_L = 0.08$	$\tau_L = 0.04$
Married Fem. LFP	2.8	4.1	6.5	4.2	6.9
Agg. Hours	3.2	3.6	4.1	3.6	4.2
Agg. Hours (married fem.)	5.8	7.2	9.8	7.4	10.2
Hours per worker (female)	2.9	3.2	3.2	2.9	2.9
Hours per worker (male)	2.6	2.6	2.4	2.6	2.4
Aggregate Labor	3.0	3.4	3.8	3.4	3.9
Aggregate Output	3.2	3.5	4.0	3.6	4.0
Tax Rate	10.20	10.95	12.10	11.50	13.45
Δ in Married Female Hours (% of Total Δ in Hours)	48.9	54.6	64.8	56.1	65.8
Δ in Married Female Labor (% of Total Δ in Labor)	48.2	54.0	64.4	55.8	65.5

Note: Entries show effects across steady states on selected variables, as well as the contribution of married females to changes in hours (labor), driven by the changes in the tax system.

Table 6: Effects on Labor Force Participation and Human Capital (%), Narrow Base Case

	Labor Force Participation			Human Capital		
	$\tau_L = \tau_H$	$\tau_L = 0.08$	$\tau_L = 0.04$	$\tau_L = \tau_H$	$\tau_L = 0.08$	$\tau_L = 0.04$
Education						
High School	4.1	6.5	11.0	1.3	2.3	3.7
Some College	2.9	4.2	6.8	1.3	2.0	3.1
College	1.9	3.2	5.1	0.9	1.4	2.1
More than College	2.2	3.1	4.2	1.3	1.9	2.4
Child Bearing Status						
Childless	1.3	2.2	3.8	0.6	1.0	1.5
Early Child Bearer	4.1	5.9	9.5	1.9	2.7	4.0
Late Child Bearer	1.7	3.0	4.9	0.7	1.3	1.9

Note: Entries show effects across steady states on labor force participation and lifetime human human capital driven by a tax changes. Gender-based taxes correspond to the narrow-base case.

Table 7: Welfare Effects

Age Group	Proportional Income	Narrow Base ($\tau_L = 0.08$)	Narrow Base ($\tau_L = 0.04$)
25-29	-0.6	-2.0	-2.9
30-34	0.9	-0.3	-1.0
35-39	2.4	1.5	1.0
40-44	3.8	3.0	2.6
45-49	4.2	3.6	3.4
50-54	3.6	3.3	3.2
55-59	2.9	2.7	2.7
All	1.8	1.1	0.7
(%) Winners	57.0	57.1	57.3

Note: Entries show the consumption compensation for households alive at the start of the transition, as well as the fraction experiencing welfare gains, driven by tax changes. Gender-based taxes correspond to the narrow-base case.

Table 8: Welfare Effects: Newborn Married Households (%), Proportional Tax

	Panel A: No children			
	Female			
Male	High School	Some College	College	College +
High School	-3.3	-2.3	-0.8	2.0
Some College	-0.3	0.3	1.4	4.4
College	4.9	5.4	6.1	8.1
College +	8.6	8.7	9.5	11.2
	Panel B: Children Early			
	Female			
Male	High School	Some College	College	College +
High School	-9.0	-8.4	-6.6	-2.7
Some College	-5.1	-4.5	-3.2	-0.8
College	0.3	1.4	2.2	4.1
College +	5.2	5.5	6.1	7.4
	Panel C: Children Late			
	Female			
Male	High School	Some College	College	College +
High School	-5.5	-5.2	-4.4	-1.6
Some College	-2.7	-2.4	-1.6	0.9
College	3.0	3.1	3.9	5.8
College +	7.5	7.6	7.9	9.1

Note: Entries show the consumption compensation for newborn married households at the start of the transition driven by a tax change, according to the type of the spouses and childbearing status. The case considered is a uniform proportional tax.

Table 9: Welfare Effects: Newborn Married Households, Narrow Base ($\tau_L = 4\%$)

	Panel A: No children			
	Female			
Male	High School	Some College	College	College +
High School	-6.1	-3.9	-0.4	4.8
Some College	-4.6	-2.9	0.2	4.8
College	-2.0	-0.7	1.1	5.4
College +	0.0	0.7	2.4	6.1
	Panel B: Children Early			
	Female			
Male	High School	Some College	College	College +
High School	-13.4	-11.5	-7.6	-0.8
Some College	-10.3	-8.7	-5.8	-0.5
College	-7.4	-5.4	-3.7	0.5
College +	-4.2	-3.4	-2.1	1.3
	Panel C: Children Late			
	Female			
Male	High School	Some College	College	College +
High School	-9.5	-8.0	-5.2	2.2
Some College	-7.8	-6.3	-4.0	2.0
College	-4.4	-3.5	-1.8	2.5
College +	-1.7	-1.6	0.3	3.2

Note: Entries show the consumption compensation for newborn married households at the start of the transition driven by a tax change, according to the type of the spouses and childbearing status. The case considered is a gender-based system, under a narrow base, with $\tau_L = 4\%$.

Table 10: Initial Productivity Levels, by Type, by Gender

Types	Males (z)	Females (x)	x/z
hs	0.621	0.519	0.836
sc	0.701	0.639	0.875
col	0.997	0.809	0.811
col+	1.231	1.065	0.865

Note: Entries are the productivity levels of males and females, ages 25-29, using 2008 data from the CPS March Supplement. These levels are constructed as weekly wages for each type –see text for details.

Table 11: Labor Market Productivity Process for Females (α_j^x)

Types	hs	sc	col	col+
25-29	0.102	0.194	0.213	0.254
30-34	0.078	0.125	0.140	0.157
35-39	0.059	0.077	0.091	0.095
40-44	0.042	0.038	0.053	0.048
45-49	0.027	0.003	0.020	0.007
50-54	0.014	-0.031	-0.010	-0.033
55-60	0.001	-0.069	-0.042	-0.078

Note: Entries are the parameters α_j^x for the process governing labor efficiency units of females over the life cycle – see equation (4). These parameters are the growth rates of male wages.

Table 12: Distribution of Married Working Households by Type

	Females			
Males	hs	sc	col	col+
hs	17.42	10.45	2.79	0.82
sc	6.83	16.85	6.82	2.38
col	1.56	5.41	11.18	4.83
col+	0.42	1.54	5.01	5.87

Note: Entries show the fraction of marriages out of the total married pool, by wife and husband educational categories. The data used is from the 2008 U.S. Census, ages 30-39. Entries add up to 100. –see text for details.

Table 13: Fraction of Agents by Type, by Gender and Marital Status

	Males			Females		
	All	Married	Singles	All	Married	Singles
hs	32.01	23.12	8.89	26.75	19.25	7.50
sc	33.37	24.29	9.08	35.48	25.31	10.17
col	22.51	16.98	5.53	24.17	19.06	5.11
col+	12.12	9.49	2.63	13.6	10.27	3.33

Note: Entries show the fraction of individuals in each educational category, by marital status, constructed under the assumption of a stationary population structure –see text for details.

Table 14: Childbearing: Single Females

	Childless	Early	Late
hs	26.96	60.49	12.55
sc	32.39	53.38	14.23
col	53.75	30.50	15.75
col+	56.17	23.06	20.77

Note: Entries show the distribution of childbearing among single females, using data from the CPS-June supplement. See text for details.

Table 15: Childbearing: Married Couples

Childless					Early				
	Females					Females			
Male	hs	sc	col	col+	male	hs	sc	col	col+
hs	8.98	8.72	14.56	13.18	hs	66.91	60.47	43.85	38.51
sc	9.83	9.53	12.66	13.08	sc	60.23	60.93	41.10	32.37
col	8.58	10.35	11.57	11.24	col	55.99	43.17	32.55	21.36
col+	10.06	9.55	9.45	13.28	col+	51.06	36.36	30.57	15.52

Note: Entries show the distribution of childbearing among married couples. For childlessness, data used is from the U.S. Census. For early childbearing, the data used is from the CPS-June supplement. Values for late childbearing can be obtained residually for each cell. See text for details.

Table 16: Social Security Incomes: Singles

	Males	Females
hs	1	0.885
sc	1.119	0.991
col	1.203	1.004
col+	1.211	1.006

Note: Entries show Social Security incomes, normalized by the mean Social Security income of the lowest type male, using data from the 2008 U.S. Census. See text for details.

Table 17: Social Security Incomes: Married

	Females			
Males	hs	sc	col	col+
hs	1.770	1.878	1.905	1.921
sc	1.876	1.926	1.985	2.124
col	1.994	2.074	2.100	2.192
col+	2.023	2.110	2.172	2.233

Note: Entries show the Social Security income, normalized by the Social Security income of the single lowest type male, using data from the 2008 U.S. Census. See text for details.

Table 18: Labor Force Participation of Married Females, 25-54

	Females			
Males	hs	sc	col	col+
hs	60.3	75.8	83.8	89.0
sc	66.2	75.8	83.5	90.4
col	61.6	68.6	73.0	82.9
col+	53.6	60.6	62.7	76.7
Total	61.8	74.0	74.9	81.9

Note: Each entry shows the labor force participation of married females ages 25 to 54, calculated from the 2008 U.S. Census. The outer row shows the weighted average for a fixed male or female type.

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Figure 1: Average and Marginal Tax Rates, Married Households, 2 Children

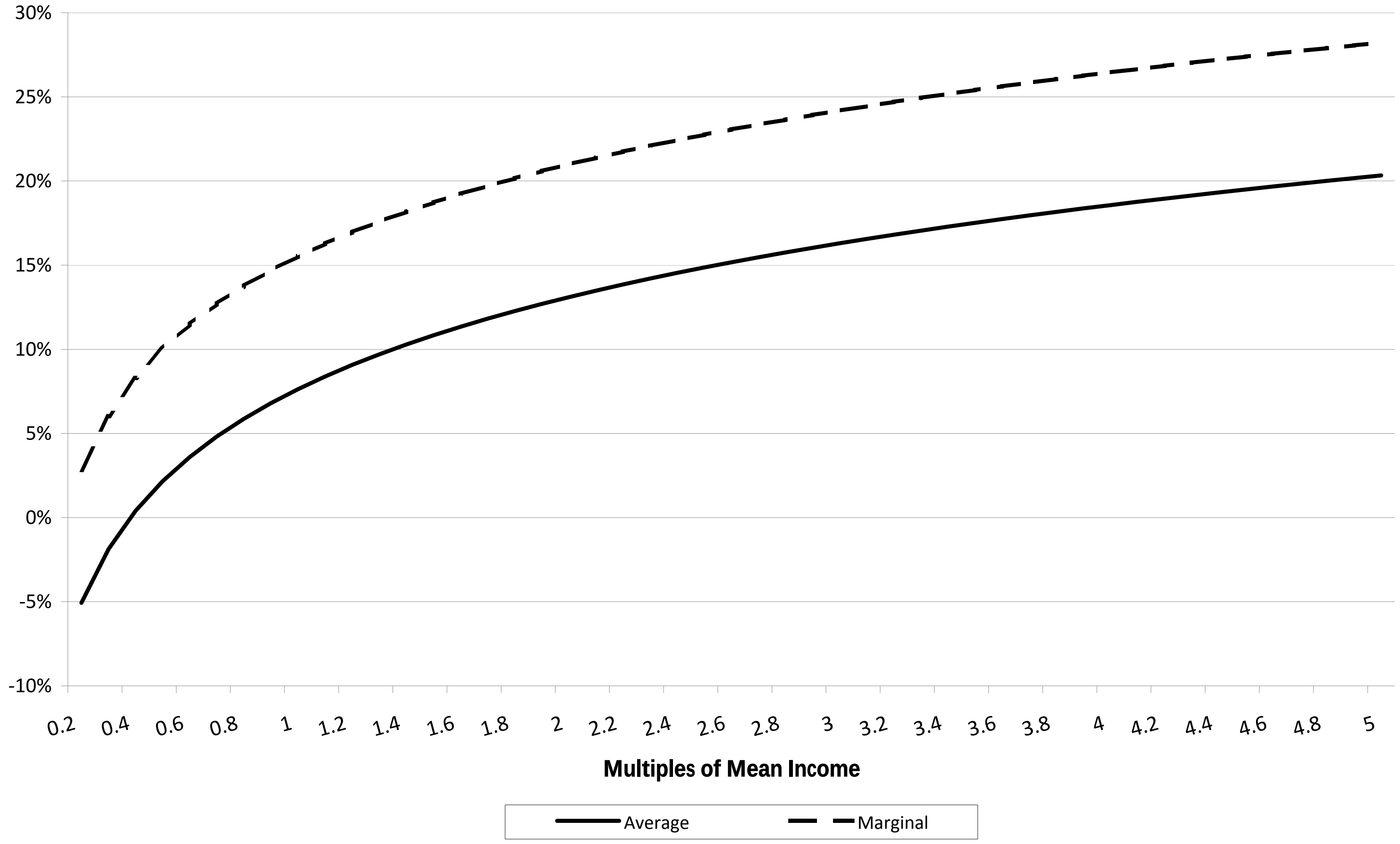

Figure 2: Labor Productivities, Males