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Social Security and Two-Earner Households*

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Abstract

The existing social security system in the U.S. has a special provision for married households: a married person can choose between own benefits and half of the spouse's benefits. Another feature of the system is the progressive calculation of benefits: benefits are determined by a concave function of past mean earnings. I develop an equilibrium life-cycle model to quantify the aggregate, cross-sectional, and welfare implications of three alternative scenarios: elimination of the spousal benefits, elimination of the progressivity of benefits, and the two changes combined. Agents start out as permanently married or single and with education levels and wage profiles, where the latter depend both on education and gender. The household is the decision maker and decides on the labor supply of its member(s) and saving. The aggregate production function has as inputs capital and labor aggregated by efficiency. Eliminating the spousal benefit provision has substantial effects. The labor force participation of married women increases by 4.5% and households composed of men with relatively high education and women with relatively low education experience significant welfare losses. When only the progressivity is eliminated, there is a decline in labor force participation of married females and households composed of men with relatively high education and women with relatively low education experience significant welfare gains. When both are eliminated, the labor force participation of married women increases and households composed of two members with high education gain most.

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1 Introduction

The implications of the U.S. public pension system has been a very active area of research. The existing literature has extensively studied the aggregate consequences of a number of potential changes, and in recent years, has explored the cross-sectional implications of current arrangements. This paper studies the aggregate, cross-sectional and welfare implications of the spousal benefit provision and the progressive nature of social security benefit calculation. In addition, the paper investigates how the spousal benefit interacts with the progressive calculation of benefits.

The social security system in the U.S. treats married and single households asymmetrically via the spousal benefit provision. The current system is a pay-as-you-go system that taxes workers at a flat rate up to a certain level of earnings. The tax rate and the maximum amount of taxable income do not depend on the workers' marital status. However, retirement benefit collections depend on the marital status of individuals. In essence, each worker is entitled to a certain amount of monthly benefit payment, called Primary Insurance Amount (PIA), that is a function of past mean labor earnings. Married households, however, are offered a special option. If the PIA of one spouse in the household is lower than half of the PIA of the other one, then she/he can claim half of her/his spouse's PIA as the spousal benefit instead of claiming her/his own benefit. In this case, the household gets 150 percent of the higher PIA as total benefit payment.[1]

As a result, a spouse who has never participated in the labor market can still earn social security income. Therefore, this rule tends to discourage labor force participation of secondary earners, who are mostly women. Moreover, since the spousal benefit and primary earner's benefit grow at the same rate, the rule is considered to be regressive.[2]

Understanding implications of this particular provision requires a model economy that explicitly deals with labor force participation decisions of wives in different households.

[1] Until recently, the number of retired wives who had the option of choosing between spousal and own benefits was quite low. In 1960 only 2.4% of women beneficiaries were so called dually entitled. The number today is much higher, about 12% (Rix and Williamson (1999)).

[2] In particular, households with two similar but low earnings can be at a disadvantage compared to households with only one earner with high earning. Using detailed earnings histories, Gustman and Steinmeier (2001) calculate that although the basic benefit formula in the current social security system is progressive, its progressivity declines significantly once spousal and survivor benefits are taken into account.

Another feature of the social security system that is important for married households is its progressive structure. The benefit formula is a piecewise-linear concave function of past mean earnings. Hence, the replacement rate for workers with low earnings is higher than the one for workers with high earnings. Furthermore, the degree of progressivity built into the benefit formula affects the number of married households who claim spousal benefits. In particular, for households with one high-wage and one low-wage spouse, the progressive benefit formula results in social security benefits that are more similar than their earnings. This makes the spousal benefit less attractive. As a result, a *less* progressive system is likely to result in more married households getting spousal benefits.

With these considerations in mind, I build and calibrate a general-equilibrium overlapping generations model. Agents start out as married or single and their marital status do not change over the life-cycle. Agents are also born with certain education levels. These education levels together with age determine life-cycle wage profiles. The household is the decision maker, and decides on labor supply of its member(s) and saving. The labor supply decision of a married household is a joint decision, and involves a labor market participation decision for the female. The households with two working members incur fixed utility costs, where the costs differ across households. After retirement, all households face mortality risk. Besides income and capital incomes taxes, workers pay social security taxes, and after retirement, they collect social security benefits. As in the current system, the benefit of a retiree is determined by a piecewise-linear concave function. Total benefit collection of a household depends on its marital type and past mean labor earnings of its members.[3] The calibrated model economy closely resembles features of the 2000 U.S. economy. The model is consistent with observations on gender and wage premia across schooling groups, labor force participation and the structure of marital sorting, under a structure of taxation that resembles the structure currently prevailing in the U.S.

[3] This paper is not the first paper to model the benefit calculation function as in the current system. Kotlikoff, Smetters and Walliser (1998a), Hugget and Ventura (1999), Nishiyama and Smetters (2005) and Fuster, İmrohoroğlu and İmrohoroğlu (2006) are some of the papers that model progressive benefit functions that return benefits as a function of past mean earnings. Kotlikoff, Smetters and Walliser (1998) approximates the function with a sixth order polynomial whereas the others use the piecewise linear function. Since Kotlikoff, Smetters and Walliser (1998a) and Nishiyama and Smetters (2005) use only single-earner households in their models, they scale up benefits in an attempt to capture the spousal benefit.

I consider *three* changes to the current social security rules. In each change I keep the pay-as-you-go character of the social security system, and compare the steady states of benchmark and reformed economies. First, the spousal benefit provision is eliminated. In this economy, regardless of marital status every worker gets what she/he is entitled to as benefit. Second, the progressive benefit function is replaced with a *linear* function. The aim of this change is to investigate implications of the progressive nature of the benefit function in an environment in which the participation decisions of married women is modeled. Finally, the special treatment to married households is eliminated together with replacement of the progressive benefit function by a linear function. The main findings of the paper can be summarized as follows:

- *Eliminating the spousal benefit.* After the change, the married households who claim spousal benefits experience losses in retirement income. The largest response comes from single-earner married households. The wives in these households enter the labor force. As a result, the labor force participation of married females increases by 4.5%. This increase is critical for the change in aggregate labor, as hours worked by males or females do not change much. Most of the increase in married females labor force participation comes from females with low education, especially from the ones who are married to men with high education. These households also increase their savings. Aggregate capital stock increases by about 2.3% and aggregate output increases by 1.25%. Moreover, the results suggest that the spousal benefit provision favors traditional single-earner households (composed of a low-skilled wife and a high-skilled husband), since for these households the reform results in large *welfare losses*.

- *Eliminating the progressivity of the benefit calculation.* This change increases the retirement benefits of workers with high labor earnings and decreases benefits of workers with low labor earnings. Interestingly, number of married households claiming spousal benefits increases by 41% and the participation rate of married women decreases by 1.8%. This is a result of the increase in benefits for men with high education relative to those for women with low education. Therefore, for females in such households, the opportunity cost of participating in the market increases, and they leave the labor force. For these households, the resulting rise in the benefits also lowers their savings.

In aggregate, the capital stock *decreases* by about 0.8% and the output decreases by 0.4%. While with the first change, the traditional households were losers (in terms of welfare), they are the biggest winners with the current reform.

- *Eliminating the spousal benefit together with the progressivity of the benefit calculation.* The final change to the current system that I consider eliminates the spousal benefit in addition to the replacement of the progressive benefit function. Contrary to the second reform the participation rate of married women increases by about 3.5%. As in the first reform, both the capital stock and the output increase. The aggregate capital stock *increases* by 0.8%, while the aggregate output increases by 0.55%. The biggest winners (in terms of welfare) are the married households with two high-wage earning members.

In all three changes, the participation response of the married females is the major component of the changes in labor supply. The first reform shows that the spousal benefits discourage married women from labor market participation. The second and third reforms demonstrate that the spousal benefit plays a critical role in determining implications of removing the progressivity of the benefit calculation. More importantly, these alternatives help us understand the degree of redistribution built into the current system.

Related Literature – This paper is related to two strands of literature. First, it builds on papers that analyze aggregate and cross-sectional implications of various reforms to the current pay-as-you-go social security system. Recent contributors include Auerbach and Kotlikoff (1987), İmrohoroğlu, İmrohoroğlu and Joines (1995), Kotlikoff, Smetters and Walliser (1998a), Huggett and Ventura (1999), Conesa and Kruger (1999), Fuster (1999), Storesletten, Telmer and Yaron (1999), Nishiyama and Smetters (2005), Gustman and Steinmeier (2004), Fuster, İmrohoroğlu and İmrohoroğlu (2006), and Huggett and Parra (2006). Second, it is related to papers that analyze macroeconomic implications of the participation (extensive) margin. Cho and Rogerson (1988), Cho and Cooley (1994), Mulligan (2001) and Chang and Kim (2006), among others, are examples of the papers in this group.

Using a simple structural model, Blau (1997) investigates the effects of the spousal benefit

provision on labor force participation of married women.[4] In order to overcome estimation problems, he assumes away households' saving decisions and labor supply decisions along hours margin, the progressive calculation of benefits and general equilibrium implications of eliminating the provision. The current paper is a first attempt to integrate these features to study the aggregate and cross-sectional implications of the spousal benefit provision.

Rest of the paper is organized as follows. Section 2 details specifics of the model. Section 3 describes the way I calibrate the benchmark economy. Section 4 has a detailed description of the reforms that I study together with my findings. Section 5 concludes.

2 A Life-Cycle Model with Two-Earner Households

In this section I describe the model.

Demographics

The economy is populated by overlapping generations that consists of a continuum of males and a continuum of females. In every period, a new generation of individuals is born. There is no population growth. Agents in this economy live at most J periods. They begin life as workers and after the mandatory retirement age j_R they retire. After retirement agents face mortality risk. In particular, at start of age $j > j_R$ they die with probability ρ_j. Each agent enters economic life as married or single. I assume that a constant fraction ϕ of the newborns are married and the rest is single. Marital status of agents do not change over their life spans. I assume that husbands and wives age together. Hence, they retire and die at same age.

Productive Heterogeneity

Each individual is endowed with one unit of time and supply labor services for j_R periods. Working-age agents differ by their market productivity levels. Market productivity of an agent, $e_i(z, j)$, depends on the agent's skill (education) type z, age j, and gender i. Skill type z takes n possible values, with $z \in Z = \{z_1, z_2, ..., z_n\}$. I assume that each agent is born with a particular skill type and this skill type does not change. I allow, however, market productivity levels differ by gender and age for each skill type. In addition, there is no uncertainty about a worker's future earnings.

[4] See also Gustman and Steinmeier (2004) and Blau (1998) and Blau(1998).

For married households, let z denote skill type of the wife and $\tilde{z}$ denote skill type of the husband. I denote by $M(z, \tilde{z})$ the distribution of married households by skill types of spouses, and by $S_i(z)$ the distribution of single households of gender i, with $i \in \{m, f\}$, by skill type. I assume that these distributions are same at all ages.

Preferences

In this economy agents value consumption and leisure. The momentary utility function for a single person of gender $i \in \{f, m\}$ is given by

$$U_{si}(c, l) = \ln(c) - \theta_i \frac{l^{1+\frac{1}{\gamma}}}{1+\frac{1}{\gamma}}, \tag{1}$$

where c is consumption, l is labor, and parameter γ is the Frisch elasticity of labor supply.

For a married household, momentary utility function is given by

$$U(c, l_m, l_f, q) = 2\ln(c) - \theta_m \frac{l_m^{1+\frac{1}{\gamma}}}{1+\frac{1}{\gamma}} - \theta_f \frac{l_f^{1+\frac{1}{\gamma}}}{1+\frac{1}{\gamma}} - \chi(l_f)q. \tag{2}$$

Here c is again consumption and l_i, $i \in \{m, f\}$, is labor supply. The parameter q stands for per period utility cost of joint-work and $\chi(l_f)$ is an indicator function such that

$$\chi(l_f) = \begin{cases} 1, \text{ if } l_f > 0 \\ \\ 0, \text{ otherwise} \end{cases}. \tag{3}$$

I assume that husbands always work, but wives may stay out of the labor force. Following Cho and Rogerson (1988) I assume that if a wife participates in the labor market then her household incurs a utility cost of $q \in R_+$.[5] The household draws its utility cost from a distribution $\Phi(q|z, \tilde{z})$ upon birth. I assume that q is constant over the household's life-cycle.

Income

For a working-age married household total household income is sum of labor earnings and interest income. Working-age agents participate in a competitive labor market. Let w denote the wage rate per efficiency unit of labor. Households are born with no assets and are not allowed to borrow. They can save in the form of risk-free capital and earn a

[5] The utility cost can be interpreted as utility loss due to inconvinience for scheduling and/or less family time with children.

competitive rental rate r. Upon death, asset holdings of the households are not rebated back to the agents in the economy. I focus on a steady state equilibrium in which w and r are constant over time.

For a married household of age j, if wife works l_f hours and husband works l_m hours, then their labor earnings are $e_f(z,j)l_f w$ and $e_m(\tilde{z},j)l_m w$, respectively. Moreover, if the household's assets are a , then the total pre-tax household income is $e_f(z,j)l_f w + e_m(\tilde{z},j)l_m w + ra$. Similarly, pre-tax income of a single agent of gender i and age j is the sum of labor earnings, $e_i(z,j)l_i w$, and interest income ra.

There is a pay-as-you-go social security system that pays social security benefits to retirees. Therefore, for retired households total household income is sum of benefit payments from the social security system and interest income. The benefit that an agent is entitled to depends on her/his past mean labor earnings. For a retiree of gender $i \in \{f,m\}$ the benefit that she/he can claim is given by $B(\bar{e}_i)$, where $\bar{e}_i$ is her/his past mean labor earnings. Functional form for $B(\bar{e}_i)$ is

$$B(\bar{e}_i) = \begin{cases} \xi_1 \bar{e}_i & \text{if } \bar{e}_i \leq \kappa_1 \\ \xi_1 \kappa_1 + \xi_2(\bar{e}_i - \kappa_1) & \text{if } \kappa_2 \geq \bar{e}_i \geq \kappa_1 \\ \xi_1 \kappa_1 + \xi_2(\kappa_2 - \kappa_1) + \xi_3(\bar{e}_i - \kappa_2) & \text{if } \bar{e}_i \geq \kappa_2 \end{cases} \tag{4}$$

where ξ_1, ξ_2 and ξ_3 are all between 0 and 1. Hence, up to a past earnings level of κ_1 the person is entitled to $\xi_1 \bar{e}_i$, and ξ_1 is simply the replacement rate. If the past earnings is greater than κ_1 but less than κ_2, then she/he is entitled to $\xi_1\kappa_1 + \xi_2(\bar{e}_i - \kappa_1)$, and finally if the past earnings is greater than κ_2, then she/he is entitled to $\xi_1\kappa_1 + \xi_2(\kappa_2 - \kappa_1) + \xi_3(\bar{e}_i - \kappa_2)$. This particular functional form is the one used by the the current social security system.[6]

In accordance with the current law, I assume that $\xi_1 > \xi_2 > \xi_3$. Therefore, the benefit function is progressive. Given that the social security system finances itself, such a system redistributes resources from workers with high past earnings to the ones with low past earnings.

[6] See http://www.ssa.gov/policy/docs/statcomps/supplement/2000/apnd.pdf for details.

For a j-year old worker the law of motion for $\bar{e}_i$ is given by

$$\bar{e}_i' = E(e_i(z,j)l_i w, \bar{e}_i) = \begin{cases} \frac{(j-1)\bar{e}_i + \min\{e_i(z,j)l_i w, E_{\max}\}}{j} & \text{if } j \leq j_R \\ \bar{e}_i & \textit{otherwise} \end{cases}. \tag{5}$$

In this formulation $E_{\max}$ is the maximum level of earnings that is applied to benefit formula.

A single retired household collects social security benefits according to (4). On the other hand, a married household is treated differently. If one of the members' benefit payment is less than half of the other's, then the member with lower benefits can claim half of her/his spouse's benefits instead of his/her own. Hence, each married agent compares his/her benefits with half of his/her spouse's benefits and decide whether to claim spousal benefits. Therefore, the social security payments that the married household receives is given as

$$H(\bar{e}_f, \bar{e}_m) = \max \ \{B(\bar{e}_m) + B(\bar{e}_f), B(\bar{e}_m) + \frac{1}{2}B(\bar{e}_m), B(\bar{e}_f) + \frac{1}{2}B(\bar{e}_f)\}. \tag{6}$$

Taxation

Households pay income tax, social security tax, and capital income tax. Income tax that a household pays depends on the household's taxable income and marital status. The taxable income is sum of labor earnings and interest income. I assume that benefit payments are exempt from income taxes. Income tax schedules for married households is given by $T^M(.)$, whereas $T^S(.)$ denotes the income tax schedule for single households.

Taxable income for social security purposes consists only of labor earnings up to a certain level $E_{\max}$. For earnings below this cap, a worker faces a proportional social security tax rate τ^p. I denote the total social security tax payments schedule by $T^p(.)$.

In this economy interest income is subject to double taxation. Besides income taxes, households pays an additional capital income tax for their interest earnings. I denote this additional proportional tax by τ^k.

Technology

There is a single representative firm in the economy which hires capital and labor. Let K denote the aggregate capital and L denote the aggregate labor in efficiency units. The production technology of the firm is given by

$$Y = K^\alpha L^{1-\alpha}, \tag{7}$$

where $\alpha \in (0,1)$ is the output share of capital. The capital depreciates at a constant rate $\delta \in (0,1)$. The representative firm hires capital and labor to maximize its profits and as a result w and r are given by marginal products.

2.1 Households' Decision Problem

As stated previously, married households differ by their ages j, skills of the members, z and $\tilde{z}$, and cost of joint work q. At the start of each period, the households observe their current asset holdings a and past mean earnings of the male and the female $\bar{e}_m$ and $\bar{e}_f$. I group these state variables as $x = (a, \bar{e}_m, \bar{e}_f)$.

Single households differ by their gender (f or m), their ages (j) and their skills (z). Again prior to any decision making, a single household observes current asset holdings (a) and past mean earnings ($\bar{e}_m$ or $\bar{e}_f$). I group these as $x_{si} = (a, \bar{e}_i)$, $i \in \{m, f\}$. All types of households at age 1 have zero units of asset holdings.

Single Households

Consider the problem of a j-year old single person of gender $i \in \{m, f\}$. Given (z, j, x_{si}), she/he decides on current consumption (c_{si}), labor supply (l_{si}), and next period asset holdings (a'_{si}). I write this problem as

$$V_{si}(z, j, x_{si}) = \max_{a'_{si} \geq 0,\, l_i} U_{si}(c_{si}, l_{si}) + \beta(1 - I(j)\rho_{j+1}) V_{si}(z, j+1, x'_{si}), \tag{8}$$

subject to

$$c_{si} + a'_{si} = e_i(z,j) w l_{si} - T^p(e_i(z,j) w l_{si}) - T^S(e_i(z,j) w l_{si} + ra) + (1+r)a - \tau^k ra + I(j) B(\bar{e}_i), \tag{9}$$

$$x'_{si} = (a'_{si}, E(e_i(z,j) w l_{si}, \bar{e}_i)), \tag{10}$$

$$I(j) = \begin{cases} 0 \text{ if } & j \leq j_R \\ 1 \text{ if } & j_R < j \leq J \end{cases}, \tag{11}$$

$$l_{si} = 0 \text{ if } j_R < j \leq J,\ l_{si} \in [0,1] \text{ if } j \leq j_R, \tag{12}$$

where β is the discount factor. Note that since I focus on steady states, w and r are constant. I assume that agents cannot borrow, i.e., $a'_{si} \geq 0$. Equation (9) states the budget constraint for the household. Consumption and savings of the household must be equal to

the disposable resources of the household at age j. Note that after age j_R, agents are not allowed to work, but they collect social security income. Finally, Equation 10 specifies how the state of next period, x'_{si}, is determined.

Married Households

Consider the problem of a j-year old married household. The household observes the relevant variables, $(z, \tilde{z}, q, j, x)$. Consequently, the household decides on current consumption (c), labor supply of the husband (l_m), labor supply of the wife (l_f), and next period asset holdings $(a\prime)$. The household's joint maximization problem can be written as

$$V(z,\tilde{z},q,j,x) = \max\{ \begin{array}{l} \max\limits_{a'\geq 0,\, l_f,\, l_m} U(c,l_m,l_f,q) + \beta(1-I(j)\rho_{j+1})V(z,\tilde{z},q',j+1,x'), \\ \max\limits_{a'\geq 0,\, l_m} U(c,l_m,0,q) + \beta(1-I(j)\rho_{j+1})V(z,\tilde{z},q',j+1,x')\} \end{array}$$

subject to

$$\begin{aligned} c + a' \;=\; & e_m(\tilde{z},j)wl_m + e_f(z,j)wl_f - T^p(e_m(\tilde{z},j)wl_m) - T^p(e_f(z,j)wl_f) \\ & -T^M(e_m(\tilde{z},j)wl_m + e_f(z,j)wl_f + ra) + (1+r)a - \tau^k ra \\ & +I(j)H(\bar{e}_f,\bar{e}_m), \end{aligned} \tag{13}$$

$$x' = (a', E(e_m(\tilde{z},j)wl_m,\bar{e}_m), E(e_f(z,j)wl_f,\bar{e}_f)), \tag{14}$$

$$I(j) = \begin{cases} 0 \text{ if } j \leq j_R \\ \\ 1 \text{ if } j_R < j \leq J \end{cases}, \tag{15}$$

$$l_m = 0 \text{ if } j_R < j \leq J,\; l_m \in [0,1] \text{ if } j \leq j_R, \tag{16}$$

$$l_f = 0 \text{ if } j_R < j \leq J,\; l_f \in [0,1] \text{ if } j \leq j_R. \tag{17}$$

Next period state of the household, x', is given by equation (14).

2.2 Equilibrium

I am now ready to define a steady state equilibrium for this economy. Given the basic demographic variables, J, j_R, ρ_j, and ϕ; earning profiles, $e_i(z,j)$ $i \in \{m,f\}$; the distribution of households $M(z,\tilde{z})$, $S_m(z)$ and $S_f(z)$; the benefit functions $B(\bar{e})$ and $H(\bar{e}_f,\bar{e}_m)$; the income

tax functions, $T^M(.)$ and $T^S(.)$, a capital income tax rate τ^k, and a government spending G, a steady state equilibrium consists of a set of decision rules $c(z,\tilde{z},q,j)$, $l_i(z,\tilde{z},q,j)$, $a(z,\tilde{z},q,j)$, $c_{si}(z,j)$, $l_{si}(z,j)$, and $a_{si}(z,j)$, aggregate capital stock K, aggregate labor supply L, rental rates for labor and capital w and r, and the social security tax τ^p such that:

1. The set of decision rules $c(z,\tilde{z},q,j)$, $l_i(z,\tilde{z},q,j)$, $a(z,\tilde{z},q,j)$, $c_{si}(z,j)$, $l_{si}(z,j)$, and $a_{si}(z,j)$ solve the dynamic problems of married and single households.

2. Factor markets are competitive, i.e.,

$$w = F_2(K,L) \text{ and } r = F_1(K,L) - \delta.$$

3. Capital and labor markets clear, i.e.,

$$\begin{aligned} K &= \sum_{z,\tilde{z},q,j\leq j_R} \phi M(z,\tilde{z})\Phi(q|z,\tilde{z})a(z,\tilde{z},q,j) + \sum_{z,i,j\leq j_R} \frac{(1-\phi)}{2} S_i(z)a_{si}(z,j) \\ &\quad + \sum_{z,\tilde{z},q,j>j_R} \left(\prod_{k=j_R+1}^{j}(1-\rho_k)\right) \phi M(z,\tilde{z})\Phi(q|z,\tilde{z})a(z,\tilde{z},q,j) \\ &\quad + \sum_{z,i,j>j_R} \left(\prod_{k=j_R+1}^{j}(1-\rho_k)\right) \frac{(1-\phi)}{2} S_i(z)a_{si}(z,j). \end{aligned}$$

   and

$$L = \sum_{z,\tilde{z},q,i,j\leq j_R} \phi M(z,\tilde{z})\Phi(q|z,\tilde{z})e_i(z,j)l_i(z,\tilde{z},q,j) + \sum_{z,i,j\leq j_R} \frac{(1-\phi)}{2} S_i(z)e_i(z,j)l_{si}(z,j).$$

4. Social security budget balances, i.e.,

$$\begin{aligned} & w\tau^p \sum_{z,\tilde{z},q,i,j\leq j_R} \phi M(z,\tilde{z})\Phi(q|z,\tilde{z}) \min(e_i(z,j)l_i(z,\tilde{z},q,j), E_{\max}) \\ & + w\tau^p \sum_{z,i,j\leq j_R} \frac{(1-\phi)}{2} S_i(z) \min(e_i(z,j)l_{si}(z,j), E_{\max}) \\ = & \sum_{z,\tilde{z},q,j>j_R} \left(\prod_{k=j_R+1}^{j}(1-\rho_k)\right) \phi M(z,\tilde{z})\Phi(q|z,\tilde{z})H(\bar{e}_f(z,\tilde{z},q,j), \bar{e}_m(z,\tilde{z},q,j)) \\ & + \sum_{z,i,j>j_R} \left(\prod_{k=j_R+1}^{j}(1-\rho_k)\right) \frac{(1-\phi)}{2} S_i(z)B(\bar{e}_i(z,j)). \end{aligned}$$

5. Government budget balances, i.e.,

$$\begin{aligned} G &= \sum_{z,\tilde{z},q,j\leq j_R} \phi M(z,\tilde{z})\Phi(q|z,\tilde{z})T^M(.) + \sum_{z,i,j\leq j_R} \frac{(1-\phi)}{2} S_i(z)T^S(.) \\ &+ \sum_{z,\tilde{z},q,j>j_R} \left(\prod_{k=j_R+1}^{j} (1-\rho_k) \right) \phi M(z,\tilde{z})\Phi(q|z,\tilde{z})T^M(.) \\ &+ \sum_{z,i,j>j_R} \left(\prod_{k=j_R+1}^{j} (1-\rho_k) \right) \frac{(1-\phi)}{2} S_i(z)T^S(.) + \tau^k rK \end{aligned}$$

3 Parameter Values

In this section I summarize my calibration strategy and discuss parameter values that I use to simulate the model economies.

Demographics

I calibrate my model economy to the U.S. economy in 2000. I use the U.S. Census data unless stated otherwise.[7] Length of a period is set to be 10 years. Age 1 in the model corresponds to all ages between 25 and 34. Agents live at most 6 periods ($J = 6$) and they retire after age 4 ($j_R = 4$). Since all agents die at the end of final period I set probability of death after this period to 1 ($\rho_7 = 1$). For simplicity I assume that probability of death at ages 5 and 6 are the same, i.e., $\rho = \rho_5 = \rho_6$. I set these probability values so that number of retired agents is 20 percent of the entire population ($\rho = 0.382$), as it is the case for the U.S. population 25 years and older. In the data 74 percent of people between ages 25 and 64 are married. Therefore, in my model I use 74 percent as the fraction of married individuals in the population ($\phi = 0.74$).

Skills and Endowments

I choose five skill types corresponding to educational attainments in the population. Table 1 summarizes my classification. I assume that there are 5 skill types. As a result, there are 25 different types of married households by skill types of the members.

In order to calculate the distribution of married and single households across skill types, I consider the population between ages 25 and 64. First, I divide the total population into

[7] Source: Census data tabulated by IPUMS-USA, Minnesota Population Center, University of Minnesota (www.ipums.org).

Table 1: Classification of Skill Types

Skill Type	Educational Attainment
<hs	less than high school degree
hs	high school diploma
sc	less than 4 years of college education
col	college degree
col+	post college education

two groups according to marital status. Next, I divide these groups according to skill types of the households. Using the number of observations for each subgroup, I construct the distributions of households by skill types, $M(z, \tilde{z})$, $S_m(z)$ and $S_f(z)$ in the model (see Tables 2 and 3). From Table 2, I observe the well known fact about assortative mating. Married households are concentrated along the diagonal of the table, i.e., spouses in most households have similar educational attainment levels.[8]

Table 2: Distribution of Married Households by Skill Types

	Female					
Male	<hs	hs	sc	col	col+	Total
<hs	0.0676	0.0424	0.0232	0.0039	0.0018	0.1389
hs	0.0316	0.1350	0.0728	0.0184	0.0068	0.2646
sc	0.0174	0.0745	0.1351	0.0432	0.0155	0.2858
col	0.0039	0.0236	0.0576	0.0758	0.0261	0.1870
col+	0.0016	0.0089	0.0262	0.0442	0.0427	0.1236
Total	0.1222	0.2845	0.3150	0.1855	0.0928	1.0

Table 3: Distribution of Single Households by Skill Types

	Males	Females
<hs	0.1581	0.1754
hs	0.2696	0.2646
sc	0.2985	0.3185
col	0.1823	0.1488
col+	0.0915	0.0927

[8] The level of marital sorting by education has been quite high and constant from 1940 until 1980s, but increased since then. See Mare and Schwartz (2005) for changes in assortative mating by education from 1940 to 2003.

Next, I determine the market productivity levels for each skill type. I consider again individuals who are older than 25 and younger than 64. I divide the sample into 40 subgroups by age, gender and skill type of individuals, respectively. In order to construct market productivity profiles I first calculate mean hourly wages by dividing total wage and salary income by total hours worked.[9] Then, I normalize these mean wages with the mean hourly wage for the whole sample to find relative market productivity levels**.** Table 4 reports these productivity values.

Two features of this table are worth noting. First, as documented in Olivetti (2006), age-earning profiles for females are flatter than the ones for males. Second, as Eckstein and Nagypál (2004) document there is a significant difference between earnings of people with post-college education and college graduates, and post-college premium is relatively significant. Given these facts and the fact that the fraction of people with post college degree is quite high, around 0.10, it is important to treat this group separately.

Table 4: Productivity Values by Types, by Gender

	Males					Females				
	Skill					Skill				
Age	<hs	hs	sc	col	col+	<hs	hs	sc	col	col+
1	0.662	0.747	0.833	1.132	1.340	0.559	0.611	0.703	0.946	1.119
2	0.765	0.887	1.056	1.579	1.887	0.603	0.672	0.816	1.166	1.433
3	0.833	0.982	1.168	1.689	2.033	0.640	0.722	0.867	1.145	1.418
4	0.914	1.070	1.296	1.867	2.226	0.695	0.744	0.893	1.188	1.441

Production Technology

There are 2 parameters to be determined on the production side of the model. I set the capital share α to be 0.317. In the absence of population growth and growth in labor efficiency, I set the depreciation rate δ so that annual rate is 0.07 (see Table 5). These values are consistent with a notion of capital that excludes residential capital consumer durables and government owned capital for the period 1960-2000. The corresponding notion of output is then GDP accounted for by the business sector. Altogether, this implies an annual capital

[9] Hours worked per week and number of weeks worked last year are the two variables that are available in the Census data. I use these to find total hours worked. I exclude self-employed people and people who are not working from the sample.

to output ratio of about 2.325.[10]

Table 5: Parameter Values

γ	0.5
β	0.818 ($\beta^{0.1}\tilde{=}0.98$)
θ_m	13
θ_f	16.9
α	0.317
δ	0.516
ρ	0.382
ϕ	0.74
κ_1	0.112 of mean income
κ_2	0.673 of mean income
$E_{\max}$	1.33 of mean income
ξ_1	0.90
ξ_2	0.32
ξ_3	0.15
τ^p	0.11
τ^k	0.161

Preference Parameters

There are four preference parameters: θ_m, θ_f, γ and β. I calibrate these parameters to match four data targets. I choose the values for θ_m and θ_f so that benchmark values of hours per worker by males and females match the ones observed in the data. In the data males spend about 0.451 of their available non-sleeping time in the market while the same number is 0.362 for females.[11] Values of θ_m and θ_f I use in the benchmark model are reported in Table 5.

Other preference variable γ is the Frisch elasticity of labor supply. I choose γ so that it is within the range of its estimates in the literature (see Table 5). For married women Blundell & MaCurdy (1999) reports a range from 0.5 to 1, for males MaCurdy (1981) finds a range from 0.10 to 0.40 and Altonji (1986) finds a range from 0 to 0.35.

Finally, I choose the remaining preference parameter, the discount factor β, so that the

[10] See Guner, Ventura and Yi (2006) for details.

[11] For these statistics the sample is the group of people who are between 25 and 64. First I find yearly total hours by each individual and then divide these by 5000 to find labor hours per unit of time. I assume that 5000 hours is the total amount of time available for work and leisure.

steady-state capital to output ratio matches the value in the data consistent with the choice of the technology parameters (2.325).

Female Labor Force Participation

An important element of the model is the participation decision of females. The distribution of utility cost, $\Phi(q|z,\tilde{z})$, determines the labor force participation rate of females. Since this distribution depends on skill types of members of married households, I have to specify 25 distribution functions. I assume that all of these distributions are exponential, and denoted by

$$\Phi(q|z,\tilde{z}) = 1 - e^{-\frac{q}{\bar{q}(z,\tilde{z})}}.$$

This distribution is specified by its single parameter $\bar{q}(z,\tilde{z})$, which is the mean. For any type $(z,\tilde{z})$ married households, $\bar{q}(z,\tilde{z})$ determines the labor force participation rate of married females. This allows me to choose this parameter to match the labor force participation rate for the corresponding group in the data. The sample I consider is a group of married females older than 25 and younger than 64. First, I group these married females according to skill types of the members of the households that they belong to. Next, for each group I find employment to population ratio. Table 6 shows the participation rates of married females by types of households for 2000 US economy. By setting 25 mean utility costs I match participation rates by types of married households. Table 6 also reports the participation rates for the benchmark economy and Table 7 shows the values of mean utility cost values, $\bar{q}(z,\tilde{z})$, used in the benchmark economy.

Table 6: Labor Force Participation of Married Women, (%)

	Data					Benchmark				
	Female					Female				
Male	<hs	hs	sc	col	col+	<hs	hs	sc	col	col+
<hs	38.15	57.65	67.05	73.76	68.15	38.28	57.40	66.74	73.06	67.44
hs	44.25	61.60	72.06	77.77	80.12	44.00	61.63	71.70	77.90	79.80
sc	45.32	61.45	69.56	77.70	83.10	45.17	60.98	69.58	77.55	82.87
col	44.22	57.71	63.21	68.85	79.87	44.45	57.45	62.87	68.82	79.49
col+	40.86	50.68	57.02	60.64	75.28	41.16	50.28	57.34	60.35	76.27

Table 7: Mean Utility Cost Values

	Female				
Male	<hs	hs	sc	col	col+
<hs	1.19	0.73	0.67	0.77	1.01
hs	0.81	0.55	0.5	0.56	0.64
sc	0.65	0.47	0.45	0.5	0.49
col	0.42	0.32	0.35	0.45	0.39
col+	0.35	0.3	0.31	0.44	0.36

Social Security System

One feature of the equilibrium in the environment is that social security budget balances at all times. The current social security law determines both social security tax rate and benefit levels. However, I cannot use both of them in my model, since social security budget would not balance for obvious reasons. Therefore, I have to take either tax side or benefit side from the law. Since I consider reforms that change the way benefits are calculated, I take the benefit function from the law and let the social security tax rate adjust so that budget balances.

Benefit function has 5 parameters to be determined. According to the 2000 social security rules, ξ_1 is 0.90, ξ_2 is 0.32 and ξ_3 is 0.15. Besides, bend points in the benefit function in the current law, κ_1 and κ_2, are \$531 and \$3202.[12] These are applied to average indexed monthly earnings. In order to be consistent with the law, I multiply these bend points (\$531 and \$3202) with 12 to arrive at a yearly figure and then normalize them with mean household income for 2000.[13] For benchmark calculations, I multiply these normalized numbers with mean household income in the benchmark model to determine the bend points. The values of κ_1 and κ_2 that I use in the benchmark model are reported in Table 5.

Maximum taxable labor earnings for social security purposes in 2000 is \$76,200. In order to be consistent with previous calibration strategy I normalize this cap with mean household income for 2000. Again, I use mean household income that comes out of the model and determine income cap $E_{\max}$ in the model (see Table 5).

[12] See http://www.ssa.gov/policy/docs/statcomps/supplement/2000/apnd.pdf for details.

[13] Mean household income for 2000 is \$57,135 (from Census).

Income Tax and Capital Income Tax

In the U.S. tax law statutory tax rates are applied to taxable incomes of households. In order to be able to capture the way actual tax payments are linked to households incomes, I don't use statutory tax rates but estimate effective tax functions for married and single households for their reported income. I follow the procedure described in Kaygusuz (2006). I use income tax data for 2000 tabulated by Internal Revenue Service.[14] Total income tax paid, total income, total number of returns and total number of taxable returns are available for certain income brackets. Using this data I find the average tax rate within each income bracket with following formula

$$average\ tax\ rate = \frac{\left\{\frac{\text{total income tax paid}}{\text{number of taxable returns}}\right\}}{\left\{\frac{\text{total income}}{\text{number of returns}}\right\}}. \tag{18}$$

I also normalize average incomes with mean household income for each bracket. Then, I estimate the relation between these normalized income levels and average tax rates. This procedure is similar to the one in Gouveia and Strauss (1994). In particular, I estimate the following tax functions for married and single households:

$$T^M(income) = [0.1023 + 0.0733 \log(income)]income,$$

and

$$T^S(income) = [0.1547 + 0.0497 \log(income)]income.$$

I use these income tax functions in all of the model economies. Marginal tax rates derived from these tax functions are shown in Figure 1.

Finally, I estimate the capital income tax rate to proxy the corporate income tax. Between 1987 and 2000, corporate income tax revenue was approximately 1.92 percent of GDP. Given my assumption about the production technology, I should have a 16.1 percent capital income tax to replicate this share. Hence, I set τ^k as 0.161.

4 Reforms

In this section I specify the tax reforms that I study in this paper. I focus on two aspects the current social system. First aspect is the spousal benefit. In the current system, a

[14] Source: Statistics of income division, *Individual Income Tax Returns* bulletin for 2000. Publication number :1304.

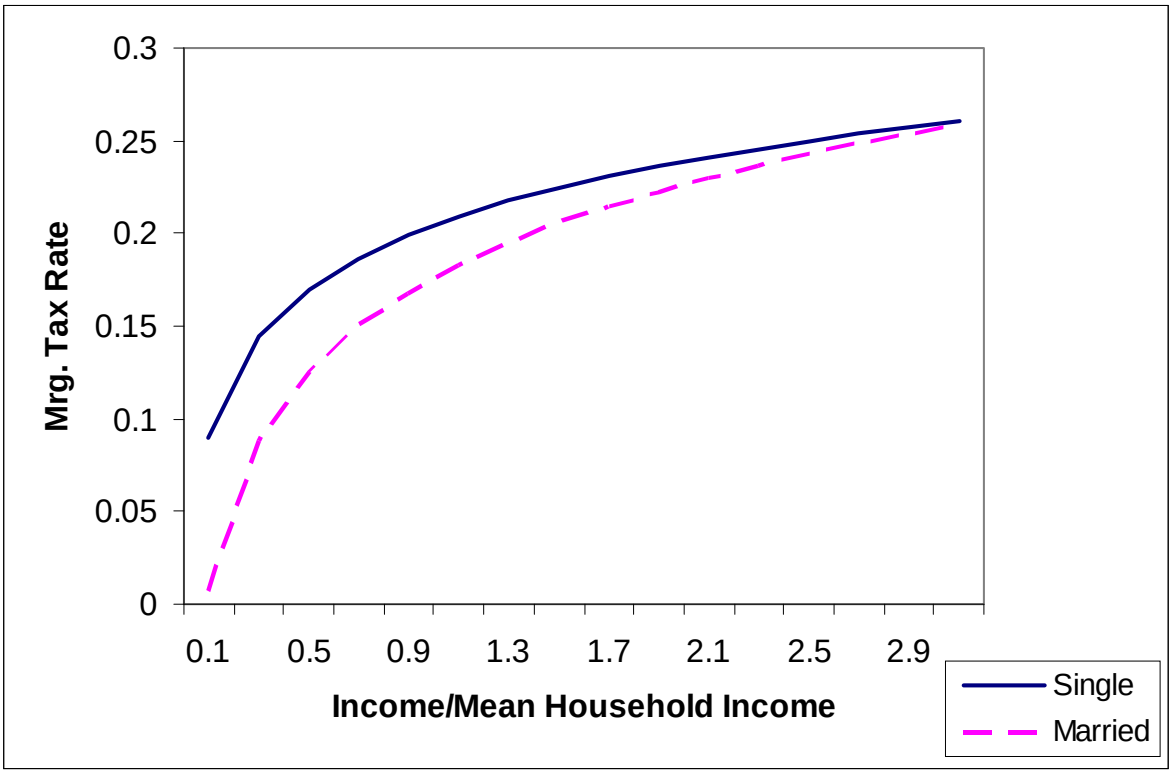

Figure 1: Marginal Tax Functions

spouse with lower benefits can claim half of his/her spouse's benefits instead of his/her own. It is obvious that this rule discourages women from labor market participation as non-participating married women can claim spousal benefits. Indeed, when the spousal benefit provision was added to social security law in 1939, one of the explicit aims was to encourage traditional bread winner-home maker households.[15] Another feature of this provision is that since the spousal benefit grow with primary earners benefits, it provides more benefits to rich single-earner households. In particular, households with two similar but low earnings are in a clear disadvantage compared to households with one high earnings member.[16]

A second aspect of the current system that I consider is the shape of the benefit formula.

[15] See Carlson (2005) for development of 1939 amendments to social security system. One person testifying before Congress reported: "The mother's services are worth more in the home than they are in the outside labor market and ... she should be enabled to stay home and care for the children."

[16] See Nicolaou and Stanfield (2000).

As I explain in Section 2, the benefit function is a piecewise-linear concave function. As a result, it redistributes resources from retired workers with high labor earnings to the ones with low labor earnings. Due to gender gap and differences in skills, females in most married households have lower earnings than their husbands. However, due to the progressive nature of the benefit calculation, differences in benefit entitlements are smaller than differences in earnings. As the calculation gets less progressive, the gap between entitlements approaches to the gap between earnings. Therefore, a less progressive system is likely to result in more married households qualifying for the spousal benefit.

In order to gain insight about how the current system works for different types of households, I study long-run implications of three hypothetical reforms. In Reform 1, I simply remove the spousal benefit option given to married households regarding benefit collection. In Reform 2, I replace progressive calculation of benefits with a flat replacement function. Finally, in Reform 3 I remove the spousal benefit and replace the progressive benefit function with a flat replacement function at the same time.[17] Note that none of these hypothetical reforms change the pay-as-you-go feature of the social security system.

With Reform 1 a married household's social security benefits are given by

$$H(\bar{e}_f, \bar{e}_m) = B(\bar{e}_m) + B(\bar{e}_f).$$

Hence, the total benefit that a married household receives becomes sum of the benefits that each member of the household is entitled to. In order to balance social security budget I adjust social security tax rate (τ^p).

This reform should affect the married households who take advantage of spousal benefit option. The total benefits of these households will decrease and they will respond in a way to compensate for their losses. Such households consist of all single-earner households and some of two-earner ones. Recall that the two-earner households also can take advantage of the option if one of the earners' past earnings is considerably lower than the other one. Table 8 shows the fraction of married households who claim spousal benefits according to types for the benchmark economy. This table gives us an idea about which types of households

[17] All of these reforms will possibly change labor supply and saving behavior of households. As a result sum of revenues from income tax and capital income tax might change. To keep the tax revenue from these sources unchanged, I introduce a flat tax on income.

will be affected most after the reform.

Table 8: Fraction of Married Households Who Claim Spousal Benefits, Benchmark

	Female				
Male	<hs	hs	sc	col	col+
<hs	0.61	0.39	0.26	0.09	0.11
hs	0.64	0.49	0.24	0.14	0.05
sc	0.69	0.54	0.37	0.14	0.08
col	1.00	1.00	0.53	0.36	0.13
col+	1.00	1.00	1.00	0.47	0.29

In Reform 2 I change the way the benefits are calculated while spousal benefit rule is kept intact. The benefit formula in the benchmark economy is given by

$$B(\bar{e}_i) = \begin{cases} 0.90\bar{e}_i & \text{if } \bar{e}_i \leq 0.0261 \\ 0.90(0.0261) + 0.32(\bar{e}_i - 0.0261) & \text{if } 0.1565 \geq \bar{e}_i \geq 0.0261 \\ 0.90(0.0261) + 0.32(0.131) + 0.15(\bar{e}_i - 0.1565) & \text{if } \bar{e}_i \geq 0.1565 \end{cases} .$$

Figure 2 shows this function**.** I replace this function with a linear function so that I remove progressivity of the benefit function. The new function, also shown in Figure 2, that I use in Reform 2 is

$$B(\bar{e}_i) = \vartheta \bar{e}_i.$$

In this experiment I keep the social security tax rate in the benchmark economy unchanged and choose ϑ so that social security budget balances.

As one can see from the figure, Reform 2 should penalize workers with low labor earnings and make workers with high labor earnings better off. Benefit collections of the retired workers with high labor earnings should increase and benefit collections of the retired workers with low labor earnings should decrease. In the benchmark economy most of the agents with low earnings are females whereas most of the agents with high earnings are males. As a result, for some married households ratio of wife's benefit entitlement to husband's benefit entitlement decreases. Hence, we should expect to see more married households claiming spousal benefits.

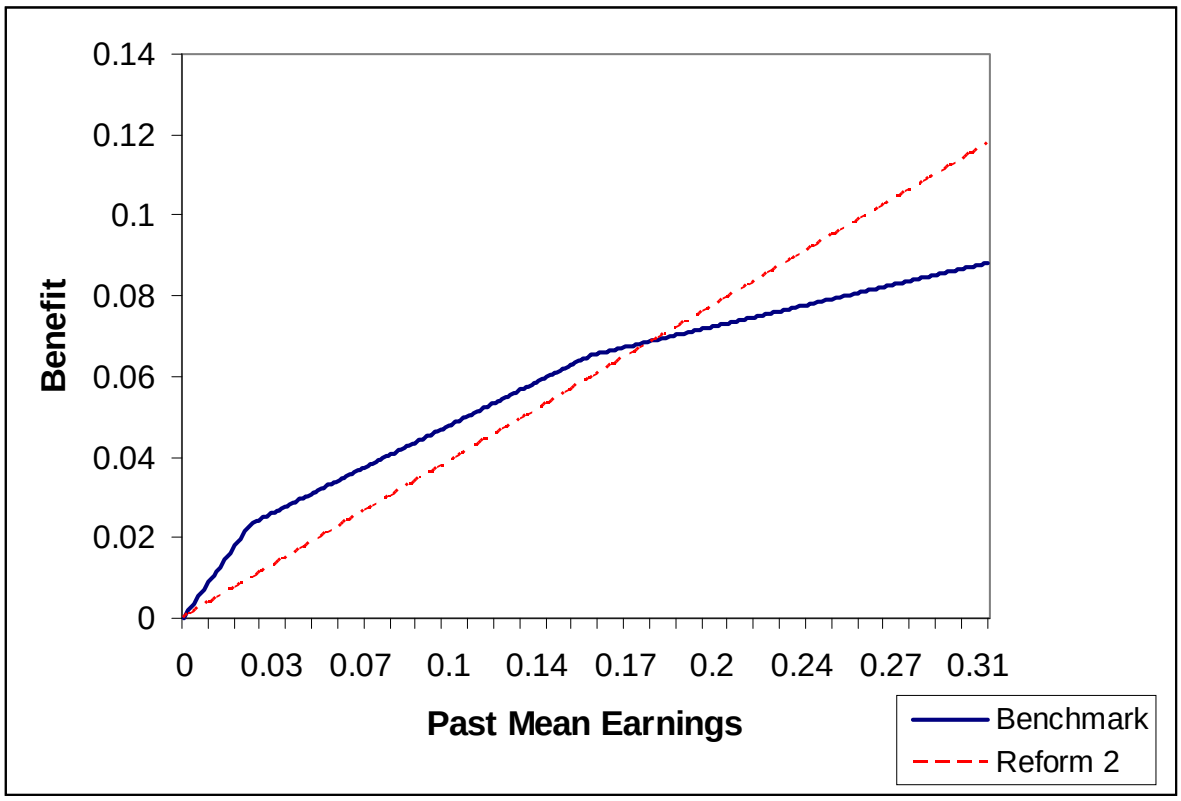

Figure 2: Benefit Formulas

The third reform removes the progressivity of the benefit function together with the spousal benefit. I keep the social security tax rate unchanged and choose the parameter of the new benefit function, ϑ, so that the social security budget balances. Similar to Reform 1, the households claiming the spousal benefits should experience losses in social security benefits. In addition, as in Reform 2 benefit collections of the retired workers with high labor earnings should increase and benefit collections of the retired workers with low labor earnings should decrease. Contrary to Reform 2, there won't be any married households claiming spousal benefits. Outcomes of Reform 2 and 3 should show us how the progressive nature of the benefit function in the current system interacts with the spousal benefit. Moreover, we should see the importance of modelling the participation decisions for married females when studying implications of a widely discussed feature of the social security, i.e. the progressivity of benefit calculation.

4.1 Reform 1: Eliminating the Spousal Benefit

Aggregate effects of Reform 1 are shown in Table 9. The results show that current social security rules encourage married women to stay out of the labor force. When I remove the spousal benefit, labor force participation rate of married women increases by 4.54 percent (about 2.9 percentage points). At the same time, aggregate capital stock increases by 2.29 percent, aggregate labor in efficiency units increases by 0.99 percent and aggregate output increases by 1.25 percent. There are no significant changes in hours per working males and females. Note that the social security tax rate declines from 11 percent to 10.3 percent.

Table 9: Aggregate Effects, Reform 1

	Data	Benchmark	Reform 1	% change
Aggregate Hours	-	100.00	100.99	0.99
Hours per Worker (males)	0.451	0.453	0.4526	-0.09
Hours per Worker (females)	0.36	0.3559	0.3557	-0.06
LFP of married women	63.71	63.62	66.51	4.54
Y	-	100.00	101.25	1.25
K	-	100.00	102.29	2.29
L	-	100.00	100.77	0.77
w	-	100.00	100.48	0.48
Spousal Benefits (%) (recipients among married h.h.)	-	43.97	0	-
τ^p	-	0.11	0.103	-

Note: Table 9 reports the values of the aggregate variables in the data, in the benchmark economy and after Reform 1. Last column shows percentage changes after the reform. Reform 1 eliminates the spousal benefits paid to married households.

Now I report more detailed results in Table 10. Panel A shows the percentage change in benefit collections by married households. All household types shown in this table lose benefit collections, however, the losses vary systematically. As the female's skill type decreases and the male's skill type increases, the loss in benefit collections of the household increases. In particular, households with husbands with at least a college degree and wives with at most a high school degree experience the most significant losses. This finding is well in line with what Table 8 suggests. Note that there are losers from all types of households. This is not unexpected, since among all types of married households there are single-earner

families who lose after the reform, although the fraction of these are low among higher skilled households.

Table 10: Cross Sectional Effects, Married Households, Reform 1

Panel A
% Change in Social Security Benefits

	Female				
Male	<hs	hs	sc	col	col+
<hs	-17.01	-9.44	-4.18	-2.16	-2.89
hs	-15.96	-8.53	-3.69	-1.65	-1.14
sc	-16.04	-12.24	-5.43	-1.94	-0.54
col	-19.10	-13.08	-9.60	-5.66	-1.27
col+	-20.60	-17.88	-12.30	-8.68	-3.58

Panel B
% Change in LFP

	Female				
Male	<hs	hs	sc	col	col+
<hs	5.21	4.16	2.58	0.48	3.58
hs	7.79	4.39	2.52	2.10	0.84
sc	7.93	6.10	4.16	1.66	1.78
col	10.44	9.86	8.20	3.54	3.76
col+	12.57	10.76	10.66	5.52	2.55

Panel C
% Change in Assets After Retirement

	Female				
Male	<hs	hs	sc	col	col+
<hs	17.16	9.33	4.10	-0.78	4.87
hs	16.06	8.89	5.27	2.30	1.87
sc	14.26	9.42	4.99	2.74	11.08
col	18.07	11.39	8.22	3.93	-1.48
col+	16.40	14.13	10.78	6.99	1.59

Panel D
% Change In Welfare

	Female				
Male	<hs	hs	sc	col	col+
<hs	-0.81	0.41	1.14	1.53	1.25
hs	-0.39	0.62	1.34	1.64	1.67
sc	-0.18	0.64	1.17	1.68	1.86
col	-0.31	0.45	0.86	1.33	1.87
col+	-0.29	0.02	0.54	1.06	1.78

Note: Panels in Table 10 report cross sectional implications of eliminating the spousal benefits. All numbers shown in these panels are percentage changes relative to the benchmark economy. See Table 1 for definitions of <hs, hs, sc, col and col+.

Panel B reports the percentage change in labor force participation of married women by skill types of married households. The responses of households follow the general pattern in Panel A. This table shows the way the spousal benefit discourages married women from market participation. After the loss of the spousal benefit, opportunity cost of staying at home increases for the females. Hence, some of them start working. The opportunity cost is higher for females who are married to high skilled men because the spousal benefit increases with skill of the spouse. Therefore we observe a larger response as the woman is less skilled relative to the husband. Note that the increase in labor supply of these females

does not contribute much to the aggregate output (see Table 9) since they mostly have low market productivity.

Next, I report how the asset holdings of married households at the time of retirement change after the reform. Like female LFP, savings is another margin in which households who are affected negatively by this reform can try to improve their incomes after retirement. Indeed, as shown in Panel C households increase their savings in order to compensate for their losses in their retirement incomes. This, together with a lower social security tax rate, is an important contributor to the increase in the aggregate capital stock after this reform. Once again, the group of households who respond to the reform most in terms of labor supply increase their asset holdings more than the other households.

Finally, Panel D reports the percentage change in welfare of households from initial steady state to final steady state after the reform. The numbers in this table show the percentage increase/decrease in consumption that is needed to make a household living in the benchmark economy as well off as in the economy after the reform.[18] As this table shows there are losers and winners after the reform. The households who were taking the advantage of the spousal benefit the most are the biggest losers, while all households with skilled (college or more) wives gain. The reason why there are winners is that there is a decline in the social security tax rate and a rise in the wage rate. Welfare gains are larger for the groups of households in which the female labor force participation is higher (see Table 6).

4.2 Reform 2: Removing the Progressivity of the Benefit Calculation

Reform 2 replaces the progressive benefit calculation formula with

$$B(\bar{e}_i) = 0.38\bar{e}_i,$$

where $\vartheta = 0.38$ balances the social security budget. An immediate implication of this reform is that workers with past mean earnings lower than some threshold level lose from

[18] The welfare analysis carried out in this paper does not take transition across steady states into account. Hence, these values are imperfect measures of the actual changes in welfare. However, aggregate capital does not change much. Therefore, these numbers are close approximates of the numbers if I had also considered the transition across steady states.

retirement income, whereas the others get more retirement income. Hence, retirement income is redistributed back from workers with low earnings to workers with high earnings. Note that this reform does not change spousal benefit rule.

I first report the aggregate implications of the reform. Table 11 shows the percentage changes in the aggregate variables. Aggregate output of the economy decreases by 0.41 percent, aggregate capital decreases by 0.84, whereas the aggregate labor in efficiency units decreases by 0.23 percent. The labor force participation rate of married women decreases by 1.78 percent. In addition, hours per worker for males and females slightly increase. Decline in aggregate output and decline in participation of married women are two striking statistics from this table.

Table 11: Aggregate Effects, Reform 2

	Benchmark	Reform 2	% change
Aggregate Hours	100.00	99.77	-0.23
Hours per Worker (males)	0.453	0.4537	0.15
Hours per Worker (females)	0.3559	0.3568	0.25
LFP of married women	63.62	62.49	-1.78
Y	100.00	99.59	-0.41
K	100.00	99.16	-0.84
L	100.00	99.78	-0.22
w	100.00	99.80	-0.20
Spousal Benefits (%) (recipients among married h.h.)	43.97	61.88	40.72
τ^p	0.11	0.11	-

Note: Table 11.reports values of the aggregate variables before and after Reform 2. Last column reports percentage changes of these variables. Note that Reform 2 replaces the progressive benefit function with a linear benefit function.

Why does LFP of married women decline after this reform? Panel A in Table 12 shows the percentage change in benefit collections of married households by skill types. The key observation is that the male's skill level is critical. For households with husbands who have a college degree or more, the benefit collections increase significantly. For almost all other types of married households benefit collections decrease. The decrease experienced by (<hs,<hs) married households and the increase experienced by (col+,col+) households are expected. The former type of households have two low earning members whereas the latter

have two high earning members. What is striking in this table is the increase experienced in benefits by households with low skilled (<hs, hs or sc) wives and high skilled husbands (col or col+). For such households, benefit entitlements of females decrease because they have low earnings and benefit entitlements of males increase because they have high earnings. Recall that in the benchmark economy most of these households collect spousal benefits (see Table 8). Hence, after the reform the spousal benefits increases for these households simply because spousal benefits are determined by the husbands' benefits. As a result, total benefits of these households increase at the rate of the husbands' benefits.

Table 12: Cross Sectional Effects, Married Households, Reform 2

Panel A
% Change in Social Security Benefits

	Female				
Male	<hs	hs	sc	col	col+
<hs	-13.81	-15.80	-15.15	-14.60	-9.27
hs	-8.59	-12.61	-14.16	-12.53	-7.25
sc	-1.16	-1.35	-5.83	-7.97	-1.93
col	27.74	25.71	24.56	13.73	11.27
col+	33.40	33.40	33.40	27.95	20.51

Panel B
% Change in LFP

	Female				
Male	<hs	hs	sc	col	col+
<hs	-2.06	-1.35	0.90	0.75	4.07
hs	-3.34	-2.06	-0.14	0.48	-0.16
sc	-2.42	-3.57	-1.66	-0.34	1.99
col	-2.42	-1.86	-3.40	-2.60	0.18
col+	-1.07	-0.77	-0.81	-4.05	-3.61

Panel C
% Change in Assets After Retirement

	Female				
Male	<hs	hs	sc	col	col+
<hs	12.86	15.12	14.06	11.85	6.13
hs	13.95	14.19	15.39	10.56	6.01
sc	16.81	9.76	13.18	12.64	15.69
col	-23.75	-21.24	-16.03	-13.85	-10.70
col+	-24.48	-23.85	-23.13	-18.97	-16.67

Panel D
% Change In Welfare

	Female				
Male	<hs	hs	sc	col	col+
<hs	-1.95	-2.04	-1.97	-1.83	-1.31
hs	-1.32	-1.61	-1.69	-1.54	-0.91
sc	0.08	-0.38	-0.80	-0.98	-0.67
col	3.34	2.98	2.77	1.63	1.19
col+	3.64	3.60	3.53	2.99	2.25

Note: Panels in Table 12 report cross sectional implications of replacing the progressive benefit function with a linear one. All numbers shown in these panels are percentage changes relative to benchmark economy. See Table 1 for definitions of <hs, hs, sc, col and col+.

Next, in Panel B, I report the percentage change in labor force participation of married

women by types of married households. Females who are married to college graduate or post college graduate males drop out of the labor force. Among the rest, some enter the labor force and some exit the labor force. What drives the women out of the labor force is the increase in benefit collections of their husbands. Fraction of married households claiming spousal benefits increases by 40.72 percent (see Table 11). By comparing Tables 8 and 13 one can observe the types of households who begin to collect spousal benefits after the reform. As the benefit collections of the males increase, more women claim half of the benefit collections of their spouses instead of working themselves. Not surprisingly, the decline in labor force participation increases as the females' skill decreases.

Table 13: Fraction of Married Households Who Claim Spousal Benefits, Reform 2 Economy

	Female				
Male	<hs	hs	sc	col	col+
<hs	0.73	0.58	0.38	0.18	0.25
hs	1.00	0.54	0.36	0.15	0.11
sc	1.00	1.00	0.50	0.29	0.08
col	1.00	1.00	1.00	0.48	0.26
col+	1.00	1.00	1.00	1.00	0.44

Next, I report the percentage change in asset holdings of the married households right after retirement. Panel C reports these numbers for different types of married households. The households who lose retirement income after the reform try to compensate for their losses by saving more whereas the ones that gain retirement income reduce their savings.

Finally, Panel D reports the welfare implications of Reform 2 by types. Once again, male's skill type is the vital determinant of the changes in welfare. The losses range from 2.04 percent to 0.38 percent whereas the gains range from 3.64 percent to 0.08 percent. The biggest winners are the households who have high skilled males and collect spousal benefits in the benchmark economy. Although the progressivity is expected to work more in favor of top earning households (col+,col+), due to spousal benefit rule the households who were single-earners or become single-earners enjoy the biggest gains.

In summary, removing the progressivity of the benefit function in the current social security system has significant implications. As expected high income households gain from this reform. However, some mid-income earning married households gain from the reform

disproportionately. In particular households who gain most from these reports are the ones with a high skilled husband and low skilled wife. In these households wives leave the labor force and claim spousal benefits since with a flat benefit rule, they become much more attractive. Interestingly, these are exactly the households Reform 1 affecting most negatively in terms of labor. Therefore, next I consider a combination of these two reforms.

4.3 Reform 3: Eliminating the Spousal Benefit and Removing the Progressivity of the Benefit Calculation

In the new economy (after reform) the benefit function is a linear one and there is no spousal benefit payments. I take the social security tax rate from benchmark economy ($\tau^p = 0.11$). The benefit function is now given by

$$B(\bar{e}_i) = 0.42\bar{e}_i,$$

where once more $\vartheta = 0.42$ balances the social security budget. Note that social security system in this economy is more generous than Reform 2 since spousal benefits are now eliminated.

Table 14 shows the percentage changes of the aggregate variables. Labor force participation of married women increases by 3.49 percent. The hours of male workers and the hours of female workers slightly decrease. At the same time aggregate capital increases by 0.77 percent. As a result, the aggregate output increases by 0.55 percent.

I begin with discussing the impact of the reform on benefit collections of married households (Panel A, Table 15). Households with low earning members lose benefits and the ones with high earning members gain benefits. There are some important differences between implications of this reform and Reform 2. Low types of households lose even more and high types of households win more. Moreover, a comparison between Tables 12 and 15 shows that the effects on households with high skilled husbands (col or col+) and low skilled wives (<hs, hs or sc) are now much less significant. In contrast to Reform 2, wives in these households are not allowed to enjoy half of their spouses' benefits. Even though the replacement is larger, the very low types (<hs,<hs) lose more because a big fraction of them collect spousal benefits in Reform 2 economy (see Table13). On the other hand, the

Table 14: Aggregate Effects, Reform 3

	Benchmark	Reform 3	% change
Aggregate Hours	100.00	100.68	0.68
Hours per Worker– Males	0.453	0.4524	-0.13
Hours per Worker– Females	0.3559	0.3554	-0.14
LFP of married women	63.62	65.84	3.49
Y	100.00	100.55	0.55
K	100.00	100.77	0.77
L	100.00	100.45	0.45
w	100.00	100.10	0.10
Spousal Benefits (%) (recipients among married h.h.)	43.97	0	-
τ^p	0.11	0.11	-

Note: Table 14 reports values of the aggregate variables before and after Reform 3. Last column reports the percentage changes. Note that Reform 3 replaces the progressive benefit function with a linear one and eliminates the spousal benefit.

high type households who do not claim spousal benefits in Reform 2 economy receive even higher benefits because the replacement rate of benefit function is bigger.

Panel B reports the percentage change in labor force participation of married females by types of households. Contrary to Reform 2 labor force participation of women increases for all types. Clearly, spousal benefit rule makes a big difference in terms of labor supply for most women married to high skilled men (col or col+). On the other hand, changes for some household types are not as big as in Reform 1. This is not surprising, since the participation responses of women are directly related to changes in benefit collections (see Tables 10 and 15).

Next, Panel C reports the percentage change in asset holdings of married households right after retirement. As expected changes are in line with changes in benefit collections. To compensate for losses in benefits, low type households increase their assets as much as 26.66 percent. On the other hand, high type households decrease their assets as much as 15.85 percent. One finding to note here is that relative to Reform 2 more households increase their savings and less households decrease their savings. Hence, the aggregate capital stock increases contrary to the decrease after Reform 2. These reforms shows us the importance of participation decision of married females when studying implications of progressive structure

Table 15: Cross Sectional Effects, Married Households, Reform 3

Panel A
% Change in Social Security Benefits

	Female				
Male	<hs	hs	sc	col	col+
<hs	-24.11	-17.45	-12.75	-8.90	-3.25
hs	-18.85	-15.47	-10.16	-5.39	1.77
sc	-10.96	-9.19	-5.68	-2.59	6.36
col	2.99	6.90	10.09	12.30	17.95
col+	6.30	10.28	14.70	18.56	23.90

Panel B
% Change in LFP

	Female				
Male	<hs	hs	sc	col	col+
<hs	4.94	2.93	3.89	0.91	4.45
hs	5.47	3.97	3.34	1.89	2.48
sc	7.46	3.57	2.20	1.39	2.42
col	6.47	8.07	5.39	1.72	3.56
col+	9.32	8.27	8.82	5.12	0.86

Panel C
% Change in Assets After Retirement

	Female				
Male	<hs	hs	sc	col	col+
<hs	26.66	22.29	12.71	5.42	5.37
hs	24.90	18.25	11.69	8.37	0.63
sc	15.88	9.96	6.17	3.23	16.84
col	-5.74	-7.13	-3.36	-9.98	-14.11
col+	-4.33	-4.66	-7.69	-13.11	-15.85

Panel D
% Change In Welfare

	Female				
Male	<hs	hs	sc	col	col+
<hs	-3.41	-2.47	-1.83	-1.19	-0.90
hs	-2.82	-2.14	-1.48	-0.82	-0.14
sc	-1.75	-1.31	-0.80	-0.38	0.25
col	0.39	0.79	1.12	1.41	1.90
col+	0.76	0.95	1.41	1.93	2.58

Note: Panels in Table 15 report cross sectional implications of replacing the progressive benefit function with a linear one together with eliminating the spousal benefits. All numbers shown in these panels are percentage changes relative to the benchmark economy. See Table 1 for definitions of <hs, hs, sc, col and col+.

of the social security.

Finally, I report the welfare implications of Reform 3. Panel D shows that there are significant changes in the welfare of the married households. This table demonstrates the degree of progressivity built in to the social security system by the two rules I change. Low income households lose as much as 3.41 percent in welfare whereas high income households gain as much as 2.58 percent. Contrary to Reform 2, the biggest winners are not the traditional single-earner families. The biggest winners are high skilled two-earner households.

5 Conclusions

This paper builds a general equilibrium life-cycle model in which there are two-earner and single-earner households, and members in two-earner households make labor force participation decisions. I use this framework to study two features of the current social security system: the spousal benefit provision and the progressive calculation of social security benefits. The results show that labor force participation of married women is critically affected by these rules. In the benchmark economy, households composed of relatively high-earner men and relatively low-earner women are the ones who use spousal benefits most extensively. Therefore, the elimination of spousal benefits results in higher labor force participation of married women in these households, and adversely affects (in terms of welfare) these households.

The results also show that the implications of changing the progressive structure of the current benefit formula depend critically on its interaction with the spousal benefits. When I replace the current formula with a proportional one but keep the spousal benefits, labor force participation of women, aggregate capital, and aggregate output decline. This is due to significant increase in earnings of high skilled men and women who are married to these men simply drop out of the labor force. The married households who claim spousal benefits are the biggest winners with this reform. When I replace the current formula with a proportional one and remove spousal benefits, the results are very different. Labor force participation of married women, aggregate capital, and aggregate output increase. In this world, the biggest winners are the households with two high-wage members. These results suggest that modelling two-person households, who can make participation decisions for their secondary earners, can be critical for a proper evaluation of widely considered reforms that try to alter the progressive nature of the current social security system.

The current model can be extended in several dimensions. In this paper I make the simplifying assumptions that a husband and a wife retire and die concurrently and there are no transitions between marital groups. As a result, there are no survivors' benefits and benefits to divorced individuals, which is an extension of the spousal benefit provision in current legislation. The model can be easily extended to include these features. Furthermore, the current framework can be used to study the effects of replacing the current pay-as-you-go

social security system with a fully-funded system. In particular, such an exercise will allow to investigate the importance of the demographic composition of society and the participation decisions of secondary earners in evaluating reforms that replace the current pay-as-you-go system. I leave these questions for future work.[19]

[19] In a recent paper Guner, Kaygusuz and Ventura (2006), using a model economy that shares several features with the current paper, try to undertake such an exercise to study the aggregate and cross-sectional implications of fundamental income tax reforms for the U.S. economy.

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