The Effect of Public Pensions on Women’s Labor Market Participation over a Full Life-Cycle*  

Carlos Bethencourt and Virginia Sánchez-Marcos  
University of La Laguna and University of Cantabria  

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Abstract

We use a life-cycle model of household savings and female labor market participation decisions to evaluate several reforms of the US Social Security pension system. In our model returns to labor market experience apply, so participation decisions affect not only current earnings and Social Security pension eligibility but also future earnings. We measure the effect of removing spousal benefit, removing the survivor’s pension and extending from 35 to 40 the number of periods preceding retirement that are considered to calculate each worker’s pension benefit. We find that the effects are substantial on female labor market participation from age 35.
1 Introduction

The participation of married women in labor force increased dramatically in the US in the last century. Greenwood, Sehadri and Yorukoglu (2005) explore the role played by the development and dissemination of household appliances in explaining the increase in the labor force participation of women. There are other papers that emphasize changes in medical/contraceptive technology, such as for instance Goldin and Katz (2002) or Albañesí and Olivetti (2009). In the context of a life-cycle model, Attanasio, Low and Sánchez-Marcos (2008) explore the employment behavior of different cohorts of women and find that decreases in the child-care costs together with changes in female wages relative to males are key elements in accounting for the higher attachment to the labor market of younger cohorts of women. More recently, Eckstein and Lifshitz (2011) and Fernández and Wong (2014) explore the effect of changes in education distribution, marital stability, wages and fertility on female labor market behavior across cohorts. As a result of the said increase in female labor market attachment the US came to have the sixth highest female labor participation rate out of 22 OECD countries in 1990. However, as documented by Blau and Kahn (2013) by 2010 its rank had fallen to 17th. They argue that family-friendly policies that have emerged during the past two decades in other OECD countries may be responsible for this step backwards. In fact there are several empirical and quantitative papers that find that these policies may be important in understanding the relative performance of women in the labor market across countries.\footnote{See for instance Waldfogel (1998) or Ruhm (1998), among other empirical papers, and Erosa, Fuster and Restuccia (2010) and Sánchez-Marcos (2014) using quantitative papers.} However, less attention has been paid to the impact that Social Security pension rules may have had on the married female labor supply. French and Jones (2012) argue that Social Security may distort labor supply, although they find that the labor supply of young men is not very responsive to changes in the pension rules. However, we believe there are several reasons why it is interesting to analyze the effect on the complete female labor market participation life-cycle profile. One important point is that in certain aspects of the Social Security system men and women are treated asymmetrically. First, at individual level the system redistributes in favor of poor individuals since the pension formula is a concave function of average lifetime
earnings. This may favor women more than men because of the well-documented earnings gender gap. Second, at household level the system redistributes in favor of households formed by two married adults since the pension for a married household is 50% higher than the pension for a single household when only one adult qualifies for a public pension. Furthermore, when both adults are eligible for a public pension the second-earner receives his/her corresponding pension or 50% of his/her spouse’s pension, whichever is higher. Third, the pension formula establishes that benefits are proportional to average earnings over the 35 periods preceding retirement age, so the system redistributes from those individuals with a history of contributions longer than 35 years towards those with 35 years of contribution only. This may be interpreted as a kind of partial insurance against spells out of the labor market that occur at child-bearing ages, typically on the part of mothers. Finally, the Social Security system provides a survivors insurance of 100% of the spouse’s pension for those who are not eligible for a worker pension or for those whose own pension is lower than that. Another important issue that justifies our interest in the effect of Social Security pension rules on the female labor supply is that female labor supply is in general less stable over the life-cycle than that of men, in particular at child-bearing age. Finally, in the presence of non-separabilities of labor supply decisions, for instance, if there are returns to labor market experience, it is important to explore the effect of public pension rules over the whole life-cycle.

Interestingly, in countries in which the employment gender gap is smaller, e.g. in Scandinavia, the ratio of gross pension level for one-earner couples relative to single and the survivors’ pension benefits is lower (see OECD (2010)). Of course, the design of the system may be endogenous and societies in which women are less involve in the labor market may choose to protect them in old age. However, it is interesting to learn what effect pension rules have on women’s labor incentives. This is especially important at a time when developed countries are facing serious problems in achieving financial stability in their PAYG pension systems.

The aim of this paper is to further understanding female labor market incentives under the Social Security pension rules in the US. We use a partial equilibrium life-cycle model in which
forward-looking households make female labor market participation and saving decisions. In the model labor market participation decisions affect current earnings, future earnings (through a learning-by-doing technology) and Social Security pension eligibility. Households face earnings and survival uncertainty and are altruistic towards their children. Our model features the US pension system and provides a satisfactory representation of the distribution of public pensions for men and women that we observe in the data. We conduct several policy evaluation exercises: (i) removal of spousal benefits; (ii) removal of survivor pension; and (iii) extension from 35 to 40 of the number of periods preceding retirement that are considered in calculating the pension benefits. We find that removing spousal benefit and the survivors pension has a substantial effect on women’s employment decisions over the life-cycle, in particular after age 35. However, the extension of the number of years considered in calculating pension benefits changes participation only slightly.

Our paper is related to a strand of the literature that focuses on the effects of public pensions on labor incentives, in particular on male retirement decisions. In a partial equilibrium framework, Rust and Phelan (1997), French (2005) and French and Jones (2012) find that public pension plans have large effects on the labor supply of older male workers. In a general equilibrium framework, İmrohoroğlu and Kitao (2010) find that a 50% reduction in the payroll tax rate and in benefit raises the participation of men in their 60s from 50% to 62%. Wallenius (2013) and Erosa, Fuster and Kambourov (2012) find that a substantial fraction of the differences in men’s aggregate hours worked between the US and continental European countries is accounted for by differences in social security programs and taxation. However, there are few papers that consider two-adult households in analyzing the labor incentives of public pensions. Noteworthy exceptions are the papers by Van der Klaauw and Wolpin (2008) and Casanova (2010) who estimate structural dynamic models of saving and participation decisions of couples, but consider only old couples. In contrast, we assess the effect of several Social Security reforms over the complete life-cycle profile. Finally, Nishiyama (2010) and Kaygusuz (2011) use general equilibrium models of two-adult households to assess changes in the US Social Security pension rules. In contrast to Nishiyama (2010) we model the extensive margin decision of the female labor supply.
In contrast to Kaygusuz (2011) who uses a seven period model, we consider a one-year period
model and introduce earnings and wages uncertainty. A distinctive feature of our model with
respect to both the aforesaid papers is that wages are endogenous through a learning-by-doing
technology. Although the importance of human capital is emphasized in Wallenius (2013) her
analysis focuses on males only.

2 Model Economy

In this section we describe the model economy that we use to assess the impact of alternative
Social Security pension rules on female labor participation over the complete life-cycle. We
consider a partial equilibrium life-cycle model in which unitary households facing earnings and
lifespan uncertainty make female labor market participation and saving decisions. Although we
ignore any general equilibrium effects of the policy reforms that we implement, female wages are
endogenous as we assume that they depend on labor market experience. This is an important
feature in studying female labor supply decisions because it introduces an additional trade-off
of labor market breaks. Furthermore, we assume that households are altruistic towards their
children, so there is a bequest motive to save. Household size evolves exogenously over the life
cycle. We assume that all households are initially made up of two adults who remain married
and may have two children at a particular age. Household size changes deterministically with the
arrival and emancipation of children, but it changes stochastically as individuals die. In particular
we assume that there is survival uncertainty from the first period of compulsory retirement. This
is an essential feature of the model since we are interested, among other things, in exploring
the effect of survivor benefits on women labor supply over the life-cycle. However, all household
members die at age \( T \).

2.1 Household problem

Households derive utility from consumption and disutility from the female labor supply. We
assume that children affect the fixed monetary cost of work. Husbands always work and only
wives make labor supply decisions on the extensive margin. Then we assume that there is a fixed utility cost of work that may change with a woman’s age. Female labor supply affects a woman’s current earnings, but also her future wages and the public pension for which she is eligible. Thus the number of years of labor market experience is a state variable in our model economy, which enable us to capture important features of the data. First, there is empirical evidence that accumulated labor market experience is highly correlated with wages (see for instance Eckstein and Wolpin (1989)) and then labor market breaks related to child-bearing have a trade-off in terms of future wages that may be important in understanding the labor supply decision. Second, according to current rules of the US Social Security pension system, individual pension benefit is a concave function of average lifetime earnings.

The recursive formulation of a married household problem is as follows:

\[
V^M_t(a_t, h_t, v^m_t, v^f_t) = \max_{a_{t+1}, h_t} u^M(c_t, p_t) + \beta[\pi^f_{t,t+1}\pi^m_{t,t+1}E_t V^M_{t+1}(a_{t+1}, h_{t+1}, v^m_{t+1}, v^f_{t+1}) + \pi^f_{t,t+1}(1 - \pi^m_{t,t+1})E_t V^{Wf}_{t+1}(a_{t+1}, h_{t+1}, v^m_{t+1}, v^f_{t+1}) + \pi^m_{t,t+1}(1 - \pi^f_{t,t+1})E_t V^{Wm}_{t+1}(a_{t+1}, h_{t+1}, v^m_{t+1}, v^f_{t+1})] + (1 - \pi^f_{t,t+1})(1 - \pi^m_{t,t+1})B(a_{t+1})
\]

where \(V^M_t(.)\) is the value function of a married household, \(V^{Wf}_t(.)\) is the value function of a widow household and \(V^{Wm}_t(.)\) is the value function of a widower household. State variables are \(a_t\), which denotes beginning of period household assets, \(h_t\), which denotes female human capital and \(v^m_t\) and \(v^f_t\), which are the permanent male and female productivity shocks. Decision variables are \(p_t\), which is a discrete \(\{0, 1\}\) female labor supply choice and \(c_t\), which is total household consumption. \(\pi^k_{t,t+1}\) with \(k = f, m\) is the probability of surviving from age \(t\) to age \(t+1\) for an individual of gender \(k\). Finally, \(\beta\) is the discount factor and \(B(.)\) is a bequest function to capture the assumption that individuals are altruistic towards their children. We include a bequest motive to save in our model since this enable us to target household asset holdings at old ages. This is important because private savings and public pensions are two alternative ways of providing consumption during retirement.
The intertemporal budget constraint for a household before compulsory retirement at age $R$ is as follows

$$a_{t+1} = (1 + r) \left( a_t + \left( y^f_t - f_t - t^f_t \right) p_t + y^m_t - t^m_t - c_t \right)$$

where $r$ is the interest rate and $f_t$ is the fixed cost of work at age $t$. Female earnings are $y^f_t$, and the husband’s earnings are $y^m_t$. Earnings are described in Section 2.2. Each household earner pays taxes, $t^f_t$ and $t^m_t$, that are a function of the Social Security payroll tax and individual earnings. Households can save, but are not allowed to borrow.\(^2\) We denote the child care units needed by a family at age $t$ by $g_t$ and the price of each unit of child care by $q$. Therefore, the total child care cost paid by a household in which the woman participates in the labor market is given by $f_t = qg_t$. The participation choice and the consumption choice at $t$ determine the endogenous state variables (assets and human capital) at the start of the next period.

We assume that retirement is compulsory at the age $t = R < T$ and that retired households subsequently only make saving decisions. Females can retire from the labor market in any period before $R$, however we assume that they cannot claim the public pension until $t = R$. This is a simplifying assumption, but we believe that it does not affect our main results. Under the US Social Security pension rules those who retire before the official retirement age are subject to early retirement penalties that are approximately actuarially fair.\(^3\) As a consequence, the present value of public pension income corresponding to a woman who retires from the labor market before $R$, but can only claim public pension at $R$, is equal to the present value of public pensions income that she would receive if she could claim the public pension at the actual time of retirement.\(^4\)

\(^2\)This is a common assumption in the literature that evaluates public pensions. See for instance İmrohoroglu and Kitao (2010) or French and Jones (2012).

\(^3\)There have been several attempts in the relevant literature to assess whether the penalty structure due to the early retirement is actuarially fair and the accepted result is that Social Securitys age-related reductions for early retirement are approximately actuarially fair for individuals with average mortality, see for instance Crawford and Lilien (1981), Benitez-Silva and Heiland (2007), Sun and Webb (2011) and Gruber and Wise (2005).

\(^4\)Our assumption is important if borrowing constraints are binding at old ages. This is unlikely to be the
Furthermore, we assume that the survival probability is equal to 1 up to age $t = R - 1$, so widow and widower households are all retired.

The recursive formulation of a married household at $t \geq R$ is

$$V_t^M(a_t, h_{R-1}, v_{R-1}^m, v_{R-1}^f) = \max_{a_{t+1}} u^M(c_t) + \beta \left[ \pi_{t,t+1}^f \pi_{t,t+1}^m E_t V_{t+1}^M(a_{t+1}, h_{R-1}, v_{R-1}^m, v_{R-1}^f) + \pi_{t,t+1}^f (1 - \pi_{t,t+1}^m) E_t V_{t+1}^W(a_{t+1}, h_{R-1}, v_{R-1}^m, v_{R-1}^f) + \pi_{t,t+1}^m (1 - \pi_{t,t+1}^f) E_t V_{t+1}^W(a_{t+1}, h_{R-1}, v_{R-1}^m, v_{R-1}^f) \right] + (1 - \pi_{t,t+1}^f)(1 - \pi_{t,t+1}^m)B(a_{t+1})$$ (3)

Similarly, the widow or widower household problem is as follows

$$V_t^W(a_t, h_{R-1}, v_{R-1}^m, v_{R-1}^f) = \max_{a_{t+1}} u^W(c_t) + \beta \pi_{t,t+1}^k V_{t+1}^W(a_{t+1}, h_{R-1}, v_{R-1}^m, v_{R-1}^f) + (1 - \pi_{t,t+1}^k)B(a_{t+1})$$ (4)

After compulsory retirement age a household is entitled to receive a public pension $b_t$ that is a function of its average past earnings and its composition. As explained in detail in Section 2.2 human capital in the last period before compulsory retirement and the individual permanent shock in that period are the variables used to calculate the individual pension benefits. So the budget constraint is written as:

$$a_{t+1} = (1 + r)(a_t + b_t - c_t)$$ (5)

case in our model economy, but it may be the case in the data if there are households with no assets.
Both female and male earnings, $y_t^f$ and $y_t^m$, are subject to permanent shocks, $v_t^f$ and $v_t^m$, which are positively correlated. In particular we assume

\[ v_t^f = v_{t-1}^f + \xi_t^f \]
\[ v_t^m = v_{t-1}^m + \xi_t^m \quad \text{where} \quad \xi_t = (\xi_t^f, \xi_t^m) \sim N(\mu_\xi, \sigma_\xi^2) \]

We assume that men always work and their earnings grow according to a two parameter function of their age and squared age over the life-cycle:

\[ \ln y_t^m = \ln y_0^m + \alpha_1^m t + \alpha_2^m t^2 + v_t^m \]

Finally, there is an endogenous component of female earnings. Female earnings in period $t$ depend on human capital at the start of the period. We assume a learning-by-doing technology, so human capital is the total number of years of labor market experience. Thus $h_t$ evolves as follows

\[ h_{t+1} = h_t + I(p_t = 1) \]

and female earnings are a two parameter function of human capital

\[ \ln y_t^f = \ln y_0^f + \alpha_1^f h_t + \alpha_2^f h_t^2 + v_t^f \]
from assets. Under the US Social Security system a married household is entitled to a pension benefit that is a function of the husband’s average lifetime earnings.\textsuperscript{5} Individual pension benefit is calculated as a concave function of the individual’s average lifetime earnings. More specifically, it is a function of average earnings over the last $N$ years preceding retirement age, including years with zero earnings if needed to total $N$ years (this is known as the Average Indexed Monthly Earnings (AIME)). Furthermore, a minimum number of years of contribution is required for individuals to be eligible for a public pension. In addition to the husband’s public pension, the wife is eligible for a pension in the amount of her corresponding individual pension benefit or a fraction of her husband’s pension benefit (the latter is known as spousal benefit), whichever is higher. Survivors get their own pension benefit or their spouse’s pension benefit (the latter known as a survivor’s pension), whichever is higher. As a consequence, women may be dually entitled as workers and as spouses or survivors.

As a consequence of pension rules, the complete labor market history of each individual is needed in order to calculate his/her AIME and thus the corresponding pension benefit. However, keeping track of the complete labor market history of each spouse is computationally very costly and unfeasible in a model that allows for saving decisions and features the degree of earnings uncertainty at individual level observed in the data. Our approach is therefore to build up an approximation of individual AIMEs. First, for men (who work in every period before compulsory retirement age $R$), we build an approximation $\hat{AIME}^m$ for the actual $AIME^m$ as follows

$$\ln \hat{AIME}^m = \gamma_1 + \gamma_2 \ln \left( \sum_{t=R-N}^{R-1} \frac{\hat{y}_t^m}{N} \right)$$  \hspace{1cm} (11)$$

where $\hat{y}_t^m$ represents earnings in period $t$ if the last period permanent shock is assumed in all periods\textsuperscript{6} and $\gamma_1$ and $\gamma_2$ are the coefficients of a linear regression of $\ln AIME^m$ on $\ln \sum_{t=R-N}^{R-1} \frac{\hat{y}_t^m}{N}$ using simulated data. So in order to identify these two parameters we have to solve the model.

\textsuperscript{5}We assume here that the first-earner is the husband.

\textsuperscript{6}Without this adjustment the variance in average lifetime earnings approximated would be much higher because of the increasing variance in earnings over the life cycle.
Second, for women we use the last period permanent shock together with the last period human capital (which measures years of experience) to approximate the $AIME^f$. As a test of our approximations, Section 3.2 shows that the distribution of public pensions in our simulations provides a good approximation of what is observed in the data.

3 Calibration

In this section we specify functional forms for the utility function, the bequest function and the child care cost function. Furthermore we describe both the set of parameters taken from the data and those that have to be calibrated by solving the model.

3.1 Parameters and Targets

Demographics. All women in our model begin their lives at age 25 with zero assets and live up to 61 periods. During the last 20 periods they are retired from the labor market, as are their husbands (i.e. official retirement age is 66). Individuals face survival uncertainty from the last working period and we target the death probabilities reported by the Social Security Administration. However, we calibrate the husband’s probability of death at the age of 66 in order to target the fraction of widows in the data at that age. The fraction of women older than 65 who are widows in our simulations is 36%. Finally, in regards to fertility we assume that there are three types of households: Type 1 are childless throughout all their lifetime; Type 2 have two children, the first of whom arrives when their parents are 22. There is a third type of households who also have two children, with the first child arriving when their parents are 26. We calibrate the fraction of each type of household in order to target the fraction of childless women and the average age at which the first child arrives as observed in the data. Finally, we assume that the

\footnote{See Social Security Administration Actuarial Life Table, 2007.}

\footnote{In the data this figure is 44% in 2008. Since our model does not capture the demographic transition that is taking place in the data with an increasing trend in life expectancy, we are not capturing the fact that survival probabilities at each age for the oldest cohorts of individuals were smaller than the ones that we use.}

\footnote{See OECD family database Chart SF2.3.A: Mean age of women at the birth of their first child, 2009.}
second child arrives 3 years after the first.\textsuperscript{10}

\textbf{Earnings.} The deterministic component of the male earnings process is consistent with earnings growth over the life-cycle as calculated for the cohort of individuals born in the 1940s using the Current Population Survey. We target earnings growth of 2.4\% from age 25 to 35 and of 0.7\% from 36 to 64. Innovations in male earnings and in female wages are both assumed to have a unit root. The standard deviation of the innovation for the husband’s earnings is assumed to be 0.08. This number is similar to estimates by Hugget, Ventura and Yaron (2011) and Low, Meghir and Pistaferri (2010). Furthermore, we assume the initial variance of log earnings to be 0.20, which is consistent with their estimates. There is not much evidence on the variability of female wages so we assume that the variance of female wages innovations is the same as that of men’s earnings. Finally, we assume that the correlation coefficient between the two shocks (for husband and wife) is 0.25 as estimated by Hyslop (2001).

The parameters that characterize the effect of female human capital on wages ($\alpha_1^f$ and $\alpha_2^f$) have to be calibrated by solving the model. To identify them we target the two coefficients of a regression of female log wages on the number years of experience and the squared number of years of experience as estimated by Eckstein and Wolpin (1989).\textsuperscript{11} In particular, using simulated data we draw up an ordinary least square estimate of

$$\ln w_t^f = \beta_1 + \beta_2 h_t + \beta_3 h_t^2 + u_t$$

(12)

where $u_t$ is the error term.

Finally, we assume there is an initial offered wage gender gap ($y_{0_0}^f/y_{0_0}^m$), which enable us to target the wage gender gap of 0.61 over the life-cycle as estimated in the Current Population Survey for the cohort of women born in the 1940s.

\textsuperscript{10}We assume 3 years time between births to be consistent with Natality Detail Files (see Buckles and Munnich (2012)).

\textsuperscript{11}They use the cohort of women aged 30 to 44 in 1967 in the National Longitudinal Survey.
**Childcare cost.** The shape of the function that determines the child care cost units needed by a family at age $t$, $g_t$, we build it directly from the data provided by State Child Care Resource and Referral Network offices for pre-school children.\(^\text{12}\) According to that information the child care cost for a 4-year-old child is about 20% less than that for an infant (we normalize to 1 the number of units of child care needed for an infant). We assume that child care cost is zero after that age. Given this information and considering that in our model all women with children have two of them, 3 years apart, we shape $g_t$ so that it captures the evolution of household child care costs with the age of the first child.\(^\text{13}\) Then only the price $q$ of each unit of child care is calibrated by solving the model. To identify it we include the employment rate of women aged 25 to 29 as a target in the calibration.

**Public pension rules.** According to US Pension rules, the Workers’ Primary Insurance Amount (PIA) is computed using a piecewise linear function of the AIME over the last 35 years (including years with zero earnings if needed to total 35 years) with three bend points. The PIA formula is progressive. In 2008 the first USD 711 per month of relevant earnings attracts a 90% replacement rate. The band of earnings between USD 711 and USD 4,288 per month is replaced at 32%. These thresholds are 21% and 128% of the national average wage, respectively. A replacement rate of 15% applies between the latter threshold and the earnings ceiling. Finally, in order to calculate the household pension benefit, a 50% dependants addition is available for married couples where secondary earners have built up a smaller entitlement. In the case of widow and widower households, the pension benefit is the individual pension or the deceased spouse benefit amount, whichever is the higher. So the survivor’s pension replacement rate is 100%. The earnings ceiling for benefits is USD 102,000 a year, corresponding to 253% of the national average wage.\(^\text{14}\) Furthermore, a minimum of 10 years of contributions is required to be eligible for a public pension.\(^\text{15}\) As we explained above we use an approximation of $AIME^m$ and

\(^{12}\)See Child Care Aware of America (2012).

\(^{13}\)Note that $g_t$ take on different values for each of the three household types that we consider.

\(^{14}\)See OECD (2011).

\(^{15}\)The above PIA formula applies if an individual first applies for and receives benefit at the normal retirement age of 66. Individuals are eligible to apply for Social Security once they reach the earliest retirement age of 62. Early receipt, however, permanently reduces the benefit by the Actuarial Reduction
Finally, the payroll tax is 12.4%. However, there is an earnings ceiling for contributions of USD 102,000 per year.

Preferences. We assume a discount factor of 0.98. We assume married households derive utility from consumption\(^{16}\) and that there is a utility cost of women’s work according to

\[
u^M(c_t, p_t) = 2 \ln c - \psi_t p_t \tag{13}\]

We assume that \(\psi_t\) is constant over the life-cycle except for the last 5 periods (this gives \(\psi_{25-59}\) and \(\psi_{60-64}\)). Although we try to keep heterogeneity of preferences to a minimum, allowing for a different utility cost of working at old ages helps us to capture women’s employment life-cycle profile. To calibrate these two parameters we target the female employment rate for the group of women aged 40 to 44 and the female employment rate for women aged 60 to 64.

Households where one of the spouse is deceased are widow or widower households (note that our simplification assumption on survival probabilities means that single-adult households only arise during retirement) derive utility according to

\[
u^W(c_t) = \ln c \tag{14}\]

Finally, our specification of the bequest function is as follows

\[
B(a) = \phi \ln a \tag{15}\]

\(^{16}\)We assume an intertemporal elasticity of substitution of 1. This is within the range of values estimated in the relevant literature, in particular in Attanasio and Weber (1995).
where $\phi$ captures the degree of altruism of households towards their children. In order to calibrate this parameter we include as a target the assets holdings of households with members aged 55 to 64.

**Other parameters.** We set the rate of return to savings to equal the average real return on three monthly T-bills at 0.015.

In summary there are seven parameters that must be calibrated by solving the model. We show them in Table 1 together with the targets used for their identification. As reported, we need a relatively higher utility cost of working at old ages than during the rest of the life-cycle in order to target the participation rate of women aged 60 to 64. Heterogeneity in the cost of work over the life-cycle may capture some features of the data that are missing in our model economy and that may be relevant in female labor supply decisions. In particular health status may be important in accounting for the declining profile of labor market participation at old ages (see for instance van der Klaaw and Wolpin (2008)). The price of child care that we calibrate implies that the child care cost for a new born is about 25% of an average worker’s earnings in this economy. This is above the 20% reported by the OECD\textsuperscript{17}, but note that we ignore other monetary costs related to child-bearing. In regard to the human capital function we estimate wages to be a concave function of the number of years of labor market experience. Finally, the initial female-to-male wage ratio has to be 0.58 to target the average ratio over the life-cycle of 0.60. This reflects positive self-selection of women into the labor market and is consistent with Olivetti and Petrongolo (2008) who find that there is a negative correlation between wage gender gaps and employment gender gaps across OECD countries.

### 3.2 Benchmark economy

This section provides a detailed description of the benchmark economy. First, Figure 1 shows the complete life-cycle employment profile of women both in the model and in the data. The profile in the data is smoother than in the simulations because the amount of heterogeneity in terms

\textsuperscript{17}See OECD family database Chart PF3.4.A: Childcare fees per two-year old attending accredited early-years care and education services, 2008.
Table 1: Calibration

<table>
<thead>
<tr>
<th>Targets</th>
<th>Model</th>
<th>Data</th>
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<tbody>
<tr>
<td>Women’s Employment Rate 25-29</td>
<td>0.41</td>
<td>0.41</td>
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<tr>
<td>Women’s Employment Rate 40-44</td>
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<tr>
<td>Women’s Employment Rate 60-64</td>
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<tr>
<td>Wage Gender Gap</td>
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<td>0.02</td>
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<tr>
<td>$\beta_3$, Eckstein and Wolpin (1989)</td>
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<tr>
<td>Household Median Assets 55-64</td>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$\psi_{25-59}$</td>
<td>0.67</td>
<td></td>
</tr>
<tr>
<td>$\psi_{60-64}$</td>
<td>0.88</td>
<td></td>
</tr>
<tr>
<td>$p$</td>
<td>19,420</td>
<td></td>
</tr>
<tr>
<td>$y_0^f / y_0^m$</td>
<td>0.58</td>
<td></td>
</tr>
<tr>
<td>$\alpha_1^f$</td>
<td>0.0245</td>
<td></td>
</tr>
<tr>
<td>$\alpha_2^f$</td>
<td>-0.00055</td>
<td></td>
</tr>
<tr>
<td>$\phi$</td>
<td>10.4</td>
<td></td>
</tr>
</tbody>
</table>
of fertility histories that we are able to capture is limited. However, we believe that the model provides a reasonable representation of the women’s participation behavior over the life-cycle.

Second, as shown in Table 2, the married men’s earnings distribution and the married women’s wage distribution are well captured in our simulations. It is important to note here that whereas male earnings distribution is exogenous, female wage distribution is endogenous both because of self-selection of women into the labor market and because of the returns to labor market experience. Third, median assets for the different household income percentiles in the simulations provide a good approximation of the data for the age group 55 to 64 (see Table 3).

![Figure 1: Female employment rate over the life-cycle](image)

Finally, Table 4 reports the distribution of men’s pensions. In order to be consistent with our model assumptions, we report the pensions of male workers with no reduction for early retirement. The model produces a distribution of male worker’s pensions that is fairly similar to the data. Table 5 shows the distribution of women across types of entitlement both in the model and in the data. Again, the distribution of women across different types of entitlement is close to what is observed in the data. About 40% of women are entitled to receive a worker’s pension only,
Table 2: Earnings and wages distribution

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>25%</td>
<td>25,897</td>
<td>26,832</td>
</tr>
<tr>
<td>50%</td>
<td>37,430</td>
<td>39,520</td>
</tr>
<tr>
<td>75%</td>
<td>59,077</td>
<td>54,602</td>
</tr>
</tbody>
</table>

Wife’s wage percentiles:

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>25%</td>
<td>8.55</td>
<td>7.54</td>
</tr>
<tr>
<td>50%</td>
<td>12.23</td>
<td>11.52</td>
</tr>
<tr>
<td>75%</td>
<td>17.48</td>
<td>16.60</td>
</tr>
</tbody>
</table>

Data source: IPUMS-CPS.

Table 3: Median Assets by Household Income (aged 55-64)

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>20%</td>
<td>84,012</td>
<td>122,366</td>
</tr>
<tr>
<td>40%</td>
<td>133,377</td>
<td>132,506</td>
</tr>
<tr>
<td>60%</td>
<td>191,903</td>
<td>200,770</td>
</tr>
<tr>
<td>80%</td>
<td>276,614</td>
<td>245,019</td>
</tr>
<tr>
<td>100%</td>
<td>460,210</td>
<td>458,400</td>
</tr>
</tbody>
</table>

Data source: SIPP 2008, Core and Topical.
14% to receive a spousal benefit only and 22% to receive a survivor’s benefit only. Thus, about 24% of women are dually entitled (28% in the data), with 15% entitled as workers and spouses and 9% as workers and survivors. The main discrepancy with the data comes from the fact that, as we explained above, in our simulations the fraction of widows among women 66 or older is 36% in contrast to the 44% in the data. Finally, Table 6 reports the average pensions of women workers together with other statistics of the distribution and average pensions of widows (to be consistent with our model assumptions we report average pensions of non-disabled widows whose benefits are not reduced due to early retirement of the widow or a deceased spouse). The model averages are only slightly higher than those in the data.

All in all we believe the model provides a satisfactory picture of what is observed in the data in terms of earnings, female labor market participation and public pension statistics.

Table 4: Distribution of male worker’s pensions (66 or older)

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>25%</td>
<td>14,099</td>
<td>14,869</td>
</tr>
<tr>
<td>50%</td>
<td>18,899</td>
<td>17,024</td>
</tr>
<tr>
<td>75%</td>
<td>22,499</td>
<td>22,079</td>
</tr>
<tr>
<td>Average</td>
<td>18,234</td>
<td>18,680</td>
</tr>
</tbody>
</table>


4 Policy Evaluation

In this section we explore the effect of changing some of the insurance mechanisms currently provided by the Social Security system: the spousal benefit, the survivor’s benefit and the number of periods used to calculate the AIME. Our aim is to assess the impact of these changes on female labor participation over the life-cycle. We implement three different reforms. First, we remove the spousal benefit (reform 1). Second we remove the spousal and survivor’s pensions altogether.
Table 5: Distribution of women by type of entitlement (66 or older)

<table>
<thead>
<tr>
<th></th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worker only</td>
<td>0.42</td>
<td>0.40</td>
</tr>
<tr>
<td>Spousal only</td>
<td>0.10</td>
<td>0.14</td>
</tr>
<tr>
<td>Survivor only</td>
<td>0.18</td>
<td>0.22</td>
</tr>
<tr>
<td>Worker and spousal</td>
<td>0.12</td>
<td>0.15</td>
</tr>
<tr>
<td>Worker and survivor</td>
<td>0.18</td>
<td>0.09</td>
</tr>
</tbody>
</table>


Table 6: Average women’s pensions (66 or older)

<table>
<thead>
<tr>
<th></th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workers</td>
<td>13,749</td>
<td>14,667</td>
</tr>
<tr>
<td>Percentile:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25%</td>
<td>9,299</td>
<td>10,583</td>
</tr>
<tr>
<td>50%</td>
<td>12,899</td>
<td>13,129</td>
</tr>
<tr>
<td>75%</td>
<td>17,099</td>
<td>18,114</td>
</tr>
<tr>
<td>Widows</td>
<td>16,452</td>
<td>17,928</td>
</tr>
</tbody>
</table>

Finally, we evaluate the removal of both spousal and survivor’s benefits together with increasing the number of periods considered in calculating the AIME from 35 to 40 (reform 3). This last change means that for someone who worked only for the last 35 periods preceding retirement at a constant wage, the pension would be reduced by about 12%. We summarize the implications of policy changes for participation in Table 7.

The effect on the participation rate is very substantial and concentrated mainly after age 35. The increase in labor market participation is slight for females aged 25 to 29 (at child-bearing ages). Each reform adds 1 percentage point to the employment rate of this age group. The effect on the group of women aged 40 to 44 is 7 percentage points with reform 1 and 4 additional percentage points as a result of reform 2. Finally, the extension from 35 to 40 of the number of periods considered in calculating the AIME has not additional effect on the participation rate in this group. The effect on the group of women aged 60 to 64 is an increases of 4 percentage points as a result of reform 1, of 5 additional percentage points as a result of reform 2 and of 2 points if reform 3 is implemented. Interestingly, the effect on employment at child-bearing ages is slight, even in the case of reform 3. However, in the presence of returns to labor market experience this is not trivial even when only the last 35 periods prior to retirement age are taken into account in calculating the AIME. Figure 2 plots the complete life-cycle profile under the benchmark economy and the three reform scenarios. All in all, the participation rate of women aged 25 to 65 increases by 5 percentage points as a result of reform 1 and by 4 more points with reforms 2 and 3.

The fraction of women who have never worked at the compulsory retirement age goes from 10% in the benchmark economy to between 5 and 6% under the reforms. The average number of years of experience of those who work at some point during their lives increases by 1 year as a result of reform 1 and by 2 years when reform 2 is implemented. In spite of the slight increase in the average number of years of experience, the average pensions of female workers decreases as a result of the reforms: see Table 8. This is because women who are now entitled to a worker’s pension are on average less productive. This is especially noteworthy as a result of reform 1,
Table 7: Policy evaluation: labor market

<table>
<thead>
<tr>
<th></th>
<th>Benchmark</th>
<th>Reform 1</th>
<th>Reform 2</th>
<th>Reform 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment Rate 25-29</td>
<td>0.41</td>
<td>0.42</td>
<td>0.43</td>
<td>0.44</td>
</tr>
<tr>
<td>Employment Rate 40-44</td>
<td>0.70</td>
<td>0.77</td>
<td>0.81</td>
<td>0.81</td>
</tr>
<tr>
<td>Employment Rate 60-64</td>
<td>0.46</td>
<td>0.50</td>
<td>0.55</td>
<td>0.57</td>
</tr>
<tr>
<td>All</td>
<td>0.62</td>
<td>0.67</td>
<td>0.71</td>
<td>0.71</td>
</tr>
<tr>
<td>Fraction of women who never work</td>
<td>0.10</td>
<td>0.06</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Average number of years of experience</td>
<td>28.9</td>
<td>29.9</td>
<td>30.7</td>
<td>31.0</td>
</tr>
</tbody>
</table>

which produces the highest increase in the employment rate.

Reforms 2 and 3 leave 4% of households with no Social Security pension (see Table 8) since they eliminate the survivor’s pension. Of course, these are all widow households, since husbands always work in our model. As a consequence the Gini index of Social Security household income increases dramatically from about 0.19 to 0.28 (see Table 9). However, the Gini index of household consumption goes up from 0.28 to 0.30 only. Obviously, households use savings to smooth consumption over the life-cycle. In fact, median assets of households aged 55 to 64 are almost 50% higher in the economy under reforms 2 and 3 than in the benchmark, whereas they are only 10% higher under reform 1 than under the benchmark.

5 Conclusions

In this paper we use a partial equilibrium life-cycle model of household saving and female labor market participation decisions to assess several reforms of the US Social Security pension system. In our model individuals face earnings uncertainty as well as lifetime uncertainty and a distinctive feature is that returns to labor market experience operate so participation decisions affect not only
Figure 2: Life-cycle female employment rate

Table 8: Policy evaluation: women’s pensions

<table>
<thead>
<tr>
<th></th>
<th>Benchmark</th>
<th>Reform 1</th>
<th>Reform 2</th>
<th>Reform 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fraction of women entitled to receive a pension as</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worker only</td>
<td>0.40</td>
<td>0.59</td>
<td>0.88</td>
<td>0.88</td>
</tr>
<tr>
<td>Spousal only</td>
<td>0.14</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Survivor only</td>
<td>0.22</td>
<td>0.06</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Worker and spousal</td>
<td>0.15</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Worker and survivor</td>
<td>0.09</td>
<td>0.25</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Fraction of households with no pension</td>
<td>0.0</td>
<td>0.0</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>Female worker’s average pension</td>
<td>14,499</td>
<td>12,327</td>
<td>11,646</td>
<td>11,158</td>
</tr>
</tbody>
</table>
current earnings and Social Security pension eligibility, but also future earnings. In this setup we evaluate the effect of removing spousal benefit, removing survivor’s benefit and extending from 35 to 40 the number of periods preceding retirement that are considered in calculating the worker’s Primary Insurance Amount. Our focus is on the effects of these reforms on the complete female life-cycle participation profile. We find that the effects are substantial from age 35, but slight before that age. Average participation increases by 9 percentage points.

Furthermore, as a result of the elimination of survivors benefits there is a dramatic increase in Social Security income inequality as measured by the Gini index. This is the result of 4% of households being left with no Social Security pension. However, the increase in consumption inequality is small because households use savings to smooth consumption over the life-cycle.

References


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