Private Pensions, Retirement Wealth and Lifetime Earnings*

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Abstract

This paper investigates the role of private pensions for retirement wealth distribution. Recent work has found that the standard life-cycle model fails to account for three key features of the data: (1) the correlation between lifetime earnings and retirement wealth; (2) the wealth gaps between earnings rich and earnings poor households; and (3) wealth inequality among households with similar lifetime earnings. We find that incorporating private pensions brings theory closer to the data. In particular, private pensions substantially improve the model's ability to account for the large non-pension wealth inequality observed among households with similar lifetime earnings.

JEL classification: D31; E21; J32

Keywords: Private pensions; Wealth inequality; Retirement.

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1 Introduction

This paper seeks to quantify the role of private pensions in accounting for the distribution of retirement wealth across U.S. households. In particular, it asks to what extent (defined benefit) private pensions can account for two discrepancies between the predictions of the "standard" life cycle model and the data. First, there is a large variation of retirement wealth between households with similar lifetime earnings (Venti and Wise (1998), Hendricks (2007b)). This variation in retirement wealth inequality among households with similar lifetime earnings significantly exceeds the variations predicted by the "standard" life cycle model (Hendricks (2007b)). Second, the correlation between retirement wealth and lifetime earnings is higher in the standard life cycle model than in the data (Hendricks (2007b)).

Although there is a large literature on wealth inequality using quantitative life cycle models (e.g. Cagetti and De Nardi (2006), Huggett (1996)), relatively little attention has been paid to employer sponsored pension plans.[1] This is surprising for two reasons. First, employer provided pension plans represent a significant share of household retirement wealth (Munnell and Perun (2006)). Second, household coverage by private pensions is incomplete as not all employers offer private pensions (Buessing and Soto (2006)). As a result, job loss (or, more generally switching employers) can lead to changes in households access to private pension. This suggests that private pensions status may be (partially) stochastic, and correlated with household earning shocks. Both of these factors suggest that private pensions may have a significant impact on households savings decisions and thus on the wealth distribution.

To address the role of private pensions, this paper incorporates stochastic private pension coverage into a quantitative incomplete market life-cycle model. In the model, households face stochastic incomes and stochastic private pension coverage. As in the data, the probability of a household having pension coverage is persistent and positively correlated with income. Given the interest in retirement wealth, the model also incorporates a public pension system (Social Security) which depends upon a household's

[1]Notable exceptions to this include Scholz, Seshadri, and Khitatrakun (2006), who argue that the life cycle model does a good job of matching the distribution of retirement wealth in the HRS, and Engen, Gale, and Uccello (1999).

lifetime earnings. We calibrate the model to match data from the PSID on household earnings processes and pension coverage. We then simulate the model economy with and without private pensions.

The results of our numerical experiments are compared to data drawn from the Panel Study of Income Dynamics (PSID). We follow Hendricks (2007b) and examine the variation of retirement wealth within lifetime earnings deciles of households in the PSID. When computing retirement wealth, we make use of the fact that since 1999 the PSID supplemental wealth survey has included questions on employer provided pensions.[2] We look at two measures of wealth at retirement: one based on household net worth and one which includes the present value of pensions. As we discuss in section 2, our preliminary work suggests that the inclusion of private pensions has a noticeable effect on measured wealth inequality.

We find that the inclusion of pensions in total wealths reduces wealth inequality among households with similar lifetime earnings. For households in the PSID for whom we have estimates of pension and non-pension wealth, we find that the Gini of retirement wealth is 0.68 for retirement wealth excluding pensions and 0.64 when pension wealth is included. We also find that the correlation between lifetime earnings and retirement wealth is higher when pension wealth is included in retirement wealth. These results are qualitatively consistent with our numerical experiments, where we find that the inclusion of a private pension system resembling that in the U.S. reduces the Gini of retirement wealth. However, while the inclusion of private pensions reduces the gap between the model predictions and the data, a significant fraction of wealth inequality in the data is not explained by the model.

There is a large related literature which uses quantitative life cycle models to examine wealth inequality (e.g. Huggett (1996), Quadrini (2000), Casteneda, Diaz-Gimenez, and Rios-Rull (2003), De Nardi (2004)).[3] Most closely related to this project are several recent papers which document and examine potential explanations for the large amount of retirement wealth hetereogenity between households with similar lifetime earnings.

[2]This data is an improvement over that available in earlier waves which did not include information on the value of employer provided pension plans (which is why the definition of household retirement wealth in Hendricks (2007b) did not include employer pensions).

[3]Cagetti and De Nardi (2006) provide an excellent survey of this literature.

Venti and Wise (1998) and Hendricks (2007b) document a large dispersion in the retirement wealth for households with similar lifetime earnings.[4] Venti and Wise (1998) and Hendricks (2007b) argue that a large amount of the observed dispersion in retirement wealth is due to differences in savings propensities, possibly due to hetereogenity in household preferences. Hendricks (2007a) considers the impact of discount rate heterogeneity on retirement wealth inequality. Other work has argued that marital instability can help account for household wealth hetereogenity, since married and never divorced households have higher wealth levels than divorced or never married households (Guner and Knowles (2007)). Finally, Yang (2006) argues that the timing of intergenerational bequests plays an important role in generating wealth hetereogenity among households with similar lifetime incomes.

While the literature on wealth inequality has largely abstracted from private pensions, several related papers on the adequacy of household retirement savings have incorporated private pensions. Engen, Gale, and Uccello (1999) introduce private pension coverage into a life cycle model where households face stochastic income. Scholz, Seshadri, and Khitatrakun (2006) compare household specific wealth holdings predicted by a stochastic life cycle model with data from the HRS. They conclude that the model can account for more than 80 percent of the observed variation in wealth holdings. Our paper differs from these papers both in the modeling of private pensions and in the focus on the wealth distribution of households with similar lifetime earnings.

The remainder of the paper is organized as follows. Section 2 documents some empirical findings on retirement wealth. Section 3 sets up the general model and the parameterization. In Section 4 we report the results of our numerical experiments. Section 5 concludes.

2 Preliminary Empirical Evidence

The data used in this study are drawn from the 1968-2005 waves of the Panel Study of Income Dynamics (PSID) and from the PSID supplemental wealth files. We follow

[4]Berneim and Weinberg (2001) use data from the PSID and the CEX to examine retirement wealth heterogeneity.

earlier work by Hendricks (2007b), and focus attention on households reporting wealth when the head is 65 years of age. In order to be in the sample, households retirement wealth must be observed, nonzero earnings records in 15 survey years (not necessarily consecutive) must be available, and the households core weight must be positive.

The dollar values are converted in 1994 prices using the Consumer Price Index. Time trends are removed from the data by dividing by year effects (γ_t) estimated from regressing the ln of household earnings on a quartic in experience and year dummies

$$\ln y_{it} = \alpha + X_{it}\beta + \ln \gamma_t + \epsilon_{it} \tag{2.1}$$

where y_{iy} denotes earnings of household i at date t and X_{it} is a quartic in potential experience. The experience profile ($X_{it}\beta$) is used as the age efficiency profile of households in the model.

We begin by examining the present value of lifetime earnings in the 1968-2005 waves of the PSID. Earnings are the labor income of the household head and spouse, and consist of wages, salaries, bonuses, overtime, and the business part of labor income (assigned by the PSID). Earnings are net of taxes. The value of lifetime earnings is the present value of income between the ages of 20 and 65, discounted to age 65 using a discount rate of 4 percent. We replace missing values using their predicted values in the calculation of lifetime earnings. The predicted values are based on a fixed effect regression of detrended income for men and women separately on a quartic in experience.

We examine two measures of retirement wealth. We define retirement wealth as household wealth when the household head turns 65. The first measure of wealth is the PSID variable Wealth2 (which we will often refer to as net worth). This measure includes financial wealth, private annuities, IRAs, real estate, business wealth, vehicles, life insurance policies, trusts and other assets less debts. This wealth measure is available for all of the years we look at (1984, 1989, 1994, 1999, 2001, 2003, 2005). The second wealth measure we examine adds the main element of retirement wealth missing from Wealth2, which is employer provided pensions (both defined contribution plans and defined benefit plans). In some cases, defined benefit pensions are reported in terms of the annuity flow. In these cases, we use the present value of the expected annuity flow.

Since we only have wealth data for selected years, we do not have wealth observations for all households when the head turns 65. For households for whom we have wealth observations both before and after they turn 65, we use interpolation to construct an estimate for their wealth at 65. When we have only one wealth observation between the ages of 63 and 67, we use this as retirement wealth.

The summary statistics for the sample are reported in Table 1. The majority of the single households in the sample are female. Overall, the sample characteristics are similar to those reported in Hendricks (2007b).[5]

Table 1: Sample Statistics: PSID

	Couples		Singles	
	Mean	Std.	Mean	Std
Number observations	704	–	464	–
Mean birth year	1928.7	7.2	1929.7	7.1
Years of school	12.2	3.9	11.8	3.6
Earnings Observations	26.5	5.8	27.4	5.6
Mean Earnings age 40-50	40.0	22.6	25.7	18.1
Mean lifetime earnings	4193.6	2148.0	2351.5	1406.8
Mean Retirement Wealth	392.5	938.1	140.4	320.7
Median Retirement Wealth	190.1	–	46.9	–

Dollar figures are in thousands of detrended 1994 dollars.

Since pension data is only available for the 1999-2005 supplemental wealth surveys, we also examine a subsample based on these years. Table 2 reports the sample statistics of households for whom we have estimates of private pension wealth at retirement. This reduces the number of households we have data for by more than half to 456. Overall, the characteristics of this group of households resembles the larger sample for whom we have retirement wealth.

The data supports the view that private pensions account for a significant fraction of household wealth. Roughly 45 percent of the households in the sample have pensions. The present value of private pensions accounts for nearly a quarter of mean private

[5]In the appendix we report the sample statistics when we drop the households whose retirement wealth comes from the 2005 PSID.

(excluding social security) retirement wealth.[6] Pension wealth is even more important for the median household, accounting for roughly one-third of retirement wealth.

Table 2: Sample Statistics 1999 - 2005 PSID Retirement

	Couples		Singles	
	Mean	Std.	Mean	Std
Number observations	254	–	202	–
Mean birth year	1936.2	3.3	1936.4	3.3
Years of school	13.0	3.0	12.0	3.0
Earnings Observations	32.8	1.2	32.9	1.2
Mean Earnings age 40-50	43.4	24.6	26.9	18.6
Mean lifetime earnings	4592.7	217.8	2769.5	1439.5
Mean Retirement Wealth	502.0	1197.3	186.0	434.1
Median Retirement Wealth	225.6	–	58.6	–
Mean RW (incld. Pensions)	661.1		240.9	
Median RW (incld. Pensions)	313.7	–	89.6	–

Note: Dollar figures are in thousands of detrended 1994 dollars.

The joint distribution of retirement wealth and lifetime earnings plays a key role in assessing how well the life-cycle model can match the data. As Hendricks (2007b) emphasizes, in the "standard" deterministic life cycle model, the correlation between the present value of lifetime earnings and retirement wealth is one. Moreover, there is no difference in retirement savings of households with the same lifetime earnings. However, the presence of social security (which provides higher replacements rates to households with lower lifetime earnings) provides richer households with an an incentive to save more.

These features are qualitatively consistent with the data. Table 3 reports the correlations between lifetime earnings, net worth (excluding pensions), the value of private pensions and total retirement wealth (net worth plus private pensions). The correlation between net worth and lifetime earnings is 0.47. As one would expect, the correlation

[6]These values are somewhat less than those reported from the HRS. McGarry and Davenport (1998) report that pension wealth accounted for roughly a third of mean retirement wealth in the HRS.

between total retirement wealth (net worth plus pension wealth) is higher at 0.55. Pension wealth is also positively correlated with lifetime earnings, which is consistent with the fact that private pension plans are more likely to be offered to workers with higher earnings. The correlation between earnings and private pensions in the model is also positive.

Table 3: Correlation Coefficients

	Earnings	Net Worth	Net Worth + Pension
Earnings	1.0	0.47	0.55
Net Worth	0.47	1.0	0.93
Pension	0.39	0.22	0.56

Note: Net worth is retirement wealth excluding private pensions. N = 456.

We sort households into lifetime earnings deciles where household lifetime earnings are the sum of the lifetime earnings of head and wife (if present). One question is whether richer (higher lifetime earnings) households save more than lower income households. Figure 1 plots the mean retirement savings divided by mean lifetime earnings for each decile of lifetime earnings. As can be seen, there is little difference in mean savings rates for the bottom 80 percent of the earnings distribution. However, the top two deciles have higher mean savings rates, and the gap in relative higher saving rates is more pronounced than in Hendricks (2007b). The inclusion of private pensions leads to higher mean levels of savings for all deciles, although the impact of private pensions of the savings rate is slightly larger for households in the top half of the earnings distribution.

2.1 Wealth Distribution

Table 4 summarizes key moments of the wealth distribution for our sample. The first row reports the wealth distribution for the 1994 sample, while the second row reports the distribution of retirement wealth for our sample. The wealth distribution in the PSID is slightly less concentrated than that computed using the Survey of Consumer Finance, which does a better job of surveying the rich. A comparison of the two rows shows that retirement wealth is slightly less unequally distributed than is wealth.

Figure 1: Mean Retirement Wealth/Lifetime Earnings

Table 4: Wealth Distribution: PSID

	1	1-5	5-10	10-20	20-40	40-60	60-80	80-100	Gini	N
Wealth 1994	22.3	22.9	14.4	16.9	16.3	6.5	1.5%	−0.8	0.76	8623
Retirement Wealth	19.3	18.5	13.3	16.0	17.8	9.5	4.7%	1.0	0.65	1168
Retir. Wealth (99-05)	19.9	20.2	13.6	16.9	16.6	8.2	3.9	.7	0.68	456
Retir. incl. Pen. (99-05)	16.8	19.1	13.4	16.5	19.1	9.6	4.5	1.0	0.64	456

Note: The table reports points on the Lorenz curve of wealth and retirement wealth. N denotes the sample size.

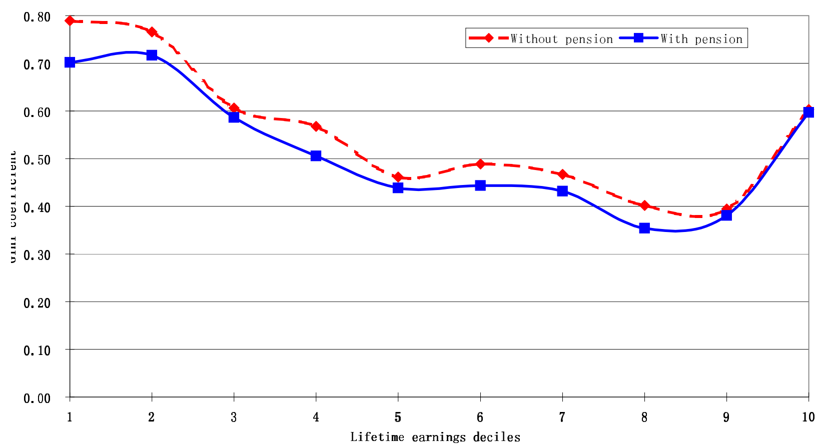
The last two rows of Table 4 reports the key moments of the wealth distribution for households whose head was between the ages of 63 and 67 between 1999 and 2005. For these households, we are able to construct measures of retirement wealth which includes private pensions. Comparing the last two rows of Table 4, one observes that including private pensions reduces the Gini by roughly 6 %, from 0.68 to 0.64.[7] This decrease in the Gini largely reflects the fact that including pensions "evens" the wealth distribution as the share of the top 20 % of the wealth distribution is decreased and that of the middle

[7]The 2005 sample includes one rich household whose exclusion has a noticeable effect on the level of the Gini. However, the size of the gap between the Gini of retirement wealth with and without pensions is not affected much by the exclusion/inclusion of this household.

20 - 60 percentiles increased.

Figure 2 plots the Gini by lifetime earnings decile. As emphasized by Venti and Wise (1998) and Hendricks (2007b), there is a large amount of wealth inequality even within lifetime earnings deciles. This fact is highlighted that the mean Gini across lifetime earnings deciles of net worth is 0.56, while including pensions in retirement wealth only reduces this to 0.52. While including pensions reduces measured wealth inequality, the effect is relatively small. Moreover, the gap between the Gini for both measures of retirement wealth and the average Gini across deciles is roughly the same (0.12).

Figure 2: Gini of Retirement Wealth

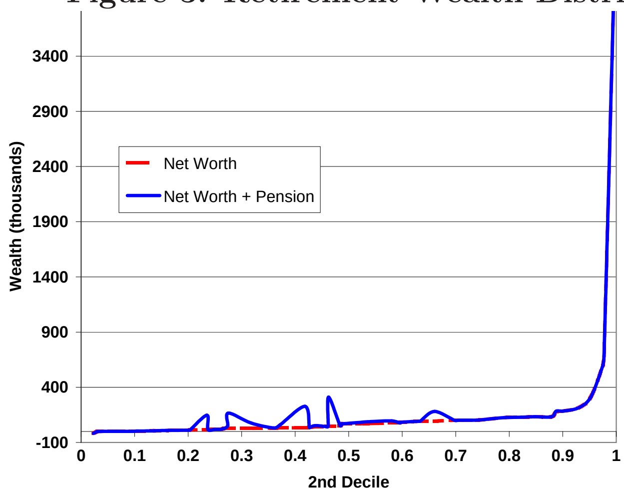


Figures 3 and 4 further illustrate the degree of wealth inequality within lifetime earnings deciles. Figure 3 (4) plots the wealth distribution within the 2nd (9th) lifetime earnings decile. These figures also illustrate the fact that pensions play a much smaller role for lower income households. For the ninth earnings decile, pensions can help account for the fact that a number of households have very little non-pension wealth. However, they do little to reduce the level of wealth inequality overall.

Overall, we find very similar relationships between retirement wealth and lifetime earnings to those summarized in Hendricks (2007b). Comparing retirement wealth including and excluding pension wealth, we have the following findings:

1. For all lifetime earnings deciles, the ratio of mean (median) retirement wealth

Figure 3: Retirement Wealth Distribution



to lifetime earnings increases if retirement wealth includes pension. The ratio increases about three percentage points on average within lifetime earnings deciles.

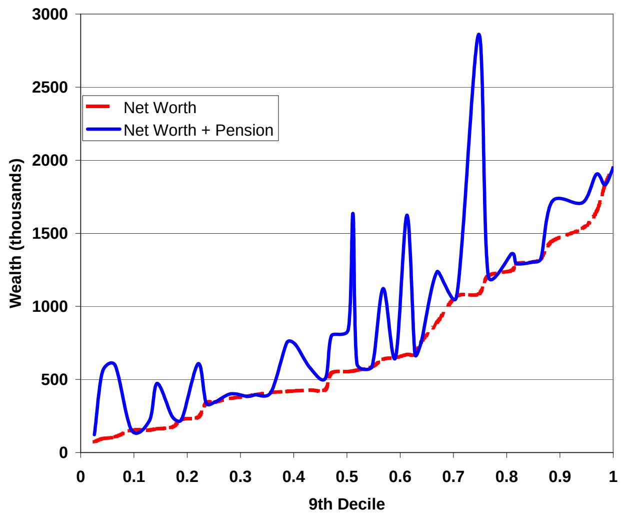
2. Including private pensions leads to a decline in wealth inequality. The Gini coefficient drops from roughly 0.68 to 0.64 when the wealth measure includes private pensions.

3. While there is sizeable retirement wealth (with and without pension) inequality among households with similar lifetime earnings, including private pensions lowers the Gini coefficient in each lifetime earnings decile. The average Gini coefficient within lifetime earnings deciles is 0.56 for wealth excluding private pensions, and 0.52 for wealth including private pensions.

3 Model

We consider a discrete time life cycle model where households live for J periods and maximize their life-time discounted utility from consumption. Households in the model face idiosyncratic shocks to labor earnings, mortality, inheritance, and private pension coverage.

Figure 4: Retirement Wealth Distribution



3.1 Preferences

Households have preferences defined over a consumption stream. The preferences are represented by

$$\sum_{j=1}^{J} \beta^{j-1} \Pi_{t=0}^{j} P_t \frac{c_j^{1-\sigma}}{1-\sigma} \tag{3.1}$$

where $\beta < 1$ is the discount factor, P_t denotes the probability that the household is alive in period t conditional on being alive in period $t-1$, σ is the coefficient of relative risk aversion, and c_j denotes consumption in period j. As in Hendricks (2007a), we assume households do not receive utility from leaving bequests.

3.2 Labor Income Process

Households work in the first $R < J$ periods. After R, households are retired and receive their retirement income. J and R are assumed to be exogenous and deterministic.

In each working period $1 \leq j \leq R$, labor earnings are determined by a deterministic age profile, h_j, and by a transitory productivity $l(e)$:

$$y_j = l(e)h_j \tag{3.2}$$

The evolution of e for household i is governed by an AR(1) process:

$$e_{i,j+1} = \rho e_{i,j} + \varepsilon_{i,j+1} \tag{3.3}$$

where ε are independent and identically normally distributed $N(0, \sigma_\varepsilon^2)$.

When $j > K$, the household i is retired. During retirement households do not receive earnings. Instead, they receive transfer income.

The transfer income consists of two parts. The first part is Social Security benefits, which depend on average earnings, $\bar{y}$, computed over the last 35 years of working life. The second part is the private pension benefits, if the household is covered by private pension plans. Household private pension coverage is stochastic. Its evolution is governed by a transition matrix, which gives probability of retaining (losing) coverage for households with current pension and probability of gaining pension coverage for households that lack coverage. More details on the transfer income are provided in the section of parameterization.

3.3 Household Problem

The state variables for the household are: period j, financial wealth k, earnings state $l(e)$, average earnings over past periods $\bar{y}$, private pension status in current period pen, and years of pension coverage until current period n_{db}. After all random variables are realized in each period, households choose consumption and saving. The Bellman equation for the household problem is given by:

$$V[k, l(e), \bar{y}, pen, n_{db}] = \max_c \left\{ \frac{c^{1-\sigma}}{1-\sigma} + \beta P_t E[V(k', l(e)', \bar{y}', pen', n'_{db}] \right\} \tag{3.4}$$

subject to the budget constraint

$$k' = (1+r)k + y + I + \tau + db - c \tag{3.5}$$

where r is the interest rate, I is a random inheritance which is governed by a probability distribution, τ is Social Security benefits, db is private pension benefits. We assume that borrowing is not allowed in the model.[8]

3.4 Model Parameterization

In this section, we outline our choice of model parameters. Table 5 lists the value of the model parameters for our benchmark parameterization. Given our interest in comparing our results to the literature, our choice of parameter values closely follows Hendricks (2007b).

3.5 Demographics

Households enter the model at age 20 (model period 1) and live up to age 95. They work until age 64 before retiring. Mortality rates are taken from the Period Life Table 1990 of the Social Security Administration. We use female mortality rates and set the rates to zero before age 52.

3.6 Preferences

The coefficient of relative risk aversion σ is set to 1.5. We choose the annual discount factor β equal to 0.958. These parameters are taken from Hendricks (2007b).

3.7 Initial Wealth

The distribution of initial wealth (capital endowment) for new households is estimated from the PSID wealth files. The sample consists of households with heads aged 19-21 in all years. Many young households hold negative net worth and we set them to zero since borrowing is not allowed in the model.

[8]We run an experiment in which we allow households to borrow up to one year of mean earnings but they must repay the debt by age 52. We find that this does not change the findings much.

Table 5: Model Parameters

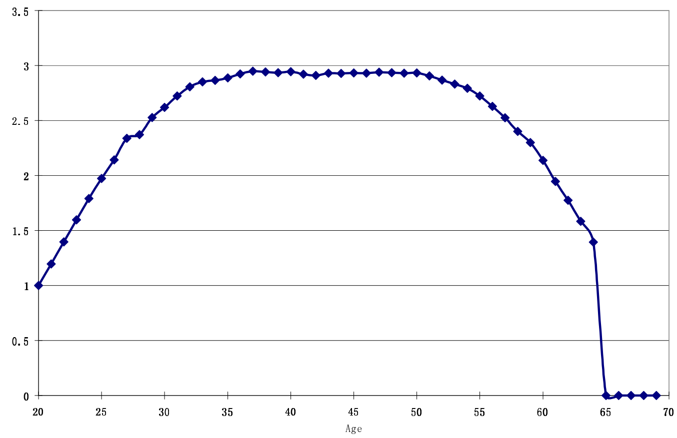
Demographics	
$J = 76$	Maximum lifespan (physical age 95)
$R = 45$	Retirement age (physical age 64)
P_t	Survival probabilities
Preferences	
$\beta = 0.958$	Discount factor
$\sigma = 1.50$	Risk aversion
Labor income	
$\rho = 0.96$	Persistence of e
$\sigma_\varepsilon = 0.21$	Standard deviation of e shocks
$\sigma_{e1} = 0.62$	Standard deviation of $e1$
$l(e) = (0.08, 0.19, 0.44, 1.00, 2.27, 5.18, 11.77)$	Labor income state
Inheritances	
$j = 33$	Age of inheritance (physical age 52)
$P_I = (0.50, 0.30, 0.10, 0.08, 0.02)$	Probabilities of inheritance
$I = (0.0, 1.6, 4.3, 15.9, 58.0)$	Inheritance amounts multiples of mean earnings per household
Private pensions	
$\theta(e) = (0.00, 0.05, 0.10, 0.20, 0.30, 0.60, 0.80)$	Pension coverage at $j = 1$
$\alpha(n_{db})$	Generosity factor. See text
Other parameters	
$r = 0.04$	Interest rate

3.8 Labor Income

The experience profile ($X_{ij}\beta$) from equation 2.1 is used as the age earnings profile of the model household. Since the regression only uses strictly positively earnings observations, the implied age earnings profile is also multiplied by the fraction of households with strictly positive earnings observed at each age. The resulting profile is shown in Figure 5.

The remaining parameters of the labor income process in working periods are ρ and σ_ε. New households draw their first labor endowment from a Normal distribution with mean zero and standard deviation σ_{e1}. The values of ρ, σ_ε, and σ_{e1} are taken from

Figure 5: Lifetime Earnings Profile



Hendricks (2007b).[9] The AR(1) process is discretized as a seven-state Markov process using the Tauchen method.

The distribution of lifetime earnings is reported in Table 6. The model does a reasonably good job of replicating the distribution of lifetime earnings.

Table 6: Distribution of Lifetime Earnings

	1	1-5	5-10	10-20	20-40	40-60	60- 80	80-100	Gini
PSID	4.4	9.5	9.1	15.5	24.5	18.0	12.3	6.6	0.32
Model	5.2	12.4	10.6	16.0	23.1	15.3	11.2	6.1	0.37

Source: The table shows the points on the Lorenz curves of annual and lifetime earnings. Data is from Hendricks (2007b).

3.8.1 Inheritance

Following Hendricks (2007b), inheritances are received at age 52 (model period 33) in the model. The distribution of inheritance is approximated on a five-point grid. The probabilities (P_I) and inheritance levels (I) are reported in Table 5. We assume

[9] These values are also used in Huggett (1996).

that households have no information about future inheritances and inheritances are not correlated with earnings.

3.8.2 Social Security Benefits

Households receive Social Security benefits during retirement. We assume that the benefits depend on average earnings, $\bar{y}$, computed over the last 35 years of working life. In each year, the contribution of current earnings to $\bar{y}$ is capped at $\bar{y}_{max} = 2.47\widetilde{y}$, where $\widetilde{y}$ is mean earnings before tax of all working age households. Social Security benefits are a piecewise linear function of average earnings:

$$\tau(\bar{y}) = 0.9\min(\bar{y}, \bar{y}_1) + 0.32\max(0, \min(\bar{y}, \bar{y}_2) - \bar{y}_1) + 0.15\max(0, \bar{y} - \bar{y}_2) \qquad (3.6)$$

where $\bar{y}_1 = 0.2\widetilde{y}$ and $\bar{y}_2 = 1.24\widetilde{y}$ are the bend points.

3.8.3 Private Pension

In the United States, many employees are also covered by private (employer sponsored) pension plans and receive pension benefits during retirement. In general there are two types of private pension plans in the U.S.: defined benefit (DB) pension plans and defined contribution (DC) pension plans. In the traditional DB plans, employees are entitled to receive regular retirement payments for as long as they live, which are most often determined by a formula. The DB plans are managed by employers and employees typically do not make active decisions.[10] In contrast to DB plans, participation in DC plans often requires active decisions by eligible employees. These employees need to make decisions about whether or not to participate, how much to contribute (subject to plan and legislative limits), and how to invest their money. Employers often provide matching contributions (up to a pre-determined limit) for employee contributions. This is typically the case for a 401(k) plan.

Since about 90% of the present value of private pensions for households with heads aged 60-69 in 2005 PSID are defined benefit, we only consider DB pension plans in this paper. The DB pension benefits, db, are given by

$$db = \alpha(n_{db})n_{db}\bar{y}_p \qquad (3.7)$$

[10] This is so particularly for private sector.

where $\bar{y}_p$ is the average earnings over last 35 years of working life, n_{db} denotes years of pension coverage, and $\alpha(n_{db})$ is the generosity factor, which represents the fraction of average earnings each year of coverage adds to pension benefits.[11] We call $\alpha(n_{db})n_{db}$ the replacement rate of average earnings.

Pension coverage is stochastic and has life cycle component. To find the pension benefits for each household in the model, we need to generate the rise in fraction of households with pension coverage over life cycle and match the distribution of replacement rate.

The pension coverage for new households is set to 20%, which is the pension coverage rate for households with heads aged below 25 in the 2004 Survey of Consumer Finances (SCF). Since the possibility of pension coverage is higher for high income households in the SCF, we set different probability of pension coverage for different income states. The fraction of each income group with pension coverage at age 20 is given in Table 5.

To generate the rise in fraction of households with pension coverage over life cycle and match the distribution of replacement rate, we approximate $\alpha(n_{db})$ with a step function[12]:

$$\alpha = \begin{cases} 0 & \text{if } n_{db} \leq 7 \\ 1.25 & \text{if } n_{db} \in [8,\ 10] \\ 1.62 & \text{if } n_{db} \in [11,\ 20] \\ 2.50 & \text{if } n_{db} \in [21,\ 35] \\ 2.50\frac{35}{n_{db}} & \text{if } n_{db} \in [36,\ 45] \end{cases} \tag{3.8}$$

To capture the fact that pension coverage is stochastic and persistent, we assume that the pension transition matrix is asymmetric. Households with pension coverage at period t face a probability of 0.91 of continuing to have coverage at $t+1$, and a complementary probability of 0.09 of losing coverage. Households without coverage at date t have a 3 percent probability of transiting to coverage at $t+1$ and a 97 percent probability of remaining uncovered in the following period.

Table 7 compares the pension coverage and the average of replacement rate with the PSID data.[13] Lifetime pension coverage is higher in the model. Our choice is based

[11] Pension benefits for some DB plans are based on earnings history, while others are based on terminal earnings. Here we assume that pension benefits depend on earnings history.

[12] Many DB plans have service requirement. See Foster (1997) and Mitchell (2003). Here we assume a vesting period of 7 years.

[13] For the PSID data, households are included in the sample if they satisfy the following criteria: (1)

on the consideration that the pension coverage in the PSID is lower than that in the 2004 SCF and other sources (e.g., Gustman and Steinmeier (1999)). For the average replacement rate, the model matches the PSID very well.

Table 7: Pensions Coverage and Replacement Rate

PSID		Model	
Coverage	Mean Replacement	Coverage	Mean Replacement
44%	34%	53%	34%

Table 8 compares the distribution of replacement rate for pension holders with the PSID data. The table reports the fraction of households in three different ranges of replacement rate and the average replacement rate for these households in each replacement range. The model comes close to replicating the replacement rate distribution.

Table 8: Distribution of Replacement Rate

	PSID		Model	
Replacement Range	Fraction	Mean Replacement	Fraction	Mean Replacement
$< 20\%$	38%	9.25%	35%	11.5%
$[20\%, 60\%]$	43%	38.11%	44%	33.5%
$> 60\%$	19%	75.21%	20%	75.6%

4 Simulation Results

In this section we present and discuss our simulation results.

4.1 The Impact of Private Pensions

head aged 60-69 in the 2005 PSID; (2) at least 20 years of nonzero earnings are observed for the head in 1968-2005, so that lifetime earnings can be calculated; and (3) non-immigrant.

We begin by examining the impact that private pensions have on the wealth distribution. Table 9 reports the wealth distribution for the benchmark economy with and without private pensions. As is well known, the benchmark life-cycle model with stochastic earnings does a relatively poor job in accounting for the wealth holdings of the top 1 percent of the wealth distribution.

Including private pensions has a significant impact on the retirement wealth distribution. The addition of private pensions leads to increased inequality in non-pension wealth in the model, with the Gini increasing from 0.56 to 0.62. This moves the model predictions considerably closer to the data, as the Gini of non-pension wealth in the data is 0.68. What drives this is that the presence of pensions reduces the amount of wealth held by relatively wealth poor households in the model and increases that of relatively wealth rich households.

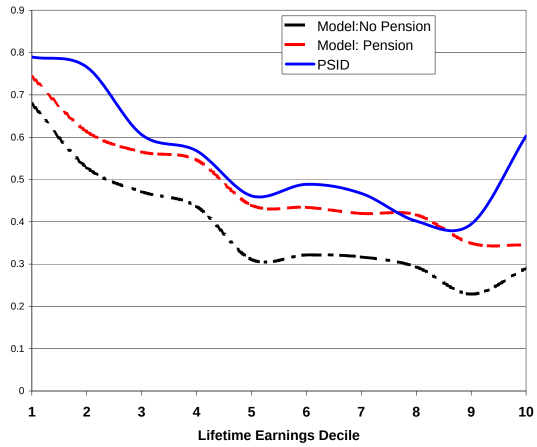
Table 9: Retirement Wealth Distribution at 65

Model	Wealth	Top 1%	1-5%	5-10%	10-20%	20-40%	40-60%	60-80%	80-100%	Gini
No-pens.	Fin	8.3	17.7	14.6	18.0	21.8	11.5	6.2	1.8	0.56
Pens.	Fin.	9.8	19.9	15.9	18.7	20.7	9.9	4.4	0.7	0.62
Pens.	Fin.+ P.	8.1	17.1	14.3	17.8	21.8	12.1	6.6	2.3	0.54
PSID	Fin	19.9	20.2	13.6	16.9	16.6	8.2	3.9	.7	0.68
PSID	Fin.+. Pen.	16.8	19.1	13.4	16.5	19.1	9.6	4.5	1.0	0.64

Tempering this result, however, is the fact that there remains a large difference between measured inequality of total private wealth (including pensions) in the data and the data. Whereas the model predicts a Gini of wealth including pensions of 0.54, the PSID data predicts a Gini of 0.64. The impact of pensions on the total wealth distribution – which includes private pensions – works in the opposite direction. The intuition is that the presence of defined benefit pensions reduces the need of many prime age households to save against retirement. This works to reduce the fraction of income held by the richest households. At the same time, in our model, some low income households qualify for pensions which leads them to reduce their non-pension wealth.

This trade-off can also be seen in the Gini coefficients for each lifetime earnings decile. Figure 6 plots the Gini coefficient for each lifetime earning decile for the net

Figure 6: Gini Coefficient of Retirement Wealth (Net Worth)

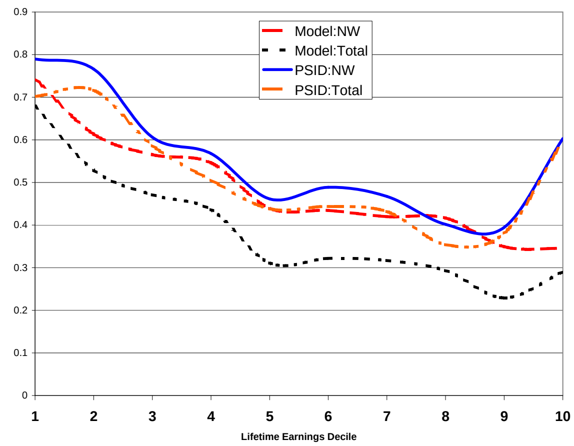


worth measure of retirement wealth for the model simulations with and without private pensions, as well as the PSID data. Introducing pensions into our model goes a long way towards reducing the gap between the model and the data emphasized by Hendricks (2007b). However, this success is largely undone when one compares total retirement wealth including pensions. As can be seen from Figure 7, for each lifetime earnings decile the gap between total retirement wealth (including pensions) predicted by the model with pensions and the data are only slightly smaller than the gap between net worth in the model without private pensions and the data.

4.2 Within Decile Wealth Distribution

A key dimension along which to evaluate the impact of pensions is their impact on the distribution of wealth within lifetime earnings declines. We focus on the second and ninth lifetime earnings deciles. To begin, it is worthwhile to look at what part of the distribution that the standard model misses. As shown in Hendricks (2007b), the benchmark model without private pensions does a very good job of matching the bottom 80 percent of the wealth distribution of the second income decile. What the model misses – even with bequests – is the large wealth holdings of the wealthiest households in second income decile. In contrast, the model misses the wealth distribution of the ninth lifetime earnings decile in the opposite way. The model significantly over predicts the savings of

Figure 7: Gini Coefficient of Retirement Wealth (Total)

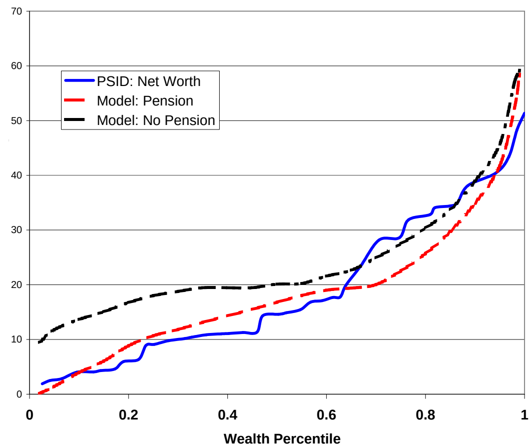


the bottom 80 % of the wealth distribution, while slightly under predicting the wealth of the top few percentiles.

Private pensions – in principle – should help to deal with the second discrepancy between model and data. The intuition is that private pensions are relatively common among higher income workers. The presence of private pensions reduces the level of non-pension savings. This is the picture that emerges in Figure 8, which reports the non-pension wealth (labeled "NW") for the model with and without private pensions as well as that from the PSID for the ninth lifetime earnings decile. Private pensions moves the distribution of wealth distribution downwards for lower wealth households, thus reducing the gap between the model and the data.

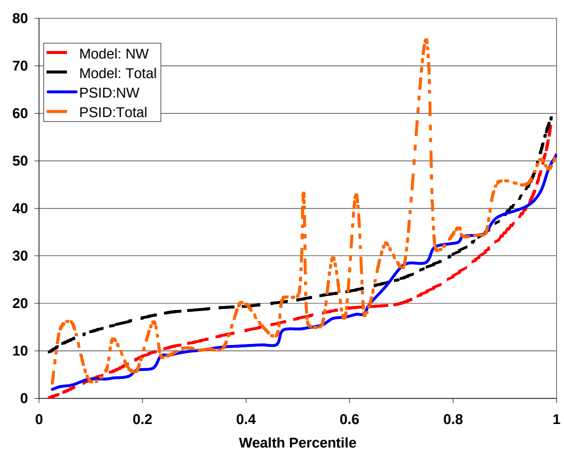
The introduction of private pensions, however, leads to significant gaps in the joint distribution of pension and non-pension retirement wealth. Figure 9 plots the distribution of retirement wealth including and excluding pension wealth i the model and the PSID for the ninth lifetime earnings decile. On the one hand, many low net worth households have pensions in the data – which matches the fact that in the model all low net worth households have pensions. However, there are two discrepancies between the data and the model predictions. First, a number of low net worth households in the data lack pensions. Second, some relatively high net worth households have very large pensions – which results in the richest households holding more wealth than predicted

Figure 8: Retirement Wealth Ninth Lifetime Earnings Decile



by the model. As a result, private pensions can only partially resolve the discrepancy between theory and data.

Figure 9: Retirement Wealth Ninth Lifetime Earnings Decile



The same qualitative effect of private pensions can be seen in the second and fifth lifetime earnings deciles. However, the effect is much smaller for the lower lifetime earnings groups. This is due to two forces. First, lower lifetime earnings households are much less likely to receive private pensions in the model economy. Second, the presence of social security already causes many low income households to hold very little savings.

This in turn means that most low income households save very little, which means that there is little scope for pensions to offset non-pension savings.

4.3 Social Security and the Wealth Distribution

A number of papers have emphasized the important role played by social security in accounting for the distribution of wealth (e.g. Huggett and ventura (2000)). Given that private pensions are a significant fraction of retirement wealth, it is interesting to compare the relative effect of private pensions and social security on the wealth distribution in the model. To illustrate this point, we consider two counterfactuals where we shut down social security in our model: (i) shut down social security in the model without private pensions, and (ii) shut down social security in the model with private pensions.

The results of these experiments are reported in Table 10. The first row reports the wealth distribution for the economy with no social security and no private pensions. The elimination of social security in the model without private pensions leads to a significant fall in wealth inequality, with the Gini declining from 0.56 to 0.44. This is not surprising since all households have to save more, particularly for poor households. When social security is shut down in the model with private pensions, the Gini coefficient also drops significantly for retirement wealth with and without private pensions.

There are two messages from these counterfactual experiments: (i) Including private pensions still has a big impact on the non-pension retirement wealth when there is no social security, with the Gini increasing from 0.44 to 0.49, and (ii) Compared to Table 9, we find that social security has a larger impact on wealth inequality than private pensions. This is likely due to the fact that only part of households is covered by private pensions, while social security covers all households in the model.

5 Conclusion

This paper explores the impact of private pensions on the distribution of retirement wealth. We find that incorporating private pension system resembling that prevalent in the U.S. moves the predictions of the model closer to the data. However, there remains

Table 10: Wealth at 65: Without Social Security

Model	Wealth	Top 1%	1-5%	5-10%	10-20%	20-40%	40-60%	60-80%	80-100%	Gini
No-pens.	Fin	6.2	14.0	12.1	16.7	22.8	14.1	9.4	4.5	0.44
Pens.	Fin.	7.1	15.5	13.0	17.5	22.1	13.4	8.1	3.2	0.49
Pens.	Fin.+ P.	6.3	14.1	12.2	16.8	22.7	14.1	9.3	4.5	0.45
PSID	Fin	20.6	17.9	13.8	17.7	17.1	8.4	4.0	.7	0.67
PSID	Fin.+. Pen.	16.9	17.5	13.1	17.1	19.9	10.1	4.5	1.0	0.63

a significant degree of wealth hetereogeneity within lifetime earnings deciles that the model with private pensions fails to account for.

Appendix A: The PSID Data

We compute after tax income using two methods. The first method using Taxsim. The second is based on a manual estimate of household taxes.

For comparison with Hendricks (2007b), we also report the sub-sample of households when we drop the additional households for whom we have retirement wealth from the 2005 supplemental wealth survey.

Table 11: Sample Statistics for 1984-2003 Retirement Wealth: PSID

	Couples		Singles	
	Mean	Std.	Mean	Std
Number observations	655	–	419	–
Mean birth year	1927.7	6.5	1928.5	6.5
Years of school	11.7	3.6	11.4	3.3
Earnings Observations	25.8	5.5	26.5	5.3
Mean Earnings age 40-50	34.2	20.7	22.8	15.2
Mean lifetime earnings	3969.6	2087.6	2185.0	1333.4
Mean Retirement Wealth	388	810.6	156.8	532.1
Median Retirement Wealth	195.5	–	49.7	–

Dollar figures are in thousands of detrended 1994 dollars.

Appendix B: Numerical Solution

We use numerical dynamic programming techniques to approximate the decision rules as well as the value function. The dynamic program has five state variables in addition to period j: financial wealth k, earnings state $l(e)$, average earnings over past periods $\bar{y}$, private pension status in current period pen, and years of pension coverage until current period n_{db}.

We discretize the state-space along the two continuous state variables, k and $\bar{y}$. The model is solved using backward induction. In the last period ($j = J$) the policy functions are trivial. In periods prior to J, we calculate optimal decision rules for each possible combination of nodes, using stored information about the subsequent period's decision rules and value function. We follow Tauchen (1986) to approximate the distributions of the innovations to the labor income process. For points which do not lie on the state-space grids, we evaluate the value function using a bi-cubic spline interpolation along the two dimensions. After computing the values of all the alternatives, we pick the maximum, thus obtaining the decision rules for the current period. This process is iterated until $j = 1$.

Once we determine the optimal decision rules for all possible nodes in each period, we conduct simulations. We simulate the income history of 10,000 households. We then compare our numerical results with the results in Hendricks (2007b) and the PSID data. Because a large amount of computation time is required to solve the model, all programs are parallelized and run on SHARCNET.[14]

[14]SHARCNET is a multi-institutional High Performance Computing network that spans 17 academic institutions in Ontario, Canada.

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