Private Pensions, Retirement Wealth and Lifetime Earnings*

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October 2010

Abstract

This paper investigates the effect of private pensions on the retirement wealth distribution. We incorporate stochastic private pension coverage into a calibrated life-cycle model with stochastic earnings. While private pensions lead to higher wealth inequality, the model generates less inequality in retirement wealth than observed in the PSID. We find that a life-cycle model with private pensions, heterogeneous life-cycle earnings profiles and permanent return differences across households can largely account for the sizeable variation in retirement wealth.

JEL classification: D31; E21; J32

Keywords: Private pensions; Wealth inequality; Retirement.

*We thank Jim Davies, conference participants at the 2008 PSID Conference on Retirement Wealth, the 2009 FESAMES and the 2009 SERC, and seminar participants at Guelph, NTU and SMU for their helpful comments. We thank Xiaoyu Yu for outstanding research assistance. This research was supported by the PSID small research grant "Private Pensions, Retirement Wealth and Lifetime Earnings." The authors thank SHARCNET for access to computing facilities without which this research could not have been conducted. MacGee is grateful to the Federal Reserve Bank of Cleveland for their support during the writing of this paper. The views expressed herein are those of the authors and not necessarily those of the Federal Reserve Bank of Cleveland or the Federal Reserve System.

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1 Introduction

Although there is a large literature on wealth inequality using quantitative life cycle models (e.g. Huggett (1996), De Nardi (2004), Cagetti and De Nardi (2008)), relatively little attention has been paid to employer sponsored pension plans. This is surprising, as employer provided pension plans represent a significant share of household retirement wealth, with estimates ranging from 20 - 40 % of total retirement saving (Munnell and Perun (2006), Gustman, Steinmeier, and Tabatabai (2010)). In addition, pension coverage is incomplete as not all employers offer private pensions (Buessing and Soto (2006)), which may lead to different saving rates for workers with and without access to employer provided pensions.

This paper tackles this gap in the literature, and undertakes a quantitative examination of the impact of private pensions on the U.S. retirement wealth distribution. To address this issue, we incorporate private pensions into an incomplete market life-cycle model calibrated to the U.S. economy. In the model, households face stochastic income, and 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 lifetime earnings, and stochastic inheritances.[1]

We use this model to address two closely related questions. First, do private pensions have a large quantitative impact on the distribution of retirement wealth? Second, can private pensions help account for two discrepancies between the "standard" life cycle model and the data documented by Hendricks (2007b): for reasonable parameter values, the life-cycle model generates (i) too little variation in retirement wealth between households with similar lifetime earnings; and (ii) the model implies too tight a relationship between lifetime earnings and retirement wealth.

To evaluate and discipline our model results we use the Panel Study of Income Dy-

[1]Extending the model to include an explicit bequest motive does not impact our main results.

namics (PSID) to construct estimates of retirement wealth and lifetime earnings. We make use of the fact that since 1999 the PSID supplemental wealth survey has included questions on employer provided pensions. This allows us to compare two measures of household wealth at retirement: one based on net worth and a more comprehensive measure which includes the present value of private pensions.

Private pensions are a significant component of PSID retirement wealth, accounting for roughly 25 % of total private (excluding social security) retirement wealth, and roughly one in two households have a private pension. Although pension wealth is more unequally distributed than non-pension wealth, including pensions in retirement wealth lowers inequality, as the Gini is 0.62 versus 0.65 for net worth. We also find that the correlation between lifetime earnings and retirement wealth is higher when pension wealth is included in retirement wealth. Interestingly, the correlation between retirement wealth and earnings varies across income groups, with the top half of lifetime earnings having a much higher wealth-earnings correlations than the bottom 50 percent.

Similar to Venti and Wise (1998) and Hendricks (2007b), we find significant dispersion in retirement wealth within lifetime earnings deciles.[2] Including private pensions lowers within decile wealth inequality, with the average Gini coefficient within lifetime earnings deciles declining from 0.55 for net worth to 0.51 for total private retirement wealth. We also find that private pensions increase mean saving rates for each decile of lifetime earners by roughly two percentage points.

We simulate the model economy, calibrated to U.S. data, with and without a private pension system. While private pensions have a significant impact on retirement wealth, the quantitative effect on retirement net worth inequality is roughly half as large as Social Security. This is due to the very different coverage and replacement rates of the two pensions systems. We also find, as suggested by Huggett and Ventura (2000), that the U.S. social security system encourages higher savings rates for households with high

[2]Bernheim, Skinner, and Weinberg (2001) use the PSID and the CEX to examine retirement wealth inequality.

lifetime earnings even in the presence of private pensions. However, our model suggests that this effect can account for only a third of the difference between the average saving rates of the top two deciles of lifetime earners and middle earners.

We find that private pensions can partially account for the discrepancies between the life-cycle model and the data emphasized by Hendricks (2007b). Private pensions lead to a more unequal retirement net worth distribution, with the mean Gini for net worth within lifetime earnings deciles increasing to 0.49 from 0.39 in the no pension economy. This accounts for nearly two-thirds of the difference between the standard life cycle model and the PSID Gini of 0.55. While the correlation between retirement net worth and lifetime earnings is lower in the pension than the no-pension model economy, at 0.80 it remains well above the 0.64 observed in the PSID. However, the model correlations for the top (bottom) half of lifetime earners are much closer to the PSID estimates.

While the life-cycle model with private pensions can largely account for the distribution of retirement net worth, the model understates the degree of inequality in total retirement wealth (net worth plus private pensions). This reflects two key differences between the joint distribution of pension and non-pension wealth in the model and data. First, virtually all model households with high lifetime earnings and low net worth have private pensions, while in the PSID many high earners with low net worth lack pensions. Second, the pension offset effect in the model is larger than in the data. As a result, the model generates too few households with high earnings and large pension and non-pension retirement wealth.

This leads us to introduce two additional mechanisms which may increase the dispersion of retirement wealth: earnings profile heterogeneity and rate of return heterogeneity. We find that the life cycle model augmented to include private pensions, return and profile heterogeneity can largely account for the dispersion of retirement wealth, as the model closely matches the data Gini for both non-pension retirement wealth (0.67 versus 0.65 in the data) and total retirement wealth (0.60 versus 0.62 in the data). The Gini of retirement net worth *within* lifetime earnings deciles is close to the data: with a

cross-decile mean of 0.47 versus 0.51 in the PSID. While the correlation between earnings and retirement net worth remains higher in the model, at 0.72, than the data, 0.64, the correlations within the top and bottom half of lifetime earners are very close to the data. The correlation between net worth and lifetime earners for the top (bottom) half of earners is 0.72 (0.18) in the model versus 0.71 (0.14) in the PSID.

These positive results are tempered by a continued discrepancy between the model predictions and the data for households with pensions. While the model now generates a number of high earners without pensions with low retirement wealth, it generates too few households with large pension and non-pension wealth. This is driven by a (too) large pension offset effect. As a result, mean savings rates for households with pensions in the PSID are higher than predicted by the model. Interestingly, this leads to the opposite problem of Hendricks (2007b), as the model now generates *more dispersion* in retirement net worth than in the data.

Our results have important implications for the debate over what drives the large variation in retirement wealth. Venti and Wise (1998), Hendricks (2007b) and Hendricks (2007a) argue that a large amount of the observed dispersion in retirement wealth is due to differences in savings propensities, possibly due to heterogeneity in household preferences. Our findings suggest preference heterogeneity may play a smaller role. Not only does the model extended to include pensions, profile and return heterogeneity largely account for retirement wealth dispersion, it also moves the model predictions for life-cycle wealth inequality closer to the data. Hence, while our findings do not fully account for the quantitative differences between the life-cycle model and the data, they greatly reduce the gap to be explained by preference heterogeneity.

There is a sizeable literature which uses quantitative life cycle models to examine wealth inequality.[3] While much of this literature abstracts from private pensions, several related papers on the adequacy of household retirement savings have incorporated private pensions.[4] In an important contribution, Engen, Gale, and Uccello (1999) introduce

[3]Cagetti and De Nardi (2008) provide an excellent survey of this literature.

[4]Several recent papers compare the effects of defined benefit versus define contribution pension plans

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 Health and Retirement Study (HRS). They conclude that most HRS households have accumulated more wealth than their optimal targets. Our paper differs both in the modeling of private pensions and in the focus on the retirement wealth distribution. In our model pensions are conditioned on each households earnings history and private pension coverage is stochastic, whereas in both of these papers pensions only depend on last period earnings.

Most closely related to this project are several recent papers which examine alternative explanations for the discrepancies between the life cycle model predictions for retirement wealth dispersion and the PSID data documented by Hendricks (2007b). Guner and Knowles (2007) argue that marital instability is important for accounting for household wealth heterogeneity, since married and never divorced households have higher wealth levels than divorced or never married households. Yang (2009) explores the role of the timing of intergenerational bequests, and finds that this can lead to higher retirement wealth dispersion.

The remainder of the paper is organized as follows. Section 2 documents some empirical findings on retirement wealth. Section 3 outlines the model and the parameterization. In Section 4 we report the results of our numerical experiments involving private pensions. Section 5 explores the impact of household heterogeneity in life-cycle earnings profiles and asset returns on the retirement wealth distribution, while section 6 concludes.

2 Empirical Evidence: Retirement Wealth

The data is drawn from the 1968-2005 waves of the Panel Study of Income Dynamics (PSID) and the PSID supplemental wealth files. We focus on households reporting wealth when the head is 65 years of age. In order to be in the sample, households retirement

on household retirement wealth, e.g. see McCarthy (2003)

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 into 1994 prices using the Consumer Price Index. Time trends are removed by dividing by year effects (γ_t) estimated from regressing household earnings y_{it} on a quartic in potential experience X_{it} and year dummies

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

To construct lifetime earnings, we use the labor income (net of tax) of the household head and spouse, which consist of wages, salaries, bonuses, overtime, and the labor part of business income. The present value of lifetime earnings is the discounted sum of earnings between ages 18 and 65, where the discount rate is 4 percent.[5]

We examine two measures of retirement wealth, where "retirement" refers to the year the household head turns 65. The first is the PSID variable Wealth2 (which we refer to as net worth), which includes financial wealth, private annuities, IRAs, real estate, business wealth, vehicles, life insurance policies, trusts and other assets less debts. The second wealth measure adds employer provided pensions (both defined contribution plans and defined benefit plans) to Wealth2, and is available biannually for 1999-2005.[6] We use this to compute pension wealth for households whose head turned 65 between 1997 and 2007, which gives us a sample of 455 households.[7]

As can be seen from Table 1, private pensions are a significant component of wealth – nearly a quarter of mean (excluding social security) retirement wealth. Roughly 51 per-

[5]We replace missing values using their predicted values, which are based on a fixed effect regression of detrended income for men and women separately on a quartic in experience.

[6]For households who turn 65 between wealth observations: (i) If we observe wealth before and after they turn 65, we use interpolation to estimate their wealth at 65, or (ii) If we only observe wealth once between the ages of 63 and 67, we use this as their retirement wealth.

[7]The supplementary appendix (available on the authors website) reports more details on how we construct pension wealth. The Appendix also reports summary statistics of the larger sample (1168) of households for whom we can compute retirement net worth using PSID wealth data collected in 1984, 1989, 1994, 1999, 2001, 2003, and 2005. The data reported here resembles the larger sample.

cent of households have private pensions. Private pension wealth is even more important for households with pensions, accounting for roughly one-third of retirement wealth. The median values of private pensions are $148,500 and $96,000 for couples with pensions and singles with pensions, respectively. The ratio of net worth to lifetime earnings is also higher, for couples (9.6 %) than for single person households (6.7 %).

Table 1: Sample Statistics: 1999 - 2005 PSID

	Couples		Singles	
	Mean	Std.	Mean	Std
Number of observations	253	–	202	–
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
Earnings at age 40-50	43.4	24.6	26.9	18.6
Lifetime earnings	4582.7	2169.6	2767.5	1437.3
Retirement wealth	441.6	728.4	185.5	430.5
Median retirement wealth	225.6	–	59.2	–
Private pension wealth	143.4	340.9	42.9	90.6
R.W. (incld. Pensions)	585.0	953.7	228.4	446.1
Median R.W. (incld. Pensions)	316.0	–	83.7	–

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

The distribution of retirement wealth at age 65 is less unequal than the distribution of wealth across all households. The first row of Table 2 reports the cross sectional wealth distribution for the 1994 PSID, while the second row reports the distribution of retirement net worth wealth for our sample. Comparing the two rows, one sees that the Gini of net worth at retirement is 0.11 points lower than the Gini for net worth across all households. This reflects the life-cycle nature of wealth accumulation for retirement, which leads to increasing levels of wealth as households approach retirement.

The last three rows of Table 2 reports the distribution of pension and retirement wealth for households whose head age was between 63 and 67 at some point between 1999 and 2005. Including pensions tends to equalize the overall distribution of retirement wealth. Comparing the second and fourth rows of Table 2, including private pensions

Table 2: Wealth Distribution: PSID

	Top 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
Retir. Wealth (99-05)	14.2	19.2	14.6	19.0	18.8	9.1	4.3	0.8	0.65	455
Pension (99-05)	18.3	26.2	14.2	20.0	19.0	2.3	0.0	0.0	0.78	455
Retir. incl. Pens. (99-05)	14.6	17.6	14.2	17.6	20.1	10.2	4.6	1.1	0.62	455

Note: N denotes the sample size. Wealth and Retirement Wealth refer to net worth (Wealth2).

reduces the Gini by roughly 5%, from 0.65 to 0.62. This reflects the "evening" effect of pension wealth on the wealth distribution, as pensions increase the middle 20 - 60 percentiles share of wealth. Combined with the fact that pensions are more unequally distributed than net worth,this suggests that pensions offsets net worth accumulation.

The overall magnitude of pensions in our sample are slightly lower than estimates based on the Health and Retirement Survey (HRS).[8] Gustman and Steinmeier (1999) and McGarry and Davenport (1998) use the HRS to examine pension wealth for households with at least one member aged 51-61 in 1992, which is a nearly identical birth cohort to ours, albeit observed roughly a decade earlier. They find that pension wealth accounted for roughly a third of mean retirement wealth in the HRS, and that roughly two-thirds of households had some pension coverage.[9] The equalizing effect of pension wealth on total wealth is consistent with the findings of Kennickell and Sunden (1997) and Wolff (2007), who used cross-sectional data from the Survey of Consumer Finances.

[8]The main data sources for pension wealth are the Survey of Consumer Finances (SCF) and the Health and Retirement Survey (HRS). Compared to the PSID, the SCF provides better coverage of the wealthiest households (which it over-samples), which is why SCF wealth measures typically have higher Gini's. Since the SCF is a cross-sectional survey, it provides limited information on earnings histories. The HRS is perhaps the most widely used data source for retirement wealth, and has a larger sample of households with detailed data on the composition of retirement wealth (see Gustman, Steinmeier, and Tabatabai (2010) for an overview of pension data in the HRS).

[9]One possible explanation of lower pension coverage rates in our PSID sample is that some IRA accounts included in net worth originated with rolled over pension plans.

2.1 Lifetime Earnings and Retirement Wealth

The joint distribution of retirement wealth and lifetime earnings plays a key role in assessing how well the predictions of the life-cycle model match the data. We focus on three dimensions of the joint distribution. The first is the correlation between lifetime earnings and retirement wealth, which the standard life-cycle model predicts should be positive. The second is how (whether?) saving rates vary with income, while the third is the extent of wealth inequality among households with similar lifetime earnings.

Table 3 reports the correlations between lifetime earnings, net worth (excluding pensions), total retirement wealth (net worth plus private pensions) and private pensions. The life-cycle model prediction that lifetime earnings and retirement wealth are positively correlated is borne out in the data (we discuss their quantitative fit in Sections 4 and 5). The correlation between total retirement wealth (net worth plus pension wealth) and lifetime earnings (0.7) is higher than that of net worth and lifetime earnings (0.64). Consistent with the higher prevalence of employer pensions among higher paid positions, private pension wealth is positively correlated with lifetime earnings and net worth.

Table 3 also shows that the correlation between earnings and wealth differs dramatically with income. We divide the sample into halves based on lifetime earnings, and look at the correlations within each group. The correlations for the top half of earners between earnings and wealth are slightly higher than for the entire sample. However, the relationship is much weaker for the bottom half of earners.

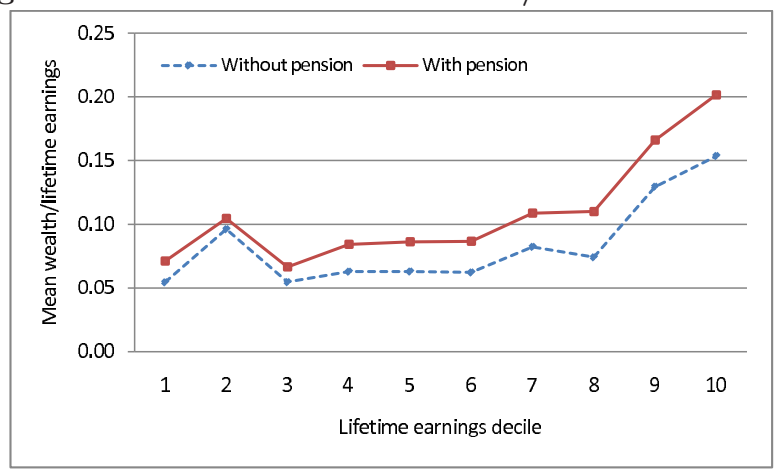
Table 3: Correlation Coefficients

		Earnings	Net Worth	Net Worth + Pension	Pensions
All Households	Earnings	1.00	0.64	0.70	0.65
	Net Worth	0.64	1.00	0.95	0.59
Top 50 % Earners	Earnings	1.00	0.71	0.73	0.64
	Net Worth	0.71	1.00	0.95	0.57
Bot. 50 % Earners	Earnings	1.00	0.14	0.17	0.06
	Net Worth	0.14	1.00	0.98	0.09

Note: Net worth is private retirement wealth excluding private pensions. N = 455.

To examine the relationship between saving rates and lifetime earnings, we sort households into lifetime earnings deciles. For each decile, the average saving rate is mean retirement wealth divided by mean lifetime earnings. As can be seen from Figure 1, there is little difference in mean saving rates for the bottom 80 percent of earners. However, the top two deciles have higher mean savings rates. This gap in saving rates is slightly more pronounced than in Hendricks (2007b) (who also looks at the PSID) or Venti and Wise (2000) (who use the HRS). The inclusion of private pensions leads to higher levels of savings for all deciles, although the impact of private pensions on the savings rate is slightly larger for households in the top half of the earnings distribution.

Figure 1: Mean Retirement Wealth/Lifetime Earnings



We follow Venti and Wise (1998) and Hendricks (2007b) and examine the wealth distribution within lifetime earnings deciles. As Figure 2 illustrates, there is sizeable retirement wealth inequality even within lifetime earnings deciles. Although pensions reduce retirement wealth inequality, the effect is not large. The mean Gini of net worth across lifetime earnings deciles is 0.55, while including pensions in retirement wealth only reduces this to 0.51. Figure 2 also shows that the gap between the Gini for net worth and total retirement wealth is primarily due to households in the fourth through seventh lifetime earnings deciles.

Figure 2: Gini of Retirement Wealth

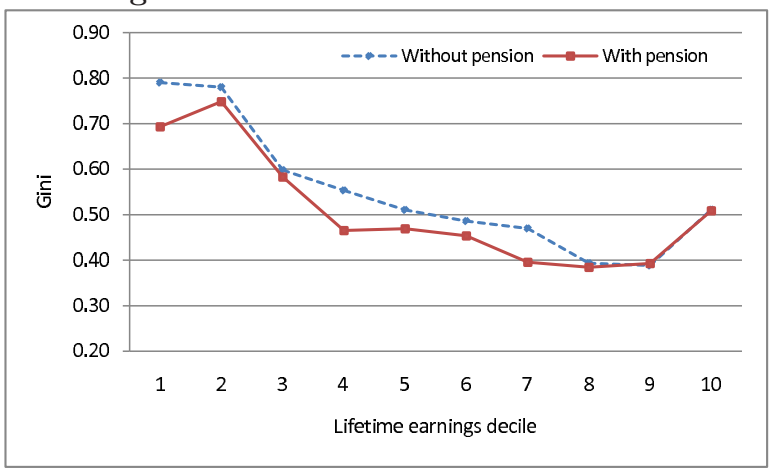


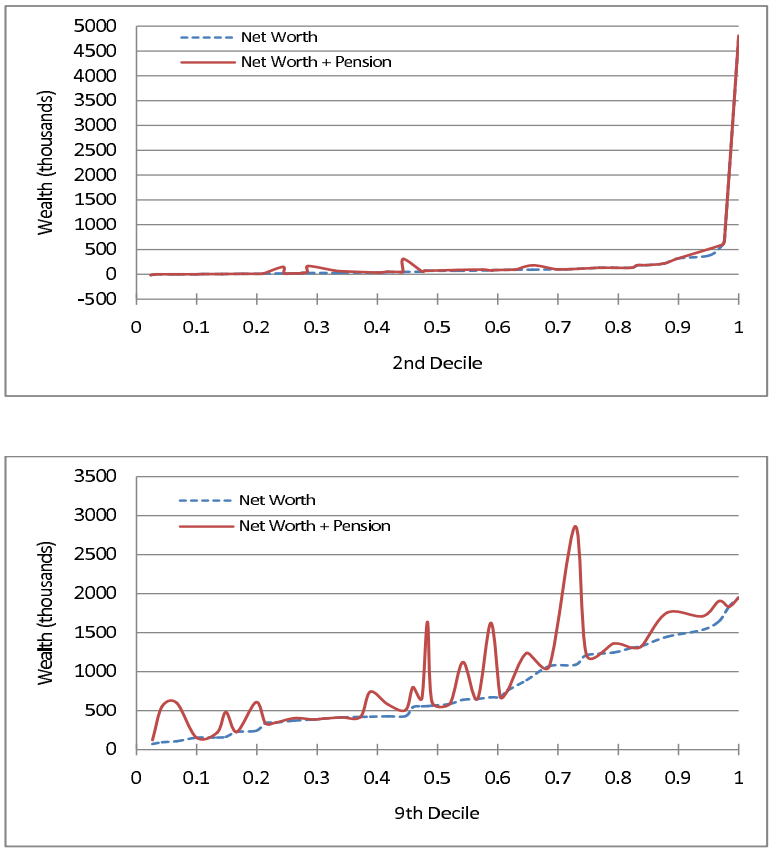
Figure 3 plots the distribution of net worth and total retirement wealth within the 2nd and 9th deciles of lifetime earnings. Within each decile, we order households according to their net worth and plot net worth and total retirement wealth (net worth plus pensions) for each household. Figure 3 highlights three key points. First, private pensions play a very small role for low lifetime earners, as very few households have private pensions (and the value for those with pensions is very small). Second, many (but not all) of the lowest net worth households in the ninth decile have private pensions. This suggests that pensions help account for why some high lifetime earners have low net worth at retirement. Third, some households have both both high net worth and pension wealth.

2.2 Summary: Key Facts

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 to lifetime earnings increases if retirement wealth includes pension. The ratio

Figure 3: Retirement Wealth Distribution: 2nd and 9th decile



Note: Households are ordered within each decile according to net worth.

increases about two percentage points on average within lifetime earnings deciles.

2. Including private pensions leads to a decline in wealth inequality. The Gini coefficient drops from 0.65 to 0.62 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 average Gini coefficient in each lifetime earnings decile from 0.55 for net worth to 0.51 for total private retirement wealth.

4. The correlation between lifetime earnings and total retirement wealth is slightly

larger than that between earnings and net worth. However, the correlation between earnings and net worth is very small for the bottom half of lifetime earners.

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 face idiosyncratic shocks to labor earnings, mortality, inheritance, and private pension coverage.

3.1 Preferences

Households 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.

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 persistent productivity, e:

$$y_j = eh_j \tag{3.2}$$

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 $j > R$, the household is retired and no longer receives earnings. Instead, they receive transfer income from Social Security and private pensions. Social Security benefits depend on average earnings, $\bar{y}$, over the last 35 years of working life. Private pension benefits are based upon average earnings and the number of years of coverage. The evolution of household private pension coverage is stochastic, and governed by a transition matrix. More details on transfer income are provided in section 3.4.

3.3 Household Problem

The state variables for the household are: age j, financial wealth k, earnings state e, average earnings over past periods $\bar{y}$, private pension status in the current period pen, and years of pension coverage until current period n_{db}. Each period, households choose consumption and saving after the realization of uncertainty. The Bellman equation for a household of age j is:

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

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, and db is private pension benefits. We assume that borrowing is not allowed in the model (we relax this assumption in section 4.4.2).

3.4 Model Parameterization

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

Table 4 lists the benchmark parameter values. Households enter the model at age 20, work until age 64 before retiring and live to a maximum age of 95. We use female mortality rates from the Period Life Table 1990 of the Social Security Administration, and assume that the probability of dying before age 52 is zero. We follow Hendricks (2007b) and set the coefficient of relative risk aversion σ to 1.5, and the annual discount factor β to 0.958.

Table 4: Model Parameters

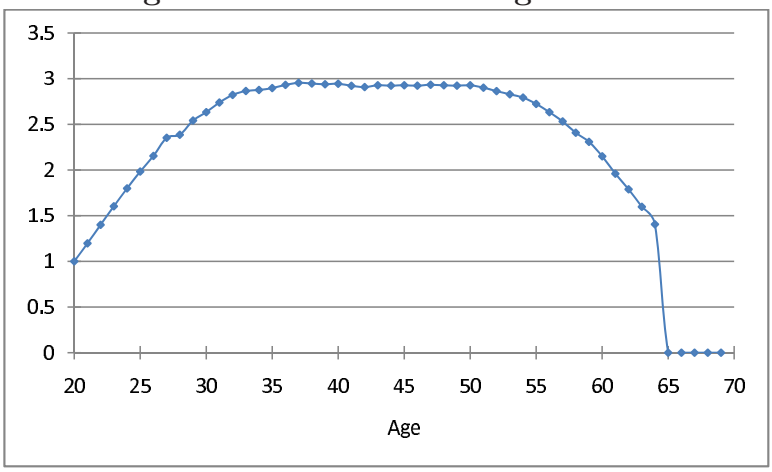
Demographics	
$J = 76$	Maximum lifespan (physical age 95)
$R = 45$	Last working period (physical age 64)
P_j	Survival probabilities
Preferences	
$\beta = 0.958$	Discount factor
$\sigma = 1.50$	Risk aversion
Labor income	
$\rho = 0.96$	Persistence of e
$\sigma_\varepsilon = 0.21$	Standard deviation of e shocks
$\sigma_{e1} = 0.62$	Standard deviation of $e1$
$e = (0.08, 0.19, 0.44, 1.00, 2.27, 5.18, 11.77)$	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

3.4.1 Labor Income

The experience profile ($X_{ij}\beta$) from equation 2.1 is used as the age earnings profile in the model. Since the regression uses only strictly positively earnings observations, the implied age earnings profile is multiplied by the fraction of households with strictly

positive earnings observed at each age. The resulting profile is shown in Figure 4.

Figure 4: Lifetime Earnings Profile



The remaining parameters of the labor income process 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 from Huggett (1996). 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 5. The model does a reasonably good job of replicating the distribution of lifetime earnings.

Table 5: Distribution of Lifetime Earnings

	Top 1%	1-5%	5-10%	10-20%	20-40%	40-60%	60-80%	80-100%	Gini
PSID	3.9	9.2	9.0	15.2	24.2	18.6	13.2	6.7	0.31
Model	5.2	12.4	10.6	16.0	23.1	15.3	11.2	6.1	0.37

Note: The table shows the Lorenz curve of lifetime earnings.

3.4.2 Initial Wealth and Inheritance

The distribution of initial wealth (capital endowment) for new households is estimated from the PSID wealth files.[10] The sample consists of households with heads aged 19-21 in all years. Since there is no lending technology in the model, young households with negative net worth are assigned to zero initial wealth.

Hendricks (2007b) estimates the size distribution of lifetime inheritance, discounted to age 52, which is the mean age of inheritance in the PSID. The distribution of inheritance is approximated on a five-point grid. The probabilities (P_I) and inheritance levels (I) are reported in Table 4. Following Hendricks (2007b), inheritances are received at age 52 (model period 33) in the model. We assume that households have no information about future inheritances and inheritances are not correlated with earnings.

3.4.3 Social Security Benefits

Households receive transfers from a social security system 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 of all working age households. Social security benefits are a piecewise linear function of average earnings:

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

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

3.4.4 Private Pension

There are two types of (employer sponsored) private pension plans in the U.S.: defined benefit (DB) pension plans and defined contribution (DC) pension plans. In traditional DB plans, employees receive regular retirement payments for as long as they live, which

[10] Assuming that all households start with zero initial wealth has little effects on our findings.

are generally determined by a formula based on earnings history and years of coverage. DB plans are managed by employers, and employees typically do not make active decisions. In contrast, participation in DC plans (such as a 401(k)) often requires active decisions by eligible employees about 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.

We model pensions as DB plans since roughly 80% of the present value of private pensions for our PSID sample are defined benefits. Pension benefits, db, are given by

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

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. We call $\alpha(n_{db})n_{db}$ the replacement rate of average earnings.

We calibrate the pension system to match the life cycle profile of pension coverage and the distribution of replacement rates. 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 SCF. To match the positive correlation between earnings and pension coverage, we assign higher probabilities of pension coverage ($\theta(e)$) to higher income groups at age 20.

The pension transition matrix is asymmetric. This generates a life-cycle profile of pension coverage and pension accumulation. Households with pension coverage at period t face a probability of 91 percent of continuing to have coverage at $t+1$, and a complementary probability of 9 percent of losing coverage. Households without coverage in period 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.

We approximate $\alpha(n_{db})$ with a step function. This allows us to capture two key features of DB pensions. First, many DB plans have a minimum service requirement before the pension benefits become vested (see Foster (1997) and Mitchell (2003)). Here we assume a vesting period of 7 years. Second, many DB benefit plans base the pension

payout on a combination of years of service and average salary over the last few years of service. The step function captures this by increasing the weighting with years of service.

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

The benchmark parameterization closely matches the PSID data. PSID pension coverage rate (for our sample for which we have estimates of private pension wealth at retirement) is 51 %, while the model generates a coverage rate of 53 %. Table 6 compares the distribution of replacement rates for pension holders in the model with the PSID data.[11] The model closely replicates the replacement rate distribution.

Table 6: 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%
All	100	34%	100	34%

Our calibration strategy does not directly target the distribution of pension wealth at retirement. As can be seen from Table 7, with the exception of the top 1%, the model does a good job of replicating the pension wealth distribution.

[11] Our replacement rates are for households with a pension with: (1) a head aged 60-69 in the 2005 PSID; (2) at least 20 years of nonzero earnings for the head in 1968-2005; and (3) non-immigrant.

Table 7: Distribution of Pension Wealth

	Top 1%	1-5%	5-10%	10-20%	20-40%	40-60%	60-80%	80-100%	Gini
PSID	18.3	26.2	14.2	20.0	19.0	2.3	0.0	0.0	0.78
Model	7.8	22.8	19.1	22.6	22.2	5.4	0.0	0.0	0.72

4 Private Pensions and Retirement Wealth

In this section, we examine the impact of private pensions on the distribution of retirement wealth in our benchmark economy. There are three key findings. First, net worth at retirement is more unequally distributed in the model economy with private pensions. This moves the model predictions for the retirement wealth distribution closer to the data. As a result, we can partially account for the discrepancies between the life-cycle model predictions and the data emphasized by Hendricks (2007b). The second finding is negative: the pension offset effect on net worth is larger in the model than in the data. This causes the model to "miss" the joint distribution of pension and non-pension wealth, which results in too little inequality in total retirement wealth compared to the data. Finally, while significant, the quantitative impact of private pensions on the retirement wealth distribution is much smaller than that of Social Security.

4.1 Private Pensions and the Retirement Wealth Distribution

Table 8 reports key moments of the Lorenz curve for retirement wealth in the model economy and the PSID. There are two key points to take away from Table 8. First, private pensions lead to higher inequality in net worth at retirement. The Gini of retirement net worth is 0.56 in the economy without private pensions, while the Gini in the private pension economy is 0.62. This moves the predictions of the model closer to the data, as the PSID Gini is 0.65. Second, Table 8 highlights a key discrepancy between the model and data: the joint distribution of pension and non-pension wealth. This results in too large a gap between the Gini of total retirement wealth (including pensions) and net

worth in the model, 0.08 (0.62 - 0.54), relative to the data gap of 0.03 (0.65 - 0.62).

Table 8: Retirement Wealth Distribution at 65

	Wealth	Top 1%	1-5%	5-10%	10-20%	20-40%	40-60%	60-80%	80-100%	Gini
Model: No Pens.	R.W.	8.3	17.7	14.6	18.0	21.8	11.5	6.2	1.8	0.56
Model: Pens.	R.W.	9.8	19.9	15.9	18.7	20.7	9.9	4.4	0.7	0.62
Model: Pens.	R.W.+ Pens.	8.1	17.1	14.3	17.8	21.8	12.1	6.6	2.3	0.54
PSID (99-05)	R.W.	14.2	19.2	14.6	19.0	18.8	9.1	4.3	0.8	0.65
PSID (99-05)	R.W.+. Pens.	14.6	17.6	14.2	17.6	20.1	10.2	4.6	1.1	0.62

Note: The table reports the Lorenz curve of retirement wealth.

The key model mechanism linking private pensions to net worth is the *offset effect*. Private pensions offset (lower) non-pension wealth for two reasons. First, since a private pension provides post-retirement income, intertemporal smoothing of consumption leads households with a pension to consume more in earlier periods than an otherwise identical household without a pension. Second, private pensions provide longevity insurance, which reduces the need for households with large pensions to hold precautionary wealth to self-insure against longevity risk.[12] Working in the opposite direction are two forces that lower offset. First, the risk of losing pension coverage, combined with a pension replacement rate that rises steeply with additional years of coverage, creates a precautionary motive for non-pension retirement saving. Second, the combination of social security and no-borrowing may lead to some households who would have saved less than the value of the private pension being "forced" to over-accumulate retirement assets.

If all households had private pensions and the same offset rate, private pensions would have little impact on the distribution of net worth (but would impact the level). However, private pension coverage in the model (and the data) is incomplete, as only half of households have a private pension at retirement. This partial coverage, combined with different offset effects across households, is why net worth inequality is higher in the private pension economy.

[12]There are no private annuity markets in the model. While some private annuity markets exist, they account for a small share of retirement wealth (see Poterba (2006) and Johnson, Burman, and Kobes (2004)).

While the model net worth distribution closely resembles the data, the model generates too little inequality in total retirement wealth. From Table 8, this appears to be largely due to higher displacement of non-pension retirement savings of higher income households in the model than in the data. To better understand this pension offset effect, we sort households into lifetime earnings deciles, and compute the mean saving rate for households with and without pensions. To control for the higher income associated with employer pension contributions (which are deferred labour compensation), we define total lifetime earnings as lifetime earnings plus the present value of pension benefits at 65. The saving rate is total retirement wealth (pensions plus net worth) divided by total lifetime earnings.

We find that the level of pension offset varies across lifetime earnings deciles. For all deciles, the ratio of net worth to lifetime earnings is lower for households with private pensions. However, the offset effect is larger for high income households. For the bottom half of lifetime earners, households with private pensions have slightly higher saving rates than households without private pensions. Private pension coverage has little impact on the average saving rates for households in the upper middle part of the lifetime earnings distribution (deciles 6 to 8). However, for the top two deciles, private pensions coverage leads to lower average saving rates. This is due to lower Social Security replacement rates for high lifetime earners, which makes the longevity insurance provided by private pensions more valuable, and results in reduced precautionary savings.

This offset pattern qualitatively resembles the PSID data.[13] However, pensions displace less wealth for the highest lifetime earners in the PSID than in the model. For the highest three lifetime earnings deciles, the ratio of net worth to lifetime earning is higher for households with pensions than without pensions. This is a key reason why the joint distribution of net worth and pension wealth in the model differs from the data.

A similar pattern appears when we examine the correlation between lifetime earnings

[13]This is also consistent with recent evidence that 401k plans offset saving by high income households but increase saving rates for lower income households (Chernozhukov and Hansen (2004)).

and retirement wealth (see Table 9). The model understates the correlation between pension wealth and net worth, which is 0.19 versus 0.59 in the PSID. Together with the (too) large pension offset effect in the model, this leads to a lower correlation between pensions and total retirement wealth in the model (0.45) than in the data (0.80). The private pension economy also generates too tight a relationship between retirement wealth and lifetime earnings. While the lifetime earnings - net worth correlation is lower in the pension economy (0.80) than in the standard life-cycle model (0.85), it is well above the 0.64 observed in the PSID. However, the model correlations are much closer to the data for the top and bottom half of earners, with the model generating much higher correlations between wealth and earnings for the top half than the bottom half of lifetime earners. Overall, while private pensions reduce the correlation between earnings and net worth, they can only partially account for the Hendricks (2007b) correlation puzzle.

Table 9: Correlation Coefficients in Private Pension Economy

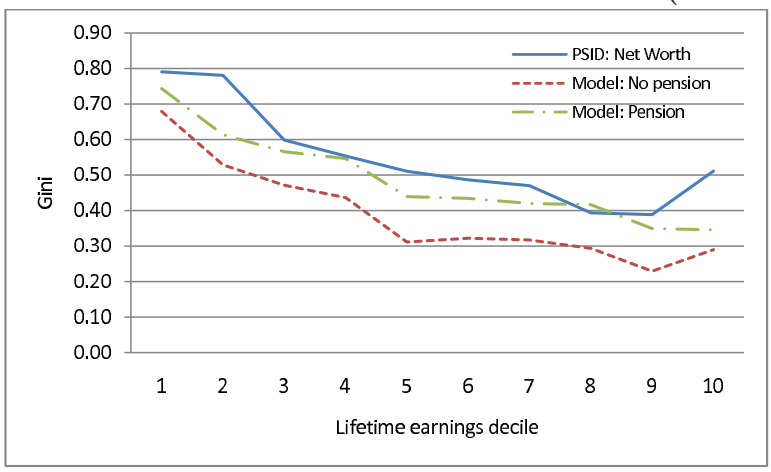
		Earnings	Net Worth	Net Worth + Pension	Pensions
All Households	Earnings	1.00	0.80	0.85	0.48
	Net Worth	0.80	1.00	0.96	0.19
Top 50 % Earners	Earnings	1.00	0.80	0.84	0.25
	Net Worth	0.80	1.00	0.96	0.00
Bot. 50 % Earners	Earnings	1.00	0.19	0.27	0.43
	Net Worth	0.19	1.00	0.93	-0.02

4.2 Within Decile Wealth Distribution

The private pension economy features higher dispersion in net worth among households with similar lifetime earnings than the economy without private pensions. Figure 5 plots the Gini coefficient for each lifetime earning decile for retirement net worth in the model economies, as well as the PSID. As in Hendricks (2007b), we find that the life-cycle model (without pensions) generates too little within decile wealth dispersion. Within decile wealth inequality in the private pension economy is closer to the data, with a mean

(across deciles) Gini of 0.49 compared to 0.39 in the economy without pensions.

Figure 5: Gini Coefficient of Retirement Wealth (Net Worth)

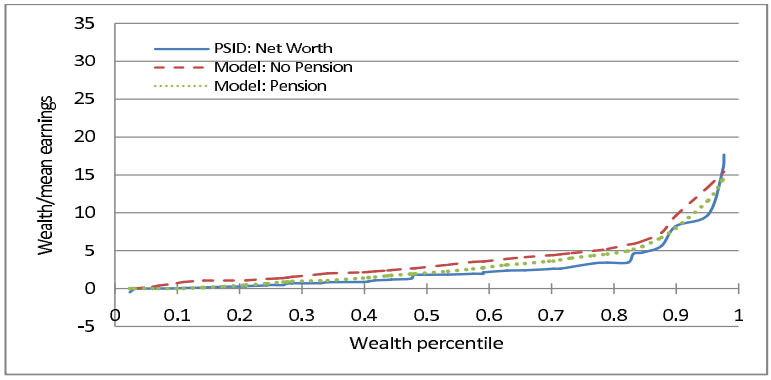


To understand why the private pension economy generates higher wealth inequality, we examine the wealth distribution within the second and ninth lifetime earnings deciles. As Figure 6 illustrates, the standard life-cycle model (without pensions) misses different regions of the PSID distribution for low than high lifetime earners. For the second earnings decile, the model without private pensions closely matches the bottom 80 percent of the wealth distribution, but (even with inheritances) understates the wealth of the wealthiest 5 percent. In contrast, the model significantly over predicts the savings of the bottom 60 percent of the wealth distribution of the ninth lifetime earnings decile.

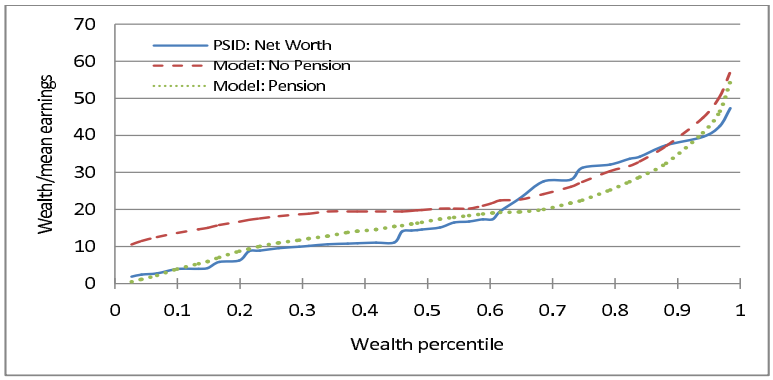
As Figure 6 highlights, private pensions mainly increase non-pension wealth inequality by reducing the non-pension wealth of the wealth poorest in each lifetime earnings decile. This effect is smaller in the second decile for two reasons. First, lower lifetime earnings households are less likely to receive private pensions. Second, the high replacement rate of social security for low income households leads to low savings rates, so there is little scope for pensions to offset non-pension savings.

The private pension model significantly understates total retirement wealth inequality between households with similar lifetime earnings. Comparing the within decile of total

Figure 6: Non-pension Retirement Wealth: 2nd and 9th Lifetime Earnings Deciles



2nd decile



9th decile

retirement savings (pension plus non-pension wealth), one finds that the model generates an average Gini across deciles of 0.37, versus 0.51 in the PSID sample. The difference, of 0.14, is only slightly smaller than the gap of 0.16 between the model without private pensions and the data.[14] This reflects two key differences between the joint distribution of pension and non-pension retirement wealth in the model and the data. First, a number of high lifetime earners with low net worth in the data lack pensions, while in the model almost all of these households have private pensions. Second, some relatively high net worth households in the data have large pensions – which results in the richest households

[14]See the online appendix for the plot of the Gini by earning decile.

holding more wealth than predicted by the model. This is another symptom of too large a pension offset effect in the model.

4.3 Comparing Social Security and Private Pensions

While most quantitative life cycle models incorporate social security, private pensions are rarely explicitly modeled.[15] This is surprising, as mean pension wealth is significant, roughly 70 % of mean social security wealth (Gustman, Steinmeier, and Tabatabai (2010)), and is a large component of mean non-social security retirement wealth.[16]

To examine the relative quantitative impact of social security and private pensions on retirement wealth, we simulate the benchmark economy without social security.[17] This leads us to two key conclusions. First, private pensions have a much smaller impact on the wealth distribution in the model than social security. Second, even when private pensions are included, social security still boosts the saving rates of higher income relative to lower income households.

Table 10 reports the retirement wealth distribution without social security for the benchmark economy with and without private pensions. Comparing the first three rows of Table 10 with their counterparts in Table 8 illustrates the large effect of social security on the distribution of private retirement wealth. In the benchmark economy, removing Social Security lowers the retirement wealth Gini by over 20 % (i.e, the Gini falls from 0.56 to 0.43). The effect of Social Security on wealth inequality is roughly twice as large as that of private pensions, which increase wealth inequality by roughly 10 % (from a Gini of 0.43 to 0.48 without social security, and from 0.56 to 0.62 with social security).

[15] The large effects of social security on the U.S. wealth distribution are well known, see for example Huggett (1996) and Huggett and Ventura (2000).

[16] The average expected value of social security payments is roughly three-quarters as large as average net worth for near retirement households in the U.S. For the median household, the expected value of social security payments exceeds median net worth (Gustman, Steinmeier, and Tabatabai (2010)).

[17] When we shut down social security, we scale households labour endowments by $\frac{1}{1-12.4\%}$, where 12.4% is the payroll tax for the Old-Age, Survivors, and Disability Insurance program.

The larger impact of social security on private retirement wealth inequality reflects two factors. First, the average expected present value of social security in the benchmark economy is roughly 1.8 times the value of private pensions. Secondly, the distribution of social security across households differs significantly from private pensions, as social security covers all households while only half of households receive a private pension. Moreover, private pensions are concentrated among middle and upper earners, while social security covers all workers and provides much higher replacement rates of pre-retirement incomes for lower earnings deciles. As a result, Social Security has a larger effect on the saving of lower income than higher income households. This leads to a large decrease in the share of net worth held by the bottom half of the wealth distribution.

Table 10: Retirement Wealth Distribution at 65 (No Social Security)

	Wealth	Top 1%	1-5%	5-10%	10-20%	20-40%	40-60%	60-80%	80-100%	Gini
Model: No-pens.	R.W.	5.9	13.5	11.8	16.7	23.3	14.5	9.7	4.7	0.43
Model: Pens.	R.W.	6.6	14.8	12.6	17.6	22.7	13.8	8.4	3.4	0.48
Model: Pens.	R.W.+ Pens.	5.9	13.5	11.9	16.8	23.2	14.4	9.6	4.6	0.43

These experiments also shed light on the debate over whether life-cycle models can account for the higher saving rate of high lifetime earners. Dynan, Skinner, and Zeldes (2004) argue that social security is an implausible explanation for why high earners have higher savings rates. In our benchmark economy with social security and private pension, we find that the ratio of mean lifetime retirement savings (including pensions) to mean lifetime earnings increases by nearly 40 % moving from the eighth to the tenth earnings deciles. This is nearly half of the increase observed in the PSID (see Figure 1). This increase is driven mainly by the low replacement rate of social security. By comparison, in the economy without social security, private saving rates increase by only half as much (roughly 20 %). This suggests, as argued by Huggett and Ventura (2000), that social security may play a significant role in explaining the higher saving rates of high earners.[18]

[18]There is some debate over how much higher the saving rate of households with high lifetime labour

4.4 Robustness: Bequest Motive and Borrowing

In this section, we briefly discuss robustness with respect to the simplifying assumptions of no bequest motive and no borrowing. We find that these assumptions are not quantitatively important for our main results.[19]

4.4.1 Bequest Motive

To investigate the effect of bequests, we follow De Nardi (2004) and introduce a "warm glow" voluntary bequest motive. Households derive utility from leaving bequests, and receive at most one inheritance between ages 40-60.

Adding a bequest motive does not significantly increase wealth inequality. In the model without private pensions, introducing bequests increases the Gini from 0.56 to 0.57, while in the pension economy the Gini decreases from 0.62 to 0.61. The small impact of the bequest motive is likely due to two factors. First, we maintain the assumption that households only know the distribution of future inheritances.[20] Second, the bequest motive has a small effect on the amount of retirement wealth for most households, although it has a large impact on dissaving for retirees (as in De Nardi (2004)).

4.4.2 Borrowing

To examine the impact of the no borrowing restriction, we run an experiment where households can borrow up to one year of mean earnings, which must be repaid by age 51 (since mortality risk begins at age 52). The borrowing rate is set at the rate of return plus 4%. We find that this has little impact on our results.

earnings is. Similar to Hendricks (2007b) and Venti and Wise (1998), we find that savings rates are relatively flat across earnings deciles, increasing only modestly for the highest quintile of lifetime earners. Dynan, Skinner, and Zeldes (2004) – who use proxies for permanent household income – find much larger increases in savings rates with household income.

[19] More detailed discussion of these experiments are reported in the online appendix.

[20] Assuming that households can observe their parents' productivity and wealth level would make solving the model computationally more difficult as two more state variables would be required.

5 Profile and Return Heterogeneity

While private pensions reduce the gap between the life cycle model and the data, a significant fraction of retirement wealth inequality between households with similar lifetime earnings remains unaccounted for in the Section 4 experiments. This leads us to ask whether private pensions combined with rate of return heterogeneity and earnings profile heterogeneity, can account for the discrepancy between data and theory.

The motivation for introducing these channels is twofold. First, both returns and earning profiles influence households savings decisions over the life-cycle. Second, there is empirical evidence that both return and profile heterogeneity exist, as Hendricks (2007b) finds differences in the average rate of return on saving across households in the PSID, while differences in earnings profiles across education groups are well established.

We find that the life cycle model augmented to include private pensions, return and profile heterogeneity can largely account for the dispersion of retirement wealth:

1. The model closely matches the Gini for both non-pension retirement wealth (0.67 versus 0.65 in the data) and total retirement wealth (0.60 versus 0.62 in the data)

2. The Gini of retirement net worth *within* lifetime earnings deciles is close to the data: with a cross-decile mean of 0.47 versus 0.51 in the PSID.

3. The correlation between earnings and retirement net worth is reduced to 0.72, versus 0.64 in the data. The correlations within the top and bottom half of lifetime earners are even closer, as the model correlation for the top half (bottom) of earners is 0.72 (0.18) versus 0.71 (0.14) in the PSID.

These positive results are tempered by a discrepancy between the model predictions and the data for households with pensions. The model generates a larger pension offset effect than observed in the data. As a result, mean savings rates for households with pensions in the PSID are higher than predicted by the model. This leads to *higher* net worth dispersion for households with pensions than in the data.

Overall, our interpretation of these results leads us to conclude that the life-cycle model can largely account for the large differences in retirement wealth observed in the U.S. Indeed, if anything our results suggest that the life-cycle model generates too much, not too little, inequality in retirement net worth.

5.1 Paremertization: Earnings Profile and Rate of Return

We follow Hendricks (2007b) and introduce a simple form of rate of return heterogeneity. Specifically, we assume that each household i draws a rate of return r_i on savings at birth. Hendricks (2007b) uses PSID wealth data to calibrate a return process with four types, $r \in \{0.0023, 0.0316, 0.0485, 0.0872\}$ with associated probabilities $P_q = (0.15, 0.35, 0.40, 0.10)$.

Profile heterogeneity is introduced by extending the model to include three education types: no high school, high school and college. We use our PSID sample to calibrate the fraction of each type. This yields 34% of households without a high school education, 43% whose highest level of schooling is high school, and 23% with a college degree.[21] We use the age-profiles reported in Table 2 of Cocco, Gomes, and Maenhout (2005). We keep all other features in the model unchanged.

5.2 Results

The life-cycle model, augmented to include earnings profile and return heterogeneity, closely matches the PSID retirement wealth distribution. Table 11 reports the retirement wealth distribution for the augmented model with profile and return heterogeneities. The extended life-cycle model slightly over predicts the degree of inequality in non-pension retirement wealth, and slightly under predicts total retirement wealth inequality. However, the difference between the Gini of net worth and total retirement wealth is reduced by nearly half, to 0.05 (0.67 - 0.62), compared to the benchmark economy.

[21] The cutoffs for grade of school are: < 12, 12-14, and ≥ 15.

Table 11: Wealth at 65: Augmented Model

	Wealth	Top 1%	1-5%	5-10%	10-20%	20-40%	40-60%	60-80%	80-100%	Gini
Model: No-pens.	R.W.	10.5	19.8	15.5	19.2	20.1	9.8	4.3	0.9	0.62
Model: Pens.	R.W.	11.9	21.7	16.4	19.3	19.3	8.2	2.9	0.2	0.67
Model: Pens.	R.W.+ Pens.	10.0	18.9	14.9	18.7	20.2	10.6	5.2	1.5	0.60

The extended model lowers the correlations between lifetime earnings and retirement wealth. The correlation between lifetime earnings and net worth in the extended model is reduced to 0.72 (from 0.85 in the "standard" life-cycle model), versus 0.64 in the data, while the correlation between lifetime earnings and total retirement wealth is 0.77 versus 0.70 in the data. The reduction in the model correlation of 0.13 (0.85 - 0.72) is driven roughly equally by private pensions, which lowers the correlation by 0.05, and profile and return heterogeneity, each of which lowers the correlation by roughly 0.04.

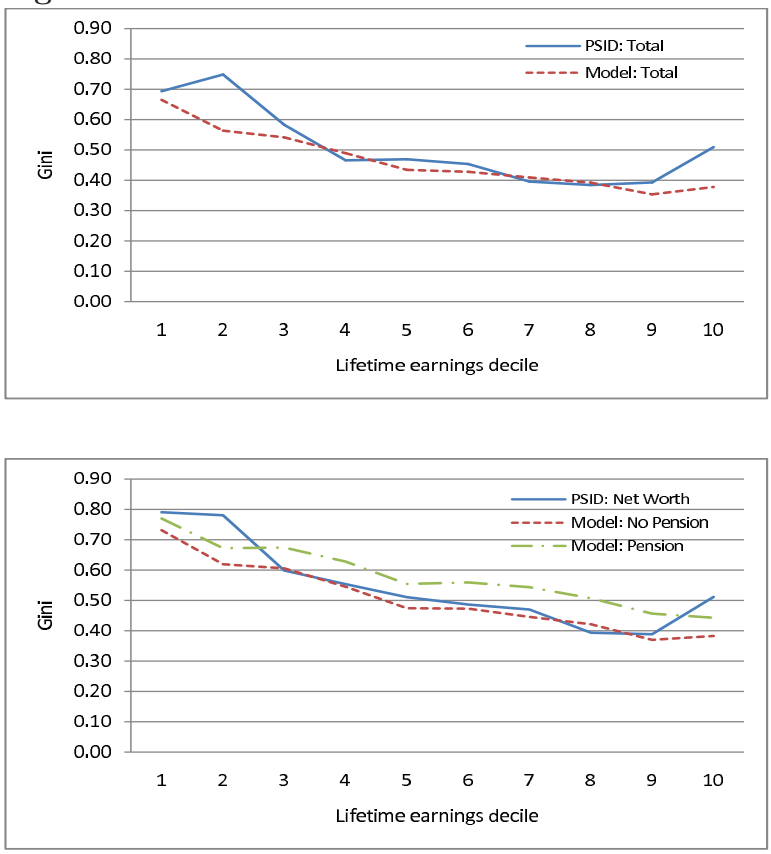
The model matches the earnings-wealth correlation within the top and bottom half of lifetime earners even more closely. Looking at the top 50 percent of lifetime earners, the correlation of earnings with net worth is 0.72 (model) versus 0.71 (data), while the earnings-total retirement correlation is 0.77 (model) versus 0.73 (data). The model generates slightly higher correlations for the bottom half of lifetime earners, 0.18 versus 0.14 for net worth, and 0.24 versus 0.17 for net worth plus pensions.

Given the similarity of the model and data correlations within the top half of lifetime earners, it is not surprising that the model and data correlation between lifetime earnings and retirement net worth (total retirement wealth) for households with pensions are very close: 0.74 (0.78) in our PSID sample and 0.71 (0.78) in the model. However, the augmented model generates too high a correlation between lifetime earnings and net worth for households without pensions: 0.75 versus 0.46 in the PSID. Interestingly, the gap between the model and the data is also large within the top half of lifetime earners, where the model correlation is 0.73 versus 0.56 in the data.

The augmented model largely accounts for the substantial wealth inequality within lifetime earning deciles. Examining Figure 7, one observes that the model now accounts

for the dispersion of total retirement wealth for all but the second and the tenth deciles of lifetime earners. The mean Gini of total retirement wealth across lifetime earnings decile is 0.47 (versus 0.37 in the benchmark economy with private pensions), which is close to the 0.51 observed in the data. As with the economy wide retirement net worth distribution, the pension economy slightly over-predicts the dispersion of non-pension wealth within lifetime earnings deciles. In the model with private pensions, the mean Gini of non-pension retirement wealth across lifetime earnings decile is 0.58, versus 0.55 in the PSID. Private pensions play a key role in increasing net worth inequality, as when we shut down private pensions the mean Gini declines to 0.51.

Figure 7: Gini Coefficient of Retirement Wealth



To better understand wealth inequality within earning deciles, we again examine the

distribution of retirement wealth within the second and ninth lifetime earnings deciles. Figure 8 plots the distribution of net worth and total private retirement wealth in the second and ninth lifetime earnings deciles. In the ninth earnings decile, the model now accounts for the sizable number of households with high life-time earnings who have low net worth and low private pensions wealth. For non-pension wealth the model generates slightly lower wealth holdings for the wealth poorer half of the ninth deciles. Indeed, the main difference between the model and the data is now that the model under predicts wealth for most of the bottom half of the distribution.

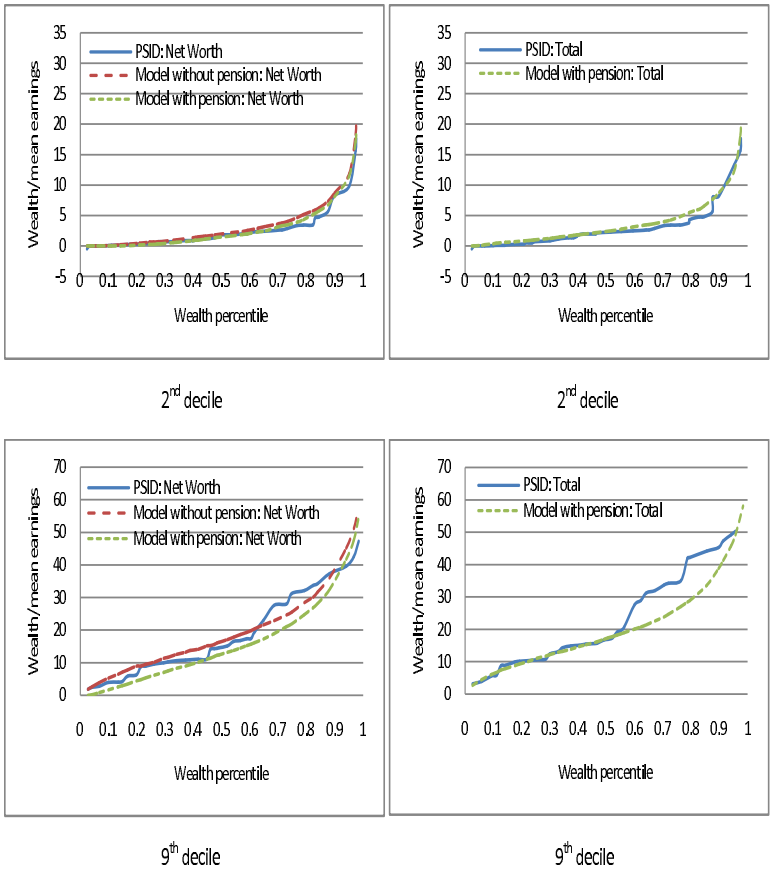
The extended model helps to deal with the main problem in the second lifetime earnings decile, which was an insufficient number of earnings poor households with large retirement wealth. As Figure 8 (panels a and b) show, the augmented model increases the wealth level of the richest households in the low income group while having little impact on the savings of most low lifetime earners. This is mainly driven by return heterogeneity, which leads to some households receiving high returns on inherited wealth.

5.2.1 Pension Offset Effect: Too Large in the Model?

While the augmented model reduces the gap between the model and the data, it does not fully match the joint distribution of pension and non-pension wealth. As in section 4, this is largely driven by too large a pension offset effect in the model. This leads to a much lower saving rate for the highest decile of lifetime earners with pensions in the model than in the PSID (roughly 11 % versus 18 %). Unlike the pension economy without profile or return heterogeneity, however, the augmented model is qualitatively consistent with the PSID in that the average saving rates for all but the lowest quintile of lifetime earners with pensions exceeds those without pensions.

To better understand the pension offset effect, we follow Gustman and Steinmeier (1999) and estimate simple OLS regressions of wealth on lifetime earnings and pension status. Our PSID estimates are similar to Gustman and Steinmeier (1999), who examined data from the HRS, and imply a pension offset effect of roughly 50 percent.

Figure 8: Retirement Wealth Distribution: 2nd and 9th Lifetime Earnings Deciles



However, the OLS estimate of the offset effect in the model is much larger, roughly 75 percent. When we estimate the regression on the top and bottom half of earners, we find that the offset effect is 76 percent and 61 percent, respectively. Overall, the saving data suggest that the main discrepancy between the model and the data is much higher pension offset rates for high lifetime earners with large pensions in the model.[22]

[22]There is debate over the magnitude of the pension offset effect in the data (see Bernheim (2002)).

5.2.2 Decomposing Profile and Return Heterogeneity

To understand the contribution of earnings profile and rate of return heterogeneity to higher levels of wealth inequality, we consider each type of heterogeneity individually.[23] The effects of earnings profile and rate of return heterogeneity individually are very similar. In the presence of private pensions, earning profile (return) heterogeneity increases the Gini of non-pension retirement wealth to 0.66 (0.65) from 0.62, and the Gini of total retirement wealth to 0.58 (0.57) from 0.54 (see Table 8). When both earnings profile and rate of return heterogeneity are combined, wealth inequality is smaller than the sum of the two individually. However, the combination leads to a decrease in the gap between non-pension and total retirement wealth inequality. This highlights the importance of simultaneously modeling different types of heterogeneity.

5.2.3 Life-cycle Wealth Inequality

Within cohort wealth inequality varies significantly over the life-cycle, initially declining between the ages of 20 to 45, and then remains roughly constant until households hit retirement age (Hendricks (2007a) and Budria, Diaz-Gimenez, Quadrini, and Rios-Rull (2002)). As can be seen from Figure 9, both our benchmark and augmented versions of the life-cycle model are qualitatively consistent with this pattern. However, wealth inequality declines much more in the benchmark version of the life-cycle model than when we incorporate private pensions, earning profile and return heterogeneity.

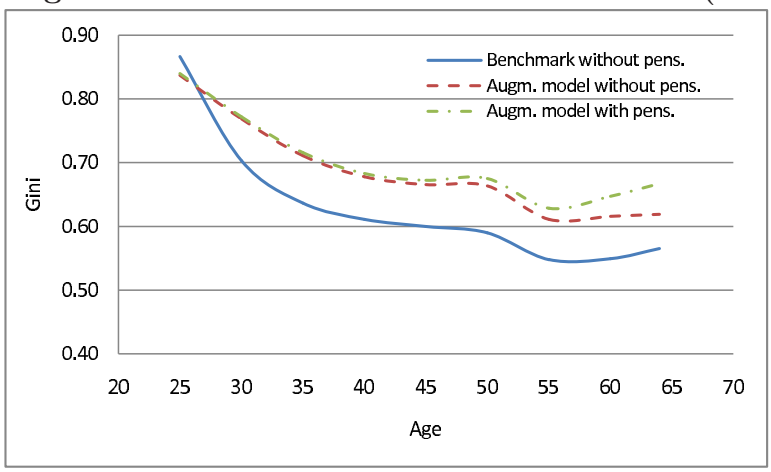
This quantitative difference is interesting, since Hendricks (2007a) finds that wealth inequality declines less in the PSID than in the standard life-cycle model. Hendricks reports that the PSID Gini of net worth declines from roughly 0.87 at age 25 to 0.65 at age 60, with most of the decline occurring before age 45. Similar to Hendricks (2007a), our benchmark economy without pensions generates too large a decline in wealth inequality, so that for ages 30 and up the Gini coefficients are roughly 0.1 smaller than in the data. In contrast, the life-cycle model augmented to include private pensions, earning profile

[23] More detailed results of these experiments are reported in the online appendix.

and return heterogeneity generates an age-Gini profile similar to the PSID, as the Gini declines from roughly 0.85 at age 20 to 0.65 at age 60.

The slower decline in life-cycle inequality is driven both by permanent differences in earning profiles and rate of returns. Life-cycle wealth inequality declines much less for households with flatter than steeper profiles, as households with flat profiles also have the lowest lifetime earnings and high replacement rates from social security. This generates low savings rates, which results in slow changes in wealth inequality. In contrast, households with the steepest earning profiles (university graduates) have highly unequal wealth early in life, as the steep expected earnings profile leads many households to initially save little. Similarly, wealth inequality for households with higher returns to savings varies relatively less over the life-cycle. This is due to the fact that the high return pushes up the savings rates of low wealth households, while the large wealth effect for household with relatively larger wealth early in life discourages saving.

Figure 9: Age-Gini Coefficient of Retirement Wealth (Net Worth)



6 Conclusion

Private pensions are an important component of U.S. retirement wealth. We find that incorporating a private pension system in the "standard" life-cycle model leads to higher inequality in retirement net worth and lowers the correlation between lifetime earnings and retirement wealth. This moves the model predictions closer to the data, and helps account for why some high lifetime earners have little non-pension wealth.

These findings are important for the debate over what factors drive the large heterogeneity in retirement wealth among households with similar lifetime earnings (Venti and Wise (1998) and Hendricks (2007b)). Unlike Hendricks (2007b)), we find that the incomplete market life-cycle model, extended to include private pensions, earnings profile heterogeneity, and rate of return heterogeneity, can largely account for the large differences in retirement wealth across households with similar lifetime earnings, and the lifetime earnings-retirement wealth correlation. Our findings thus challenge an emerging view that preference heterogeneity across households and/or behavioral factors play a large and essential role in quantitatively accounting for retirement wealth inequality (Venti and Wise (1998), Lusardi (2000) and Hendricks (2007a)).

Our findings suggest that an important question for future work is a better understanding of the offset effect of private pensions on non-pension wealth. The pension offset effect in the model is larger than in the data, especially for the highest deciles of lifetime earners. One possible explanation, which we plan to explore in future research, is that tax considerations lead to differential pension offset rates across income groups.

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