

Private Pensions, Retirement Wealth and Lifetime Earnings*

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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. Private pensions lead to higher net worth inequality at retirement, which is closer to the inequality observed in the PSID than a model without private pensions. However, the offset effect of private pension wealth on net worth is much larger in the model than in the data. We find that taxation and inflation can largely account for the difference.

JEL classification: D31; E21; J32

Keywords: Private pensions; Wealth inequality; Retirement Wealth.

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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. We model private pensions as defined benefit type in the paper as the majority of private pensions for our Panel Study of Income Dynamics (PSID) sample households with heads aged 65 in 1997-2007 are defined benefits. 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 net worth

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

between households with similar lifetime earnings; and (ii) the model implies too tight a relationship between lifetime earnings and retirement net worth.

To evaluate and discipline our model results we use the 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, total private wealth, which includes both net worth and the present value of private pensions.

Private pensions are a significant component of PSID retirement wealth, accounting for roughly 25% of total private wealth at retirement, 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 of total private wealth is 0.62 versus 0.65 for net worth. We also find that the correlation between lifetime earnings and total private wealth is higher than the correlation between lifetime earnings and net worth.

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 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 net worth, its quantitative effect on net worth inequality at retirement is roughly one third of 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

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

U.S. social security system encourages higher savings rates for households with high lifetime earnings even in the presence of private pensions.

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 net worth distribution at retirement, with the mean Gini for net worth within lifetime earnings deciles increasing to 0.43 from 0.35 in the economy without private pensions. This accounts for nearly half of the difference between the standard life cycle model and the data (a mean Gini of 0.55 in PSID). The correlation between lifetime earnings and net worth at retirement is lower in the pension economy (0.76) than the no-pension model economy (0.83), which moves the model closer to the data (0.67). To better match the data, we introduce the rate of return heterogeneity into the model with pensions. This further improves the model predictions as the mean Gini of net worth increases to 0.50 and the correlation between lifetime earnings and net worth is reduced to 0.66.

While the life-cycle model with private pensions can largely account for the net worth inequality and the correlation between lifetime earnings and net worth, the pension offset effect in the model is counterfactually high (95% in the benchmark model with pensions versus 49% in the data). This leads us to introduce two additional features which may lower the pension offset effect: taxation and inflation. This is because private pension benefits are fully taxable and private DB pension benefits are usually delivered as nominal annuities. We find that tax and inflation considerations can largely account for the big gap in pension offset effect between the model and the data. The pension offset rate falls to 80% in the model with tax and 67% in the model with both tax and inflation. After further introducing rate of return heterogeneity, it drops to 57%, which is very close to that in the data. The augmented model also performs well in other dimensions, with the mean net worth Gini of 0.48 and the correlation between lifetime earnings and net worth of 0.68.

Our results shed light on the importance of DB pensions as a source of retirement

income. We find that DB pensions offset net worth. The offset effect is larger for a real annuity than that for a nominal annuity. Tax and inflation considerations have a large impact on the offset effect. Our study points to the importance of incorporating these two features for evaluating the impact of any pension reform (both public pensions, for example, Social Security, and private pensions) on private saving.

Our results also have important implications for the debate over what drives the large variation in retirement wealth. Venti and Wise (1998), Hendricks (2007a) 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 heterogeneity in household preferences. Our findings suggest preference heterogeneity may play a smaller role. Not only does the model extended to include private pensions 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 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

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

⁴Several recent papers compare the effects of defined benefit versus define contribution pension plans on household retirement wealth, e.g. see McCarthy (2003)

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. Section 4 reports the results of our numerical experiments involving private pensions. We explore the impact of private pensions and other features on the retirement wealth distribution, correlation between lifetime earnings and retirement wealth, and pension offset effect. Finally, section 5 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 (in 1984, 1989, 1994, 1999, 2001, 2003, and 2005). We focus 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 into 2005 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

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

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.⁵ For missing earnings over the working years, we replace them 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. The present value of lifetime earnings is the discounted sum of earnings between ages 18 and 65, where the discount rate is 4 percent.

We examine two measures of retirement wealth, where “retirement” refers to the year the household head turns 65. The first is net worth, which includes financial wealth, IRAs, account balance of defined contribution plans, real estate, business wealth, vehicles, cash value in life insurance policies, trusts and other assets less debts. The second wealth measure adds the value of defined benefit (DB) private pension plans to net worth, which we refer to as total private wealth.

Information on DB pension plans is available biannually in 1999-2005 PSID wealth files. To compute the value of DB pension wealth at age 65, there are two scenarios: (i) Head and/or wife expect future benefits: If we have data on the expected amount of pension benefits and frequency, we convert them to an annual amount. DB pension wealth is then equal to the annual amount times expected years of receiving benefits at age 65. For the number of expected years of receiving benefits, we consider mortality risk and use a discount rate of 4%; If the expected benefits are in terms of percentage of pay, DB pension wealth is equal to the labor income in current survey year times the percentage times expected years; If the expected benefits are a lump sum payment, DB pension wealth is equal to the lump sum payment; and (ii) Head and/or wife are currently

⁵Federal and state income tax liabilities are calculated using the NBER’s Taxsim program. More details are provided in the online appendix.

receiving benefits: DB pension wealth is equal to the annual amount received times the expected years of receiving benefits.⁶ We use this method to compute DB pension wealth for households whose head turned 65 between 1997 and 2007, which gives us a sample of 455 households.

Table 1 reports the distribution of retirement wealth and DB pension wealth for households whose head age was between 63 and 67 at some point between 1999 and 2005. Including DB pensions tends to equalize the overall distribution of retirement wealth. Comparing the first and third rows of Table 1, including DB pensions 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 DB 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 DB pensions offsets net worth accumulation. The equalizing effect of DB pension wealth on total private 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.

Roughly 44 percent of our sample households have DB private pensions. As can be seen from Table 1, DB pensions are a significant component of wealth – nearly one fifth of total private wealth at retirement. DB pension wealth is even more important for households with DB pensions, accounting for slightly more than one-third of total private wealth.⁷ The median values of DB pension wealth is \$179,200 (in 2005 dollars) for households with DB pensions. As for the mean total private wealth, it stood at \$562,700 in 2005 dollars. The wealth level in PSID is lower than that in the Survey of Consumer Finances (SCF). The SCF oversamples high income households and provides

⁶If the respondent gives a report of “I don’t know” or “refuses” for pension value, we assume the value is zero.

⁷The overall magnitude of pensions in our sample are slightly lower than estimates based on the Health and Retirement Survey (HRS). see Gustman, Steinmeier, and Tabatabai (2010) for an overview of pension data in the HRS.

better data at the top end of the wealth distribution. Juster, Smith, and Stafford (1999) find that the wealth data in the PSID lines up well with data from the SCF up through the 98th percentile of the wealth distribution.

2.1 Lifetime Earnings and Retirement Wealth

The joint distribution of lifetime earnings and retirement wealth 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 2 reports the correlations between lifetime earnings, net worth, total private wealth (net worth plus DB pensions) and DB pension wealth. The correlation between lifetime earnings and total private wealth (0.70) is higher than that of lifetime earnings and net worth (0.67). Consistent with the higher prevalence of employer pensions among higher paid positions, DB pension wealth is positively correlated with lifetime earnings and net worth.

Table 2 also shows that the correlation between lifetime earnings and retirement 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 retirement wealth are slightly higher than for the entire sample. However, the relationship is much weaker for the bottom half of earners.

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 DB pensions leads to higher levels of savings for all deciles, although the impact of DB pensions on the savings rate is slightly larger for households in the top half of the earnings distribution.

We follow Venti and Wise (1998) and Hendricks (2007b) and examine the wealth inequality within lifetime earnings deciles. As Figure 2 illustrates, there is sizeable retirement wealth inequality even within lifetime earnings deciles. The mean Gini of net worth across lifetime earnings deciles is 0.55. Including DB pensions reduces retirement wealth inequality. The mean Gini of total private wealth is reduced to 0.51.

2.2 Pension Offset Effect

Recent studies have shown that pension wealth could lead to a significant reduction of non-pension wealth, i.e., there is an offset effect (Gale (1998), Gustman and Steinmeier (1999), Attanasio and Rohwedder (2003), Engelhardt and Kumar (2011)). For example, using an instrumental-variable identification strategy, Engelhardt and Kumar (2011) find that each dollar of pension wealth is associated with a 53–67 cent decline in non-pension wealth at the mean for older workers in the 1992 wave of the Health and Retirement Study (HRS). To examine the extent of pension offset effect in our PSID data, we follow Gustman and Steinmeier (1999) and estimate a simple OLS regression of net worth on DB pension status.⁸ Our estimate implies a pension offset effect of 49% for our PSID sample households. In a later section of the paper, we will show that the pension offset effect has a large impact on net worth inequality for households with similar lifetime earnings.

⁸We also control for lifetime earnings, marital status and education in the regression.

2.3 Summary: Key Facts

Overall, we have the following findings using the PSID data:

1. For all lifetime earnings deciles, the saving rate increases if retirement wealth includes DB pension. The ratio increases about two percentage points on average within lifetime earnings deciles.
2. Including DB pensions leads to a decline in retirement wealth inequality. The Gini coefficient drops from 0.65 to 0.62 when the wealth measure includes DB pensions.
3. While there is sizeable retirement wealth (with and without DB pension) inequality among households with similar lifetime earnings, including DB pensions lowers the average Gini coefficient from 0.55 for net worth to 0.51 for total private wealth.
4. The correlation between lifetime earnings and total private wealth is slightly larger than that between lifetime earnings and net worth. The correlation between earnings and net worth is very small for the bottom half of lifetime earners.
5. The offset effect of DB pensions on net worth is 49% for our PSID sample households.

Hendricks (2007b) shows that for reasonable parameter values, the standard life-cycle model (without private pensions) generates (i) too little variation in retirement net worth between households with similar lifetime earnings, and (ii) too tight a relationship between lifetime earnings and retirement net worth. Next we present our life-cycle model (with and without private pensions). We then discuss their quantitative fit in Section 4.

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

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

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 :

$$y_j = eh_j \quad (3.2)$$

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

$$e_{i,j+1} = \rho e_{i,j} + \varepsilon_{i,j+1} \quad (3.3)$$

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:

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

subject to the budget constraint

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

where r is the interest rate, I is a random inheritance which is governed by a probability distribution (see below), τ is Social Security benefits, and db is private pension benefits. We assume that borrowing is not allowed in the model.⁹

3.4 Model Parameterization

Table 3 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 set the coefficient of relative risk aversion σ to 1.5. The annual discount factor β is chosen at 0.962 to match the mean net worth at age 65 in the data.

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

⁹In an unreported experiment, we find that relaxing the simplifying assumption of no borrowing is not quantitatively important for our main results.

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 the online appendix.

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 fifteen-state Markov process using the Tauchen method. The model does a reasonably good job of replicating the distribution of lifetime earnings, with a Gini coefficient of lifetime earnings of 0.31 in the data and 0.32 in the model.

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 3. 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 $\bar{y}_{max} =$

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

$2.47\tilde{y}$, where $\tilde{y}$ is mean earnings of all working age households. Social security benefits are a piecewise linear function of average earnings:

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

where $\bar{y}_1 = 0.2\tilde{y}$ and $\bar{y}_2 = 1.24\tilde{y}$ 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 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 private pensions as DB plans since roughly 80% of the present value of all private pensions for our PSID sample are defined benefits. Pension benefits, db , are given by

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

where $\bar{y}$ 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 DB pension coverage and the distribution of replacement rate. We assign higher probabilities of pension coverage ($\theta(e1)$) to higher income groups at age 20 (see Table 3). The pension transition

matrix is asymmetric. Households with pension coverage at period t face a probability of 96 percent of continuing to have coverage at $t + 1$, and a 4 percent of probability of losing coverage. The probability of having pension coverage at period $t + 1$ conditional on no coverage at period t ranges from zero to 3 percent depending on earnings state. 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.¹¹

$$\alpha = \begin{cases} 0 & \text{if } n_{db} < 7 \\ 0.01 & \text{if } n_{db} \in [7, 15] \\ 0.0145 & \text{if } n_{db} \in [16, 25] \\ 0.0185 & \text{if } n_{db} \in [26, 35] \\ 0.0225 & \text{if } n_{db} \geq 36 \end{cases} \quad (3.8)$$

The benchmark parameterization closely matches the PSID data. The DB pension coverage rate at age 65 is 44% in both the data and the model.¹² Table 4 compares the distribution of replacement rates for DB pension holders in the model with the PSID data.¹³ The model closely replicates the replacement rate distribution.

Our calibration strategy does not directly target the distribution of pension wealth at retirement. With the exception of the top 1%, the model actually does a good job of replicating the pension wealth distribution. The Gini coefficient of DB wealth is 0.76 in

¹¹As many DB participants faced a maximum limit on service years for benefit purposes, we cap the number of years of coverage at 35.

¹²The coverage rates from the bottom to top quartiles in PSID are 22%, 43%, 53% and 55%. They are 23%, 43%, 51% and 57% in the model.

¹³Our 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.

the model compared to 0.79 in the data.

4 Private Pensions and Retirement Wealth

In this section, we examine the impact of DB pensions on the distribution of retirement wealth in our model economies. There are three key findings. First, net worth at retirement is more unequally distributed in the model economy with private pensions than in the model without 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). Second, the pension offset effect on net worth is much larger in the benchmark model than in the data. We further introduce taxation, inflation, and rate of return heterogeneity in the model and find that these features together can largely account for the gap between the model and the data. Finally, while significant, the quantitative impact of private pensions on the net worth distribution is much smaller than that of Social Security.

4.1 Benchmark Results

We consider two versions of the benchmark model: one without pensions (the standard model) and one with DB pensions. The Gini of net worth in the model without pensions is 0.50, which is much lower than that in the PSID (0.65). Including DB pension in the model leads to higher inequality in net worth at retirement. The Gini of net worth in the private pension economy is 0.54.¹⁴

The private pension economy also features higher dispersion in net worth among households with similar lifetime earnings than the economy without private pensions. Figure 3 plots the Gini coefficient of net worth at retirement for each lifetime earning

¹⁴The online appendix reports the Lorenz curve for retirement wealth in the model economies.

decile 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 net worth dispersion, with a mean Gini of 0.35. Within decile net worth inequality in the private pension economy is much higher, with a mean Gini of 0.43. This moves the model predictions closer to the data (mean Gini of 0.55).

To further understand why the private pension economy generates higher wealth inequality, we examine the net worth distribution within the second and ninth lifetime earnings deciles. As Figure 4 illustrates, private pensions mainly increase net worth inequality by reducing the net worth for households with pensions. This effect is smaller in the second decile than in the ninth 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 key model mechanism linking DB pension wealth to net worth is the *offset effect*. DB pensions offset (lower) net worth 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.¹⁵ Working in the opposite direction are forces that lower offset. No-borrowing constraint in the model may lead to some households to accumulate non-pension wealth that will not be offset by pension wealth as DB pension wealth is illiquid. Other factors in the real world may also affect the offset rate. For example, if households create mental accounts for different types of assets or lack basic levels of economic literacy, the pension offset effect could be lower (Thaler (1990)).

If all households had private pensions and the same offset rate, private pensions

¹⁵While some private annuity markets exist, they account for a very small share of retirement wealth (see Poterba (2006) and Johnson, Burman, and Kobes (2004)).

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 less than half of households have a DB 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.

Overall, Figure 4 suggests that there is significant offset in the model. How large is exactly the offset effect? Our simple OLS regression, which controls for lifetime earnings, shows that the pension offset effect in the benchmark model is about 95%. This is much higher than what is observed in the data, which is 49%.

A similar pattern appears when we examine the correlation between lifetime earnings and retirement wealth (see Table 5). Although the correlation between lifetime earnings and DB pension wealth is similar in the model with pensions and the data (0.36 versus 0.37), the model understates the correlation between DB pension wealth and net worth, which is 0.06 versus 0.29 in the PSID. When we break down model households into top half and bottom half according to lifetime earnings, the correlation is negative suggesting high offset effect in the model with pensions. On the other hand, the model with pensions can partially account for the correlation puzzle emphasized in Hendricks (2007b). Hendricks (2007b) shows that the standard model without private pensions generates a correlation between lifetime earnings and net worth that is too high, 0.83, compared to the data. We find that the correlation between lifetime earnings and net worth is 0.76 in the model with pensions, which is closer to our PSID data (0.67). The model with pensions also performs better when we break down households into top half and bottom half according to lifetime earnings. In the model with pensions, the correlation between lifetime earnings and total private wealth (net worth plus pension) is higher than the correlation between lifetime earnings and net worth, which is also consistent with the data.

4.2 Comparing Social Security and Private Pensions

While most quantitative life cycle models incorporate social security, private pensions are rarely explicitly modeled.¹⁶ This is surprising, as mean private pension wealth is a significant component of retirement wealth.

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.

In the benchmark economy with private pensions, removing Social Security lowers the net worth Gini by over 20% (i.e, the Gini falls from 0.54 to 0.41). As removing private pensions from the model lowers the Gini from 0.54 to 0.50, the effect of Social Security on net worth inequality is about three times larger than that of private pensions. The larger impact of social security on net worth inequality reflects two factors. First, the average expected present value of social security in the benchmark economy is roughly two times the value of DB private pensions. Second, the distribution of social security across households differs significantly from private pensions, as social security covers all households while less than half of households receive a DB 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.

¹⁶The large effects of social security on the U.S. wealth distribution are well known, see for example Huggett (1996) and Huggett and Ventura (2000).

¹⁷When 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.

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 total private wealth (net worth + DB pensions) to mean lifetime earnings increases by nearly 25% moving from the eighth to the tenth earnings deciles. This is nearly one third of the increase observed in the PSID (see Figure 1). This increase is driven mainly by the lower replacement rate of social security for top earners. By comparison, in the economy without social security, private saving rates increase by less than 10%. 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.

4.3 Rate of 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 benchmark experiments. This leads us to ask whether private pensions combined with rate of return heterogeneity can account for the discrepancy between data and theory.

Households are likely to face different rate of return in reality, for example due to different portfolio holdings. 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 $P_q = (0.15, 0.35, 0.40, 0.10)$. We introduce a simple form of rate of return heterogeneity. Specifically, we assume that each household draws a rate of return on savings from those four types at birth.

The life-cycle model, augmented to include rate of return heterogeneity, better matches the PSID retirement wealth distribution. The model now predicts a net worth Gini of 0.59, which is higher than that in the benchmark model with pensions (0.54) and closer

to that in the data (0.65). The augmented model largely accounts for the substantial net worth inequality within lifetime earning deciles. The mean Gini of net worth across lifetime earnings deciles is 0.50 (versus 0.43 in the benchmark economy with private pensions), which is close to 0.55 observed in the PSID.

To better understand wealth inequality within earning deciles, we again examine the distribution of net worth within the second and ninth lifetime earnings deciles. Due to the return heterogeneity, the model now generates the sizable number of households with high life-time earnings who have low net worth and low private pensions wealth and households with low life-time earnings who have relatively high net worth, which is consistent with the data. Hence retirement wealth inequality increases in the augmented model.

The augmented model also moves the correlations between lifetime earnings and retirement wealth closer to the data. The correlation between lifetime earnings and net worth in the augmented model is reduced to 0.66 (from 0.76 in the benchmark model with pensions), versus 0.67 in the data, while the correlation between lifetime earnings and total private wealth is 0.71 versus 0.70 in the data. The pension offset effect in the augmented model, 80%, is lower than in the benchmark but still much higher than in the data.

4.4 Pension Offset Effect

The pension offset effect implied by the benchmark is counterfactually high (95% versus 49% in the data). In this section we consider a few factors that could potentially account for the gap. The first factor is taxation. Our benchmark model does not include taxes because we use after-tax earnings in the model. As DB pension benefits are fully taxable, introducing taxation in the model is likely to lower the pension offset effect in the model. Second, inflation could also reduce the pension offset rate. In the private sector, few pensions are protected against inflation by formal indexation. Private DB pension

benefits are usually delivered as nominal annuities. As a result inflation will cut the real value of future DB benefits. When model households take inflation into account, they accumulate more non-pension wealth and hence pension offset effect is smaller.

To explore the impact of these factors, we run a series of experiments to understand their contributions. The first experiment is based on the benchmark with pensions, but we add taxation in the model. For federal income tax, we choose the 1997 tax rates for married households filing jointly. While a few states do not, most states in the U.S. impose an individual income tax. Given the complexity of the state tax structure, we consider a simplified state income tax with progressive tax rates of 2%, 3%, 4%, 5%, and 6% (these brackets roughly capture the state income tax rates applied in many states). The same income thresholds are used for both state and federal income taxes. We follow exactly the rule in U.S. to tax Social Security benefits with a maximum of 85% of Social Security benefits could be taxed. We also allow \$10,000 deductions. The second experiment further adds a moderate inflation of 2.5% in the model when households calculate the present value of DB pension benefits. The third experiment, a “combo”, includes taxation, inflation (2.5%), and the rate of return heterogeneity considered in last section.

We find that including taxation lowers the pension offset rate, which falls to 80% from 95% in the benchmark. Inflation further reduces the offset rate. It is 67% in the experiment with both taxation and inflation. Thus, taxation and inflation accounts for most of the gap between data and model. The pension offset rate is 57% in the “combo” experiment, which is close to that in the data (49%).¹⁸ Our “combo” experiment also performs well in matching retirement wealth inequality and correlation between earnings and retirement wealth. The Gini of net worth is 0.56, and the mean Gini of net worth across lifetime earnings deciles is 0.48 (versus 0.55 in the data).¹⁹ The correlations

¹⁸The offset rates for the top half and the bottom half of lifetime earners in the experiment are 57% and 47%, respectively.

¹⁹The figure that shows the Gini coefficients of net worth across lifetime earnings deciles is provided

between lifetime earnings and net worth, total private wealth, and DB pensions in the “combo” experiment are 0.68, 0.74, and 0.35 respectively (versus 0.67, 0.70, and 0.37 in the data). However, the correlation between net worth and DB pensions is still lower (0.09 versus 0.29 in the data), which also suggests that the pension offset effect is still larger in the model than in the data. This could be due to the fact that our model does not accurately capture the full set of incentives and opportunities facing households. For example, if households create mental accounts for different types of assets or lack basic levels of economic literacy, the pension offset effect could be lower (Thaler (1990)).

5 Conclusion

Private pensions are an important component of U.S. retirement wealth. We find that incorporating a private pension system, modelled as DB type, in the “standard” life-cycle model leads to higher inequality in net worth at retirement and lowers the correlation between lifetime earnings and net worth. 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 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)).

in the online appendix.

The offset effect of pension wealth on non-pension wealth, however, is much higher in our benchmark model with private pensions than in the data. We find that tax and inflation considerations can largely account for the gap. Our paper points to the importance of incorporating private pensions, tax, and inflation in a life-cycle when studying retirement wealth accumulation and wealth inequality. Future work may extend the model to incorporate other features, for example uncertain health expenditure late in life and intergenerational links, to better match the saving rate for high earnings households.

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Table 1: Retirement Wealth Distribution: 1999-2005 PSID

	Top 1%	1-5%	5-10%	10-20%	20-40%	40-60%	60-80%	80-100%	Gini	Mean	N
Net worth	16.6	18.4	14.6	18.4	18.2	9.0	4.1	0.7	0.65	457.3	455
DB pension wealth	17.2	24.0	16.3	23.2	18.6	0.7	0.0	0.0	0.79	105.4	455
Total private wealth	14.7	17.7	14.1	17.6	20.1	10.2	4.6	1.1	0.62	562.7	455

Note: This table shows the Lorenz curve of retirement wealth, Gini coefficient, and mean wealth. Total private wealth = net worth + DB pension wealth. The mean wealth levels are in thousands of 2005 dollars. N denotes the sample size.

Table 2: Correlation Coefficients: 1999-2005 PSID

		Earnings	Net Worth	Total Private Wealth	DB Pension Wealth
All Households	Earnings	1.00	0.67	0.70	0.37
	Net Worth	0.67	1.00	0.97	0.29
Top 50 % Earners	Earnings	1.00	0.76	0.76	0.28
	Net Worth	0.76	1.00	0.97	0.26
Bot. 50 % Earners	Earnings	1.00	0.13	0.18	0.28
	Net Worth	0.13	1.00	0.98	0.02

Note: This table reports the correlation coefficients for households with head aged 63-67 in 1999-2005 PSID. Total private wealth = net worth + DB pension wealth. The sample size is 455.

Table 3: Benchmark Parameters

Demographics	
$J = 76$	Maximum lifespan (physical age 95)
$R = 45$	Last working period (physical age 64)
P_j	Survival probabilities
Preferences	
$\beta = 0.962$	Discount factor
$\sigma = 1.50$	Risk aversion
Labor income	
$\rho = 0.96$	Persistence of e
$\sigma_e = 0.21$	Standard deviation of e shocks
$\sigma_{e1} = 0.62$	Standard deviation of $e1$
$e = (0.08, 0.12, 0.17, 0.24, 0.35, 0.49, 0.70, 1.00, 1.42, 2.02, 2.88, 4.09, 5.82, 8.28, 11.77)$	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	
$\theta(e1) = (0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.04, 0.14, 0.16, 0.18, 0.22, 0.25, 0.28, 0.30, 0.30)$	DB pension coverage rate at $j = 1$
$\alpha(n_{db})$	Generosity factor. See text
Other parameters	
$r = 0.04$	Interest rate

Table 4: Distribution of DB Pension Replacement Rate

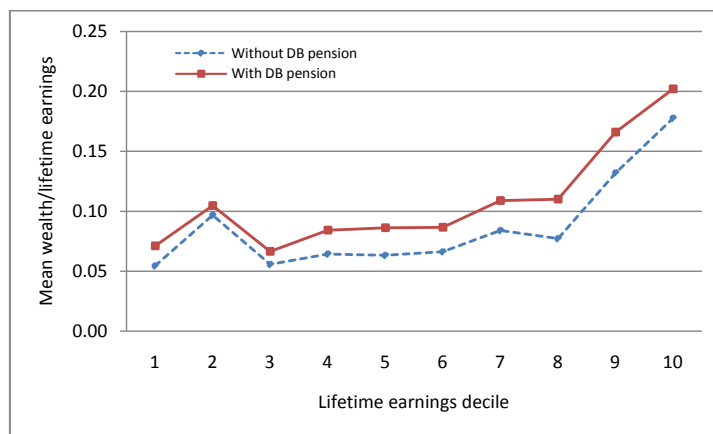
	PSID		Model	
Replacement Range	Fraction	Mean Replacement	Fraction	Mean Replacement
< 20%	35%	10%	35%	11%
[20%, 60%]	46%	38%	45%	37%
> 60%	19%	74%	20%	75%
All	100%	35%	100%	35%

Table 5: Correlation Coefficients in Data and Model

A: PSID data					
		Earnings	Net Worth	Total Private Wealth	DB Pension Wealth
All Households	Earnings	1.00	0.67	0.70	0.37
	Net Worth	0.67	1.00	0.97	0.29
Top 50 % Earners	Earnings	1.00	0.76	0.76	0.28
	Net Worth	0.76	1.00	0.97	0.26
Bot. 50 % Earners	Earnings	1.00	0.13	0.18	0.28
	Net Worth	0.13	1.00	0.98	0.02
B: Model with private pensions					
		Earnings	Net Worth	Total Private Wealth	DB Pension Wealth
All Households	Earnings	1.00	0.76	0.82	0.36
	Net Worth	0.76	1.00	0.96	0.06
Top 50 % Earners	Earnings	1.00	0.75	0.80	0.19
	Net Worth	0.75	1.00	0.95	-0.11
Bot. 50 % Earners	Earnings	1.00	0.23	0.32	0.30
	Net Worth	0.23	1.00	0.95	-0.12
C: Model without private pensions					
		Earnings	Net Worth	Total Private Wealth	DB Pension Wealth
All Households	Earnings	1.00	0.83	—	—
	Net Worth	0.83	1.00	—	—
Top 50 % Earners	Earnings	1.00	0.81	—	—
	Net Worth	0.81	1.00	—	—
Bot. 50 % Earners	Earnings	1.00	0.31	—	—
	Net Worth	0.31	1.00	—	—

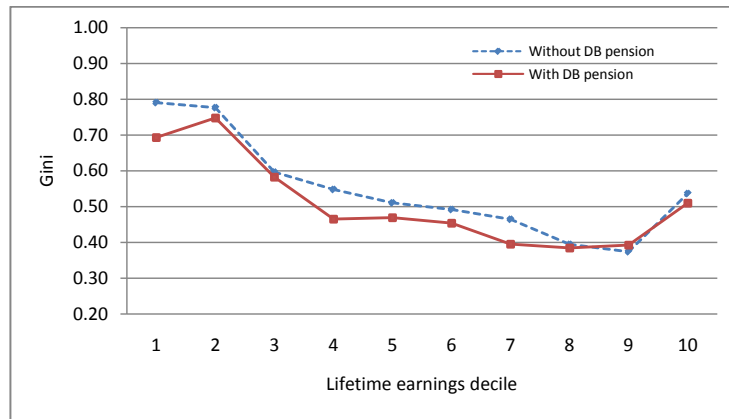
Note: Total private wealth = net worth + DB pension wealth.

Figure 1: Mean Retirement Wealth/Lifetime Earnings



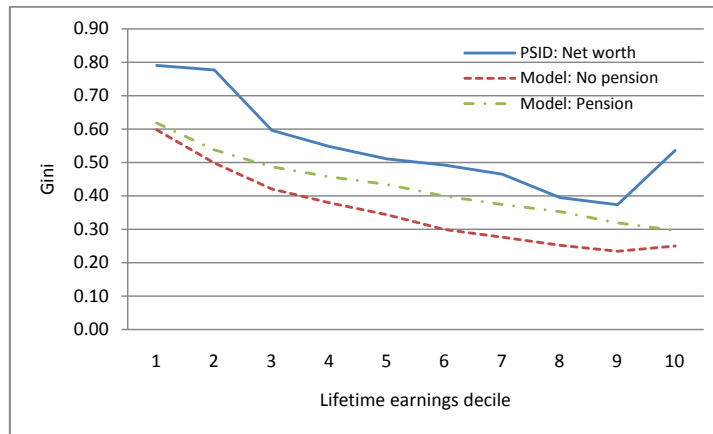
Note: This figure plots the saving rate in each lifetime earnings decile for households with head aged 63-67 in 199-2005 PSID. The saving rate is defined as mean net worth (total private wealth) divided by mean lifetime earnings.

Figure 2: Gini of Retirement Wealth



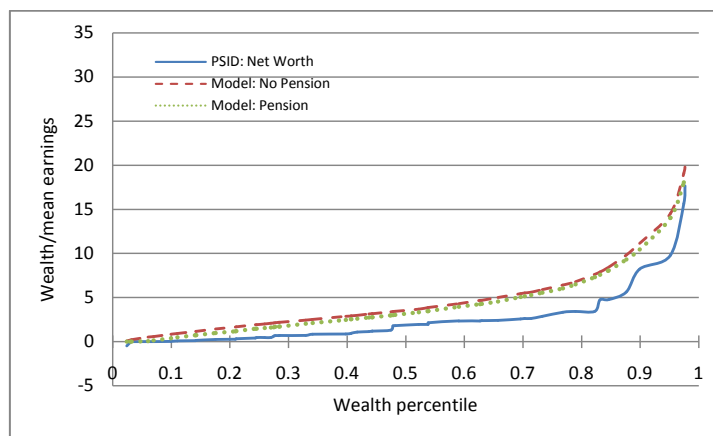
Note: This figure shows the Gini coefficient of net worth (total private wealth) in each lifetime earnings decile for households with head aged 63-67 in 199-2005 PSID.

Figure 3: Gini Coefficient of Net Worth at Retirement

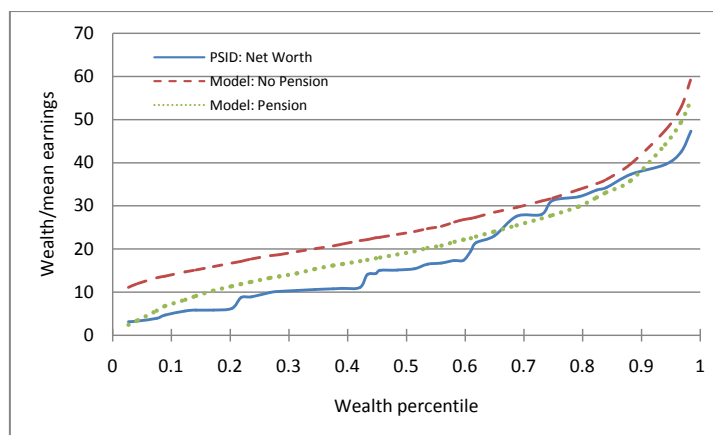


Note: This figure shows the Gini coefficient of net worth at retirement for each lifetime earnings decile in the data and benchmark models.

Figure 4: Net Worth at Retirement: 2nd and 9th Lifetime Earnings Deciles



2nd decile



9th decile