Netspar

Network for Studies on Pensions, Aging and Retirement

Netspar DISCUSSION PAPERS

Joachim Inkmann and Alexander Michaelides

Can the Life Insurance Market Provide Evidence for a Bequest Motive?

Discussion Paper 07/2010-027

Can the Life Insurance Market Provide Evidence for a Bequest Motive?*

Joachim Inkmann†

The University of Melbourne and Netspar

Alexander Michaelides‡

Central Bank of Cyprus and

London School of Economics, CEPR, FMG and Netspar

July 2010

*We thank Netspar for a grant to pursue this project. We appreciate helpful comments from Jiajia Cui, Theo Nijman, Joshua Rauh, Peter Schotman, and participants of the International Netspar Pension Workshop in Zurich in June 2010.

†Department of Finance, Level 2, Economics and Commerce Building, The University of Melbourne, Victoria 3010, Australia. Email: jinkmann@unimelb.edu.au.

‡FMG and Department of Economics, London School of Economics, Houghton Street, London, WC2A 2AE, UK. Email: a.michaelides@lse.ac.uk.

Can the Life Insurance Market Provide Evidence for a Bequest Motive?

Abstract

Using U.K. microeconomic data, we analyze the empirical determinants of participation in the life insurance market. We find that term insurance demand is positively correlated with measures of bequest motives like being married, having children and/or subjective measures of strong bequest motives. We then show that a life-cycle model of life insurance demand, saving and portfolio choice can rationalize quantitatively the data in the presence of a bequest motive. These findings provide evidence supporting the presence of a bequest motive.

JEL Classification: E21, G11.

Key Words: Portfolio choice, life insurance, bequest motive.

1 Introduction

The strength of the bequest motive has been a source of intense debate in the last thirty years. A classic exchange between Kotlikoff and Summers (1981) and Modigliani (1988) gives a range for the amount of wealth in the economy accounted for by bequests between 46% by the former and the much smaller 17% by the latter. A large empirical literature has tried to come to a satisfactory answer with regards to the strength of the bequest motive. In a widely cited paper Hurd (1987) argues against the presence of a bequest motive by comparing the wealth decumulation of households with and without children. If households with and without children behave in a similar way, then that observation can be interpreted as evidence that the intentional bequest motive is not present.

Recent work has called into question this conclusion using a more structural approach towards estimation (Kopczuk and Lupton (2007)). A parallel literature from macroeconomics has recently argued that bequest motives are needed to explain the very skewed wealth distribution observed in U.S. data. Prominent examples of this work include De Nardi (2004), Castaneda et al. (2003) and Cagetti and De Nardi (2006).

We revisit the evidence on the strength of the bequest motive through life insurance participation and portfolio choices using a detailed survey of U.K elderly households. The spirit of our exercise is similar to Bernheim (1991) who uses life insurance data to make the case for bequests. Brown (2001), on the other hand, questions these conclusions because life insurance data might be mixing different types of products, or because some of the households might still be working and be covered by their employers or because of cohort effects. We broaden this earlier analysis by breaking down life insurance participation between one arising from tax-reasons and another one more closely linked to bequests. We then provide microeconometric evidence on the determinants of life insurance participation using this new data set. Finally, we estimate the preference parameters of a life insurance and asset allocation model and show how a bequest motive can explain observed outcomes. Our analysis therefore makes the case that life insurance and asset allocation choices can provide empirical support for the presence of a bequest motive.

We proceed in a number of steps in making this case. We first empirically analyze the determinants of life insurance demand at the household level to determine the characteristics of households that participate (or not) in this market. Our data contain information on term insurance and endowment plans. The latter essentially combine a term insurance with an investment component. We find that 42% of households participate in the life insurance market, 35% in term insurance and 7% in endowment plans. Our empirical results support the interpretation that endowment plans are held for investment purposes due to tax reasons, while term insurance participation is strongly correlated with variables proxying for a bequest motive (being married, having children and stating a subjective preference for leaving bequests).

In our empirical analysis, we also separate the sample between stockholders and non-stockholders. We take this route because wealthier and more educated households can better afford and understand financial products, and because we know that stock market participation increases with wealth and education (for instance, Campbell (2006)). We find that stockholders are more likely to invest in endowment plans than non-stockholders (11% vs 4%) but less likely to demand term insurance (29% vs 39%), with the differences being statistically significant.

Given this empirical evidence, our working hypothesis will be that an operational bequest motive can be consistent with term insurance choices in household portfolios. We therefore construct a quantitative model that may replicate these empirical findings. Specifically, we build a model of life-cycle saving, portfolio and life insurance choices with Epstein and Zin (1989) preferences over a non-durable good and investigate whether reasonable preference parameters can replicate the observed term insurance participation rate, the wealth profiles and asset allocations after retirement. We use a Method of Simulated Moments to estimate the model separately for stockholders and non-stockholders due to the large difference in financial wealth profiles across the two groups in the data.[1]

[1] We do not model the endogenous decision of whether to participate or not in the stock market. Gomes and Michaelides (2005) and Sule (2006) calibrate and estimate, respectively, a life-cycle model and show that households with low financial wealth can be kept out of the stock market with a small fixed cost. Given that in our data the households that do not participate in the stock market are much poorer in terms of financial wealth than stock market participants, we think that a small fixed cost will keep these households out of the stock market as well. We do not model this endogenous choice explicitly here to keep the model relatively simple.

The estimated preference parameters require a low elasticity of intertemporal substitution for both non-stockholders and stockholders (around 0.3) and this estimate is within the range offered by the empirical evidence in Vissing-Jorgensen (2002). We also estimate the coefficient of relative risk aversion between 4.2 and 6, while the discount factor ranges between 0.9 and 0.98. For both stockholders and non-stockholders, we need a bequest motive to explain the data, with the bequest motive stronger for stockholders (consistent with the interpretation in De Nardi et al. (2010)). We view these parameter estimates as plausible and interpret our results as being consistent with the presence of a bequest motive.

Apart from explaining life insurance demands, the bequest motive can also generate a balanced portfolio comprised of both stocks and bonds and therefore can better explain portfolio allocations during retirement. Here, the bequest motive can generate a much slower decumulation of wealth during retirement, while for the same reason it can generate balanced portfolios. In the absence of a bequest motive, both financial wealth and the implicit riskless assets (state pensions) are being depleted at similar rates. A bequest motive, however, slows down the decumulation of financial wealth while the present value of pensions (the implicit riskless asset) is being depleted at the same rate with or without a bequest motive. As a result, the intentional bequest motive generates a stronger demand for the riskless financial asset generating a balanced portfolio even at retirement and in the presence of a substantial equity premium.

The remainder of the paper is organized as follows. In Section 2, we present multivariate Probit (reduced form) results on the actual determinants of life insurance demand. In Section 3 we outline the model of household choices during retirement and in Section 4 we estimate the structural parameters of this model and compare the moments in the data to the ones from the model. Section 5 discusses the implications of the model for the bequest motive and performs some robustness checks and Section 6 concludes.

2 Empirical Analysis

In this section we investigate the correlates of participation in the life insurance market using a sample of elderly households for the U.K.

2.1 Dataset

The empirical part of the paper is based on the English Longitudinal Study of Ageing (ELSA). ELSA is a biannual panel survey among those aged 50 and over (and their younger partners) living in private households in England. We are using the first wave of ELSA collected in 2002/03. Since we are interested in identifying bequest motives in our sample, we restrict our analysis to elderly households defined as consisting of a retired single, or a couple with at least one retired person.[2] We exclude 684 households with outstanding mortgages to remove life insurance holdings which might have been imposed by the mort-

[2] With this restriction, we exclude 2,206 non-retired households.

gage seller and therefore can not be interpreted as resulting from a voluntary decision of the household.[3] Some further details regarding the construction of the sample are provided in Appendix A.

2.2 Descriptive Statistics

2.2.1 Life Insurance Holdings

Households participating in ELSA are requested to report holdings of “any life insurance policies.” If confirmed, households are asked to indicate if the life insurance has “a savings component” defined as “the value of the fund that will be paid at some point in the future.” This question separates term insurance without an investment component from endowment plans which combine term insurance with an investment component. In an endowment plan, the accumulated amount of insurance premiums and reinvested returns are invested (usually on behalf of the owner of the contract) and returns are distributed to the life insurance account of the owner. If she is alive at the plan’s maturity date, the owner of an endowment plan will receive the value of the fund. In contrast to this, a term insurance does not pay out anything if the insurance holder is alive at the maturity of the contract. The reasons for choosing an endowment plan in favour of alternative investments like mutual funds are tax-related. Appendix B gives more details on the different types of life insurance holdings in the U.K. and overviews their tax treatment.

[3] In the U.K., is is not mandatory by law to combine a mortgage with a life insurance. However, mortgage sellers still may require this.

Table 1 reports a 42% participation rate in the life insurance market in our sample. This number is close to the aggregate life insurance participation rate of 47% reported for the U.K. by the Association of British Insurers (ABI) for the year 2004.[4] Table 1 (last row) further reports that 35% of the households in our sample hold a term insurance, while 7% invest in an endowment plan.

2.2.2 Life Insurance, Stock Market Participation, and Financial Wealth

Table 1 also decomposes the total sample into stock market participants and non-participants (also called stockholders and non-stockholders from now on).[5] The stock market participation rate is 42% but the difference in total life insurance holdings of stockholders (41%) and non-stockholders (44%) is small and statistically insignificant. However, there are much more pronounced and statistically significant differences in the various types of life insurance products. Stockholders are less likely than non-stockholders to hold a term insurance (29% vs 39%) but more likely to hold an endowment plan (11% vs 4%). This confirms the view that endowment plans are predominantly seen as an investment. They are more attractive to stockholders, who are usually more wealthy

[4] See the ABI publication "UK Insurance - Key Facts 2005" available from http://www.abi.org.uk. According to ABI, the average annual premium per household is £807 and the total premium income of the life insurance industry is £31 billion. These numbers indicate that life insurance holdings are an important component of the portfolio of an average household in the U.K.

[5] A stock market participant is defined as a household that has stocks in an individual savings account (ISA), or a personal equity plan (PEP), or indirect stock holdings in an investment trust, or direct holdings of stocks. Indirect holdings in occupational of private pension schemes are not accounted for. Savings-related forms of life-insurance holdings are excluded as well because we do not observe the allocation in the underlying investment unit (which we need for the matching exercise later in the paper).

and possess a higher level of financial sophistication than non-stockholders (see, e.g., Campbell (2006)).

Table 2 shows life insurance holdings and stock market participation rates across the wealth distribution. As expected, stock market participation increases monotonically with financial wealth and reaches 78% for the group of households with financial wealth exceeding £50,000. Similarly, investments in endowment plans increase monotonically with financial wealth but participation rates remain relatively modest (14% for the most wealthy group of households). On the other hand, term insurance holdings monotonically decrease with financial wealth and reach a minimum of 25% for the most wealthy households.

2.2.3 Life Insurance and Bequest Motives

Table 3 reports life insurance participation rates for households with a possibly operational bequest motive. These households are either married, and/or with children and/or reporting a positive probability of leaving a bequest. These correlates for bequests have been previously discussed in the literature. Auerbach and Kotlikoff (1991) discuss the important role of life insurance for securing an adequate consumption level of widows. Correspondingly, Bernheim et al. (2003) and Inkmann et al. (forthcoming) suggest that a bequest motive may result from being married. Children are used as a proxy for a bequest motive by Hurd (1987) and Hurd (1989). Subjective bequest probabilities are investigated by Hurd and Smith (1999) who provide evidence that these probabilities are valid predictors of actual bequests.

It turns out that married households hold significantly larger amounts of all life insurance forms. Households with children hold significantly more term insurance than households without children (37% vs 27%) but the same amount of endowment plans (7%). Households reporting a positive probability of leaving a bequest are less (more) likely to have a term insurance (endowment plan) than households reporting a zero bequest probability. The multivariate analysis presented below will explore if these correlations persist once other covariates are controlled for.

Table 3 also relates the three proxies for intentional bequests to the self-reported, expected life insurance payout. All three groups indicating a possible bequest motive expect significantly higher life insurance payouts. The difference is particularly strong for households reporting a positive probability of leaving a bequest. These households on average expect a life insurance payout of about £5,800 compared to about £1,800 for households not expecting to leave a bequest.

2.2.4 Life Insurance Covariates

Table 4 shows averages for a number of covariates for the whole sample and the subsamples of households holding a life insurance, a term insurance, an endowment plan or stocks. Interestingly, it should first be noted that the characteristics of households owning endowment plans are similar to those that participate in the stock market (they are wealthier and more educated relative to the average (last column)).

The value of life insurance increases with a decreasing survival probability. The questionnaire asks individuals of age less than, or equal to, 65 (69, 74, 79, 84 and 89) "What are the chances that you will live to be 75 (80, 85, 90, 95 and 100, respectively) or more?" and gives a range from $0-100$ for possible answers. We compare these subjective survival probabilities with gender- and age-specific "objective" survival probabilities from the Government Actuary's Department (GAD).[6] Hurd and McGarry (1995) and Hurd and McGarry (2002) show for the U.S. that subjective probabilities tend to aggregate well to population probabilities. Table 4 confirms this finding for all subsamples. Individuals buying a term insurance report substantially lower survival probabilities than individuals buying an endowment plan. This can be seen as additional evidence that term insurance is purchased with a bequest motive in mind.

Table 4 also reports average pension income for the different subsamples. Households with endowment plans or stocks on average have more pension income than households with a term insurance (about £ $12,000$ vs £ $9,000$). Moreover, the average unconditional expected life insurance payout is about £$5,500$. Conditional on owning a life insurance policy, the average life insurance payout is about £ $12,900$, while the expected payout is larger for endowment plans (£$18,400$) than for term insurance contracts (£$11,800$).

[6] Available from www.gad.gov.uk.

2.3 Econometric Analysis

Table 5 contains the results from Probit estimations of the decision to participate in the life insurance market. We present regression results both for total life insurance holdings and their decomposition into term insurance and endowment plans. Table 5 reports the estimated marginal effects for the Probit models which are computed for a baseline of a single, 65 year-old, male with medium education, no children, a self-reported zero probability of leaving a bequest, with average survival probability, log pension, and log financial wealth.

According to Table 5, life insurance holdings decrease with age (driven by endowment plans), while education significantly affects the decision to buy a term insurance but is insignificant for savings-related products. Compared to the baseline category of medium education, a household with low education has a 3.1 percentage point higher probability of holding a term insurance. Regarding the three proxies for a possible bequest motive - being married, having children, and reporting a positive probability of leaving a bequest - we find very clear support for the hypothesis that term insurance contracts are related to intended bequests while endowment plans are unrelated. All three proxy variables turn out to be economically and statistically highly significant predictors of the decision to hold a term insurance but are insignificant for the decision to invest in endowment plans. Compared to the single baseline household, a married household shows a 7.1 percentage point higher participation probability in the term insurance market. The corresponding percentages for having children and reporting a positive bequest probability are both 4.9 percentage points. The results for the subjective survival probabilities confirm the impression that term insurance policies are held for bequest motives. A 10 percentage point decrease in the subjective survival probability of the baseline household, increases the participation in term insurance by 0.5 percentage points.

While pension income does not matter for any form of life insurance holdings, financial wealth is highly significant for all forms. The sign of the wealth coefficient, however, is different for the two forms of life insurance: negative for term insurance and positive for endowment plans. This confirms our descriptive statistics in Table 2. A unit increase in log financial wealth, which roughly corresponds to a 100% increase in the financial wealth of the baseline household, decreases participation in the term insurance market by 3.2 percentage points, but increases demand for endowment plans by 1.7 percentage points.

Table 6 shows estimation results from a loglinear regression of expected life insurance payouts conditional on participation in the life insurance market. Financial wealth is a strong positive predictor for both forms of life insurance demand but the life insurance demand elasticity of wealth is much higher for endowment plans (0.3375) than for term insurance (0.0971). Moreover, we find a highly significant negative effect of age in all three regressions. Conditional on participation, the demand for life insurance is affected by the same variables affecting the demand for stocks (see Campbell (2006)). The participation decision, however, is different from other financial markets, in particular for term insurance. This is confirmed by the results for the three indicators of a possible bequest motive, which were highly significant for the decision to participate in the term insurance market but turn out insignificant for the conditional life insurance demand. The effect of financial wealth was also of the opposite sign for the decision to purchase a term insurance.

Table 7 presents estimation results for the decision to participate in the term insurance and endowment plan markets for the subsamples of non-stockholders and stockholders. In general, the results discussed for the whole sample hold as well for the two subsamples. There are two exceptions. First, only one of the three indicators of intentional bequests - being married - turns out to be statistically significant for the stockholders' decision to purchase a term insurance, while all three variables are highly significant for non-stockholders. Second, the reported positive coefficient of financial wealth in the endowment plan participation regression is statistically significant for stockholders but insignificant for non-stockholders. These results support the view that term insurance is mostly demanded by the relatively poor households for bequest purposes while endowment plans are demanded by the relatively rich households for investment purposes.

Table 8 again distinguishes between non-stockholders and stockholders and presents loglinear regression results for the expected life insurance payout from term insurance and endowment plans conditional on participation for both subsamples. Again, the results for the whole sample are mostly confirmed in both subsamples. A notable difference exists between the term insurance demand elasticities of financial wealth which is much higher for stockholders (0.2344) than for non-stockholders (0.0608).

2.4 Summary

We provide an in-depth empirical analysis of a household's decision to participate in the life insurance market. We find it particularly insightful to differentiate term insurance holdings from investments in endowment plans. The latter attract households with the same characteristics as those investing in the stock market, and financial wealth becomes a key characteristic influencing decisions.

Term insurance is bought for completely different purposes. Participation significantly decreases with financial wealth. Moreover, all variables proxying a household's bequest motive are economically and statistically highly significant predictors for participation in the term insurance market. Furthermore, we show that term insurance policies are bought by individuals reporting a low survival probability and having lower education. We view all of these findings as very strong evidence for the hypothesis that term insurance policies are bought by the relatively poor households for bequest purposes.

3 The Model

In the next two sections we investigate the implications of a life-cycle model of life insurance demand and portfolio choice and assess the model's consistency with the empirical findings in the previous section.

3.1 Model Setup

3.1.1 Bond and Stock Market

The household can save through a riskless asset and the stock market and makes decisions at an annual frequency. We use r_f to denote the one period interest rate, $\widetilde{r}_{t+1}$ the random return on the stock market and α_t the share of wealth in stocks, and assume that neither stocks nor bonds can be sold short, therefore α_t has to lie between zero and one.

3.1.2 Life Insurance Contracts

Based on our econometric analysis, we focus on the most widely held insurance product in the ELSA data: term insurance. If the insured person dies before maturity, then a term insurance pays out the insured sum. If on the other hand the insured person lives at maturity, then the term insurance plan pays out nothing. These products usually have a fixed term maturity (for instance, ten years). Even though these policies are typically held until expiry, we can model the term insurance as a one year product that can be repriced and repurchased every year to facilitate the numerical solution. At time t, the household can purchase term life insurance which will pay $\exp(r_f)$ at time $(t+1)$ if death arrives next period. We allow for uncertainty in the age of death with p_{t+1} denoting the probability that the household is alive at date $t+1$, conditional on being alive at date t. The actuarially fair price of one unit of the life insurance product is then equal to $(1-p_{t+1})$[7]. We also use a load factor (P_l) to reflect any possible profits or non-actuarial pricing on the part of the life insurance firm. Therefore, the price of life insurance equals

$$l_t = (1 + P_l)(1 - p_{t+1}) \tag{1}$$

3.1.3 Budget Constraint

During retirement the household has liquid financial wealth (cash on hand) X_t, which can be used to purchase life insurance and save though the bond or the stock market. The household is also endowed with pension income in each period, L, but also faces idiosyncratic uncertainty (Y_i) in the form of medical expenses.[8] Mainly for simplicity we model Y_i as i.i.d., log-normal with variance equal to σ_Y^2 and mean equal to $-0.5\sigma_Y^2$.[9] The household can purchase only

[7] With probability p_{t+1} survival continues next period and the insurance gives a payout equal to zero. With probability $(1-p_{t+1})$ the insurance pays out $\exp(r_f)$ next period and therefore the current expected value of life insurance equals $(1-p_{t+1})$.

[8] De Nardi et al. (2010) emphasize the role of idiosyncratic uncertainty during retirement. It is difficult to map the U.S. data to U.K. equivalents given the differences in medical systems that might account for a large proportion of idiosyncratic expense uncertainty during retirement. Out-of-pocket medical expenditures are also typically found to follow a persistent process in the U.S. data. Rather than complicating the model further we use an i.i.d. process with a high variance to compensate for the lack of serial correlation in this uncertainty. Robustness checks are performed with regards to this value.

[9] As in the precautionary savings literature this ensures that changing the variance of the shock does not affect the mean of Y.

positive amounts of the life insurance product. At time t (in the most general version of the model), there are two state variables (age and cash on hand) and three control variables (consumption/saving, the share of wealth in stocks (α_t), and the share of wealth allocated to the life insurance product (α_{lt})).

Cash on hand evolves according to

$$X_{t+1} = (X_t - C_t)(1 - \alpha_{lt})[\alpha_t \exp(\widetilde{r}_{t+1}) + (1 - \alpha_t)\exp(r_f)] + LY_i \qquad (2)$$

If the individual dies in period $t+1$, then next period cash on hand is augmented by the life insurance payout which equals $\alpha_{lt}(X_t - C_t)\exp(r_f)/l_t$ but the household does not receive a pension in that instance.

3.1.4 Preferences

We model household saving and portfolio choices from retirement onwards at an annual frequency. The household lives for a maximum of T (35) periods after retirement. Household preferences are then described by the Epstein-Zin (1989) utility function:

$$V_t = \left\{(1-\beta)C_t^{1-1/\psi} + \beta\left(E_t(p_{t+1}V_{t+1}^{1-\gamma} + (1-p_{t+1})b_1(b_2 + X_{t+1})^{1-\gamma})\right)^{\frac{1-1/\psi}{1-\gamma}}\right\}^{\frac{1}{1-1/\psi}} \qquad (3)$$

where β is the time discount factor, b_1 is the strength of the bequest motive, ψ is the elasticity of intertemporal substitution (EIS) and γ is the coefficient of relative risk aversion. The parameter b_2 allows for a threshold bequest motive as discussed by Lockwood (2009). b_2 describes the threshold wealth level below which a houshold leaves no bequest.

The specification of the bequest motive is potentially a controversial issue in (3). Cocco (2005) and Yogo (2008) make a similar assumption with $b_2 = 0$, while Kopczuk and Lupton (2007) assume that utility from leaving a bequest is linear in wealth. Our specification is closest to De Nardi (2004) in functional form but separates risk aversion from the elasticity of intertemporal substitution. The state variables in each period are current cash on hand and age. In each period t, $t = 1, ..., T$, the household chooses optimal consumption C_t and the shares of saving allocated to the stock market (α_t) and the life insurance product (α_{lt}) with all shares being between zero and one.

3.1.5 Wealth Distribution and Pension Income

To eventually compare the predictions of the model with the data, we will feed certain exogenous inputs from the data in the model. The main ones are an initial wealth distribution and a reasonable pension level. At the same time, based on our empirical results, we also condition these exogenous inputs on stock market participation status and solve two different models, one in which stock market participation is allowed and another where it is not, therefore requiring different inputs for wealth and pension income depending on the stock market participation status. We make this choice following the literature that has shown that wealth and stock market participation are positively correlated and that, to a first approximation, non-stockholders are poorer than stockholders so that a small fixed cost of participation can keep non-stockholders out of the stock market either in infinite horizon or finite horizon models (see, for example, Haliassos and Michaelides (2003), Gomes and Michaelides (2005), Sule (2006) or the evidence summarized in Guiso et al. (2002) and Campbell (2006)). This assumption is consistent with our data with mean financial wealth at retirement for stockholders being approximately five times the mean wealth of non-stockholders.[10] Using these exogenous inputs we start a simulation from age 65 onwards and for each age compute the average life insurance participation rate, average portfolio demand and financial wealth.[11]

4 Matching the Data

We estimate the structural parameters of the life-cycle model with the goal to match the age profiles of term life insurance participation, demand conditional on participation, financial wealth and the share of wealth allocated to stocks generated from the model with the data.

[10] Median wealth differences are similarly extreme with median wealth for non-stockholders being 5,000 GBP, while median wealth for stockholders equalling 49,000 GBP. It should also be noted that this data set does not oversample the rich (like the U.S. Survey of Consumer Finances). We therefore expect the differences in the actual population to be even more extreme than the ones noted in ELSA.

[11] To compute aggregate statistics we derive the demographic weights that would be implied by the survival probabilities used by the household. We then weight each cohort by the respective demographic weight. The conditional survival probabilities are taken from the U.K. GAD for 2002-2004.

4.1 Estimation Method

We will use a Method of Simulated Moments proposed by Duffie and Singleton (1993) to estimate the model. The structural parameters $\hat{\theta}$ are determined as:

$$\hat{\theta} = Argmin_{\theta} D' S^{-1} D.$$

Let Y_t and $\tilde{Y}_t$ denote the observations at time t of the actual and simulated endogenous variables, respectively. Let T be the sample size of the observed series whereas TH data points are simulated to compute moments from the structural model. We have:

$$D = \left(\frac{1}{T} \sum_{t=1}^{T} moment(Y_t) - \frac{1}{TH} \sum_{t=1}^{TH} moment(\tilde{Y}_t) \right).$$

The asymptotically efficient optimal weighting matrix S^{-1} equals the inverse of the variance-covariance matrix of the data. Following Appendix B in De Nardi et al. (2010), we use a diagonal weighting matrix for S^{-1} with the elements along the diagonals being the variance of each moment.

We need to determine which moments to choose. For the non-stockholders we pick financial wealth accumulation, term life insurance participation rates and the expected term insurance payout conditional on participation over five year age intervals (giving a total of fifteen moments). For stockholders we use the same moments, also adding the share of wealth in stocks, giving a total of twenty moments.

4.2 Solution Technique and Calibrated Parameters

This problem cannot be solved analytically. Given the finite nature of the problem a solution exists and can be obtained by backward induction, the numerical Appendix C offers some details on the solution method. There is a large number of parameters to choose and we follow standard practice in calibrating some parameters to maintain the tractability of the estimation method. The maximum age that can be reached is 100, but agents will face a probability of death each period. We assume a constant interest rate equal to 2%. For the stockholders, the mean equity premium is set at 4% with a standard deviation of 20%. The standard deviation (σ_Y) of the i.i.d. shocks during retirement is set at 0.3, but we provide sensitivity analysis to this choice. The mean pension levels are constant. For stockholders they are set at £11,899 per annum and for non-stockholders they are equal to £7,711. Life insurance policies are assumed to be actuarially unfair. We set $P_l = 0.2$ and, for the lack of other evidence, we use the upper range of the estimated loads from the annuity market found in Mitchell et al. (1999) but we also provide robustness checks to this value. To start simulating financial wealth life histories based on the solved policy functions, the initial financial wealth distribution from the data at age 65 is used to start the process.

4.3 Results for Non-stockholders

The results for the non-stockholders are given in Table 9. There is evidence for a weak bequest motive ($b_1 = 0.02$) and no evidence for a threshold financial wealth ($b_2 = 0.0$). The elasticity of intertemporal substitution is estimated to be relatively low ($\psi = 0.33$), consistent with the estimates in Vissing-Jorgensen (2002). Risk aversion is estimated at 4.22 which is within the range of recent estimates (see the discussion in De Nardi et. al. (2010)). Non-stockholders are relatively impatient with the discount factor at 0.9, which is within the range of empirical plausibility (see, for instance, the recent paper by Love (2010)).

Figure 1, left hand panel, compares the predictions of the model with the data and illustrates that the model makes plausible predictions about the data. The mean life insurance participation is relatively constant throughout retirement and mean financial wealth declines only gradually during retirement. The term insurance payout also declines during retirement and also matches the data.

4.4 Results for Stockholders

The results for the stockholders are given again in Table 9. There is evidence for a strong bequest motive ($b_1 = 5.62$) but not for a threshold wealth level ($b_2 = 0$). The elasticity of intertemporal substitution is estimated at around the same level as for non-stockholders ($\psi = 0.3$) which is slightly at odds with the literature that finds higher elasticities for wealthier households (for instance, Vissing-Jorgensen (2002)). Nevertheless, there are two main differences in the current setup relative to empirical estimates based on Euler equations. First, the discount factor is estimated to be much higher for stockholders than for non-stockholders (0.98 versus 0.90), and the discount factor also affects saving behavior. Second, the bequest motive is estimated to be much stronger for stockholders than for non-stockholders and this parameter also affects saving behavior. Typical estimates of the elasticity of intertemporal substitution keep both the discount factor and the bequest motive implicitly the same across groups and this might be affecting the final results.

The risk aversion coefficient needs to be estimated slightly higher than the one for non-stockholders ($\gamma = 6$ vs $\gamma = 4.22$) reflecting the presence of the equity premium: to generate balanced portfolios a slightly higher risk aversion is needed for stockholders. A stronger bequest motive is also necessary to prevent decumulation of financial wealth during retirement. It should be noted that the estimated bequest motive being stronger for richer households is consistent with the recent work by De Nardi et. al. (2010) whose findings can be interpreted in a similar way.

Figure 1, right hand panel, compares the model predictions with the data. Life insurance participation is slightly decreasing during the later retirement period and the model generates this prediction. Mean financial wealth is also predicted to be relatively constant during retirement (hence the need for a bequest motive) while the share of wealth in stocks is slightly higher than in the data in the early retirement period. The strong bequest motive also helps to keep the portfolio being balanced between bonds and stocks despite the equity premium. This arises because the rapid decumulation of the implicit riskless asset in the form of pensions means that the portfolio can be kept relatively balanced by replenishing the loss of pensions with the financial riskless asset. The mean term insurance payout decreases during retirement whereas it shows an upward trend in the data (but the standard deviation of this variable is substantial in the data).

5 Robustness Results

If the bequest parameter b_1 is set equal to zero then there is no participation in the life insurance market. Thus, if the intentional bequest motive is eliminated, the model needs to be extended in different directions if life insurance demands are to be rationalized. We therefore interpret the results from the baseline model as providing supportive evidence for the presence of a bequest motive through the life insurance market.

We next perform some comparative statics to better understand the working of the model. Table 10 reports the baseline results for non-stockholders. The column "$\sigma_Y = 0$" reduces idiosyncratic uncertainty to 0% and shows that life insurance participation dramatically increases. On the other hand, the column "$\sigma_Y = 0.9$" presents what happens when idiosyncratic uncertainty increases from $\sigma_Y = 0.3$ to $\sigma_Y = 0.9$ and shows that life insurance participation is almost completely driven to zero. Why drives these results? Higher idiosyncratic uncertainty implies that savings for precautionary reasons increase and the extra savings can be used either for precautionary or bequest reasons in case of death. With zero idiosyncratic uncertainty, on the other hand, the need for precautionary saving is less pronounced and the household finds it cheaper to satisfy the bequest motive through the life insurance market. Thus, perhaps counterintuitively, the model predicts that the presence of very high idiosyncratic uncertainty that generates a lot of precautionary saving, can actually crowd out the life insurance market.

Decreasing the load factor from 20% ($P_l = 0.2$) to zero (column "$P_l = 0$") does not generate a substantial change in results early in retirement but does generate a substantial increase towards the end of life (for the fifth age group, life insurance participation increases from 26 to 69 percent). The final column, "$0.5L$", decreases the fixed pension received during retirement by 50%. This does have a substantial effect on life insurance participation choices and at first sight these look counterintuitive. Specifically, life insurance participation is reduced in the presence of lower pension payouts. It seems the bequest motive is more likely to be important when the household first satisfies its own consumption needs, and a lower pension makes these needs more pressing, crowding out life insurance demand.

Table 11 repeats the same experiments for stockholders. Eliminating idiosyncratic uncertainty (column "$\sigma_Y = 0$") for this richer group has less of an effect on life insurance demand and wealth decumulation, even though the effects go in the same way as for non-stockholders (more wealth decumulation and higher life insurance participation). The effects are more dramatic with the large increase in idiosyncratic uncertainty from $\sigma_Y = 0.3$ to $\sigma_Y = 0.9$ (column "$\sigma_Y = 0.9$"). Due to the higher wealth accumulation for precautionary reasons, life insurance demand is almost completely crowded out as the household can use the accumulated savings from self insurance to satisfy the bequest motive in case of death. The effect on portfolio choice is consistent with the temperance effect: higher income uncertainty is predicted to reduce the share of wealth allocated to the stock market. Using actuarially fair life insurance (column "$P_l = 0$") increases demand for life insurance and this is mostly seen by the higher life insurance payout at different age groups. Setting the pension level to 50 percent of the previous level (column "$0.5L$") again crowds out life insurance participation. This happens because the household feels it should satisfy its own consumption needs first, as in the non-stockholder case. We conclude that pension provision and household expectations about pension payouts are important determinants of life insurance participation.

6 Conclusion

Using microeconomic data from the U.K. we find that correlates of intentional bequest motives (being married, having children and/or subjective measures of preferences towards leaving bequests) are positively correlated with life insurance demand for protection (as opposed to tax-favored investment) reasons. We then estimate preference parameters from a structural model that can rationalize observed choices of life insurance demand with a plausible preference parameter configuration. A key requirement is the need for a bequest motive to explain observed choices. We interpret the results from this analysis as supportive evidence for the presence of a bequest motive.

Appendix A The Data[12]

We prepare the data on the financial unit level because the "Income and Assets" module of ELSA is distributed to all financial units within a household. A financial unit is either a single person, or a couple if the latter declares to share their income and assets. If a couple treats their income and assets separately, it will consist of two financial units. All covariates (like age, gender, education) are matched to the person answering the "Income and Assets" module. The first wave of ELSA comprises 12,100 individuals and our sample consists of 4,422 households. The reduction is explained by excluding households without a member in retirement (2,206 observations), excluding partners from couples who report joint income and assets (3,536 observations), excluding financial units with an outstanding mortgage (684 observations), and excluding obser-

[12] The data (ELSA) were made available through the UK Data Archive. ELSA was developed by a team of researchers based at the National Centre for Social Research, University College London and the Institute for Fiscal Studies. The data were collected by the National Centre for Social Research. The funding is provided by the National Institute of Aging in the United States, and a consortium of UK government departments coordinated by the Office for National Statistics. The developers and funders of ELSA and the Archive do not bear any responsibility for the analyses or interpretations presented here.

vations with missing values for our variables of interest ($1,252$ observations).

Appendix B The U.K. Life Insurance Market

The ELSA questionnaire explains that "there are two types of life insurance in the U.K. One type is pure insurance - i.e. the individual gives a company money each year. If that individual dies the company pays money to their dependents but if they don't die (before a certain date), the company just keeps all the money. The other type of life insurance has a savings component so even if the individual does not die before a certain date they will receive a sum of money (typically the value of a fund) on that day." The first type of life insurance is term insurance. The second type of life insurance is typically an endowment plan. The ELSA questions "are designed to get at both types of life insurance since we need to know both separately."

The Association of British Insurers distinguishes protection- and savings related life insurance forms in the U.K.[13] Protection-related life insurance can be used to protect a household's future financial well-being. If the policy holder passes away during the term of the insurance, the insurance company pays a prespecified lump sum to the beneficiaries of the policy. In return, the holder of the policy agrees to pay a premium in monthly (or sometimes annual) frequency. A savings-related life insurance policy is an investment product. The policy holder agrees to pay a premium, which can be of a lump sum type

[13] See the ABI publication "UK Insurance - Key Facts 2005" available from http://www.abi.org.uk.

or paid at regular intervals. Premium payments are pooled by the insurer and invested. The insurance company pays out the accumulated investment returns in addition to the prespecified lump sum to the beneficiaries of the policy at the time the owner of the policy dies or the term expires, whichever comes first. Investment returns are either distributed when they occur (unit-linked policies) or smoothed and paid out in terms of a bonus on an annual basis (with-profit policies). A term insurance is a protection-related life insurance product while an endowment plan is a savings-related product.

HM Revenue & Customs explains the taxation of savings-related life insurance in the U.K.[14] To understand this, it is important to differentiate qualifying and non-qualifying policies. Broadly speaking, a qualifying policy (for example, an endowment plan) requires premium payments at regular intervals (ruling out single premium policies) and a term of at least 10 years. A non-qualifying policy (for example, an investment bond) is a single premium policy with a term of at least 5 years. Income and gains from both forms of policies are taxed at 20% at source. High-rate tax payers pay an additional 20% tax on income and gains on non-qualifying policies. However, non-qualifying policies allow the owner to withdraw 5% of the amount invested in each year before the policy matures without immediate taxation consequences. Taxation is deferred to the time the policy expires. This can be attractive for households expecting a lower tax rate at the maturity of the contract. Qualifying policies become non-qualifying if cashed in or if premium payments are interrupted

[14] Help sheet 320 available from http://www.hmrc.gov.uk/helpsheets/hs320.pdf.

either before 10 years or 75% of the term have passed, whichever comes first. Qualifying policies with a long term of, for example, 25 years are also sold in combination with a mortgage (endowment mortgage). Insurance policies can also be placed in an individual savings account (ISA). In this case, neither the insurance company nor the owner need to pay tax on income or capital gains.[15] However, the maximum amount of premiums paid to an ISA life insurance is limited.

For comparison, during the time our data is collected (2002/03), a high- (low-) rate tax payer would need to pay 40% (20%) capital gains tax on mutual funds. There is a "taper relief" for assets that were held for a long time which reduces the tax to a minimum of 24% (12%) for high (low-) rate tax payers.[16] This comparison shows that there are tax incentives, in particular for high-rate tax payers, to invest in savings-related life insurance like endowment plans. Finally, it is worth mentioning that the proceeds of a life insurance are subject to 40% inheritance tax if the total estate exceeds the inheritance threshold (£ 250,000 in 2002/03). However, this can be avoided if the policy is written in trust.

[15] ELSA contains information on life insurance holdings in ISA accounts. We classify these as savings-related. Thus, they are included in the endowment plan category.

[16] Since April 2008, the capital gains tax has been 18% flat.

Appendix C Numerical Solution

There are two state variables (age and cash on hand) and three control variables (consumption, share of wealth in stocks, and share of wealth in life insurance for bequest reasons) in the most general version of the model. The household problem is therefore given by

$$V_t(X_t) = \underset{c_t,\alpha_t,\alpha_{lt}}{MAX} \left\{ (1-\beta)C_t^{1-1/\psi} + \beta \begin{pmatrix} E_t(p_{t+1}V_{t+1}^{1-\gamma} + \\ (1-p_{t+1})b_1(b_2+X_{t+1})^{1-\gamma}) \end{pmatrix}^{\frac{1-1/\psi}{1-\gamma}} \right\}^{\frac{1}{1-1/\psi}}$$

where the evolution of the state variable is given in (2).

We solve the model recursively backwards[17] starting from the last period. In the last period ($t = T$) the policy functions are trivial and the value function corresponds to the bequest function. We need to solve for three control variables in every year. For every age t prior to T, and for each point in the state space, we optimize using grid search. From the Bellman equation the optimal decisions are given as current utility plus the discounted expected continuation value ($E_tV_{t+1}(.)$), which we can compute since we have just obtained V_{t+1}. We perform all numerical integrations using Gaussian quadrature to approximate the distributions of the innovations to the risky asset returns. We discretize the state-space along the continuous state variable and use cubic splines to perform the interpolation of the value function for points which do not lie on

[17] We use a value function approach to solve the problem (unlike Zeng (2008) who uses an Euler equation approach).

the state space grid, with more points used at lower levels of wealth where the value function has high curvature. Once we have computed the value of each alternative we pick the maximum, thus obtaining the policy rules for the current period. Substituting these decision rules in the Bellman equation, we obtain this period's value function ($V_t(.)$), which is then used to solve the previous period's maximization problem. This process is iterated until $t = 1$.

References

Auerbach, Alan J. and Laurence J. Kotlikoff, "The Adequacy of Life Insurance Purchases," *Journal of Financial Intermediation*, 1991, *1 (3)*, 215–41.

Bernheim, Douglas, "How Strong Are Bequest Motives? Evidence Based on Estimates of the Demand for Life Insurance and Annuities," *The Journal of Political Economy*, 1991, *99* (5), 899–927.

_ **, Lorenzo Forni, Jagadeesh Gokhale, and Laurence J. Kotlikoff**, "The Mismatch between Life Insurance Holdings and Financial Vulnerabilities: Evidence from the Health and Retirement Study," *American Economic Review*, 2003, *93 (1)*, 354–365.

Brown, J.R., "Are the Elderly Really Over-Annuitized? New Evidence on Life Insurance and Bequests," in D Wise, ed., *Themes in the Economics of Aging*, University Of Chicago Press, 2001, pp. 91–126.

Cagetti, M. and M. De Nardi, "Entrepreneurship, Frictions, and Wealth," *Journal of Political Economy*, 2006, *114* (5), 835–870.

Campbell, John Y., "Household Finance," *Journal of Finance*, 2006, *61* (4), 1553–1604.

Castaneda, Ana, Javier Diaz-Gimenez, and Joseé-Victor Rios-Rull, "Accounting for the U.S. Earnings and Wealth Inequality," *Journal of Political Economy*, 2003, *111* (4), 818–857.

Cocco, Joao F., "Portfolio Choice in the Presence of Housing," *Review of Financial Studies*, 2005, *18* (2), 535–567.

De Nardi, Mariacristina, "Wealth Inequality and Intergenerational Links," *Review of Economic Studies*, 2004, *71*, 743–768.

— , **Eric French, and John Jones**, "Why Do the Elderly Save? The Role of Medical Expenses," *Journal of Political Economy*, 2010, *118*, 39–75.

Duffie, D. and K.J. Singleton, "Simulated Moments Estimation of Markov Models of Asset Prices," *Econometrica*, 1993, pp. 929–952.

Epstein, Larry G. and Stanley E. Zin, "Substitution, Risk Aversion, and the Temporal Behavior of Consumption and Asset Returns: A Theoretical Framework," *Econometrica*, 1989, pp. 937–969.

Gomes, Francisco and Alexander Michaelides, "Optimal Life-Cycle Asset Allocation: Understanding the Empirical Evidence," *Journal of Finance*, 2005, *60* (2), 869–904.

Guiso, Luigi, Michael Haliassos, and Tullio Jappelli, "Household Portfolios," in Luigi Guiso, Michael Haliassos, and Tullio Japelli, eds., *Household Portfolios*, The MIT Press, 2002.

Haliassos, Michael and Alexander Michaelides, "Portfolio Choice and Liquidity Constraints," *International Economic Review*, 2003, *44* (1), 143–177.

Hurd, M.D., "Savings of the Elderly and Desired Bequests," *The American Economic Review*, 1987, *77* (3), 298–312.

Hurd, Michael D., "Mortality Risk and Bequests," *Econometrica*, 1989, *57 (4)*, 779–813.

— **and J. P. Smith**, "Anticipated and Actual Bequests," *NBER Working Paper*, 1999, *No. 7380.*

— **and Kathleen McGarry**, "Evaluation of the Subjective Probabilities of Survival in the Health and Retirement Study," *Journal of Human Resources*, 1995, *30 Supplement*, 268–292.

— **and** — , "The Predictive Validity of Subjective Probabilities of Survival," *Economic Journal*, 2002, *112*, 966–985.

Inkmann, Joachim, Paula Lopes, and Alexander Michaelides, "How Deep is the Annuity Market Participation Puzzle?," *The Review of Financial Studies*, forthcoming.

Kopczuk, W. and J. Lupton, "To Leave or not to Leave: the Distribution of Bequest Motives," *Review of Economic Studies*, 2007, *74* (1), 207–235.

Kotlikoff, L.J. and L.H. Summers, "The Role of Intergenerational Transfers in Aggregate Capital Accumulation," *The Journal of Political Economy*, 1981, *89* (4), 706–732.

Lockwood, Lee, "Bequest Motives and the Annuity Puzzle," *Working Paper, University of Chicago.*, 2009.

Mitchell, Olivia, James M. Poterba, Mark Warshawsky, and Jeffrey R. Brown, "New Evidence on Money's Worth of Individual Annuities," *American Economic Review*, 1999, *89*, 1299–1318.

Modigliani, F., "The Role of Intergenerational Transfers and Life Cycle Saving in the Accumulation of Wealth," *The Journal of Economic Perspectives*, 1988, *2* (2), 15–40.

Sule, Alan, "Entry Costs and Stock Market Participation over the Life Cycle," *Review of Economic Dynamics*, 2006, *9* (4), 588–611.

Vissing-Jorgensen, Annette, "Limited Asset Market Participation and the Elasticity of Intertemporal Substitution," *Journal of Political Economy*, 2002, *110* (4), 825–853.

Yogo, Motohiro, "Portfolio Choice in Retirement: Health Risk and the Demand for Annuities, Housing, and Risky Assets," *Wharton working paper*, 2008.

Zeng, L., "Optimal Consumption and Portfolio Choice for Retirees," *Working paper*, 2008.

Tables and Figures

Table 1: Life insurance holdings and stock market participation

Subsample		LI = 1	TI = 1	EP = 1	LI = 0	# Obs.
SM = 1		761	551	210	1114	1875
	Row-%	41	29	11	59	42
SM = 0		1108	994	114	1439	2547
	Row-%	44	39	4	56	58
	p-value in %	100	0	0	100	
All		1869	1545	324	2553	4422
	Row-%	42	35	7	58	100

Notes to Table 1: The table shows the number and percentage of households with (LI = 1) and without (LI = 0) life insurance holdings for the total sample and the subsamples of households participating in the stock market (SM = 1) or not (SM = 0). Life insurance (LI = 1) is decomposed into term insurance (TI = 1) and endowment plans (EP = 1). The p-values denote the level of significance for differences in the life insurance participation rates of stockholders and non-stockholders. The sample consists of retired households in the first (2002/03) wave of the English Longitudinal Study of Ageing (ELSA).

Table 2: Life insurance holdings and stock market participation across the wealth distribution

Subsample		LI = 1	TI = 1	EP = 1	SM = 1	# Obs.
FW ≤ 10,000		889	831	58	238	1846
	Row-%	48	45	3	13	42
10,000<FW≤50,000		524	423	101	707	1389
	Row-%	38	30	7	51	31
FW > 50,000		456	291	165	930	1187
	Row-%	38	25	14	78	27

Notes to Table 2: The table shows the number and percentage of households with life insurance (LI = 1) holdings, decomposed into term insurance (TI = 1) and endowment plans (EP = 1), and participating in the stock market (SM = 1), for subsamples defined by the amount of financial wealth (FW) in £. The sample consists of retired households in the first (2002/03) wave of the English Longitudinal Study of Ageing (ELSA).

Table 3: Life insurance holdings and bequest motives

Subsample	LI = 1	TI = 1	EP = 1	LI payout	# Obs.
Married	47	37	10	7238	2376
Unmarried	37	33	4	3411	2046
p-value in %	0	1	0	0	
Children	44	37	7	5838	3653
No children	34	27	7	3703	769
p-value in %	0	0	60	3	
Pr[Bequest>0]>0	42	34	8	5792	4061
Pr[Bequest>0]=0	43	41	2	1804	361
p-value in %	87	2	0	0	

Notes to Table 3: The table shows percentage of households holding a life insurance (LI = 1), decomposed into term insurance (TI = 1) and endowment plans (EP = 1), for subsamples defined by the presence of a possible bequest motive. For the same subsamples, the table also shows the mean expected life insurance payout (LI payout). A bequest motive is expected for married households, for households with children and for households which report a positive probability of leaving a bequest. The p-values denote the level of significance for the difference in the life insurance participation rates and mean life insurance payouts of households with and without bequest motive. The sample consists of retired households in the first (2002/03) wave of the English Longitudinal Study of Ageing (ELSA).

Table 4: Subsample averages of covariates

Variable	LI = 1	TI = 1	EP = 1	SM = 1	All
Age / 10	6.97	7.07	6.49	6.81	7.04
Female	0.52	0.54	0.41	0.47	0.54
Low education	0.63	0.68	0.43	0.43	0.61
Medium education	0.28	0.25	0.39	0.39	0.29
High education	0.09	0.07	0.18	0.18	0.10
Survival probability	0.51	0.49	0.61	0.56	0.51
GAD probability	0.52	0.50	0.63	0.56	0.51
Pension income in £	9384	8727	12517	11899	9460
Financial wealth in £	53153	39143	119959	105065	56480
Life insurance payout in £	12934	11782	18429	8844	5467
Allocation to stocks in %	15.48	14.19	21.63	39.01	16.54
# Observations	1869	1545	324	1875	4422

Notes to Table 4: The table shows averages of covariates for the whole sample (All) and the subsamples of households reporting life insurance holdings (LI = 1), decomposed into term insurance (TI = 1) and endowment plans (EP = 1), and stock market participation (SM = 1). The sample consists of retired households in the first (2002/03) wave of the English Longitudinal Study of Ageing (ELSA).

Table 5: Marginal effects for life insurance Probit estimations: all

	LI		TI		EP	
Parameter	Estimate	t-Value	Estimate	t-Value	Estimate	t-Value
Age / 10	**-0.0414**	-4.27	0.0001	0.01	**-0.0433**	-2.96
Female	-0.0223	-1.61	-0.0023	-0.20	**-0.0194**	-1.99
Low education	**0.0319**	1.98	**0.0309**	2.28	-0.0005	-0.05
High education	0.0019	0.08	-0.0111	-0.57	0.0012	0.10
Married	**0.0820**	4.88	**0.0711**	4.86	0.0027	0.27
Children	**0.0631**	3.39	**0.0493**	3.12	0.0117	1.03
Pr[Bequest>0]>0	**0.0530**	2.12	**0.0490**	2.42	0.0181	0.86
Survival probability	**-0.0464**	-1.94	**-0.0490**	-2.48	0.0122	0.79
Log pension	0.0004	0.05	-0.0038	-0.53	0.0046	1.03
Log financial wealth	**-0.0249**	-6.99	**-0.0316**	-8.76	**0.0165**	2.80
% Correct predictions	59.38		65.76		92.67	

Notes to Table 5: The table shows estimated marginal effects and t-values obtained from Probit estimations for total life insurance holdings (LI = 1), term insurance holdings (TI = 1) and endowment plan holdings (EP = 1). Significant coefficients at the 10% level are given in bold. The marginal effects are computed for a single, male baseline household of age 65 with medium education, no children, a self-reported zero probability of leaving a bequest, with average survival probability, log pension, and log financial wealth. The sample consists of 4,422 retired households in the first (2002/03) wave of the English Longitudinal Study of Ageing (ELSA).

Table 6: OLS estimation results for log life insurance payout: all

	LI		TI		EP	
Parameter	Estimate	t-Value	Estimate	t-Value	Estimate	t-Value
Intercept	**11.550**	21.6	**11.379**	19.3	**10.443**	7.80
Age / 10	**-0.5826**	-11.8	**-0.5652**	-10.3	**-0.5910**	-4.85
Female	**-0.4294**	-6.05	**-0.3899**	-4.99	**-0.5878**	-3.59
Low education	**-0.5159**	-6.06	**-0.5104**	-5.32	**-0.4626**	-2.42
High education	**0.4163**	3.09	**0.4734**	2.87	0.1157	0.53
Married	**-0.1875**	-2.38	**-0.2175**	-2.55	-0.1115	-0.53
Children	0.1267	1.30	0.1350	1.31	0.1467	0.51
Pr[Bequest>0]>0	-0.0363	-0.38	0.0132	0.13	-0.3721	-1.56
Survival probability	0.1234	1.04	0.1537	1.20	-0.2800	-0.89
Log pension	-0.0007	-0.02	0.0171	0.37	-0.0538	-0.67
Log financial wealth	**0.1200**	6.71	**0.0971**	5.11	**0.3375**	4.95
R^2 (in %)	28.77		24.21		39.34	
Number of observations	1698		1433		265	

Notes to Table 6: The table shows parameter estimates and heteroskedasticity-consistent t-values obtained from OLS estimations of the log life insurance payout for total life insurance holdings (LI), term insurance holdings (TI) and endowment plan holdings (EP). The estimation conditions on reported positive life insurance payouts. Significant coefficients at the 10% level are given in bold. The sample consists of 4,422 retired households in the first (2002/03) wave of the English Longitudinal Study of Ageing (ELSA).

Table 7: Marginal effects for life insurance Probit estimations: non-stockholders versus stockholders

	Non-Stockholders				Stockholders			
	TI		EP		TI		EP	
Parameter	Estimate	t-Value	Estimate	t-Value	Estimate	t-Value	Estimate	t-Value
Age / 10	0.0128	1.46	**-0.0187**	-1.65	**-0.0246**	-1.69	**-0.1022**	-2.58
Female	0.0075	0.53	-0.0070	-1.08	-0.0176	-0.90	-0.0544	-1.63
Low education	**0.0623**	3.36	0.0040	0.60	-0.0030	-0.14	-0.0138	-0.51
High education	0.0688	1.61	0.0011	0.08	**-0.0473**	-1.75	-0.0063	-0.21
Married	**0.0581**	3.27	0.0009	0.14	**0.0986**	3.37	0.0087	0.27
Children	**0.0588**	2.90	0.0153	1.44	0.0325	1.25	0.0043	0.14
Pr[Bequest>0]>0	**0.0488**	2.36	0.0174	1.41	0.0208	0.28	-0.0654	-0.60
Survival probability	-0.0283	-1.25	0.0071	0.71	**-0.0974**	-2.32	0.0214	0.41
Log pension	-0.0002	-0.02	0.0008	0.23	-0.0021	- 0.19	0.0134	0.99
Log financial wealth	**-0.0282**	-6.65	0.0069	1.55	**-0.0464**	-3.75	**0.0393**	2.21
% Correct predictions	61.88		95.52		70.67		88.80	
Number of observations	2547				1875			

Notes to Table 7: The table shows estimated marginal effects and t-values obtained from Probit estimations for term insurance holdings (TI = 1) and endowment plan holdings (EP = 1). The left panel contains estimation results for non-stockholders and the right panel for stockholders. Significant coefficients at the 10% level are given in bold. The marginal effects are computed for a single, male baseline household of age 65 with medium education, no children, a self-reported zero probability of leaving a bequest, with average survival probability, log pension, and log financial wealth. The sample consists of 4,422 retired households in the first (2002/03) wave of the English Longitudinal Study of Ageing (ELSA).

Table 8: OLS estimation results for log life insurance payout: non-stockholders versus stockholders

	Non-Stockholders				Stockholders			
	TI		EP		TI		EP	
Parameter	Estimate	t-Value	Estimate	t-Value	Estimate	t-Value	Estimate	t-Value
Intercept	**12.234**	18.3	**10.869**	6.25	**9.3327**	8.01	**9.2871**	4.62
Age / 10	**-0.6277**	-10.1	**-0.6208**	-4.51	**-0.3989**	-3.78	**-0.5366**	-2.71
Female	**-0.3916**	-4.51	-0.3481	-1.55	**-0.3326**	-2.04	**-0.7703**	-3.28
Low education	**-0.3352**	-2.75	**-0.6109**	-2.16	**-0.7133**	-4.54	-0.4297	-1.64
High education	0.3731	1.59	0.2308	0.44	**0.3927**	1.74	0.0465	0.19
Married	**-0.2253**	-2.36	-0.2111	-0.75	-0.1778	-1.04	-0.0653	-0.22
Children	0.1377	1.15	0.0006	0.01	0.1096	0.58	0.1570	0.43
Pr[Bequest>0]>0	0.0705	0.68	**-0.4518**	-1.87	-0.1309	-0.39	-0.2196	-0.40
Survival probability	0.1780	1.33	-0.2957	-0.71	0.1268	0.43	-0.2094	-0.43
Log pension	-0.0195	- 0.34	-0.0258	-0.19	-0.0117	-0.13	-0.0479	-0.49
Log financial wealth	**0.0608**	2.94	**0.3201**	3.15	**0.2344**	3.91	**0.3861**	4.24
% Correct predictions	19.68		40.20		22.40		32.35	
Number of observations	950		100		483		165	

Notes to Table 8: The table shows parameter estimates and heteroskedasticity-consistent t-values obtained from OLS estimations of the log life insurance payout for term insurance holdings (TI) and endowment plan holdings (EP). The estimation conditions on reported positive life insurance payouts. The left panel contains estimation results for non-stockholders and the right panel for stockholders. Significant coefficients at the 10% level are given in bold. The sample consists of 4,422 retired households in the first (2002/03) wave of the English Longitudinal Study of Ageing (ELSA).

Table 9: Estimated structural parameters using the Method of Simulated Moments

	Non-Stockholders		Stockholders	
Parameter	Estimate	Standard Error	Estimate	Standard Error
b_1	0.02	0.02	5.62	0.11
b_2	0.00	0.02	0.00	0.01
γ	4.22	0.32	6.00	0.26
ψ	0.33	0.11	0.30	0.02
β	0.90	0.08	0.98	0.01

Notes to Table 9: The table reports estimated parameters for the non-stockholder and stockholder models using a Method of Simulated Moments estimator to pick the structural parameters that minimize the distance between some selected moments in the data and in the model. For the non-stockholders the moments are the mean participation in the life insurance market, the mean life insurance payout and mean wealth both done over five year intervals from age 65 to 89 for which available data exist giving a total of 15 moments. For the stockholders the share of wealth in stocks is also matched giving a total of 20 moments. Standard errors are computed using a diagonal weighting matrix that is based on the inverse of the variance of the empirical moments. Numerical derivatives are used to compute the derivative of the moment conditions. In both models the preference parameters that vary are b_1 and b_2 that capture the strength of the bequest motive, the elasticity of intertemporal substitution (ψ), the relative risk aversion coefficient (γ) and the discount factor (β).

Table 10: Robustness of results to changes in the economic environment: non-stockholders

	Data	Baseline	$\sigma_Y = 0$	$\sigma_Y = 0.9$	$P_l = 0$	$0.5L$
Financial wealth (in 1,000 £)						
65 <= Age < 70	18.6	31.0	29.9	35.3	31.0	30.1
70 <= Age < 75	17.9	23.5	20.9	35.2	23.4	21.3
75 <= Age < 80	25.5	18.3	15.3	33.8	18.1	15.3
80 <= Age < 85	11.9	15.3	11.8	31.5	14.8	11.4
85 <= Age < 90	20.9	13.7	9.3	25.7	12.7	8.7
Term insurance market participation (in %)						
65 <= Age < 70	37	40	54	1	40	12
70 <= Age < 75	43	42	72	0	45	13
75 <= Age < 80	41	45	83	0	52	13
80 <= Age < 85	37	46	89	0	66	13
85 <= Age < 90	39	26	91	1	69	2
Term insurance payout (in 1,000 £)						
65 <= Age < 70	6.5	7.2	5.9	0.4	8.4	3.4
70 <= Age < 75	4.1	6.0	5.3	0.0	6.9	3.1
75 <= Age < 80	5.4	4.2	4.9	0.0	4.7	2.1
80 <= Age < 85	5.5	3.2	4.8	0.0	3.6	0.8
85 <= Age < 90	2.6	0.9	4.4	0.1	2.5	0.0

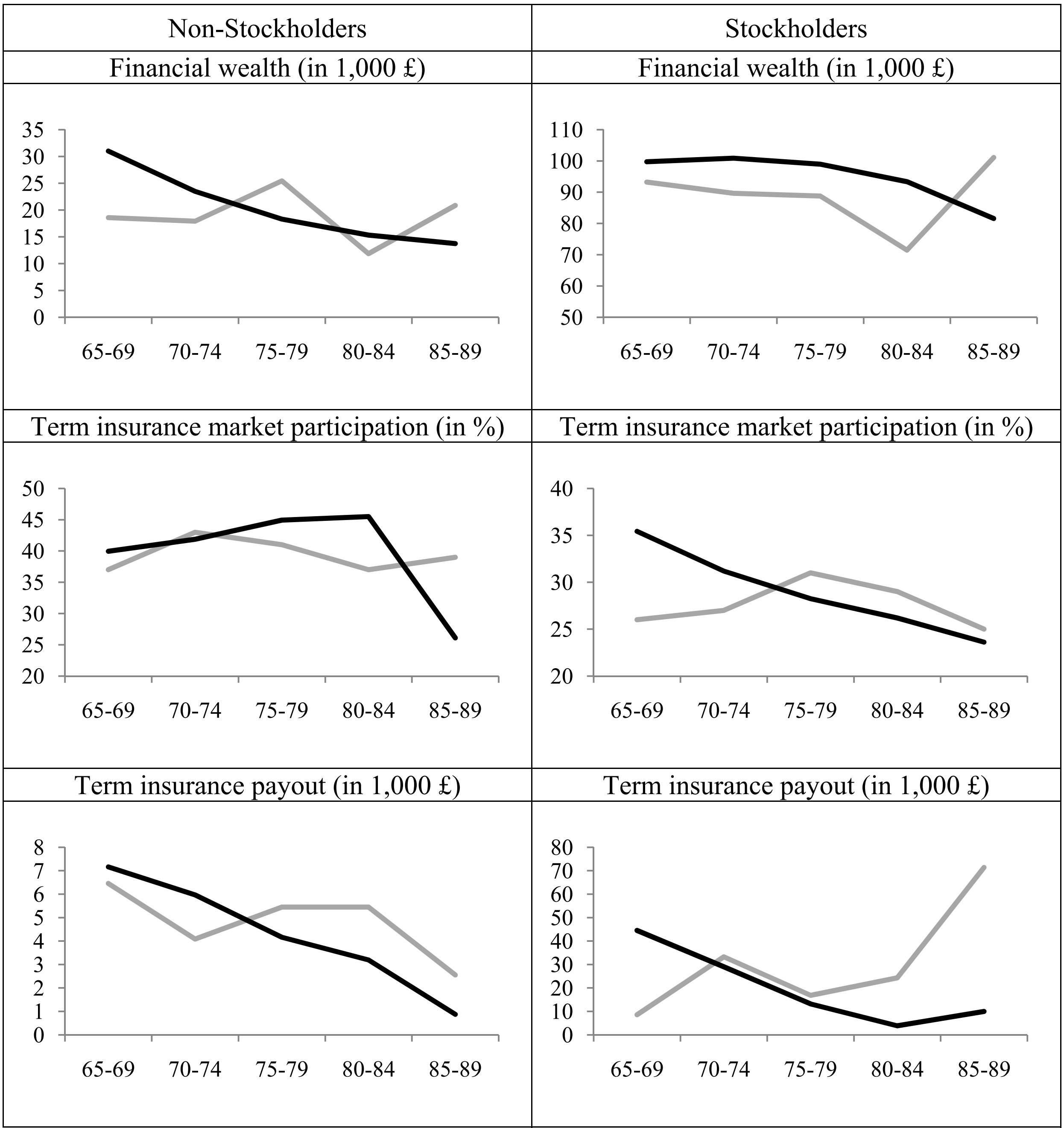
Notes to Table 10: The table compares mean financial wealth, term life insurance participation, and term life insurance payout for non-stockholders in the data with averages simulated from the model using the baseline parameterization in Table 9. Compared to the "Baseline" results, the "$\sigma_Y = 0$" and "$\sigma_Y = 0.9$" results reflect variations in the volatility of idiosyncratic uncertainty, the "$P_l = 0$" results, a reduction in the load factor on life insurance premiums from 20% to zero, and the "$0.5L$" results, a decrease in pension income by 50%.

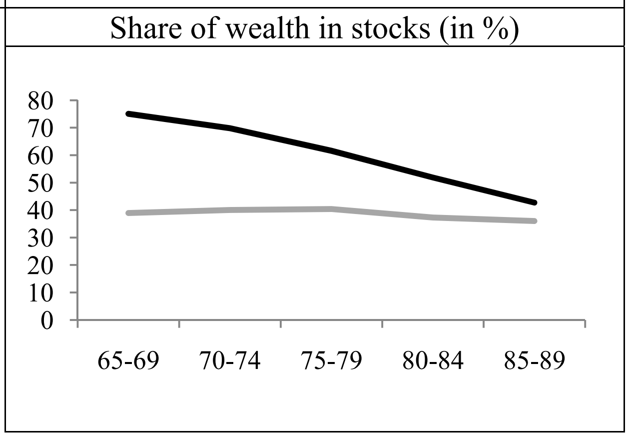
Table 11: Robustness of results to changes in the economic environment: stockholders

	Data	Baseline	$\sigma_Y = 0$	$\sigma_Y = 0.9$	$P_l = 0$	$0.5L$
Financial wealth (in 1,000 £)						
65 <= Age < 70	93.2	99.7	99.2	104.3	99.8	97.7
70 <= Age < 75	89.6	100.9	98.8	114.4	100.5	92.9
75 <= Age < 80	88.8	98.9	96.3	119.1	99.4	86.3
80 <= Age < 85	71.5	93.4	90.3	119.4	93.9	77.7
85 <= Age < 90	101.1	81.6	77.9	109.7	80.4	63.7
Term insurance market participation (in %)						
65 <= Age < 70	26	35	36	5	36	8
70 <= Age < 75	27	31	35	0	32	6
75 <= Age < 80	31	28	31	0	26	4
80 <= Age < 85	29	26	25	0	24	1
85 <= Age < 90	25	24	26	2	27	5
Term insurance payout (in 1,000 £)						
65 <= Age < 70	8.6	44.5	41.8	30.1	52.0	27.9
70 <= Age < 75	33.3	29.0	29.5	0.0	35.2	24.3
75 <= Age < 80	16.9	13.2	14.7	0.0	15.4	17.1
80 <= Age < 85	24.3	3.9	11.3	0.0	6.2	2.1
85 <= Age < 90	71.4	10.0	15.0	1.2	14.8	0.9
Share of wealth in stocks (in %)						
65 <= Age < 70	39	75	75	60	75	64
70 <= Age < 75	40	70	71	52	70	60
75 <= Age < 80	41	62	63	48	62	55
80 <= Age < 85	32	52	51	43	52	49
85 <= Age < 90	36	43	45	36	45	39

Notes to Table 11: The table compares mean financial wealth, life insurance participation, term life insurance payout, and the share of wealth in stocks for stockholders in the data with averages simulated from the model using the baseline parameterization in Table 9. Compared to the "Baseline" results, the "$\sigma_Y = 0$" and "$\sigma_Y = 0.9$" results reflect variations in the volatility of idiosyncratic uncertainty, the "$P_l = 0$" results, a reduction in the load factor on life insurance premiums from 20% to zero, and the "$0.5L$" results, a decrease in pension income by 50%.

Figure 1: Average age profiles: model predictions (black line) versus data (grey line)





Notes to Figure 1: The graphs compare observed moments to predicted moments generated from the non-stockholder (left panel) and stockholder (right panel) model. The predicted moments are based on a Method of Simulated Moments estimator which minimizes the distance between age-group-specific observed and predicted moments by means of an optimal choice of preference parameters which are summarized in Table 9. The data stops at age 89 (all ages over 89 are coded 90 in ELSA to avoid household identification issues) but the model has been solved on the assumption that households might live for a maximum of 100 years.