# Risky Assets Ownership Decisions by the Elderly in the UK: Evidence from the Retirement Survey

**Dimitris Georgarakos**

Queen Mary, University of London

October 2002

**Abstract**

The main aim of this paper is to shed more light on the portfolio behaviour of the older part of the UK population over the period 1988-94. We utilize data from the Retirement Survey and we employ different econometric specifications in order to model the risky asset ownership decisions over time. The unique nature of the dataset allows us to control for a variety of factors (pension rights, receipt of a lump sum, timing of retirement, changes in retirement status) that may be important for the portfolio behaviour of those people that are about to or they have recently retired. Our results are indicative for the role of the fixed participation costs and inertial behaviour in risky asset ownership decisions.

**Keywords**: Household Portfolios, Risky Asset Ownership Decisions, Random Effects Probit, Bivariate Probit, Transition Rates

**JEL classification:** C23, C35, D12, G11

**Address for Correspondence:** Department of Economics, Queen Mary, University of London, Mile End Road, London E1 4NS E-mail: D.Georgarakos@qmul.ac.uk
**Acknowledgments**: I am grateful to Roy Bailey and Gordon Kemp for their constructive suggestions. Data on the Retirement Survey made available by the ONS through the UK Data Archive at Essex University. Neither the ONS nor the UK Data Archive bear any responsibility for the analysis and the interpretation of the data employed in this paper. Any errors and ambiguities are the author's responsibility.

## 1. Introduction

The study of household portfolio choices has become an increasingly popular area of research in recent years.[1] The analysis of micro data on household finances from many countries suggests that only few households choose to hold risky financial assets despite of the higher expected return premia that these investments offer. A common observed phenomenon is the limited degree of diversification within and across different asset categories, in contrast to the predictions of the standard pricing models. Theory and empirical research have identified the fixed entry costs that the risky asset ownership entails as the key factor behind this participation puzzle. Other factors that may influence the household portfolio choices include the uninsured background risks, the informational and monitoring costs and the liquidity constraints that many households face.

The exploration of UK households' portfolio decisions and in particular investments in risky financial assets has not received great attention, primarily due to the limited information of the available household surveys. However, recent data on UK households from the Family Resources Survey, the BHPS (wave V) and the Retirement Survey offer interesting information upon asset holdings and main wealth components. The study of UK households' portfolio choices are of special interest. The decade of 80's was a period of dramatic macroeconomic changes which crucially influenced the composition of household portfolios. The privatisation of large nationalized industries in the mid-eighties altered distinctively the percentage of those holding risky assets. (More than one out of five households owned risky financial assets in the late 80's, while this percentage did not exceed the 10% prior to the

[1] For the first systematic collection of both theoretical and empirical works in the area, see the recently published volume by Guiso, Haliassos and Jappeli (2001).

privatisation episode.)[2] In addition, the "right to buy policy", which gave the right to the tenants of publicly owned houses to buy the house that they lived at prices lower than the market prices, had considerable implications for households' housing wealth. Furthermore, the strong incentives that were given for private pension plans during the 80's altered, to some extent, the way that people saved for their retirement. All the above stylised facts make interesting the analysis of UK household portfolios.

In this paper we utilize panel data from the Retirement Survey (waves 88 and 94). The use of UK data from this source is interesting for two more reasons:

i) The sample consists of individuals that are close to the retirement age or they have recently retired. Exploring portfolio decisions made by the elderly is of particular interest since various factors (pension status and coverage, bequest motives, health risks) are likely to affect their savings choices.[3]

ii) The sample period, although starting after the macroeconomic changes of the mid-eighties, has been marked by the substantial changes in housing wealth, the dominant component in households' total wealth. (Housing prices boomed in the late 80's, followed by a period of severe slump in prices up to the market's levelling-out around 1994.)

For an earlier research on households' assets and wealth based on Retirement Survey data see Disney et al. (1995) and Disney et al. (1998). The current study has focused on the exploration of risky assets ownership decisions and how these have changed over the period covered by the survey.

[2] According to figures from the FES – see Banks and Smith (2001).
[3] For a recent study on US elderly households see Hurd (2001).

## 2. Data

In this paper we employ panel data from the two waves (1988/ 89 and 1994) of the Retirement Survey. The 1988/ 89 survey interviews those individuals within households that are between 55 and 69 years old ("key respondents") and their spouses even if they are outside this age group (distinguished as "key" and "non-key" spouses). The term "key benefit unit" is used to describe a benefit unit with at least one key respondent (they consist of either a single person or two persons, usually a couple). The 1994 follow-up survey interviewed the "key respondents" and their spouses. (The "non-key spouses" from the original survey are not eligible for the 1994 survey in their own right, and they are not interviewed if the key respondent is not interviewed.)

Our analysis can be developed in two levels:

i) An individual level, where we consider the "key respondents" as distinct decision units. The balanced panel consists of 2,248 "key respondents", a "moving" age cell of individuals who were in the 55 to 69 age group in 1988/ 89 (3,543 individuals comprise the full unbalanced panel).

ii) A benefit unit level, where the "key benefit unit" is treated as the unit of analysis (income and wealth variables are aggregated at the benefit unit level while demographics are defined over the head). The household head is considered to be the benefit unit head, while in the cases that he/ she is not included in the "key benefit unit" the man is considered as the head (or the eldest of the two persons of the same gender). The balanced panel consists of those "key benefit units" that their head is interviewed in both waves (1,539 cases)[4]. More than 95% of the benefit unit heads

[4] From the 1,662 benefit units that were interviewed in both waves we have to exclude the 123 where the head was not interviewed in 1994. The full unbalanced panel consists of 2,577 benefit units providing information apart from the 3,543 "key respondents" on their 620 "non-key" spouses (11 of those have been interviewed for first time in 1994 as new spouses).

are "key respondents" which means that we do not expect serious differences in the results between these two levels of analysis.

In the first part of this paper (section 3) we exploit information from the full unbalanced panel of the "key benefit units". The analysis gives insight for the portfolio behaviour of benefit units with at least one of their members aged 55 to 69 in 1988. In the second part (sections 4 and 5), the models that we estimate are based exclusively on balanced panels. In this case we facilitate a significantly higher number of observations for the estimation by using data on "key respondents". (In addition, the analysis on an individual level may give us a clearer picture for the impact of unobserved heterogeneity which is inflated – in some cases – from changes in the composition of benefit units over time.)

The economic variables used have been deflated using the Consumer Price Index[5] and all the values are expressed in constant 1994 prices. In the regression analysis we control for age and time effects, nevertheless we do not control for cohort effects assuming that the participants in the Retirement Survey belong to the same "wide" cohort.[6]

## 3. Panel Data Static Models for Discrete Choices

### i. Random Effects Probit model

In this section we present models that exploit information from the panel dimension of the data. The main aim is to model and explore the binary choice of owning versus not owning risky assets by taking into account the unobserved

[5] OECD, Economic Outlook, 1994.
[6] As an alternative we could control for cohort, age and time effects which are restricted to sum up to zero (Deaton and Paxson (1994)). This leads to results with a less plausible interpretation.

heterogeneity. We control for various demographic characteristics (defined over the head) like age, a crucial factor for the understanding of stockownership decisions.[7] Other demographic factors that we control for are the gender, the marital status, children (that may serve as an indication of a bequest motive) and whether the head has more than standard education. Higher education usually implies better knowledge of financial matters which results to lower information and monitoring costs. Reported health problems are used as an approximation for "health risk", a source of risk that is likely to affect household attitudes towards portfolio risk.

The survey provides information mainly on individuals that are close to the retirement age or they have recently retired. For this reason we control for the impact of factors like the retirement status, the timing of retirement as a result of the financial situation, the receipt of a lump sum and the coverage by occupational or personal pension plans.[8] Net income, financial and housing wealth are variables that proxy benefit unit's economic well-being. For the latter two we have information only on banded values. Since the survey uses the same nominal bands in both years we adjust for inflation the aggregated at benefit unit level midpoints from the 1988/ 89 wave and then correspond these to the appropriate 1994 band (more details are provided in the Appendix). The housing wealth bands represent gross housing wealth and we have included a dummy controlling for mortgage outstanding debts. We also control for benefit units that have inherited property since they are endowed with higher initial wealth. Information provided by the survey allows us to control for factors that are interesting from a behavioural point of view. Specifically, we control for the (subjective) views that the benefit units have for the management of their financial holdings and their standard of living. Satisfactory management of financial holdings

[7] The limited age variability in our sample makes hard the identification of any possible age effects.
[8] Appendix provides details on the derivation of these variables.

usually implies confidence in financial decisions and better knowledge of the financial matters, which in turn results to less costly management for the informational intensive risky assets. On the other hand, it would be interesting to see how the respondents' view about their standard of living is associated with the decision to take higher financial risk (given that the standard of living is closely related with some wealth components – such as durables – that are not covered by our dummies for housing and financial wealth).

In *Table 1* we present estimated results from probit specifications that model the probability of risky asset ownership using the full unbalanced panel of observations on benefit units[9]. In parentheses we report estimated marginal effects, which refer to changes in the ownership probability associated with marginal changes in continuous variables (discrete 0-1 changes for dummy variables are assumed) given that the remaining variables are held constant at their means. The left side specification is a standard probit model applied on the pooled sample of data assuming independent observations. By its nature the model neglects individual heterogeneity and the possibility that current ownership may be related with past ownership. In the right side we present results from a static random effects probit model which allows for unobserved heterogeneity. The latter specification allows for certain unobserved characteristics to affect in a similar way past and current ownership choices. The results from the two models are qualitatively the same, however the formal LR test (reported at the bottom of the *Table 1*) strongly rejects the null of zero serial correlation within household and suggests that the panel estimator differs from the pooled one.

[9] After the exclusion of 155 observations with missing values and severe outliers of net income the sample used in the estimation comprise 2,422 benefit units.

The set up of the random effects probit, starting from the latent variable specification, is as follows:

$$y_{it}^{*} = x_{it}^{'}\beta \ + \ \alpha_i + u_{it} \tag{1}$$

where we observe $y_{it} = 1$ if $y_{it}^{*} > 0$ (for those holding risky assets) and $y_{it} = 0$ otherwise.[10] Under the current specification the individual effects $\alpha_i$, that capture the unobserved heterogeneity, are treated as random error terms. A rather restrictive assumption is that the individual effects $a_i$ as well as the idiosyncratic error term $u_{it}$ are assumed to be independent of the regressors. Both the individual effects and the error terms are assumed to follow a normal distribution where $a_i \sim N(0,\sigma_a^2)$ and $u_{it} \sim N(0,1)$. In addition, the errors are considered to be independent over time.[11] For model's estimation we use the Butler and Moffitt (1982) computational algorithm.

Results in the right side of *Table 1* do not suggest a clear role for age.[12] Households headed by people with more than standard education have 6% higher probabilities in holding risky assets as opposed to the reference category of those with basic education. The result is consistent with the view that those with higher educational attainment usually enjoy lower informational costs on the management of the informational intensive risky assets. Retirement status and the time of retirement do not seem to have a significant impact on the relevant decision. On the other hand, it is more likely for households that have received a lump sum (either retired or not) to

[10] $y_{it}^{*}$ can be interpreted as the (unobserved) value of the desired level of risky assets for benefit unit i at time t.

[11] We can think of $\alpha_i$ as representing unobservable-time invariant individual characteristics like risk aversion, and $u_{it}$ as a time varying effect, such as individual income innovations or expectation errors (see Miniaci and Weber (2002)). At the bottom of Table 1 we report an estimate of $\rho = \sigma_\alpha^2 / (1+\sigma_\alpha^2)$, which measures the correlation between the composite latent error $\alpha_i + u_{i\,t}$ across the two waves. This can be also viewed as an indicator for the relative importance of the unobserved effect (given that the variance of $u_{it}$is set to one by normalization).

[12] Insignificant results were also obtained when we experimented with higher order polynomials. Similarly, we did not identify any significant age effects when the same model was estimated for "key respondents".

hold risky assets (the effect is significant at 10%). It may be the case that part of the received lump sum is directed to investments in financial assets. Given that households receive such a payment at a stage of their lifecycle when they have accumulated some wealth in safe assets and they have (or they are about to) paid off their mortgage debts it is likely that they will choose to invest money in risky assets (taking advantage of the equity premium). In addition, positive and significant effects are obtained for those with rights in a private pension plan. This may suggest a pension wealth effect, a (wealth) component that is not covered by the other forms of wealth that we control for. It may also reveal broader wealth effects, given that the underlying level of wealth of those holding private pensions is on average higher. Positive effects are also obtained for those with a life insurance policy since this can be viewed as an additional asset that provides hedging to some forms of risk that households may face. Households classified at higher financial and housing wealth bands have significantly higher probabilities in holding risky assets. This positive relationship is consistent with decreasing absolute risk aversion preferences. Furthermore, as higher wealth implies increasingly higher probabilities for risky assets' ownership we can claim – in contrast to the predictions of the standard pricing models – that the portfolios of the wealthier households are not simply scaled – up versions of those formed by the poorer (see Guiso et al. (2001)). Households that have inherited property have significantly higher probabilities to own risky assets. These households have higher initial endowment and they may not incur mortgage debts, factors that make more favourable the investment in risky assets.

The two dummies representing households' views for the management of their financial holdings and the standard of living, although insignificant, display the

expected signs. After controlling for other effects the results suggest a pure time effect, namely a 4% increase in risky asset ownership between the years 1988-1994.

The random effects model of *Table 1* was estimated under the restrictive assumption of strict exogeneity for all the explanatory variables. However this may not be the case for some variables like the financial wealth dummies, given that households who chose to invest in risky assets could end up with higher initial wealth at the end of the period or the beginning of the next period (see Miniaci and Weber (2001)). An immediate way to deal with the potential bias is to estimate a reduced form model that does not condition on the financial wealth dummies. Estimated results from this reduced form specification are presented in *Table 2*.

The results do not suggest noticeable differences in signs as they compared to those obtained for the random effects model in *Table 1*, but some of the RHS variables bear the effects from the omitted financial wealth dummies. The most pronounced cases are those of retirement status, early retirement, mortgage outstanding as well as households' views for portfolio management and the standard of living that turn out now to be significant. As it was expected stronger effects were obtained with respect to the net income and housing wealth dummies.

An interesting finding is that being retired is highly correlated with accumulated financial wealth. Indeed, most of the retirees in the sample are people that have recently retired (become retired just before 1988 or between 1988 - 1994) and therefore they have made investments in financial assets over their working life that they have not started to decumulate. From that respect the positive and significant result obtained for this dummy is not surprising. In addition, at this stage of the life cycle decisions about housing play a central role: many of the retirees may choose to downsize their housing wealth and reduce their housing costs. A decision to sell their

house in order to move in a smaller rented accommodation, results in high proceeds which will increase their savings and subsequently the probabilities of investing in risky assets. As it was expected, those that chose to retire early as a matter of their good financial situation have higher probabilities in holding risky assets, while an outstanding mortgage seems to discourage investments in risky financial assets. Benefit units that declare themselves satisfied with the management of their financial holdings may be more informed and / or more experienced in the management of risky assets, factors that favour the stock market participation. On the other hand, the negative sign obtained for those that do not feel satisfied with their standard of living may be indicative for their priority to improve living conditions rather than investing in risky financial assets.

### ii. Fixed Effects Logit Model

In contrast to the probit model, the logit model lends itself to a fixed effects treatment (see Green (2000)). *Table 3* shows results from the estimation of a standard logit that assumes independent observations (left side specification) and a fixed effects logit model (right side specification) using the balanced panel of benefit units[13]. Results from the conventional logit are qualitatively similar to those presented earlier for the standard probit that estimated over the full-unbalanced panel (*Table 1*).

The estimation of interest is the fixed effects logit model where we treat $a_i$ from (1) as fixed unknown parameters. Any fixed effects model applied on micro-level panel data suffers from the "incidentals parameter" problem (the number of periods T is limited while the sample size N includes thousands of observations). For

[13] The cleaned sample consists of 1367 benefit units.

fixed T, inconsistent estimators will be produced for $\alpha_\iota$ and this inconsistency will carry over to the estimator for $\beta$.[14] Unlike the case of the linear models, in the nonlinear ones we can not eliminate the $\alpha_\iota$ s (individual heterogeneity), by simply taking deviations from the group means, such that $\beta$ could be estimated consistently (even though all the $\alpha_\iota$ parameters could not). Chamberlain (1980) has suggested a different approach using conditional maximum likelihood. What we maximize is a likelihood function which conditions upon a set of statistics $t_i$ that are sufficient for $a_i$ (this means that conditional upon $t_i$ an individual's likelihood contribution no longer depends on $a_i$, but still depends on the parameters $\beta$ ).[15] In contrast to the random effects probit, the fixed effects logit produces consistent estimates even if the individual effects are correlated with observed variables, allowing the relaxation of a rather strong assumption.[16] Its main disadvantage is that benefit units that do not change stockownership status over the two periods do not contribute to the likelihood function and so have no effect on the estimation. In addition, under a conditional logit model many of the effects that we are interested in are not identified (we have to drop the time invariant dummies representing gender and educational level as well as the year dummy given that it is highly collinear with age[17]). Estimating the conditional logit model, the sample size reduces dramatically to 292 cases of benefit units that change stockownership status in the two periods (equivalently we can estimate an

[14] An $\alpha_i$ can be estimated consistently only if we have a growing number of observations on i, thus if we have $T \to \infty$.

[15] Details on the estimation procedure and a complete set of formulas can be found at Verbeek (2000).

[16] The strict exogeneity of observed characteristics $x_i$ with respect to $\alpha_i$ (required by the random effects probit estimation) is may not appealing under the current analysis: given that $\alpha_i$ may represent an individual characteristic like risk aversion, we implicitly assume that wealth, income, age and education are not correlated with risk aversion (see Miniaci and Ruberti (2001)).

[17] As Miniaci and Weber (2001) note: "In fact age and the year dummy are collinear once fixed effects are conditioned upon even if no intercept is allowed: age variability is exactly trend like if fixed differences across individuals are removed. This highlights the difficulty of identifying age profiles in panel data models if time effects are thought to be at play."

unconditional cross sectional logit with the dependent variable represent 0 to 1 status changes and explanatory variables transformed to $x_{i2} - x_{i1}$). Estimated results suggest the same pattern of coefficients on financial wealth, inherited property and private pension coverage as they compared to those from the standard logit. However, a formal Hausman test, reported at the bottom of *Table 3* suggests that there are significant differences between the conventional logit and the fixed effects model and that heterogeneity matters.[18] According to the test the relevant results are those from fixed effects logit: the effects of net income and housing wealth mainly due to the limited variation in the banded housing values, were hard to identify. Overall, the estimates that allow for fixed effects do not seem to be seriously affected when financial wealth is treated as endogenous.

### iii. Further Issues

Specifications presented in *Tables 1*, *2* and *3* condition on various demographic and relevant to pension status variables defined over the household head. We have estimated similar models controlling in addition for the characteristics of spouses. Our results were not affected and dummies on spouses' characteristics were not found to have any significant explanatory power. Since most of these characteristics are similar to those of the heads living under the same household their inclusion in the RHS variables would inflate the standard errors.

[18] We cannot test this hypothesis on the basis of a LR test since the two likelihoods (due to the different number of observations in the two models) are not comparable. For details on the particular Hausman test see Green (2000). The chi-squared statistic is calculated as:

$$\chi^2 = (\hat{\beta}_{CML} - \hat{\beta}_{ML})'[Var[CML] - Var[ML]]^{-1}(\hat{\beta}_{CML} - \hat{\beta}_{ML})$$

Apart from the above models, we have estimated standard probit regressions modelling the ownership probability of owning risky assets in each of the two waves. Results from this cross sectional analysis are broadly similar to those presented earlier and they are not reported.

However, the data that we have used in both cross sectional and panel analysis have two limitations:

The first is that financial and housing wealth, two important factors in exploring household portfolio choices, are given in broad bands. A possible solution would be the estimation of a grouped dependent variable estimator (GDV) in order to derive predicted values on these two variables (Stewart (1983)). Nevertheless, many of the variables that can be used as explanatory in GDV regressions are variables of special interest that are also used in the probit specifications. As an experiment we estimated GDV models obtaining predicted values on financial and housing wealth for 1994. In the first case interest earnings was the only regressor while in the second one a set of dummies representing the reported council tax bands (an information that unfortunately is available only for 1994) was used. The predicted values replaced the financial and housing wealth band dummies in 1994 static probit specifications without suggesting noticeable changes in the estimated results.

The second one is that the availability of a two-wave panel does not allow us to explore the dynamic nature of portfolio decisions over time. An interesting research question to address is the extent that the risky asset ownership at previous periods affects stockholding decisions at the current period. If current ownership does depend in a direct way upon past ownership (for instance due to considerable fixed entry costs and / or cumulated experience in financial management) then we have to deal with

what Heckman (1978) terms as true state dependence[19]. In this case the specification given by (1) can be modified to include an extra term $\gamma\, y_{i,t-1}$ allowing for dependency between the current desired level of risky assets and actual ownership status one period before. If there is no true state dependence then $\gamma$ should not differ significantly from zero. In the recent years there is a development of various dynamic panel data models that can be used in cases that we allow for true state dependence and/ or $u_{it}$ from (1) are serially correlated.[20]

## 4. Transition Rates

In this section we estimate various risky asset ownership and transition rates (for a similar analysis see Hurd (2001)). *Table 4* gives a summary for the ownership status of the eligible individuals that interviewed in both survey years. The steady rate of risky asset ownership that would occur in the long run if the observed transition rates between waves 1988 and 1994 remain constant, is calculated as:

$$\frac{T}{T+1}$$

with

$$T = \frac{1-P_{00}}{1-P_{11}}$$

[19] The experience of an event by an individual affects his preferences, constraints, etc. in a way that he is more likely to experience that event in the future.
[20] For an overview in dynamic panel data models see Verbeek (2000) and Miniaci and Weber (2001). For an application in household portfolio models see Hochguertel (2001).

where $P_{00}$ and $P_{11}$ are the transition probabilities from not owning risky assets in 1988 to not owning in 1994, and from owning in 1988 to owning in 1994 respectively.[21] The number of those that owned risky assets in 1988 and do not own in 1994 (187) as a proportion of all the 1988 owners (596) is 31%, much higher from the proportion of those that did not own in 1988 and become owners in 1994 (247/ 1376 =19%). However, the overall rate of risky assets owners in 1994 (33%) has increased relative to the one in 1988 (30%) since more people changed status from non ownership to ownership than the reverse. The computed steady state is 36.3% (32.8 % for risky assets that comprise only Stocks, Shares and Bonds), not too far away from the rates that are observed today.

In addition we derive an estimated measure for the steady state rate after controlling for some basic individual characteristics. First we estimate two logit specifications (results are presented in *Table 5*) that model the ownership probability of owning risky assets in 1994 for the sub-sample of those that do not own in 1988 (left-side) as well as the probability of owning risky assets for those that own in 1988 (right side). The explanatory variables in these two simple models exhibit the expected signs. Individuals with higher financial and housing wealth levels that were not owners in 1988, have higher probabilities in becoming owners in 1994. On the other hand, less evident wealth effects are obtained with respect to the probabilities of holding risky assets in 1994 for those that were owners in 1988. This may suggest the importance of fixed entry costs in the stock market. (Any remaining positive association of wealth with 1994 ownership in the second equation is consistent with considerable monitoring and management costs.) For each of the two models we have

[21] This gives a partial view on the mobility of risky assets since we explore transitions for people that sell all their risky assets or decide to add (at least one) in a riskless portfolio. We do not observe any changes in the number or share of risky assets over time.

calculated mean predicted probabilities (reported at the bottom of *Table 5*). These correspond to mean predicted ownership rates which can be used in the above formula to calculate a steady state rate. The estimated steady state as this derives from the mean predicted probabilities of the above two models is 32%. However, the samples used in the estimation of the two logit specifications include – by construction – observations on different individuals and thus we can use a slightly different approach to derive an estimated steady state. We obtain predicted probabilities from each of the two models and subsequently calculate steady state rates by assuming an individual (in 1988) with composite median characteristics[22]. In *Table 6* we present estimated steady states for this "typical" individual at different financial and housing wealth levels, by holding the remaining characteristics constant at their medians. The steady state rates are increased – almost uniformly – along higher financial and housing wealth levels in line with portfolio theory predictions that wealthier people should hold a greater share of risky assets if their preferences exhibit decreasing absolute risk aversion. More evident is the increase associated with higher financial wealth levels stressing the relative importance of the accumulated financial wealth.

## 5. Bivariate Probit model

### i. Model specification and estimated results

Our analysis in this section mainly follows the methodology proposed by Bertaut (1996) who explores the stockholding behaviour of US households utilizing

[22] The assumed characteristics are: 62 years old, female, married, has children, less than high school education, no reported health problems, retired, log (net income): 4.29, without a mortgage outstanding.

panel data from the SCF. Our results for the elderly participating in the Retirement Survey are highly comparable to those she presents.

What we observe in each of the two waves is the risky asset ownership decision *D* of an individual *i*. If $D_i$ =1 (the individual holds risky assets) then the probability $\text{Prob}(u_i < x_i'\beta)$, where $x_i$ is a set of observed individual-specific characteristics and $u_i$ are normally distributed, can be estimated by a standard probit model. Since we utilize data from a two-wave balanced panel, we can estimate a bivariate specification that models the probability of owning risky assets in each year by allowing for correlation ρ between the disturbances $u_{it}$ of each individual. This is a way to control for unobserved heterogeneity given that $u_{it}$ can be decomposed to an individual-specific, time invariant unobserved characteristic $a_i$ and a time varying effect $\nu_{it}$:

$$u_{it} = \alpha_i + \nu_{it} \; ; \; u_{it} \sim N(0, \sigma^2)$$

$$E[u_{it} \; u_{i't'}] = \sigma^2 \quad \text{if} \quad i = i' \, , \, t = t'$$

$$= \rho \quad \text{if} \quad i = i' \, , \, t \neq t'$$

$$= 0 \quad \text{if} \quad i \neq i'$$

If the errors are jointly normally distributed, risky asset ownership probabilities for 1988 and 1994 can be estimated by a bivariate probit model. The variance of $u_{it}$, $\sigma^2$, is normalized to one because only the ratio of $\beta/\sigma$ can be identified by probit maximum likelihood.[23] Under the null hypothesis that ρ equals to zero, the model consists of two probit equations, which can be estimated separately assuming independent observations. As it compares to the random effects probit applied earlier,

[23] For a full set of formulas see Green (2000).

the current specification does not restrict the estimated coefficients to be equal in both the ownership decisions made in 1988 and 1994.

*Table 4* summarizes information on risky asset ownership decisions of individuals who hold risky financial assets in both periods, those who do not invest in risky assets, as well as those who change status.

The bivariate probit that we estimate allows us to calculate predicted probabilities on each of the above ownership categories and in addition to derive conditional probabilities of continued ownership or non-ownership.

As in the previous specifications various demographic factors like age, gender, educational level are included in the part of explanatory variables. The use of a panel and the distinction of the risky asset ownership decisions into two, static, but related through unobserved heterogeneity, choices allows controlling for the impact of life-cycle changes that took place in the particular period.[24] Namely, we control for changes in the marital status – an important life-cycle factor for individuals' economic situation and consequently their financial decisions. (In particular we distinguish among those stayed married to the same spouse in 1994, those who became married between the two interview periods and those who were divorced; with those who stayed single being the omitted group.) More importantly, as a key feature of our sample is the change in the retirement status that many of the individuals experienced between the two periods, we include dummies representing those being retired in 1988, remaining retired in 1994 or become retired in 1994. Furthermore, individuals who had received a lump sum in 1994 are distinguished to those who had received the lump sum before and after 1988. We also control for respondents' well-being by the means of net income, banded housing wealth and

[24] Since the two dependent variables do not depend on the same list of explanatory variables what we actually estimate is a seemingly unrelated two equation probit specification.

median financial wealth[25]. Finally, we control for two potentially important factors. The one has to do with those – few – individuals who bought a house since the 1988 interview, given that such an important financial decision usually implies broader portfolio reallocations. The other is a dummy included in the 1994 controlling for potential credit difficulties that some individuals may face (the relevant information was not available for 1988 – see the appendix for more details).

Estimated results from the bivariate probit specification are presented in *Table 7*. The estimate of $\rho$, the correlation between the individual specific error terms, is 0.52 and the null hypothesis that individuals' risky asset ownership decisions at these two different time periods are not influenced by unobserved heterogeneity is strongly rejected by both a Wald (reported at the bottom of *Table 7*) and a Likelihood Ratio ($\chi^2(1)= 158.9$) test.

Age does not have any significant effect in both equations (higher order age factors were insignificant as well). Being married in 1988 and staying married to the same spouse in 1994 seem to have a positive – and similar in magnitude – effect on the stockownership decision in these years. Our results do not suggest any significant role for the 1988 retirement status as well as for retirement status changes observed in 1994.[26] Having received a lump sum increases the stock ownership probability in the 1988 equation. Similar results are obtained in the 1994 but only for those that had received their lump sum prior to 1988. A possible explanation offers the fact that the

[25] "Median financial wealth" is a categorical variable constructed from the mid points of the nominal financial wealth bands that individuals report. When we estimated the same model including dummies representing financial wealth bands (as in the previous specifications) the model took more than 100 iterations to converge, nevertheless the results were broadly the same to those – from the more stable specification – that we present in *Table 7*.

[26] This was similarly the case for variables that were used in earlier specifications but which have been excluded from the current one. Dummies representing occupational or personal pension coverage and rights in an insurance policy, were not found to have any individual or joint – from both equations – explanatory power.

financial environment in the mid-eighties (privatisation of large nationalized industries and extensive advertisement of their issued shares) encouraged the investment of any lump sum earnings in stocks. This may also reveal that the decision to invest money received from a lump sum in the stock market is not an immediate one. Results from another specification stress the importance of the informational advantages (that individuals with more than standard education are supposed to enjoy) on the stock ownership decisions. Individuals reporting health problems have lower probabilities in holding risky assets in 1994 (the result is insignificant in the 1988 equation) suggesting possibly that persistent health problems at a higher age increase the mortality risk, inducing a more conservative portfolio behaviour.

Net income, median financial wealth and banded housing wealth are strongly associated with higher stock ownership probabilities in both waves (the effects are of similar magnitude in both years). Dummies representing individuals who have inherited property and systematically overdrew money display the expected signs (although the last is insignificant). A clear-cut result is not obtained for the case of those that bought a new house within the interview periods, nevertheless the negative sign is may be suggestive for the impact of large housing expenditures on the relevant decision. The positive effect in 1994 equation for those with a mortgage outstanding seems puzzling, but the fact that some of them decided to buy a risky asset as they are closer (in comparison with 1988) to pay off their mortgage is may be a justification.

## ii. Predicted probabilities of risky asset ownership

Based on the estimated bivariate probit of *Table* 7 we have calculated predicted probabilities for each of the four alternative risky asset ownership categories. We consider the cases of three hypothetical individuals with their composite characteristics fixed at sample's $25^{th}$, $50^{th}$ and $75^{th}$ percentiles (they summarized by *Table 8*).

Predicted probabilities for each of the four risky asset ownership alternatives are presented in *Graph 1* with regard to the three hypothetical individuals. The first set of bars presents the probability of not holding risky assets in both interview years. The next two sets of bars show the probability of not holding risky assets in 1988 but hold in 1994, and hold in 1988 but not hold in 1994. The final set of bars shows the probability of investing in risky assets both years. Differences in predicted probabilities for the three hypothetical individuals are evident in any state and they are mainly associated with the assumed differences in financial, housing wealth, net income and educational level. Individuals with characteristics at $25^{th}$ percentile have extremely high probabilities – about 90% – to abstain from any investment in risky assets both interview years. The probabilities of holding risky assets in any of the two waves is very small and the probability of holding risky assets in both years is just 2%. On the other hand, individuals with characteristics at $75^{th}$ percentile have higher probabilities (compared to those obtained for other states) to be risky asset owners in both years. The probabilities for these individuals not to hold risky assets does not exceed the 25% while the predicted probabilities for holding risky assets in 1988 and not holding in 1994 are very low (10%). Intermediate probabilities are obtained for those with median characteristics following the tendency observed in the other two

cases. Not investing in risky assets in both years has the highest predicted probability (64%) for median individuals.

In addition to the above probabilities for the risky asset ownership status we have also calculated conditional probabilities estimating how likely is for a 1988 risky asset holder/ non-holder to continue to be a holder/ non-holder in 1994. Conditional probabilities are obtained as:

$$\text{Prob}(Y_2 = y_{i2} \mid Y_1 = y_{i1}) = \frac{\text{Prob}(Y_1 = y_{i1}, Y_2 = y_{i2})}{\text{Prob}(Y_1 = y_{i1})}$$

where $\text{Prob}(Y_1 = y_{i1})$ is derived from the univariate normal c.d.f. of the 1988 equation.

*Graph 2* that summarizes conditional probabilities, consists of two diagrams: In the left side one, the two set of bars show the conditional probabilities that non-owners in 1988 will continue to abstain from any risky asset investments, or enter the risky asset market between the interview periods. The two bar sets in the right diagram present the probability that 1988 risky asset owners will choose to leave the market until 1994 or they will continue to own risky assets.

An important result, by comparing the second set of bars from both diagrams is that individuals (of any type) appear to have much higher probabilities in holding risky assets in 1994 if they were owners in 1988 rather than if they were not. In other words, individuals that had incurred prior to 1988 the fixed entry costs associated with risky financial assets' ownership (interpreted as "participation fees" or "informational requirements") are more likely to continue to hold risky assets relative to the 1994 holders that they did not own in 1988 and they had to pay an extra participation fee. The probability for a median individual of remaining an owner is 50%, much higher from the estimated one that an individual with the same characteristics that did not

own in 1988 would add a risky asset in his portfolio in the meantime (17%). Given that these differences in probabilities are disproportional for the less well off we may infer that such fixed costs have greater importance for those with lower wealth. Thus, entry costs seem to play the dominant role in portfolio formation with those that already participate to have higher probabilities to stay into the market, even though they have to afford considerable monitoring costs each period. The fact that a median risky asset holder in 1988 has about the same probabilities (50%) to continue to hold or no longer hold risky assets in 1994 stresses the relative importance of the monitoring and management costs.

A second issue has to do with the inertial behaviour which seems to be an important factor for households' portfolio formation. The predicted probability that a median non-owner in 1988 will not hold risky assets in 1994 is very high, exceeding the 80%. Similarly, the probability of the median risky asset owner in 1988 to continue to participate in 1994 is high, reaching the 50%. In the case of those with characteristics at the $25^{th}$ percentile the probability of abstaining from the stock market is about 95%, while for the very few that held risky assets from 1988, the combination of the relative low financial, housing wealth, income and education, lower the probability of participating in both years to 30%. However, a non owner of risky assets in 1988 with characteristics at $75^{th}$ percentile has about the same probabilities of becoming an owner in 1994 or remaining a non owner. Thus, wealthier individuals seem to have a strong incentive to overcome inertial behaviour and eventually get into the market (see Bertaut (1996)).

*Graph 3* shows the effects on the stockownership conditional probabilities for the median individual assuming changes only in his financial wealth, while *Graphs 4* and *5* assume changes only in housing wealth and educational level respectively.

These graphs reveal pictures similar to those obtained by the general *Graph 2*. The most evident changes in predicted probabilities for a median individual result from the assumed differences in the levels of financial wealth. Greater financial wealth increases the probability for a non owner in 1988 to be an owner in 1994 while reduces the probability that an owner in 1988 will leave the market by 1994. Along higher financial wealth levels, it is more likely for an otherwise "typical" risky asset owner in 1988 to continue to hold risky assets in 1994 rather than change status.

Finally, for a value of rho close to zero the ownership decisions in the two years should be independent (in a behavioural, not necessarily statistical sense). Indeed *Graph 6* suggests that the probabilities of not owning (or owning) in 94 are the same, unaffected from the ownership status in 1988. On the other hand, the higher the correlation between the individual disturbances (higher values of rho), the higher the relative importance of the unobserved heterogeneity which seems to result in higher probabilities for unchanged behaviour.

## 5. Conclusions

Our study utilized panel data from the Retirement Survey in order to explore risky assets ownership decisions made by the elderly. Our results provide some insights for various aspects of portfolio behaviour for the older part of the UK population over the period 1988-94. In line with similar studies' findings from other countries, financial, housing wealth and net income were identified as important determinants in the ownership choices. The nature of the dataset enabled us to explore the impact of various factors (like the rights on pension schemes, the timing of retirement and the receipt of a lump sum) on the portfolio behaviour of the elderly.

All specifications suggest a significant role for the educational attainment, an indirect evidence for the importance of the informational advantages that these households enjoy. This result is interesting bearing in mind that differences in education tend to be eliminated by the experience in financial management that older households have naturally gained over time. Predicted probabilities from the bivariate probit analysis made strong suggestions for the role of fixed entry costs and inertial behaviour in risky asset ownership decisions. In line with our expectations such fixed costs seem to be more important for the less well off. The availability of one more wave and data on asset amounts are essential for the extension of this research and a more thorough analysis.

## References


Banks J., R. Blundell and J.Smith "*Wealth inequality in the US and Great Britain*", IFS working paper 00/20, 2000.

Banks J., A. Dilnot and H. Low "*The distribution of wealth in the UK*", IFS Commentary no. 45, 1994.

Banks J. and S.Smith "*UK Household Portfolios*" in Household Portfolios ed. Guiso L., Haliassos M. and Jappelli T., MIT Press, 2001.

Banks J. and S. Tanner "*Savings and Wealth in the UK: Evidence from Micro-Data*", Fiscal Studies, vol.17, no.2, pp.37-64, 1996.

Bertaut C. *"Stockholding Behavior of US households: Evidence form the 1983-89 Survey of Consumer Finances"*, *Review of Economics and Statistics,* Vol 80, pp.263-275, 1998.

Bertaut C. and M. Haliassos, "*Precautionary portfolio behavior from a life-cycle perspective*", Journal of Economic Dynamics and Control, vol.21, pp.1511-42, 1997.

Bertaut C. and Starr-McCluer, "*Household Portfolios in the United States*" in Household Portfolios ed. Guiso L., Haliassos M. and Jappelli T., MIT Press, 2001.

Butler J. and Moffitt R. *"A Computationally Efficient Quadrature Procedure for the One-Factor Multinomial Probit Model"*, Econometrica, pp.761-764, 1982.

Chamberlain, G. "*Analysis of covariance with qualitative data*", Review of Economic Studies, vol. 47, pp. 225-38, 1980.

Deaton, A. and C. Paxson (1994), *"Saving, growth and aging in Taiwan"*, in D.A. Wise, Studies in the Economics of Aging, Chicago University Press.

Disney R., Gallagher T. and Henley A., *"Housing Assets and Saving Behaviour among the Elderly in Great Britain"*, IFS Working Paper, 1995.

Disney R., Johnson P. and Stears G. *"Asset wealth and asset decummulation among households in the Retirement Survey*", Fiscal Studies, vol.19, no.2, pp.153-174, 1998.

Gollier C. "*What does the classical theory have to say about household portfolios?*" in Household Portfolios ed.Guiso L., Haliassos M. and Jappelli T, MIT Press, 2001.

Greene W. *"Econometric Analysis"*, New York: Macmillan, 2000.

Guiso L., M. Haliassos and T. Jappelli, "*Household Portfolios: An international comparison*", in Household Portfolios ed. Guiso L., Haliassos M. and Jappelli T., MIT Press, 2001.

Guiso L., M. Haliassos and T. Jappelli, *"Household Portfolios"*, MIT Press, 2001.

Guiso L., T. Jappelli, and D. Terlizzese, "*Income risk, borrowing constraints and portfolio choice*", American Economic Review vol. 86, pp.158-172,1996.

Haliassos M. and C. Bertaut , "*Why do so few hold stocks?*", Economic Journal, 105, pp.1110-1129, 1995.

Heckman J., *"Simple Statistical Models for Discrete Panel Data Developed and Applied to Test the Hypothesis of True State Dependence against the Hypothesis of Spurious State Dependence"*, Annales de l'INSEE, pp.227-269, 1978.

Hurd M. *"Portfolio Holdings by the Elderly"*, in Household Portfolios ed. Guiso L., Haliassos M. and Jappelli T., MIT Press, 2001.

Hochguertel S., R. Alessie and A. van Soest, "*Saving Accounts versus Stocks and Bonds in Household Portfolio Allocation"*, Scand. Journal of Economics 99 (1), pp.81-97, 1997.

Hochguertel S., R. Alessie and A. van Soest "*Household Portfolios in the Netherlands*" , in Household Portfolios ed. Guiso L., Haliassos M. and Jappelli T., MIT Press (2001)

Ioannides Y., "*Dynamics of the composition of household asset portfolios and the lifecycle*", Applied Financial Economics, vol.2, pp.145-159, 1992.

Johnston J. and J. DiNardo, *"Econometric Methods"*, McGraw-Hill, 1997.

King M. and J. Leape, "*Asset accumulation, information and the life cycle*", NBER WoP no.2392, 1987.

King M. and J. Leape, "*Wealth and portfolio composition: Theory and Evidence*", Journal of Public Economics, vol.69, pp.155-193, 1998.

Maddala G.S. "*Limited dependent and qualitative variables in econometrics*", Cambridge University Press 1983

Miniaci R. and F. Ruberti, *"Household Risky Asset Ownership: A Dynamic Analysis"*, Working Paper, Universita di Padova, 2001.

Miniaci R. and G. Weber, "*Econometric Issues in the Estimation of Household Portfolio Models*", in Household Portfolios ed. Guiso L., Haliassos M. and Jappelli T., MIT Press (2001)

Poterba J. and A. Samwick, "Household portfolio allocation over the life cycle", NBER wo.paper 6185, 1997.

Samuelson P., "Lifetime portfolio selection by dynamic stochastic programming", Review of Economics and Statistics, vol 51, pp.239-246, 1969.

Shorrocks A., "*The portfolio of asset holdings in the United Kingdom*", Economic Journal, vol. 92, pp.268-284, 1982.

Stewart M. *"On least squares estimation when the depedent variable is grouped"*, Review of Economic Studies, vol. 50, pp.53-73, 1983.

Verbeek M., *" A Guide to Modern Econometrics",* Wiley, 2001.

Uhler R. and J. Cragg, "*The structure of the asset portfolios of households*", Review of Economic Studies, pp.341-357, 1971.

**Table 1**: Ownership of Risky Financial Assets: Probit Models

| | ML Pooled | | | ML Random Effects | | |
|---|---|---|---|---|---|---|
| **Number of Observations/ Benefit Units:** 3789 / 2422 | | | | | | |
| Log Likelihood | -1633.25 | | | -1579.01 | | |
| Pseudo $R^2$ | 0.314 | | | 0.276 | | |
| **Explanatory Variable** | **coefficient estimate** | ***t-value on coefficient*** | **(marginal effect)** | **coefficient estimate** | ***t-value on coefficient*** | **(marginal effect)** |
| Age | -0.0026 | *-0.41* | (-0.001) | -0.0030 | *-0.32* | (-0.001) |
| Male | 0.0148 | *0.16* | (0.004) | 0.0728 | *0.51* | (0.014) |
| Married | -0.1522 | *-1.80* | (-0.044) | -0.2321 | *-1.77* | (-0.048) |
| Has children | 0.0779 | *1.12* | (0.022) | 0.1038 | *0.94* | (0.019) |
| More than 16 year old when finished full time education | 0.1727 | *2.89* | (0.051) | 0.2935 | *3.02* | (0.063) |
| Reported Health Problems | -0.0109 | *-0.17* | (-0.003) | 0.0009 | *0.01* | (0.000) |
| Retired | 0.0586 | *0.76* | (0.017) | 0.0490 | *0.43* | (0.009) |
| Has retired late | 0.2177 | *1.60* | (0.067) | 0.1873 | *0.98* | (0.041) |
| Has retired early | 0.0621 | *0.84* | (0.018) | 0.0716 | *0.67* | (0.015) |
| Has received lump sum | 0.1127 | *1.77* | (0.032) | 0.1729 | *1.79* | (0.034) |
| Has occupational pension | -0.0058 | *-0.10* | (-0.002) | 0.0035 | *0.03* | (0.001) |
| Has private pension | 0.2621 | *2.86* | (0.081) | 0.4071 | *2.87* | (0.097) |
| Has insurance policy | 0.1769 | *2.54* | (0.053) | 0.2033 | *2.05* | (0.044) |
| log(Net Income) | 0.2040 | *3.53* | (0.058) | 0.2847 | *3.36* | (0.057) |
| Financial Wealth £1-3,000 | 1.6102 | *6.26* | (0.549) | 2.1999 | *6.40* | (0.658) |
| Financial Wealth £3-6,000 | 1.9156 | *7.42* | (0.657) | 2.6302 | *7.53* | (0.799) |
| Financial Wealth £6-8,000 | 1.9707 | *7.11* | (0.674) | 2.7745 | *7.29* | (0.833) |
| Financial Wealth £8-10,000 | 2.0774 | *7.68* | (0.698) | 2.8524 | *7.77* | (0.844) |
| Financial Wealth £10-20,000 | 2.5413 | *9.76* | (0.789) | 3.4663 | *9.63* | (0.912) |
| Financial Wealth £20-30,000 | 2.4262 | *9.10* | (0.761) | 3.3942 | *9.13* | (0.895) |
| Financial Wealth over £30,000 | 2.7471 | *10.56* | (0.830) | 3.7680 | *10.31* | (0.940) |
| Housing Wealth £1-25,000 | 0.1253 | *0.80* | (0.037) | 0.1469 | *0.65* | (0.032) |
| Housing Wealth £25-50,000 | 0.1068 | *0.93* | (0.032) | 0.1976 | *1.19* | (0.043) |
| Housing Wealth £50-100,000 | 0.3325 | *4.31* | (0.101) | 0.4947 | *4.17* | (0.114) |
| Housing Wealth £100-150,000 | 0.3650 | *4.33* | (0.113) | 0.5074 | *3.99* | (0.121) |
| Housing Wealth £150-200,000 | 0.5035 | *4.51* | (0.166) | 0.6650 | *4.04* | (0.177) |
| Housing Wealth over £200,000 | 0.5347 | *4.15* | (0.178) | 0.7195 | *3.73* | (0.197) |
| Mortgage Outstanding | 0.0419 | *0.55* | (0.012) | 0.0653 | *0.57* | (0.013) |
| Has inherited property | 0.3284 | *5.43* | (0.100) | 0.5076 | *5.17* | (0.101) |
| Satisfied with the management of financial holdings | 0.0783 | *1.26* | (0.022) | 0.1306 | *1.45* | (0.026) |
| Dissatisfied with the standard of living | -0.0349 | *-0.34* | (-0.010) | -0.1152 | *-0.75* | (-0.023) |
| Year 1994 | 0.1596 | *2.38* | (0.046) | 0.2036 | *2.19* | (0.042) |
| Live in London | 0.0836 | *1.00* | (0.024) | 0.1129 | *0.85* | (0.024) |
| Constant | -5.0521 | *-7.58* | | -5.7223 | *-7.00* | |
| LRT $H_o$: $\rho=0$ ($\chi^2(1)$) | | | | 108.50 | ($\rho$ : 0.532 (s.e. .043)) | |

**Note**: The sample uses the full unbalanced panel of the benefit units. "Risky financial assets" comprise Stocks, Shares, Bonds, Debentures, Unit Trusts, Gilt Edged Stocks and Local Authority Securities. Explanatory variables are defined over the head except net income, financial and housing wealth. Wealth and income variables have been deflated using the CPI and are expressed in constant 1994 prices. Marginal effects in parentheses refer to change in the ownership probability associated with marginal changes in continuous variables (change in dummy variables from 0 to 1 is assumed).

**Table 2**: Ownership of Risky Financial Assets: Random Effects Probit Model

| | **ML Random Effects** | | |
|---|---|---|---|
| **Number of Observations/ Benefit Units** | 3789 / 2422 | | |
| **Log Likelihood** | -1774.16 | | |
| **Pseudo $R^2$** | 0.190 | | |
| **Explanatory Variable** | **coefficient estimate** | ***t-value on coefficient*** | **(marginal effect)** |
| Age | -0.0038 | *-0.41* | (-0.001) |
| Male | 0.1015 | *0.75* | (0.027) |
| Married | -0.2610 | *-2.09* | (-0.072) |
| Has children | -0.1146 | *-1.07* | (-0.032) |
| More than 16 year old when finished full time education | 0.3693 | *3.88* | (0.106) |
| Reported Health Problems | -0.1320 | *-1.41* | (-0.035) |
| Retired | 0.2801 | *2.66* | (0.071) |
| Has retired late | 0.1715 | *0.94* | (0.049) |
| Has retired early | 0.2208 | *2.13* | (0.063) |
| Has received lump sum | 0.2530 | *2.76* | (0.066) |
| Has occupational pension | 0.0392 | *0.40* | (0.011) |
| Has private pension | 0.4786 | *3.44* | (0.149) |
| Has insurance policy | 0.3272 | *3.42* | (0.096) |
| log(Net Income) | 0.6157 | *7.53* | (0.165) |
| Housing Wealth £1-25,000 | 0.2675 | *1.26* | (0.079) |
| Housing Wealth £25-50,000 | 0.4323 | *2.72* | (0.134) |
| Housing Wealth £50-100,000 | 0.8552 | *7.43* | (0.268) |
| Housing Wealth £100-150,000 | 0.9079 | *7.30* | (0.295) |
| Housing Wealth £150-200,000 | 1.0026 | *6.28* | (0.348) |
| Housing Wealth over £200,000 | 1.1954 | *6.35* | (0.424) |
| Mortgage Outstanding | -0.2095 | *-1.95* | (-0.052) |
| Has inherited property | 0.6593 | *6.72* | (0.176) |
| Satisfied with the management of financial holdings | 0.4226 | *4.98* | (0.113) |
| Dissatisfied with the standard of living | -0.3141 | *-2.22* | (-0.084) |
| Year 1994 | 0.2280 | *2.58* | (0.062) |
| Live in London | 0.1815 | *1.40* | (0.052) |
| Constant | -5.1012 | -7.19 | |
| LRT $H_o$: $\rho=0$ ($\chi^2(1)$) | 142.7 | ($\rho$ : 0.554 | (s.e. .038)) |

**Note:** The sample uses the full unbalanced panel of the benefit units. "Risky financial assets" comprise Stocks, Shares, Bonds, Debentures, Unit Trusts, Gilt Edged Stocks and Local Authority Securities. Explanatory variables are defined over the head except net income, financial and housing wealth. Wealth and income variables have been deflated using the CPI and are expressed in constant 1994 prices. Marginal effects in parentheses refer to changes in the ownership probability associated with marginal changes in continuous variables (change in dummy variables from 0 to 1 is assumed).

**Table 3** : Ownership of Risky Financial Assets: Logit Models

| | **ML Pooled** | | **Fixed Effects** | |
|---|---|---|---|---|
| **Number of Observations/ Benefit Units:** | 2734 / 1367 | | 584 / 292 | |
| **Log Likelihood** | -1238.5 | | -154.4 | |
| **Pseudo $R^2$** | 0.305 | | | |
| **Explanatory Variable** | **coefficient estimate** | ***t-value on coefficient*** | **coefficient estimate** | ***t-value on coefficient*** |
| Age | -0.0065 | *-0.52* | 0.0031 | *0.07* |
| Male | -0.0498 | *-0.29* | - | - |
| Married | -0.2193 | *-1.30* | -0.9807 | *-1.29* |
| Has children | 0.2581 | *1.81* | 0.5914 | *0.46* |
| More than 16 year old when finished full time education | 0.2211 | *1.94* | - | - |
| Reported Health Problems | -0.0274 | *-0.20* | 0.5131 | *1.21* |
| Retired | 0.0865 | *0.57* | -0.2609 | *-0.72* |
| Has retired late | 0.3554 | *1.44* | -0.2670 | *-0.50* |
| Has retired early | 0.1109 | *0.79* | -0.1716 | *-0.51* |
| Has received lump sum | 0.2629 | *2.07* | 0.4857 | *1.10* |
| Has occupational pension | -0.0358 | *-0.27* | -0.7687 | *-0.98* |
| Has private pension | 0.5296 | *2.90* | 2.2858 | *2.44* |
| Has insurance policy | 0.2285 | *1.63* | -0.3326 | *-1.09* |
| log(Net Income) | 0.2493 | *2.13* | 0.0872 | *0.33* |
| Financial Wealth £1-3,000 | 3.3628 | *4.66* | 2.4276 | *2.97* |
| Financial Wealth £3-6,000 | 3.9481 | *5.46* | 3.1295 | *3.71* |
| Financial Wealth £6-8,000 | 4.1893 | *5.57* | 4.1980 | *4.22* |
| Financial Wealth £8-10,000 | 4.1378 | *5.61* | 3.2382 | *3.64* |
| Financial Wealth £10-20,000 | 5.0538 | *6.98* | 3.9690 | *4.59* |
| Financial Wealth £20-30,000 | 4.8476 | *6.61* | 4.0736 | *4.47* |
| Financial Wealth over £30,000 | 5.3439 | *7.37* | 4.1742 | *4.68* |
| Housing Wealth £1-25,000 | 0.2196 | *0.65* | -0.1915 | *-0.26* |
| Housing Wealth £25-50,000 | 0.2562 | *1.22* | 0.2344 | *0.34* |
| Housing Wealth £50-100,000 | 0.6115 | *3.98* | 0.2732 | *0.42* |
| Housing Wealth £100-150,000 | 0.6354 | *3.66* | -0.0607 | *-0.09* |
| Housing Wealth £150-200,000 | 1.0164 | *4.32* | -0.1666 | *-0.22* |
| Housing Wealth over £200,000 | 1.1367 | *4.25* | -0.6856 | *-0.75* |
| Mortgage Outstanding | 0.0331 | *0.23* | 0.2932 | *0.69* |
| Has inherited property | 0.4626 | *3.98* | 1.7655 | *2.50* |
| Satisfied with the management of financial holdings | 0.1784 | *1.44* | 0.1156 | *0.40* |
| Dissatisfied with the standard of living | -0.0367 | *-0.17* | -0.7937 | *-1.60* |
| Year 1994 | 0.2248 | *1.67* | - | - |
| Live in London | 0.2169 | *1.30* | -1.7495 | *-1.14* |
| Constant | -6.9828 | *-5.87* | - | - |
| Hausman $H_o$: $\rho=0$ ($\chi^2(30)$) | 78.96 | (p-value: 0.00) | | |

**Note:** The sample uses the balanced panel of the benefit units. "Risky financial assets" comprise Stocks, Shares, Bonds, Debentures, Unit Trusts, Gilt Edged Stocks and Local Authority Securities. Explanatory variables are defined over the head except net income, financial and housing wealth. Wealth and income variables have been deflated using the CPI and are expressed in constant 1994 prices.

**Table 4** : Risky Asset Ownership in 1988 and 1994

| **Risky asset ownership in 1988** | **Risky asset ownership in 1994** | | |
|---|---|---|---|
| | **No** | **Yes** | *Total* |
| **No** | **1129** | **247** | *1376* |
| **Yes** | **187** | **409** | *596* |
| *Total* | *1316* | *656* | *1972* |

**Note:** Figures refer to the balanced panel of the "key respondents" (aged 55-69 in 1988).

**Table 5:** Logistic Estimation of Transition Probabilities

| | **Not own in 1988 to own in 1994** | | **Own in 1988 to own in 1994** | |
|---|---|---|---|---|
| **Number of Observations ("key respondents")** | 1376 | | 596 | |
| **Log Likelihood** | -554.1 | | -337.3 | |
| **Pseudo $R^2$** | 0.15 | | 0.09 | |
| **Explanatory Variable** | **coefficient estimate** | ***t-value on coefficient*** | **coefficient estimate** | ***t-value on coefficient*** |
| Age | -0.0665 | *-2.77* | 0.0285 | *1.04* |
| Male | 0.0164 | *0.09* | 0.2238 | *0.99* |
| Married | 0.2219 | *1.03* | -0.0357 | *-0.13* |
| Has children | 0.1797 | *0.72* | -0.0135 | *-0.05* |
| More than 16 year old when finished full time education | 0.3239 | *1.86* | 0.4497 | *2.16* |
| Reported Health Problems | -0.7060 | *-2.84* | 0.0099 | *0.03* |
| Retired | 0.2313 | *1.13* | -0.2451 | *-1.00* |
| log(Net Income) | 0.1498 | *1.56* | -0.0684 | *-0.60* |
| Financial Wealth £1-3,000 | 0.1217 | *0.58* | - | - |
| Financial Wealth £3-6,000 | 0.2539 | *0.82* | 0.3198 | *1.16* |
| Financial Wealth £6-8,000 | 1.0784 | *2.97* | 0.4389 | *1.11* |
| Financial Wealth £8-10,000 | 0.6610 | *1.85* | 0.2105 | *0.54* |
| Financial Wealth £10-20,000 | 0.4908 | *1.55* | 0.4314 | *1.44* |
| Financial Wealth £20-30,000 | 0.9904 | *2.44* | 0.5053 | *1.33* |
| Financial Wealth over £30,000 | 0.8707 | *2.08* | 1.5262 | *4.17* |
| Housing Wealth £1-25,000 | 1.0775 | *3.95* | 0.1528 | *0.40* |
| Housing Wealth £25-50,000 | 1.2359 | *4.80* | 0.4449 | *1.33* |
| Housing Wealth £50-100,000 | 1.7253 | *6.67* | 0.9599 | *2.68* |
| Housing Wealth £100-150,000 | 1.8294 | *4.55* | 0.4427 | *1.02* |
| Housing Wealth over £150,000 | 1.6332 | *3.40* | 1.4401 | *2.50* |
| Mortgage Outstanding | 0.1439 | *0.74* | -0.1886 | *-0.74* |
| Constant | 0.2010 | *0.13* | -1.7606 | *-1.04* |
| *Mean predicted probability* | *0.135* | | *0.713* | |

**Note:** The sample uses the balanced panel of the "key respondents" (aged 55-69 in 1988) and the explanatory variables refer to the 1988 wave. "Risky financial assets" comprise Stocks, Shares, Bonds, Debentures, Unit Trusts, Gilt Edged Stocks and Local Authority Securities. The t statistics have been computed using standard errors corrected for heteroscedasticity.

**Table 6**: Predicted Steady State rates for median individual

| | |
|---|---|
| Financial Wealth £1-3,000 | **0.248** |
| Financial Wealth £3-6,000 | **0.301** |
| Financial Wealth £6-8,000* | **0.456** |
| Financial Wealth £8-10,000* | **0.358** |
| Financial Wealth £10-20,000 | **0.355** |
| Financial Wealth £20-30,000* | **0.450** |
| Financial Wealth over £30,000* | **0.609** |
| Housing Wealth £0- 25,000* | **0.237** |
| Housing Wealth £25,000 – 50,000* | **0.287** |
| Housing Wealth £50,000 – 100,000* | **0.432** |
| Housing Wealth £100,000 – 150,000* | **0.385** |
| Housing Wealth over £ 150,000* | **0.496** |

* At least one of the underlying estimated coefficients significant at 5%

**Table 7** : Ownership of Risky Financial Assets: Bivariate Probit Model

| | **1988 equation** | | **1994 equation** | |
|---|---|---|---|---|
| **Number of Observations ("key respondents")** | 1972 | | | |
| **Log Likelihood** | -1781.6 | | | |
| **Explanatory Variable** | **coefficient estimate** | ***t-value on coefficient*** | **coefficient estimate** | ***t-value on coefficient*** |
| Age | -0.0096 | *-0.96* | -0.0031 | *-0.32* |
| Male | 0.0054 | *0.07* | 0.0127 | *0.15* |
| Married in 1988 | 0.1683 | *1.87* | - | - |
| Stay married | - | - | 0.1062 | *1.17* |
| Married between 1988-94 | - | - | -0.8202 | *-1.81* |
| Divorced/ Widowed | - | - | 0.0032 | *0.05* |
| Has children | -0.0150 | *-0.15* | 0.1684 | *1.64* |
| More than 16 year old when finished full time education | 0.1873 | *2.44* | 0.1664 | *2.13* |
| Reported Health Problems | -0.1148 | *-1.31* | -0.1662 | *-1.99* |
| Retired in 1988 | 0.0608 | *0.69* | - | - |
| Remained Retired in 1994 | - | - | 0.0311 | *0.26* |
| Became Retired in 1994 | - | - | -0.0845 | *-0.78* |
| Has received lump sum in 1988 | 0.1390 | *1.96* | - | - |
| Has received lump sum before 1988 | - | - | 0.1669 | *2.14* |
| Has received lump sum between 1988-94 | - | - | 0.0507 | *0.46* |
| log(Net Income) | 0.0784 | *2.06* | 0.0952 | *1.96* |
| Median Financial Wealth * $10^{-4}$ | 0.4650 | *11.49* | 0.4890 | *13.76* |
| Housing Wealth £1-25,000 | 0.3947 | *3.58* | 0.0160 | *0.11* |
| Housing Wealth £25-50,000 | 0.5847 | *5.98* | 0.4937 | *5.10* |
| Housing Wealth £50-100,000 | 0.5783 | *5.45* | 0.5523 | *5.17* |
| Housing Wealth £100-150,000 | 0.6902 | *3.90* | 0.4994 | *2.88* |
| Housing Wealth over £150,000 | 0.7442 | *3.66* | 0.7995 | *3.64* |
| Bought house between 1988-94 | - | - | -0.2692 | *-1.49* |
| Has inherited property | 0.3571 | *4.34* | 0.1847 | *2.38* |
| Mortgage Outstanding | -0.0359 | *-0.42* | 0.2525 | *2.28* |
| Overdrew money in 1994 | - | - | -0.2327 | *-1.04* |
| Constant | -1.3641 | *-2.24* | -1.9353 | *-2.72* |
| $\rho$ | 0.5225 (s.e. *.036*) | | | |
| Wald Test $H_o$: $\rho=0$ ($\chi^2(1)$) | 135.1 | | | |

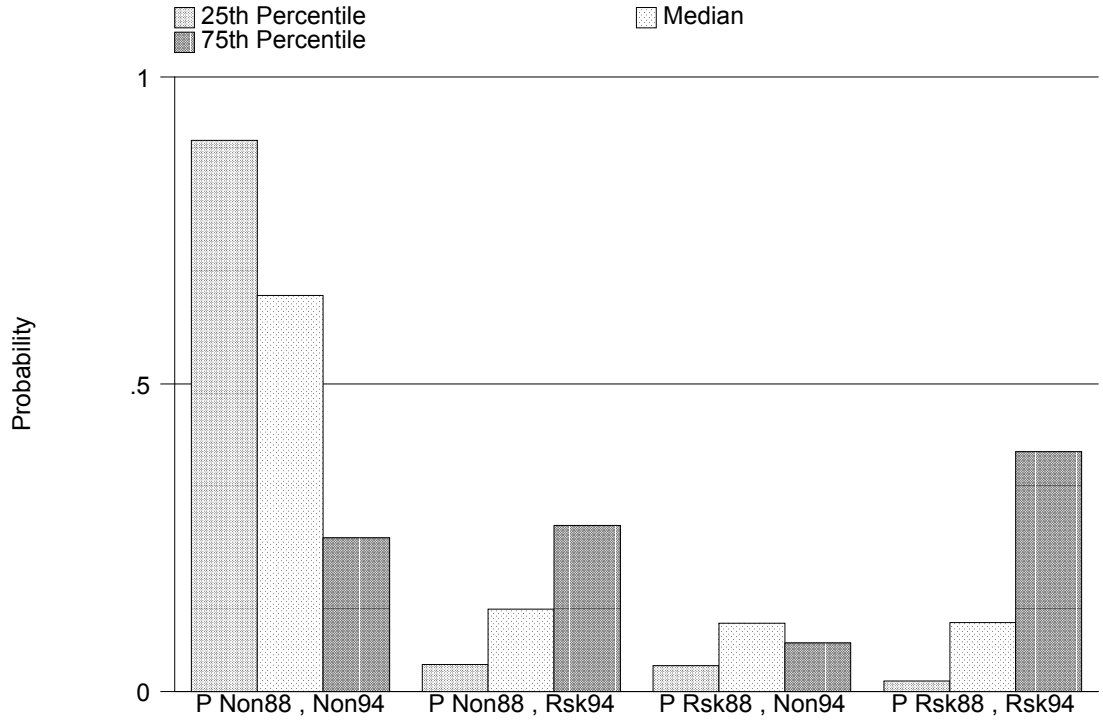
**Note:** The sample uses the balanced panel of the "key respondents" (aged 55-69 in 1988). "Risky financial assets" comprise Stocks, Shares, Bonds, Debentures, Unit Trusts, Gilt Edged Stocks and Local Authority Securities. The t statistics have been computed using standard errors corrected for heteroscedasticity assuming independence of observations across different individuals but not necessarily across time for the same individual.

**Table 8 :** Characteristics of Composite Individuals at Sample's 25th, 50th and 75th percentiles

| **Variables** | **25th Percentile** | **Median** | **75th Percentile** |
|---|---|---|---|
| Age (1988) | 58 | 62 | 65 |
| Male | No | No | Yes |
| Married in 1988 | No | Yes | Yes |
| Stay married | No | Yes | Yes |
| Married between 1988-94 | No | No | No |
| Divorced/ Widowed | No | No | No |
| Has Children | Yes | Yes | Yes |
| More than 16 year old when finished full time education | No | No | Yes |
| Reported Health Problems (1988) | No | No | No |
| Reported Health Problems (1994) | No | No | No |
| Retired in 1988 | No | Yes | Yes |
| Remained Retired in 1994 | No | Yes | Yes |
| Became Retired in 1994 | No | No | No |
| Has received lump sum in 1988 | No | No | Yes |
| Has received lump sum before 1988 | No | No | Yes |
| Has received lump sum between 1988-94 | No | No | No |
| log(Net Income) (1988) | 3.78 | 4.29 | 4.87 |
| log(Net Income) (1994) | 4.17 | 4.61 | 5.12 |
| Median Financial Wealth (1988) | 1,500 | 1,500 | 9,000 |
| Median Financial Wealth (1994) | 1,500 | 4,500 | 15,000 |
| Housing Wealth (1988) | 0 | 25-50,000 | 50-100,000 |
| Housing Wealth (1994) | 0 | 25-50,000 | 50-100,000 |
| Bought house between 1988-94 | No | No | No |
| Has inherited property (1988) | No | No | No |
| Has inherited property (1994) | No | No | Yes |
| Mortgage Outstanding (1988) | No | No | No |
| Mortgage Outstanding (1994) | No | No | No |
| Overdrew money in 1994 | No | No | No |

**Graph 1**

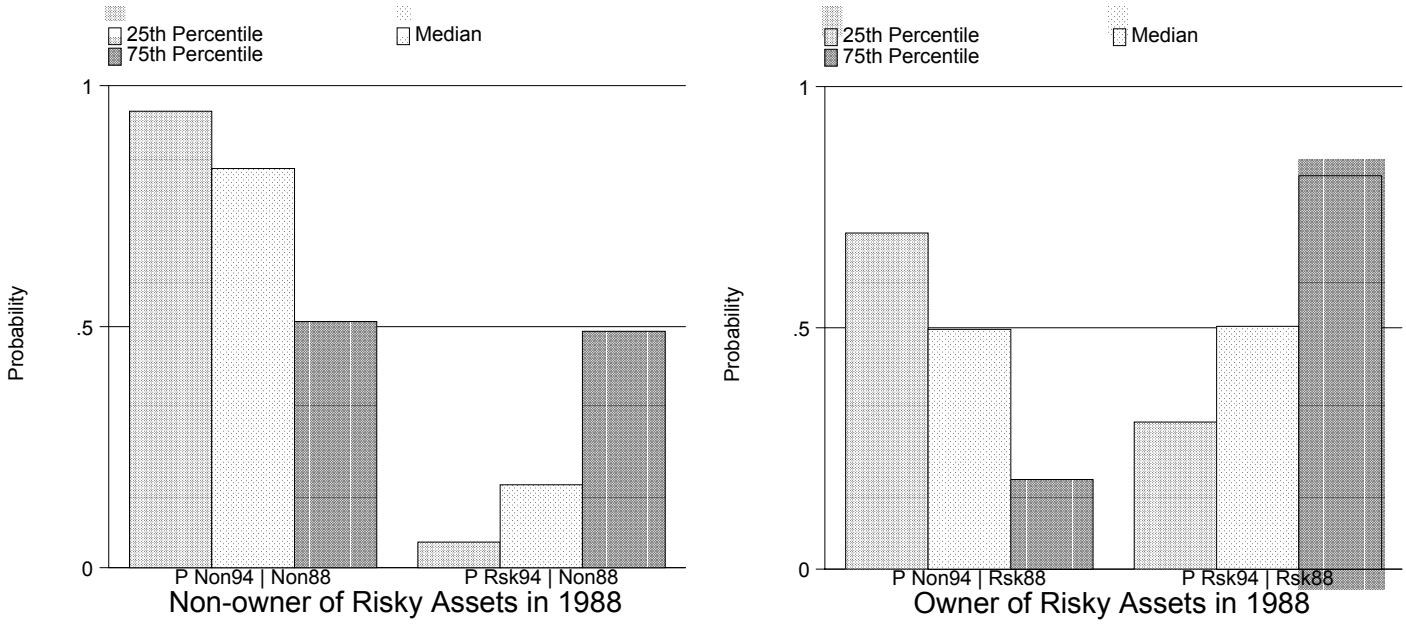
**Predicted Ownership Status for Risky Assets**
For individuals' characteristics at the 25th, 50th and 75th percentiles



## Graph 2

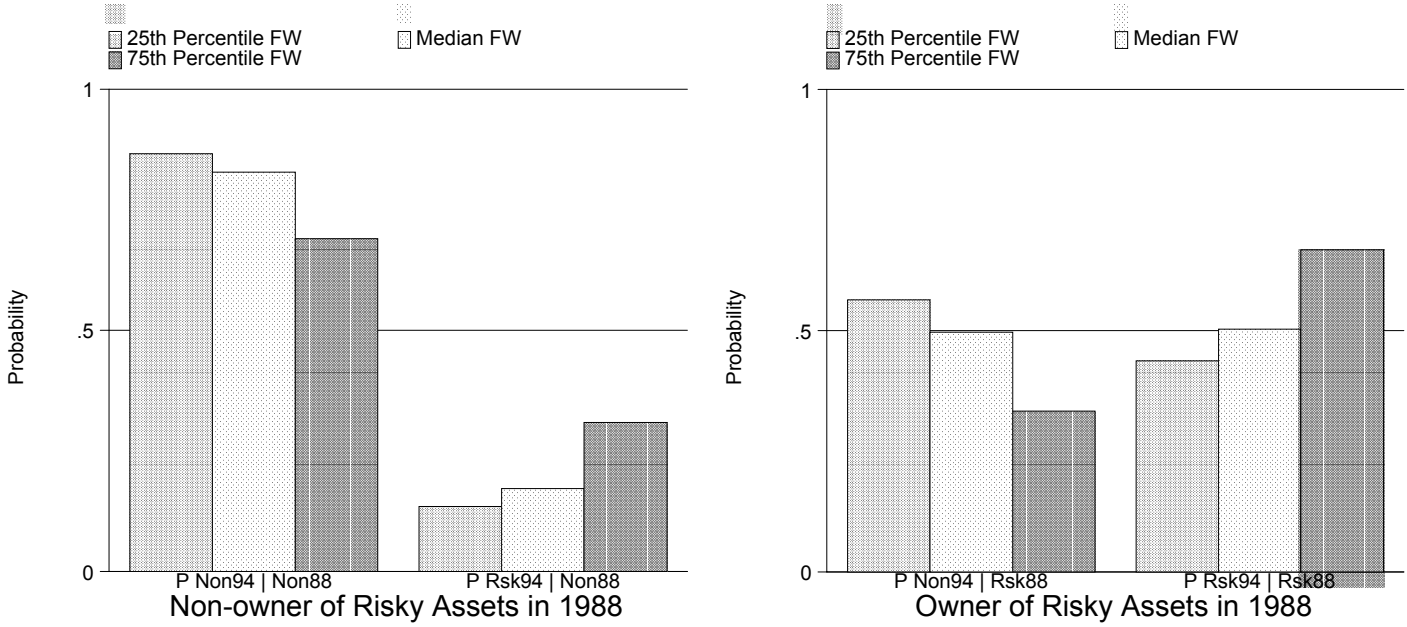
**Conditional Probabilities**

For individuals' characteristics at the 25th, 50th and 75th percentiles



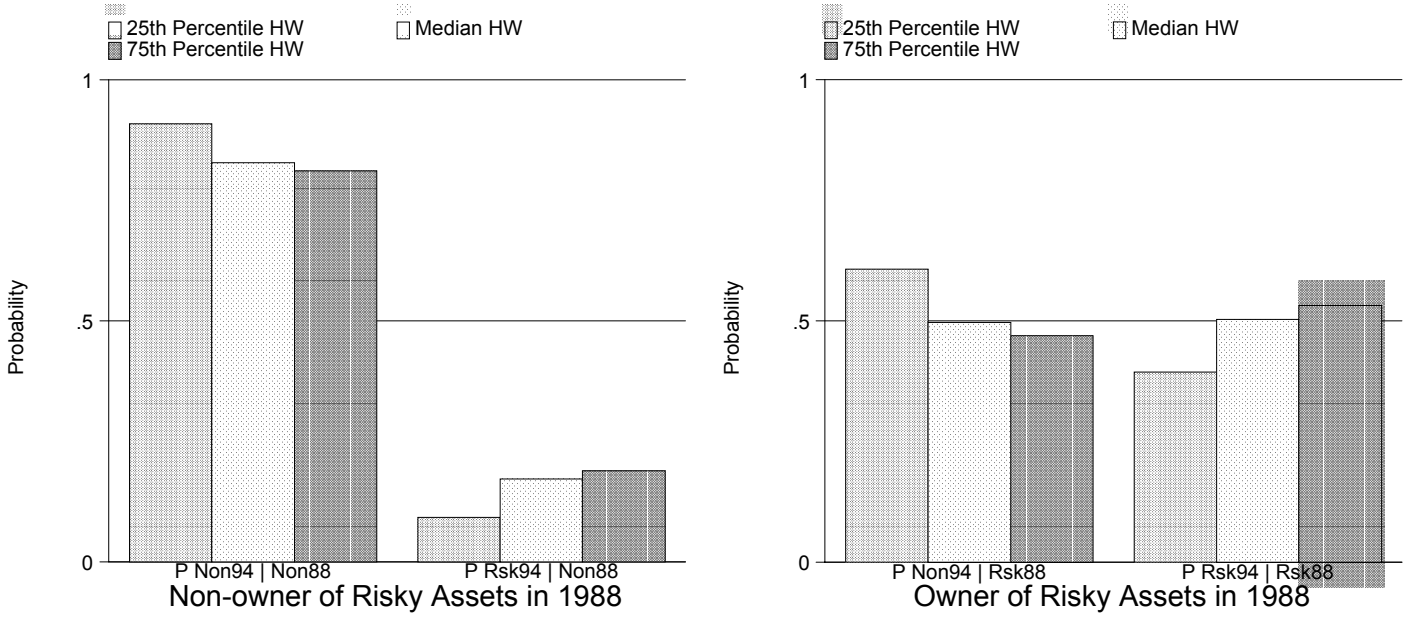
## Graph 3

**Effects from Financial Wealth changes on Conditional Probabilities**
For individuals with median characteristics



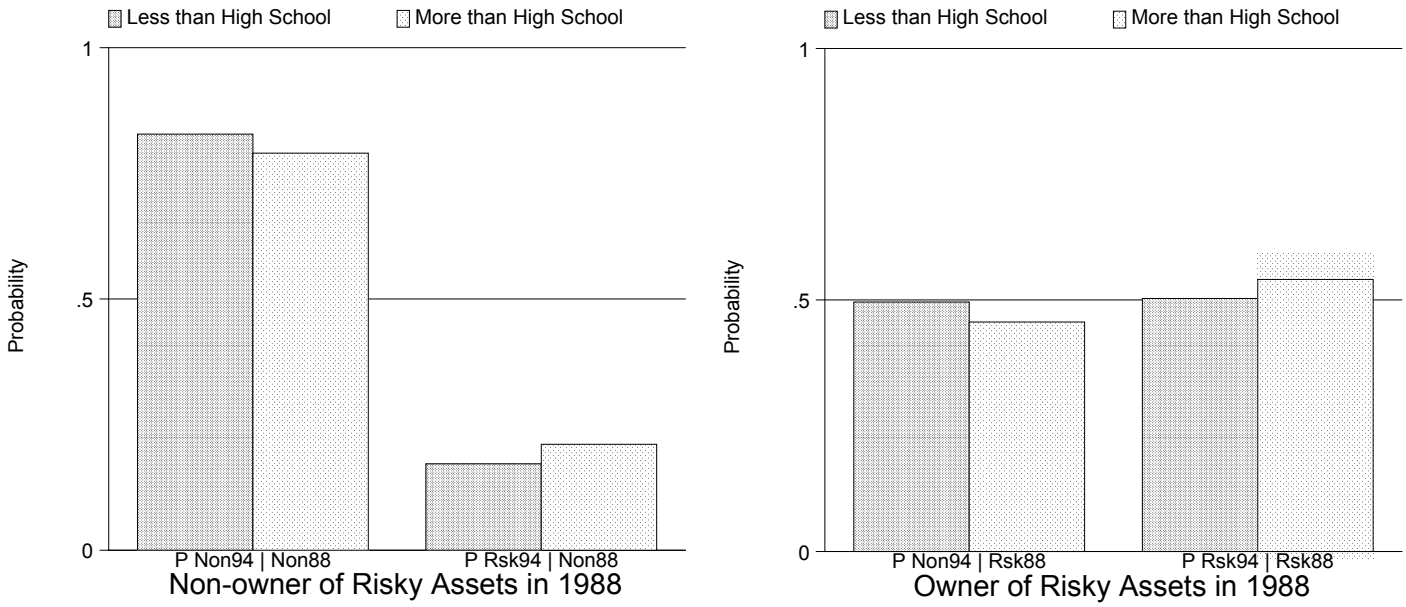

## Graph 4

**Effects from Housing Wealth changes on Conditional Probabilities**
For individuals with median characteristics



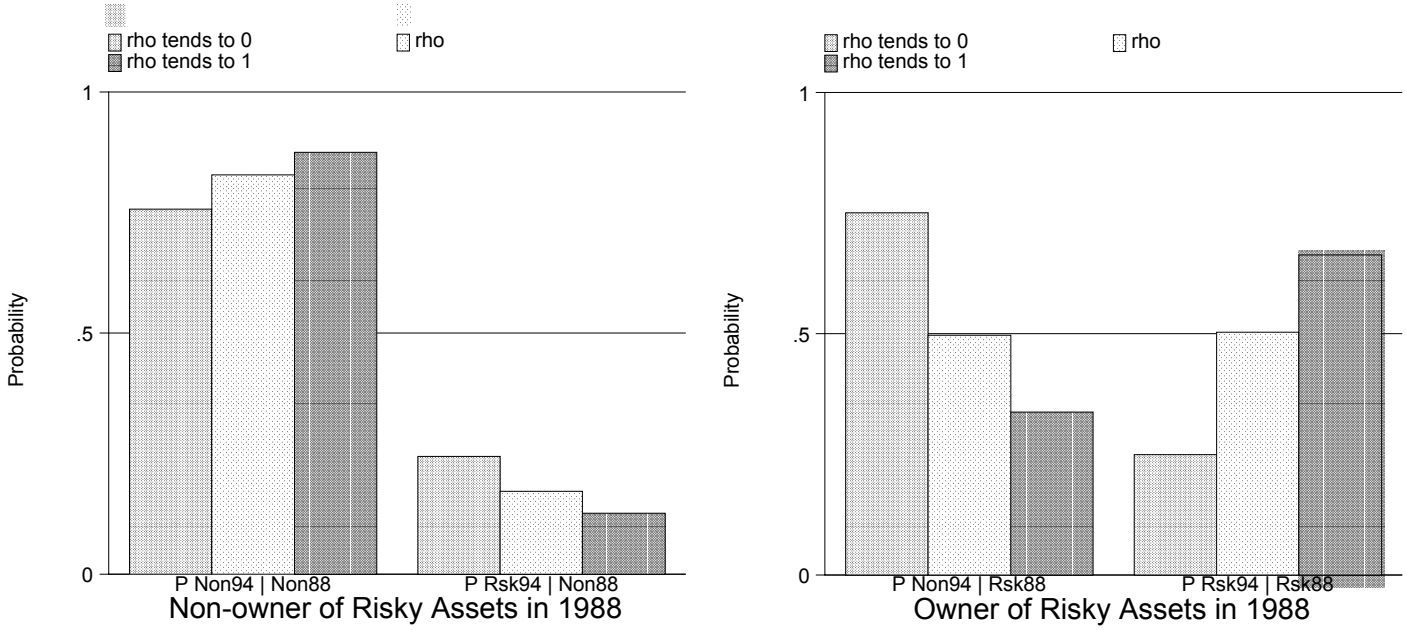
## Graph 5

**Effects from differences in Educational Level on Conditional Probabilities**
For individuals with median characteristics




## Graph 6

**Effects from differences in rho on Conditional Probabilities**
For individuals with median characteristics



# Appendix

**i)** Each individual is asked to assign the total amount of his financial wealth at one of the following nominal bands: £1-3,000, £3,000-6,000, £6,000-8,000, £8,000-10,000, £10,000-20,000, £20,000-30,000 and more than £30,000. The midpoints[27] from these bands in each of the two waves (midpoints from 1988 have been adjusted for inflation and expressed in 1994 constant prices) are aggregated at a benefit unit level producing two values (one per survey year) for each benefit unit that are re-assigned in one of these bands. The models that based on samples with "key respondents" do not require any inflation adjustment and we can simply consider a categorical variable representing midpoints or dummies representing the nominal bands. In the case of housing wealth, each benefit unit assigns the value of the house that owns in one of the nominal bands: £1-25,000, £25,000-50,000, £50,000-100,000, £100,000-150,000 and more than £150,000. In the cases where estimation involves "key respondents" we assume that housing wealth is equally shared between the two members of a couple (the midpoint of the housing wealth band is then divided by two and it is re-assigned in the appropriate band).

**ii)** Benefit units that gave an affirmative answer in the following question they are considered that they have inherited property.

"Has either of you ever inherited a house or flat, or any proceeds from the sale of house or flat, from your parents or anyone else?"

**iii)** The dummy variables that control for early/ late retirement apply only to retirees. Under the dummy "Has retired early" we have classified those retirees that they *chose*

[27] The lower bound of the highest band is considered.

to retire early and this was not due to health problems or because they made redundant/ dismissed (one of the following reasons was given: 4- was offered reasonable financial terms to retire early or take voluntary redundancy 5- to spend more time with partner/ family 6- to enjoy life while still young/ fit 7- fed up with job/ wanted a change 8- to retire at same time as husband/ wife 9- to give younger generation a chance). On the other hand the dummy "Has retired late" represents those that chose to retire later for economic reasons (1- to improve financial position).

**iv)** Note that information on the following subjective views is available only at a benefit unit level (thus these dummies are included only in the estimation of models that use observations on benefit units).

"Thinking of how you are managing on your money at the moment, would you say you are:

1- Managing very well 2- Managing quite well 3- just getting by 4- getting into difficulties"

For those giving the answers 1 or 2 our dummy "Satisfied with the management of financial holdings" takes the value one.

"The things people buy and do – their housing, furniture, food, leisure activities, etc – make up their standard of living. How satisfied do you feel with the standard of living at present?

1- Very Satisfied 2- Fairly Satisfied 3- Neither Satisfied, nor dissatisfied 4- Fairly dissatisfied 5- Very dissatisfied"

For those answering 4 or 5 our dummy "Dissatisfied with the standard of living" takes the value one.