Defined Benefit or Defined Contribution?
An Empirical Study of Pension Choices

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Abstract

We empirically study individual pension choice between two different defined benefit (DB) plans and a defined contribution (DC) plan. The DB plans differ in their contribution rates and in the way retirement benefits are calculated, as a proportion of final salary or as a proportion of lifetime earnings. We relate labor income characteristics to the choice of pension plan. Among other determinants of pension choice, we find that: (i) individuals who face higher income growth are more likely to choose DB final salary plans, and less likely to choose the DC plan; (ii) individuals who face higher earnings volatility are less likely to choose DB final salary plans; (iii) individuals with higher earnings are more likely to choose either the DC or the DB final salary plan. These results constitute evidence of self selection of individuals into different pension plans, an important issue for pension fund providers and for those involved in pension reform.

1 Introduction

Currently in many countries the government, through the social security system, provides a defined benefit (DB) state pension to retirees, which is linked to their lifetime earnings. However, in the last decade, politicians and the public alike became increasingly concerned about the sustainability of these (unfunded) pension systems. This was mainly the result of demographic trends: increases in longevity have led to an increase in pension fund liabilities, at the same time that decreases in birth rates have led to a decrease in contributions.[3]

Not surprisingly, governments have started looking into ways of resolving this underfunding. One possible route is to move towards a privatized system, in which fully-funded individual retirement accounts earn market based rates of return. Advocates of this move, correctly point out that in such a defined contribution (DC) pension system individuals are able to allocate their retirement wealth among financial assets in a way that suits their preferences (Feldstein and Ranguelova, 2001, Shiller, 2003).

On the other hand, advocates of DB pension systems argue that DC pensions lack the desirable intra-generational and inter-generational risk sharing features of DB systems. They argue that the return on the current system is low because of the overhang of unfunded liabilities, and not because of its defined benefit nature. Past generations have received a gift that must be paid off. What needs to be resolved is the problem of the underfunding, and not the nature of the system. In order to do so governments of many countries have either reduced the benefits of state pensions that retirees are entitled to receive, also through an increase in the retirement age, or are considering doing so.

Recent pension reforms have tried to address the underfunding of DB plans and also to provide incentives for individuals to save via DC plans so that, in several countries, including the United States and United Kingdom, both of these types of plans coexist, and often individuals may choose between the two. Our paper studies this choice, and the self selection that arises as a result.

[3]Bohn (2001) studies the risk sharing properties of social security systems in a model with demographic uncertainty.

More precisely, we study pension choice between two different DB pension plans and a DC plan. The DB plans differ in contribution rates and in the way retirement benefits are calculated, as a proportion of final salary or as a proportion of lifetime earnings. These correspond to the pension choices available to many UK individuals, covered by the Family Resources Survey (FRS).

We relate labor income characteristics including its growth rate, level and riskness to individual pension choices. We do so in two different ways. In the first we estimate the characteristics of the labor income process for individuals in different education/occupation groups. We then relate these characteristics to the proportion of individuals in each group who chose the DB lifetime salary, DB final salary and DC pension plan. In the second we use individual level data, rather than by education/occupation group, to explain individual pension choices.

Interestingly, we find evidence that individuals facing higher income growth are more likely to join DB final salary schemes. In these plans retirement benefits are a proportion of final salary, so that the higher is earnings growth over life the lower are contributions into the scheme, relative to retirement benefits. On the other hand, individuals facing lower income growth find it more attractive to contribute instead to the DC plan, if their income level is high, or the DB lifetime earnings plan, if their income level is low.

We also find evidence that individuals facing larger income risk are less likely to choose DB final salary pension plans. In these plans retirement benefits are a proportion of final salary, so that they increase individuals' exposure to their income risk. Instead, in the DB lifetime earnings plan, retirement benefits are based on lifetime earnings, revalued using average population earnings growth, which removes in part the risk associated with individual specific earnings growth. This explains why individuals who face higher income risk are more likely to choose this type of pensions.

Our empirical analysis also uncovers interesting evidence on the relation between individual assets and pension choices. We find that individuals with lower savings are more likely to choose the pension scheme that minimizes current contributions, which is also the scheme with the lowest retirement benefits. This is an important source of variation in the retirement

wealth of individuals.

Our results have important implications for those involved in pension reform, and those interested in the risk sharing features of alternative pension arrangements.[4] We find evidence that those individuals with lower income risk, higher income levels and higher assets are less likely to join the state pension scheme. Thus, those individuals who a priori are in a better position to provide insurance to those facing higher income risk are more likely to make alternative pension arrangements. These results lend support to the idea that it is important to incorporate agent heterogeneity in models of social security design, as in for example Conesa and Krueger (1999), and are suggestive of the nature of the heterogeneity that is important to account for.

Our results are also important for pension fund providers, since they must recognize the self selection of different individuals into different pension schemes, and adjust promised retirement benefits accordingly. For example, a pension fund provider which offers a DB final salary scheme must recognize that it is those individuals who face higher earnings growth who are more likely to join the scheme.

There is a vast literature on social security and pension choice, but one recent related paper which studies DC schemes and compares them to DB schemes is Samwick and Skinner (2004). Samwick and Skinner characterize the distribution of pension benefits for DB and DC schemes by simulating a broad range of earnings paths, portfolio composition, and portfolio returns for several different individuals. They find that in the United States, and by the end of last decade, 401(k) plans provided a distribution of expected retirement income that would be preferred by all but the more risk averse consumers. We also compare DB and DC schemes parameterized to UK data, but the focus and main contribution of our paper is to provide empirical evidence on the self selection of individual0.3(3B4(1)-n)t tf39-36.8(ann)-34D 4530.9(c409.0ng
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In section 3 we present a model of consumption and pension choice, and explain its predictions. Section 4 describes the data. Section 5 discusses our empirical results, and section 6 concludes.

2 The United Kingdom Pension System

The UK pension system is characterized by three tiers.[5] The first-tier, or the Basic State Pension (BSP), is provided by the state. All workers, but the very low paid, must contribute to the BSP. It entitles them to a flat rate retirement pension.

It is at the level of the second-tier that employees may choose between different pension schemes. These are provided by the state, employers, or private sector financial institutions. The second tier pension scheme provided by the state is denominated State-Earnings-Related Pension Scheme (SERPS).[6] All employees with earnings above a given threshold (the Primary Earnings Threshold, or PET) are automatically enrolled in the SERPS, unless they make other second-tier pension arrangements, in which case they may contract out from the SERPS. Contracting out implies that employees and employers do not have to make contributions to the SERPS, but employees will not receive any benefits from it either. Retirement benefits in the SERPS are equal to a proportion of the individual's lifetime revalued earnings. It is therefore DB in nature, with benefits based on lifetime earnings.

Contracting out from the state scheme is only possible for employees who contribute to either an occupational or a personal pension.[7] Occupational pensions are pension schemes provided by employers, and usually are of a DB nature, with retirement benefits equal to a proportion of final salary.[8] There is no legal requirement for employers to run an occupational

[5]For a more detailed description of the UK pension system than the one presented here see Blake (2003a).

[6]After April 2002 it is denominated State Second Pension (S2P), but the main features of the S2P are similar to those of the SERPS. The main difference is that the S2P provides poorer individuals with a larger pension than what was the case with the SERPS.

[7]Disney, Palacios and Whitehouse (1999) describe pension reforms in several Latin America and European countries in which individuals have a choice of switching from public to private pension schemes.

[8]We say usually because a small proportion of these schemes are DC. Blake (2003b) reports that in 1996 85% of occupational plans were DB and, according to the 24th Annual Survey of Occupational Pension Schemes (1998), the corresponding value in 1998 was 83%. Thus, in these years, the vast majority of occupational

scheme, but many employers in the UK do so. When offered an occupational pension by their employer, employees are not required to join the scheme, and may choose instead to contribute to the state pension.

A third alternative, is for employees to set up a personal pension, or a stakeholder fund at a financial institution. These personal pensions are of a DC nature. There is no legal requirement for employers to contribute towards the employee's personal pension, but they may choose to do so. It is important to note that second-tier pensions are not mandatory for the self-employed, and furthermore self-employed workers are not allowed to contribute towards the SERPS. The only alternative for these individuals, if they choose to do so, is to contribute towards a personal pension.

The third tier of the UK's pension system is voluntary, and it takes the form of additional voluntary contributions (AVCs and FSAVCs) into occupational or personal pensions, which translate in benefits upon retirement.

Table 1 summarizes the main features of each tier of the UK pension system, and of the different alternatives within the second tier. The BSP is a pay-as-you-go pension scheme in which contributions are earnings related, but retirement benefits are a flat rate for all entitled pensioners. The maximum BSP is roughly 20% of national average earnings, and it is fully indexed to retail price inflation. In order to be entitled to the maximum BSP the claimant must have qualifying years corresponding to roughly 90% of working life.[9]

Let us now focus on the features of the different pension schemes available at the second tier. In the state scheme, or the SERPS, the employees' contribution rate is 1.6% of banded earnings, i.e. earnings between the Primary Earnings Threshold (PET) and the Upper Earnings Limit (UEL). The SERPS retirement pension depends on the number of years the individual contributed to the scheme (replacement rate of 1/100 per year worked up to a maximum of 20%), and the average individual earnings between LEL and UEL in the years

schemes were DB in nature. Our data does not allow us to distinguish between occupational schemes which are DB and which are DC.

[9]The qualifying years are measured in terms of national insurance contributions while working and additional flat rate(ears)12.9(g)6inT1111T1rinins.

that he/she contributed. Upon retirement these earnings are revalued in line with average UK wide earnings growth to determine the SERPS pension, which from this age onwards is fully indexed to retail price inflation.

Similarly to the SERPS, occupational pensions usually are of a defined benefit nature. However, there are some important differences between the two, in addition to the former being provided by the state and the second by employers. Contributions towards occupational pensions are typically much higher, between four and six percent (nine percent) of earnings for employees (employers). Accordingly, retirement benefits in occupational schemes tend to be higher, with a typical replacement rate of 1/60 per year in the scheme, up to a maximum of 67% of final salary. The fact that retirement benefits of occupational schemes are a fraction of final salary, whereas in the SERPS they are a fraction of average earnings over the years in which the individual contributed, revalued using average earnings inflation, is an important difference between the two schemes that we analyze in this paper.

An important disadvantage of occupational pensions relative to the state scheme is their lower transfer value between different jobs. Although it is possible to transfer benefits accrued in one occupational scheme to another, it is costly to do so, i.e. there is a loss in terms of benefits that the individual is entitled to receive upon retirement.

Unlike occupational pensions, personal pensions have a good transfer value between jobs, since they are individual retirement accounts. In addition they allow individuals to allocate their retirement wealth among financial assets in a way that suits their individual preferences. At retirement, twenty five percent of the funds in personal pensions may be withdrawn as a lump sum amount, but the remainder seventy five percent have to be used to purchase an annuity. An important disadvantage of personal pensions is that they entail large administrative and set up costs. In terms of the tax treatment of contributions, there is income tax relief on employees' contributions to occupational and personal pensions, but not to the state pension.

The above description of the UK pension system, and the rates shown in table 1, are those in place in the year 2000. The reason why we focus on this year is that our data on pension choices is from 1999 to 2001. Although the system currently in place is similar to that

described in this section, there is a recent trend that is important to note. The recent stock market declines have led to deficits in many occupational pension plans, and some firms have decided to close DB final salary schemes to new members.

3 A Model of Pension Choice

Many UK individuals may choose between a DB pension with retirement benefits based on lifetime earnings, a DB final salary pension plan, and a DC pension. To help us think of pension choice among these alternatives, and how it relates to labor income characteristics and preference parameters, we solve a model of consumption and pension choices. We describe this model in detail in the appendix. In this section we discuss its main features and predictions.

The model is similar to those of Carroll (1997), Deaton (1991), Gourinchas and Parker (2002), but it is extended to include pension choice as in Bodie, Marcus and Merton (1988), Campbell, Cocco, Gomes and Maenhout (2000) and McCarthy (2003). We consider the problem of an individual, who plans to retire at age 65, and who faces a stochastic time of death. While alive, and in each period, the individual derives utility from the consumption of a single good, according to a time-separable power utility function. While working the individual's earnings are a deterministic function of age, and are subject to two shocks. A permanent shock that is assumed to follow a random walk, and an idiosyncratic income shock. Gross labor income above exemption level E is taxed at a progressive tax rate.

Individuals may invest in either a riskless asset (bills) or a risky asset (stocks). Stocks have a higher expected return, but also more volatility. We also assume that individuals cannot borrow against future labor income and that they cannot short-sell the financial assets.

Following the features of the second-tier of the UK pension system, individuals may choose between three pension arrangements: state, occupational and personal pensions. The state and occupational pensions are of a DB nature, but the contribution rate in the occupational pension is higher than in the state pension. In the state pension benefits are a fraction of average earnings over life, revalued using the average growth rate of earnings across the whole population. In the occupational pension, benefits are a fraction of the individual's salary at

retirement.[10]

The personal pension is of a DC nature. Individuals invest in stocks and bonds in their personal pension, and at retirement are required to convert its balance into an annuity. To reflect the large administrative and other costs associated with personal pensions, we assume that there is a fixed cost associated with them. Following the UK tax treatment of pension contributions, we allow income tax relief on contributions into personal and occupational pensions, but not into the state pension.

We model job mobility by assuming that with a given probability individuals move jobs. In case they do so, they must pay a penalty in the occupational scheme, but not in the state and personal pensions. This is to reflect the lower transfer value of occupational pensions.

We use U.K. data on income and mortality rates, in addition to the data in Table 1, to parameterize the model. Its main predictions are:

1. **State pensions are more (less) attractive for individuals facing lower (higher) than average earnings growth.**

   This is because the individuals' average earnings are revalued at retirement using a factor based on the average earnings growth of the whole population, including both individuals who face low and high earnings growth. Individuals facing lower (higher) than average earnings growth benefit (loose) from the revaluation being done based on an average rate.

2. **Occupational pensions are more attractive for individuals facing higher earnings growth.**

   This is because contributions are based on current earnings, but retirement benefits are a proportion of final salary. The higher is earnings growth the lower are contributions into the scheme relative to retirement benefits.

3. **Occupational and personal pensions are more attractive for individuals with**

[10] Gustman and Steinmeier (1983) provide a detailed analysis of pension benefit formulas.

higher earnings. Conversely, state pensions are more attractive for individuals with lower earnings.

Individuals receive income tax relief on contributions to occupational and personal pensions, but not into the state pension. Individuals with higher earnings benefit more from the income tax relief on pension contributions. In addition, due to the large set up and administrative costs of personal pensions, only individuals with large income and retirement wealth find it optimal to pay these costs.

4. **State pensions are more attractive for individuals with a lower discount factor and lower assets.**

   A lower discount factor implies that individuals care less about the future relative to the present, and are less willing to save. Because of the lower employee contribution rate in the state pension than in occupational and personal pensions, individuals who care less about the future find this alternative more attractive.[11]

5. **State and personal pensions are more attractive for individuals with higher job mobility or shorter job tenure. Conversely, occupational pensions are more attractive for individuals with longer job tenure.**

   This follows immediately from the lower transfer value of occupational pensions compared to that of state and personal pensions.

6. **Occupational pensions are less attractive for individuals with higher earnings**

In the next section we describe the data that we use to test these predictions of the model.

4 The Data

4.1 Data description

We use data from the UK Family Resources Survey (FRS), which is a continuous rotating survey of UK individuals. The survey was launched in October 1992 to meet the information requirements of the UK Department for Work and Pensions (DWP) analysts. Each year individuals are asked a wide range of questions about their individual circumstances including income, employment status, occupation, education, age and other demographic variables, and whether they contribute towards the state pension, an occupational pension, or a personal pension plan. The survey also contains information on whether individuals were offered an occupational pension plan by their employer.

We focus our analysis on the last three available years of the survey, which refer to the years 1999 through 2001. This is because information on personal pension plans was first introduced in the 2000 survey. We are interested in the pension choices of working age individuals so that we restrict the sample to individuals older than twenty years of age and younger than sixty-five years of age, which is the typical retirement age in the UK. Furthermore, we restrict the sample to those individuals who were full time employed workers at the time of the survey. This means dropping observations for unemployed individuals and those not working for any other reason, who are not actively contributing towards a pension plan. In addition, this means dropping observations for self employed workers. As we have discussed in section 2, self employed workers are not required to contribute to a second tier pension, and cannot contribute towards the SERPS even if they would like to do so. Because the survey does not allow us to distinguish between part-time self-employed and part-time employed workers, we chose to drop the latter from the sample as well.

This leaves us with a sample of 46,559 individuals, roughly evenly split over the three years of the sample. In our analysis of pension choice we pool the observations from the different

years and perform a cross-sectional analysis, but are careful to include year fixed-effects in the regressions. Of these individuals roughly three quarters were offered an occupational pension by their employers. Because the set of available pensions is different for individuals who were and who were not offered an occupational pension, for most of our analysis we split the sample between the two groups and examine the determinants of their pension choices separately. However, we also recognize that whether an individual is offered an occupational plan by his/her employer is likely to be endogenous, so that later on we pool all observations to examine what explains whether individuals are offered an occupational plan.

Table 2 reports the pension choices of full time employed workers in our data. Of those who were offered an occupational pension by their employer, roughly one quarter decided not to join it. Instead they chose to either contribute to the state scheme (19%) or to a personal pension (5%). There is also a small proportion of individuals (3%) who decided to join their employer's occupational scheme, and in addition contribute to a personal pension. Among those individuals who were not offered an occupational pension, the vast majority (roughly three quarters) decided to contribute to the state pension, with the remainder opting instead to set up a personal pension.

The FRS is meant to be representative of the pension choices of the UK population. To examine the extent to which this is the case we compare the pension choices for the individuals in the survey to those obtained from aggregate data. Using 1999 and 2000 data from a variety of sources, Blake (2003a) reports that roughly 32 percent of the UK population contributed to the SERPS, 45 percent to an occupational pension, and the remaining 23 percent to a personal pension. This data is for all individuals who were employed by someone else, thus excluding self employed, whether or not they were offered an occupational pension. In the FRS data shown in Table 2, 33 percent of the individuals contributed to the state scheme, 55 percent to an occupational pension, and the remaining 12 percent to a personal pension.[12] Thus, the main difference relative to Blake's numbers is that we have a lower proportion of individuals who contribute to a personal pension. One possible explanation for this discrepancy is that

[12]In these calculations we include the individuals who have both an occupational and personal pension under personal pension.

in our data we exclude the part-time employed, which are included in Blake's calculations.[13]

4.2 Summary statistics

Table 3 reports summary statistics (mean and median) for our variables of interest, by whether individuals were offered an occupational pension and their actual pension choices. The unit of measurement for labor income is weekly income in British Pounds, so that a weekly income of 350 pounds corresponds to an annual income of 18,200 pounds. Savings is a rank variable for the value of financial assets (excluding home equity), which takes the value of one if they are less than 1,500 pounds, two if they are above 1,500 and below 3,000, 3 above 3,000 and up to 8,000, 4 for asset values between 8,000 and 20,000, and 5 for values above 20,000 pounds.

From Table 3 we see that both among those individuals who were and who were not offered an occupational pension, the ones who chose to contribute to the state pension are those with lower income and savings. The median value for the financial assets of these individuals is less than 1,500 pounds. Perhaps not surprisingly, the individuals with higher labor income and financial assets are those who chose to contribute to both the occupational pension that they were offered and a personal pension. The patterns for the homeowner and stockholder dummies (one if homeowner or stockholder, zero otherwise), are similar to those for the savings variable.

The income and asset variables of those individuals who were offered an occupational pension and decided to join the scheme are very similar to those who were offered an occupational pension but decided instead to contribute towards a personal pension. The variable that is most different for these two groups of individuals is job tenure, which measures the number of years the individual has been in the present job. It is much longer for individuals who chose the occupational pension (median value of 10 years), than for individuals who chose the personal pension (median value equal to 5 years). This suggests that individuals who are more likely to move jobs choose a personal pension, most likely as a result of the lower transfer value of occupational plans.

[13] We do so because our data does not allow us to distinguish them from the part time self-employed.

Table 3 also reports summary statistics for education and other demographic variables. The education variable is the age at which the individual completed full-time education. Among those individuals who chose the state pension, there is a larger fraction who are not

We drop from the sample all individuals who reported negative income (fifteen observations), and estimate labor income profiles for each education/occupation group by regressing the logarithm of individual income ($linc_{it}$) for individuals that belong to that group on age dummies (age_{it}), and controlling for demographics (whether the individual is married, household composition, ethnicity (non-white), sex), and year dummies ($y2000$ and $y2001$):

$$linc_{it} = \beta_0 + \sum_{j=21}^{65} \beta_j age_{it} + \beta_Z Z_{it} + \beta_{y2000} y2000_{it} + \beta_{y2001} y2001_{it} + \epsilon_{it} \quad (1)$$

where β_j with $j = 20, ..., 65$ are the estimated coefficients on the age dummies, Z_{it} is a vector of the demographic variables mentioned above, and ϵ_{it} is the residual. We estimate equation (1) twenty-seven times, i.e., once for each education/occupation group, and then fit a third order polynomial to the estimated age dummies.

Figure 1 plots the estimated labor income profiles for six of the education/occupation groups in our sample. Focusing first on differences across education groups, we see that the labor income profile of better educated managers and senior officials is steeper and is on average higher than that of less educated ones, which is consistent with the labor income profiles estimated using US data for example by Carroll and Samwick (1997). Figure 1 also plots the labor income profiles for other education/occupation groups, to illustrate the fact that across groups there is significant variation in terms of both the level and the growth rate of income.

If we let y_{ij} denote the predicted log income for education/occupation group i and age $j = 20, ..., 65$, we compute for each group i the average growth rate and income level as:

$$\overline{\Delta y_{ij}} = \sum_{j=21}^{65} \frac{y_{ij} - y_{i,j-1}}{45}, i = 1, ..., 27 \quad (2)$$

operatives; and (ix) elementary occupations. We define three education groups according to the age at which the individual completed full-time education. The education groups that we consider are: (i) age sixteen or younger; (ii) older than sixteen and younger than nineteen years of age; (iii) older than nineteen years of age. These three groups should correspond roughly to individuals who: (i) have dropped out of school after doing the GCSE exams (approximately 50% of the observations); (ii) did A levels but did not go into higher education (approximately 25% of the observations); (iii) attended university (the remainder 25%).

$$\overline{y_{ij}} = \sum_{j=20}^{65} \frac{y_{ij}}{46}, i = 1, ..., 27. \quad (3)$$

Table 4 shows the average growth rate and level of income for each group, together with a measure of income risk. The latter is simply equal to the standard deviation of the residual in estimated equation (1). In addition to these income characteristics, we also compute a measure of job mobility for each education/occupation group. In the FRS survey individuals are asked the number of years in the present job. As a measure of job tenure we simply compute the average number of years in the present job across all individuals in each education/occupation group.

We are interested in relating these earnings characteristics to pension choices. To do so we obtain for each group the proportion of individuals who chose each of the pension alternatives available. We compute these proportions for individuals who were and who were not offered an occupational pension. They are shown in table 4. We then estimate the following equation:

$$p_i^j = \alpha_0^j + \alpha_1^j \overline{y_{it}} + \alpha_2^j \overline{\Delta y_{it}} + \alpha_3^j \sigma_{y_i} + \alpha_4^j Tenure_i + \mu_i^j \quad (4)$$

where p_i^j is the proportion of individuals belonging to group i who chose pension scheme j, for i=1,...,27. We estimate a seemingly unrelated regressions (SUR) model for $j = state$, $occupational$, $personal$ for those individuals who were offered an occupational pension. Table 5 shows the estimation results for two different specifications, which differ on whether we include job tenure as an additional independent variable.

Let us consider first the choices of individuals who were offered an occupational pension. Interestingly, we find that the proportion of individuals in a given education/occupation group who choose to contribute to the occupational pension is higher when income growth is also higher. In other words, individuals are more likely to contribute to an occupational pension when the labor income profile of their education/occupation group is steeper. This makes sense: occupational plans are of a defined benefit nature, with contributions equal to a proportion of current earnings, and retirement benefits equal to a proportion of final salary. The larger is income growth over the life-cycle, the larger are retirement benefits relative to

contributions.

On the other hand, the proportion of individuals who choose not to contribute to the occupational plan, and to contribute instead to the state pension is higher the lower is income growth, or in other words, the flatter is the labor income profile. Retirement benefits in the state scheme are a proportion of lifetime revalued earnings. The revaluation factor is based on the average earnings growth of the whole population, including individuals in education/occupation groups with high earnings growth. Therefore individuals in education/occupation groups with lower income growth will benefit less from an occupational plan with a replacement rate based on final salary, and more from a state scheme where the revaluation of their earnings is done on an average basis.

The effects of income growth on the proportion of individuals who choose a personal pension instead of the occupational pension is also negative. Thus individuals who face a flatter labor income profile are more likely to choose either a state or a personal pension. The difference between the individuals that choose a state and personal pension is in the income level. Those with a lower (higher) income are more likely to choose the state (personal) pension. Individuals with a higher income benefit more from the income tax relief on contributions to personal pensions.

It is important that pension providers recognize the self selection of individuals into the different pension schemes based on their individual characteristics, and adjust promised retirement benefits accordingly. A pension fund provider which offers a DB final salary scheme must recognize that it is those individuals with higher earnings growth who are more likely to join the scheme.

Interestingly, the effects of labor income risk on the choice of state and occupational pensions are also those predicted by the model. From table 5 we see that the larger is labor income risk the more likely are individuals to choose the state pension and the less likely they are to choose the occupational pension. In the state pension retirement benefits are based on average earnings over life, revalued using average population earnings growth, which removes in part the risk associated with individual specific earnings growth. Retirement benefits of occupational pensions are a fraction of final salary which increases individuals' exposure to

the risk in their earnings growth. Thus, we find evidence that those individuals with lower income risk and higher income levels are less likely to join the state pension plan. Those individuals who a priori may be a better position to provide insurance to those facing higher income risk are more likely to make alternative pension arrangements.[15]

It is important to note that the evidence in support of the effects of labor income risk described in the previous paragraph is not robust to the inclusion of job tenure as an additional explanatory variable. Recall that our measure of job tenure is the average number of years in the current job for individuals in each education/occupation group. From table 5 we see that the fraction of individuals choosing an occupational (state) pension is higher in occupations in which job tenure is on average longer (shorter). The poor transfer value of occupational pensions makes individuals who change jobs more frequently less willing to contribute towards these. Gustman and Steinmeier (2000) and Disney and Emmerson (2002) also present evidence of the relation between pension portability and labor mobility for the US and UK, respectively.

The last two columns of table 5 show the results for the individuals who were not offered an occupational pension. We regress the proportion of individuals in each education/occupation group who chose a personal pension on labor income characteristics. We find that those individuals who face low income growth and level, high income risk, and shorter job tenure are more (less) likely to prefer the state (personal) pension.

5.2 Individual pension choice

In this section we estimate the determinants of pension choice using individual level data. More precisely, we ask how individual income, assets and demographic characteristics affect the choice of pension plan. Throughout the analysis we include fixed effects for the twenty-seven education/occupation groups that were the focus of the analysis in the previous subsection. We pool the data from the three surveys and estimate cross-sectional regressions, but we include fixed effects for the year of the survey. The equation that we estimate is:

[15] But see Smetters and Walliser (2002) for a model in which allowing individuals to opt out of social security generates a truthful revelation equilibrium in which agents reveal private information about their skill levels. This information can be used to reduce liabilities.

$$P_i = \gamma_0 + \gamma_1 Inc_i + \gamma_2 Savings_i + \gamma_3 Homeowner_i + \gamma_4 Stock_i + \gamma_5 Tenure_i + \gamma_6 Z_i + Dummies_i + \epsilon_i \quad (5)$$

where the subscript i refers to individual i, P_i is individual i's pension choice, and Z_i is a vector of individual demographics which includes age and age squared, dummy variables for marital status, female, ethnicity, and household size.

Some of the independent variables included in equation (5) (income and job tenure) are apparently similar to those included in equation (4). But there is an important difference between the two: in equation (4) we asked how the average level of income and job tenure of a given education/occupation group affects the pension choices of that group. In equation (5) these education/occupation group effects are captured by the fixed effects. Instead, in this equation we ask how the individual specific component of income and job tenure affect the individual's choice of pension scheme.

We estimate equation (5) for those individuals who were offered an occupational pension using a multinomial logit regression. The comparison group is the individuals who joined the occupational scheme, and chose not to contribute to a personal pension. The results are shown in Table 6. In specification (b), in addition to education/occupation and year fixed effects, we also include industry and region of residence dummies. The results are similar across specifications. Robust T-statistics are shown in parenthesis below the estimated coefficients.

Individuals with lower income are more likely to contribute to the state pension. Those with higher income are more likely to contribute to both the occupational and personal pensions, perhaps as a way to take advantage of income tax relief on contributions. The income of individuals who decide to opt out of the occupational scheme and contribute instead to a personal pension is not statistically different from that of individuals who choose to contribute only to the occupational pension.

The most significant variable in explaining why individuals decide to contribute to a personal instead of an occupational pension is job tenure. Individuals with a shorter job tenure are more likely to contribute to a personal pension. In fact the estimated coefficients for the job tenure variable are negative throughout, which means that individuals in occupational

plans have the longest job tenure.

Savings and homeownership status are also important in explaining pension choices. Individuals with lower assets and lower income are also those who tend to choose the state pension, which has lower retirement benefits than the other schemes. This is consistent with the results of Dynan, Skinner, and Zeldes (2004) for the US, and it is an important source of variation in the retirement wealth of UK households.

This may be explained by heterogeneity in discount factors. Individuals with a lower discount factor are less willing to save, and are more likely to choose the pension plan that minimizes current contributions, which is the state plan. The fact that the estimated coefficients on savings and homeownership are highest for individuals who choose to contribute to both an occupational and personal pension is consistent with these individuals having higher discount factors.

Although our results are consistent with heterogeneity in discount factors, there is considerable debate in the literature as to whether this is the main source of variation in saving rates. Dynan, Skinner, and Zeldes (2004), using a variety of data sources which include consumption data, do not find support for theories relying on time preference rates, but provide evidence that is consistent with models in which precautionary savings and bequest motives drive variations in saving rates across income groups. On the other hand, Bernheim, Skinner, and Weinberg (2001) find support for "rule of thumb" theories of saving and wealth accumulation.[16]

Still with respect to the relation between savings and pension choice, it is important to note that the results in Table 6 are simply correlations. One important question is whether and how the different pension schemes and the retirement benefits associated with them affect individuals' saving rates. In a recent interesting paper Attanasio and Rohwedder (2003) use three pension reforms as a natural experiment to find that the earnings-related tier of the pension scheme has a negative impact on private savings with elasticities approaching minus

[16] Although see Huggett and Ventura (2000) for a model that is able to explain why high income households save as a group a much higher fraction of income than do low income households, based on relatively permanent earnings differences across households and the structure of the US social security system.

one.

Perhaps surprisingly, we do not find evidence that individuals who choose not to contribute to an occupational pension and who decide to contribute instead to a personal pension are more likely to be stockholders. In fact, the reverse is true in specification (b). We say surprisingly because one of the arguments used in favor of personal pensions is that they allow individuals to diversify their assets by increasing their exposure to stocks. As far as the demographic variables are concerned, we find that individuals who are not married, non-white, and belonging to larger households are more likely to contribute to the state pension. We also find that females are less likely to contribute to a personal pension, which is the opposite to what Huberman, Iyengar and Jiang (2004) find using US data.

Table 7 shows the results for individuals who were not offered an occupational pension. The dependent variable takes the value of one is the individual chose to set up a personal pension, and zero otherwise. Unsurprisingly, those individuals with higher income and savings are more likely to contribute to a personal pension. In fact, the determinants of the choice between state and personal pensions are similar to the determinants between the same choices for those individuals who were offered an occupational scheme.

5.3 Offered versus not offered an occupational pension

In the previous sections we split the sample between those individuals who were and who were not offered an occupational pension by their employer, and studied the pension choices of these two groups separately. However, the employer's decision of whether or not to run an occupational pension scheme is likely to correlated with how much employees value such a scheme. Figure 2 shows the proportion of individuals who were offered an occupational pension by their employer by occupation. The fact that there is variation in this proportion across occupations suggests that this may be the case.

To investigate this issue, and for the complete sample of full-time employed workers, we have created a dummy variable that takes the value of one if the individual was offered an occupational pension, and zero otherwise. In the second column of Table 8 we use labor income

characteristics by education/occupation group to explain the proportion of individuals who were offered an occupational pension for each education/occupation group. We find evidence that those individuals with higher income growth, higher income level, and lower income risk are more likely to be offered an occupational pension. These are precisely the earnings characteristics which make occupational pensions more desirable.

In the last two columns of table 8 we use individual characteristics to explain whether individuals were offered an occupational pension. Individuals with higher income, savings, and longer job tenure are more likely to be offered an occupational pension. Again, the individuals who were offered an occupational pension are the ones that are likely to value it more. Thus, perhaps not surprisingly, it seems that in their decision of whether or not to run an occupational pension scheme employers take into account whether employees are likely to value this scheme.

5.4 Age effects

It was only in the last three available years of the Family Resources Survey that information on personal pensions was included. For this reason we have restricted our analysis to these years. With three consecutive years of data it is not possible to disentangle age effects from cohort effects. In the regressions we have controlled for age (or cohort) effects using a second order polynomial of age. We now investigate these effects further.

Figure 3 shows the proportion of full time employed individuals who were offered an occupational pension by age. The curve is hump-shaped over the life-cycle, but with relatively little age variation, particularly after the age of 30. In Figure 4 (figure 5) we plot the proportion of individuals who chose a given pension scheme, among those who were (were not) offered an occupational plan. Most of the age variation in pension choices takes place before the age of 30 and after the age of 60.[17]

It is interesting to ask whether our model can generate the type of age patterns shown in

[17] We have checked the robustness of our previous results by eliminating from the sample individuals younger than 30 and older than 60 and estimating the regressions again. The results were similar.

figures 4 and 5, with very young individuals choosing to stay within the state scheme, but later

We have provided evidence that individuals who face higher earnings growth over their life-cycle are more likely to contribute to DB final salary plans, and less likely to contribute to DC plans. The higher is earnings growth the lower are contributions into DB final salary schemes, relative to retirement benefits. In addition, we have found that individuals who face higher income risk are less likely to contribute to DB final salary plans. This type of plans increase individuals' exposure to the risk in their earnings growth. Instead, they are more likely to contribute to the DB state plan, which being means-tested, removes in part the risk associated with individual specific earnings growth.

We have found that those individuals with lower savings are more likely to contribute to the DB state pension scheme, which has lower contribution rates, but also lower retirement benefits. This points to pension coverage as an important additional source of variation in retirement wealth across the population. Finally, we have related job mobility and demographic variables including age, marital status, sex, and household size to pension choices. Individuals with shorter job tenures are more likely to contribute to the DB state plan or to DC plans instead of occupational plans. This is due to the lower portability of the latter.

Overall, our results provide evidence of self selection of individuals into different pension funds, an important issue for pension fund providers. For example, a provider of a DB final salary plan must recognize that it is those individuals who face higher earnings growth over their life-cycle who are most likely to join such a plan, and adjust promised retirement benefits accordingly. Our results are also important for those involved in pension reform, and for those interested in the risk sharing features of alternative pension arrangements. We have found that those individuals with higher income, assets, and lower income risk are more likely to opt out of the DB state plan, and to make private pension arrangements. This restricts the risk sharing that occurs within the state plan to a particular subset of the population.[18]

Due to a lack of detailed information on pension fund providers, our analysis has focused on the determinants of the demand for pensions. In particular, we have not explored the fact that occupational pensions are provided by employers, whereas the state pension is provided by

[18]Risk sharing may still take place among the whole population through the tax code, if for example governments increase labor income tax rates in response to a deficit in the social security fund.

the state. It may be reasonable to assume that the likelihood of default on pension liabilities is higher for private employers than for the UK government. In addition, among private employers there may be substantial variation in the amount of overfunding or, more likely, underfunding of occupational schemes. The occurrence of default in occupational plans is likely to be correlated with the value of the individuals' human capital which increases the risk of DB final salary schemes relative to pensions provided by the state and to DC schemes.

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8 Appendix: A Model of Pension Choice

8.1 Setup

We set up a life-cycle model of consumption and pension choice to investigate the relation between pension choice, earnings characteristics, and preference parameters. We let t denote adult age. The individual is adult for a maximum of T periods, of which he works the first K. For simplicity K is assumed to be exogenous and deterministic. We allow for uncertainty in T in the manner of Hubbard, Skinner and Zeldes (1995). Let p_t denote the probability that the individual is alive at date $t+1$, conditional on being alive at date t. The individual i's preferences are described by the time-separable power utility function:

$$E_1 \left[\sum_{t=1}^{T} \delta^{t-1} \left(\prod_{j=0}^{t-1} p_j \right) \frac{C_{it}^{1-\gamma}}{1-\gamma} \right], \tag{5}$$

where C_{it} is the level of date t consumption, γ is the coefficient of relative risk aversion, and δ is the discount factor. To simplify we assume that the individual derives no utility from leaving a bequest.

Also to simplify, and following Deaton (1991) and Carroll (1997), we take the labor income process to be exogenous.[19] Before retirement, individual i's age t gross real labor income, Y_{it}, is given by:

$$\log(Y_{it}) = f(t, Z_{it}) + v_{it} + \varepsilon_{it} \quad \text{for} \quad t \leq K \ , \tag{6}$$

where $f(t, Z_{it})$ is a deterministic function of age and other individual characteristics Z_{it}. There are two shocks to labor income: v_{it} is an permanent shock that is assumed to follow a random walk, and ε_{it} is a purely idiosyncratic income shock. Gross labor income above exemption level E is taxed at rate τ_1 below the Upper Earnings Limit, and at rate τ_2 above this level.

[19] Of course, in reality, through their education and occupation choices individuals choose the characteristics of their earnings. These characteristics are also likely to be correlated with preferences parameters. For example: a myopic individual is less likely to invest in education and more likely to face a flat labor income profile. In addition this individual is likely to accumulate less assets over the life-cycle.

We assume that individuals may invest in either a riskless asset, which we call bills, and a risky asset which we call stocks. Bills have a constant gross real return of $\overline{R}_f$, and the excess return on stocks, $(R_{s,t+1} - R_f)$, is assumed to follow a normal distribution with mean μ and standard deviation σ_{R_S}. We assume that individuals cannot borrow against future labor income and that they cannot short-sell the financial assets.

Following the features of the UK pension system we assume that there are two mandatory pension tiers. The first is the Basic State Pension (BSP). While working individuals must pay a contribution equal to a fraction C_{BSP} of their earnings between the primary earnings threshold (PET) and the Upper Earnings limit (UEL). At retirement the BSP provides an annual real pension of P_{BSP}.

At the second tier individuals may choose between three different pension arrangements, namely state, occupational and personal pension. The state and occupational pensions are defined benefit, but differ in contribution rates, replacement rates, and tax treatment. More precisely, we let C_{State} and C_{Occ} denote the employee contribution rates to the state and occupational pension plans. Following the numbers in table 1 we will set $C_{State} < C_{Occ}$. For the state pension retirement benefits are a fraction of the individual's average revalued earnings, whereas for the occupational pension they are a fraction of the individual's earnings at retirement age. In the state pension the revaluation of earnings is done using the average growth rate of earnings across the whole population.

To model the lower transfer value of occupational pensions we assume that with probability π the individual will move jobs, in which case there is a reduction of π_{cost} in the fraction of final salary that the individual is entitled to receive.

The personal pension is defined contribution. We let C_{Pers} denote the employee's contribution rate into the personal pension plan. Asset returns in the personal pension are tax exempt. We assume funds in the retirement account are held fifty percent in stocks and fifty percent in bonds. At retirement individuals are required to convert its balance into an annuity. The annuity cost is such that individuals receive a real annuity of a_{pers} per 10,000 pounds of purchase price. To reflect the large administrative and other costs associated with personal pensions, we assume that there is a fixed cost of F of setting it up. Following the UK tax

treatment of pension contributions, we allow income tax relief at the individual's marginal tax rate on contributions into occupational and personal plans, but not into the state plan.

8.2 Calibration

We use data for the UK from several sources to parameterize the model. The survival probabilities are taken from the UK mortality tables for male individuals. We assume that all individuals die by age 100 (if not before), and that retirement age K is 65. This is the typical retirement age. The contribution rates for the different pension schemes, as well as retirement benefits, are set equal to the UK values, and are shown in Table A1. The annual annuity payment a_{pers} for annuities with 10,000 pounds purchase price is taken from Finkesltein and Poterba (2002) and equal to 658 pounds. This is the value for the real annuities compulsory market for male individuals aged sixty five. The exemption level E is taken from the UK tax code, and the tax rates τ_1 and τ_2 are set equal to 0.2 and 0.4. The latter is the UK highest income tax rate.

We will consider several different labor income profiles and variance of shocks to study the relation between these and pension choice. The average growth rate of real earnings used to

8.3 Solution Technique

This problem cannot be solved analytically. The numerical techniques that we use for solving it are standard. Given the finite nature of the problem a solution exists and can be obtained by backward induction. We discretize the state space and the choice variables using equally spaced grids. The density functions for the random variables were approximated using Gaussian quadrature methods to perform numerical integration (Tauchen and Hussey 1991). The grid points for these processes were chosen using Gaussian quadrature. In period T the utility function coincides with the value function. In every period t prior to T, and for each admissible combination of the state variables, we compute the value associated with each combination of the choice variables. This value is equal to current utility plus the expected discounted continuation value. To compute this continuation value for points which do not lie on the grid we use cubic spline interpolation. The combinations of the choice variables ruled out by the constraints of the problem are given a very large (negative) utility such that they are never optimal. We optimize over the different choices using grid search.

To save on state variables we do several approximations. In the occupational plan (DB final salary scheme) we set retirement income equal to a fraction of final salary permanent income. This prevents temporary labor income shocks at retirement age from being an additional state variable. In addition, this approximation probably is more realistic in that it prevents retirement income from being dependent on temporary shocks just before retirement. In practice, this is achieved in many DB final salary schemes by setting retirement income equal to a fraction of average salary over the last few years (typically three to five years) before retirement. In the state plan, and in order to avoid having revalued earnings as an additional state variable, we calculate retirement benefits in the following way. We first calculate the individual's average growth rate of earnings as the geometric mean of the growth rate of his permanent income between ages 20 and 65. Let g_i denote this growth rate. Then revalued earnings of individual i at age 65 are given by:

$$Rev.earnings_{i,65} = \sum_{t=0}^{45} Y_{i,20}(1+g_i)^t(1+g)^{45-t}$$

where $Y_{i,20}$ is age 20 income, and g is the average growth rate of earnings of the whole population. The first two terms in the sum approximate the individual's age $(t + 20)$ labor income which is then revalued at rate g. With this approximation the state variables of the problem are age, cash-on-hand and income. The state variables for the occupational plan are the same when the cost of moving is zero, but there is one additional state variable which is the number of times the individual moved jobs when the cost is strictly positive. For the personal pension the state variables are age, cash-on-hand, income, and retirement wealth (or annuity value during retirement). The choice variables are, in each period, and for a given pension scheme, consumption and portfolio allocation. We solve the problem for each pension plan separately and then compare individual wetirepl8(s)258.5(a)-6.4(t3236.5(t)-.5(he)-326.3(itndi).4.3

The second limitation is that our model is one of the demand for pensions. We have not explored the fact that occupational pensions are provided by employers, whereas the state pension is provided by the state. It may be reasonable to assume that the likelihood of default on pension liabilities is higher for private employers than for the UK government. Recently, the UK government has set up a pension protection fund to which employers must contribute and which pays retirement benefits in case of insolvency of occupational plans (see McCarthy and Neuberger, 2004).

Figure 1: Estimated labor income profiles

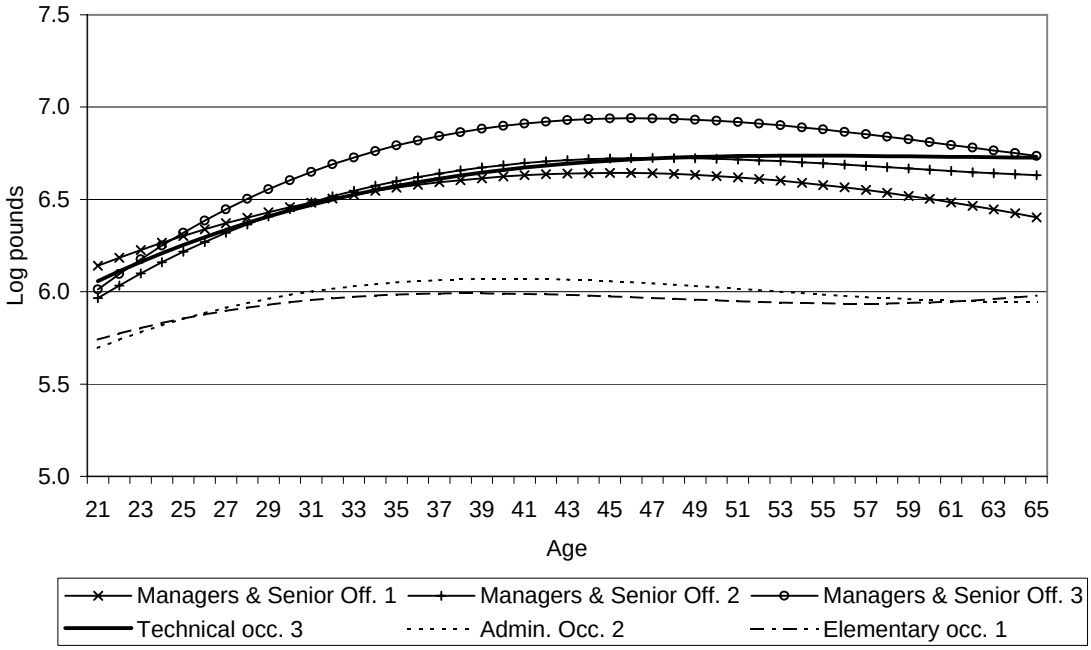

Figure 1: This figure plots the estimated labor income profiles for several occupation/education groups. The data are from the UK Family Resources Survery for the years 1999 through 2001 with the sample restricted to individuals between the ages of 20 and 65 that were full time employed. The labor income profiles for each occupation/education group were obtained by regressing log income on age dummies, controlling for sex, household composition, ethnicity and year fixed effects. The figure plots a fitted third order polynomial to the estimated age dummies.

Figure 2: Whether employer runs occupational pension scheme by occupation

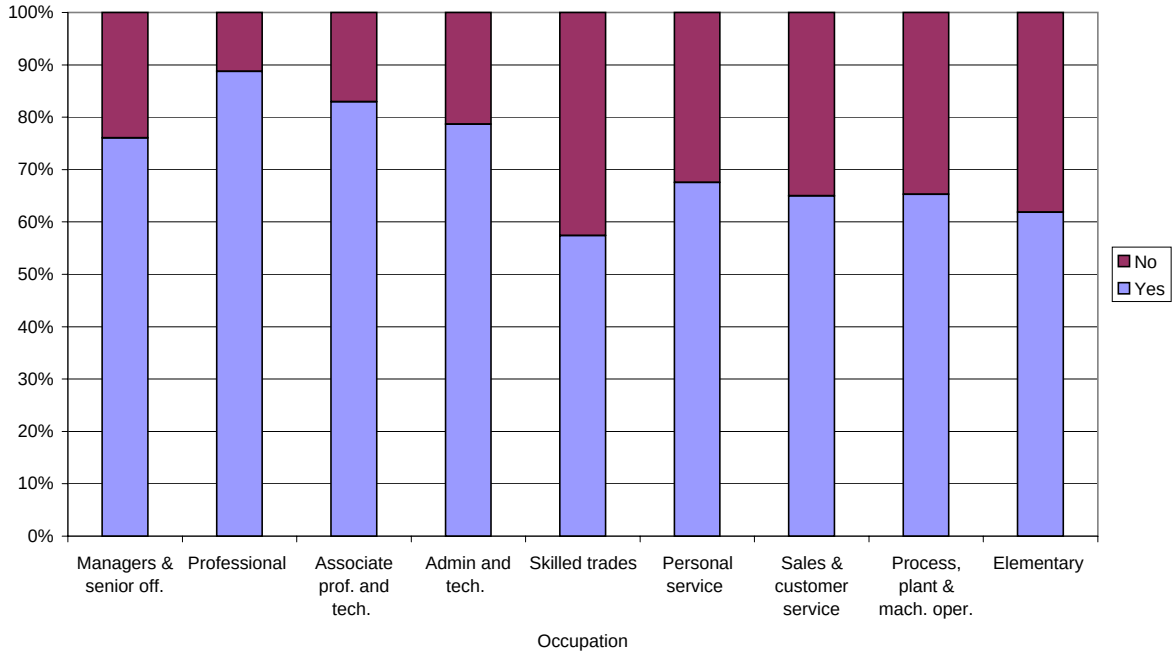

Figure 2: This figure plots the proportion of individuals who were offered (not offered) an occupational pension scheme by their employer by occupation. The data are from the UK Family Resources Survery for the years 1999 through 2001 with the sample restricted to individuals between the ages of 20 and 65 that were full time employed.

Figure 3: Proportion offered occupational pension by age

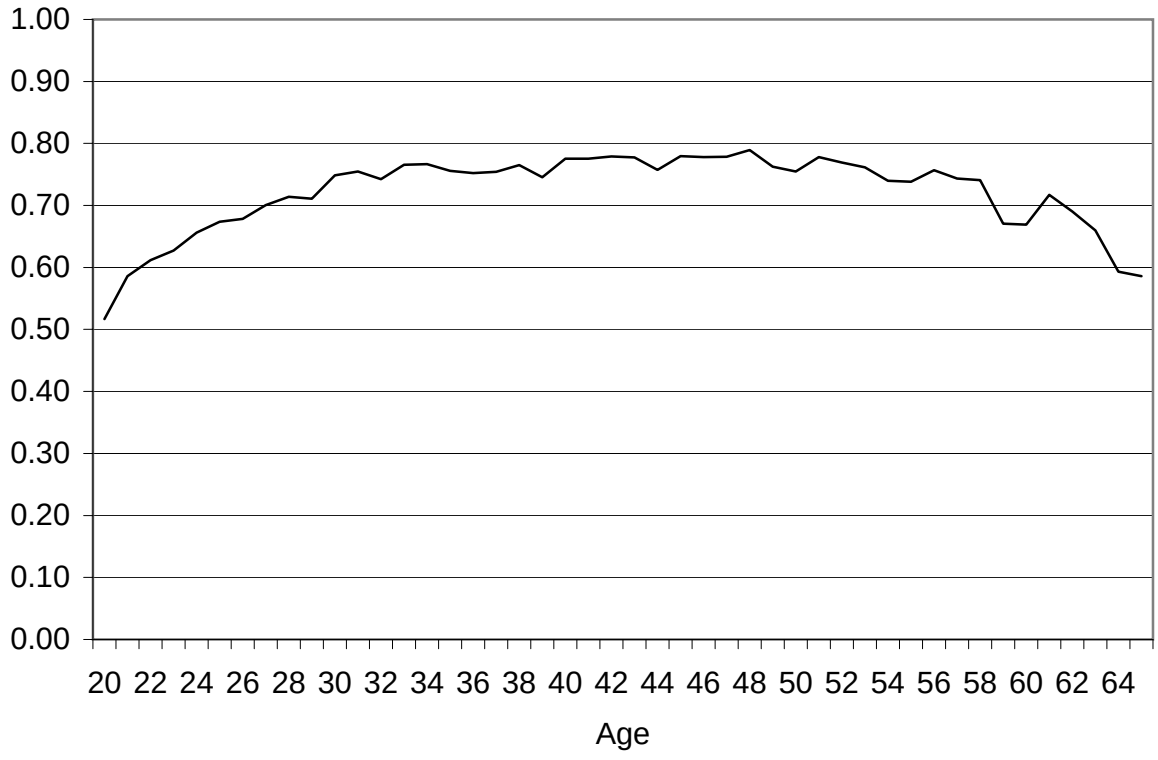

Figure 3: This figure plots the proportion of individuals who were offered an occupational pension scheme by their employer by age. The data are from the UK Family Resources Survery for the years 1999 through 2001 with the sample restricted to individuals between the ages of 20 and 65 that were full time employed.

Figure 4: Pension choice by age for full time employed individuals who were offered an occupational pension

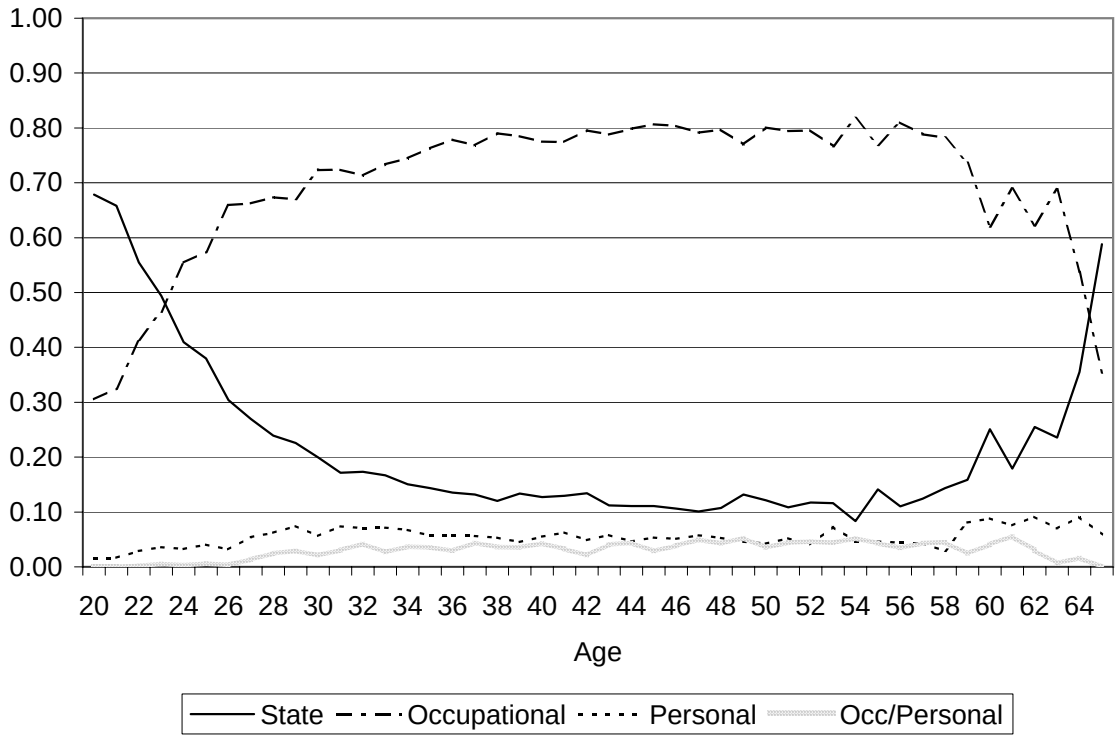

Figure 4: This figure plots the proportion of individuals who chose each pension plan among those who were offered an occupational pension scheme by their employer by age. The data are from the UK Family Resources Survey for the years 1999 through 2001 with the sample restricted to individuals between the ages of 20 and 65 who were full time employed.

Figure 5: Pension choice by age for full time employed individuals not offered an occupational pension

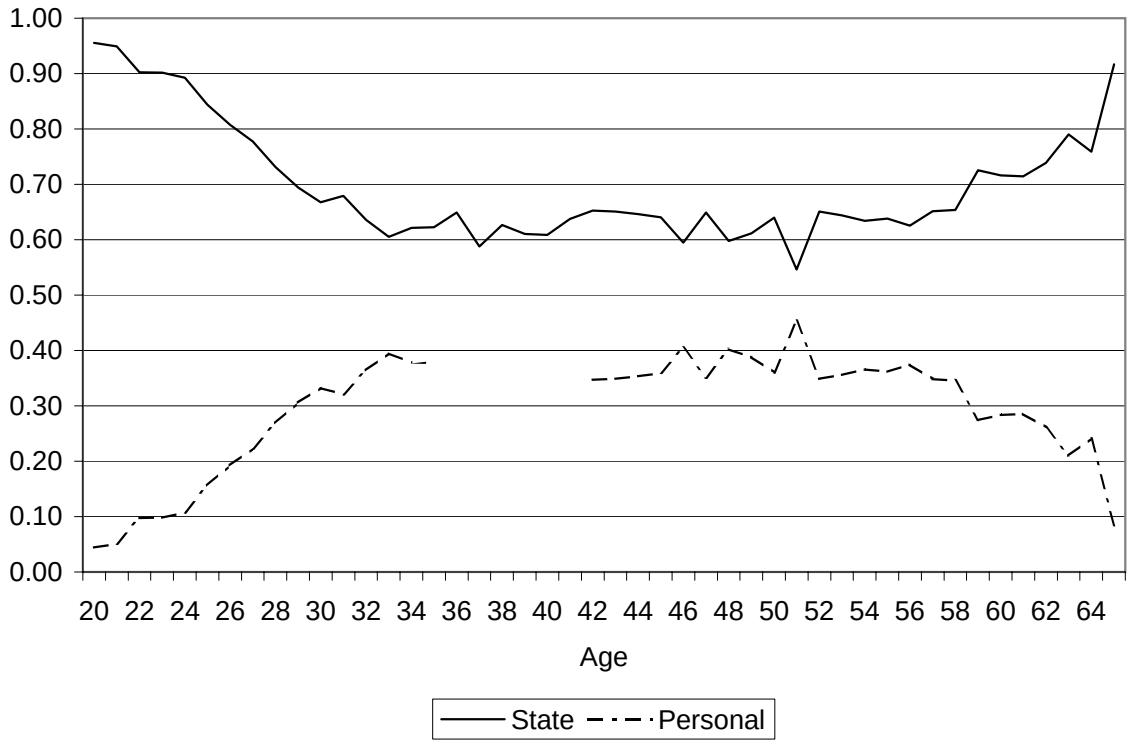

Figure 5: This figure plots the proportion of individuals who chose each pension plan among those who were not offered an occupational pension scheme by their employer by age. The data are from the UK Family Resources Survey for the years 1999 through 2001 with the sample restricted to individuals between the ages of 20 and 65 who were full time employed.

Table 1: The United Kingdom Pension System

		Contribution rate		Inc. tax relief	Replacement	Indexation	Transfer
		Employer	Employee	on contrib.	rate	at retirement	value
First tier (mandatory)	Basic State Pension (BSP)	9.2% of earnings above SET	8.4% of earnings between PET and UEL	No	Max 20% of national average earnings (flat rate)	Fully RPI indexed	Good
	State earnings related pension scheme (SERPS)	3.0%	1.6%	No	Max 20% of individual's revalued earnings	Fully RPI indexed	Good
Second tier (mandatory, except for self-employed)	Occupational (defined benefit and contracted out)	9.75%	4 to 6%	Yes	Max 67% of final salary (typically 1/60 for each year in the scheme)	Limited RPI indexed (max 5%)	Poor
	Personal pension (defined contribution and contracted out)	Typically 3%	Min 5.1% (typical 10%)	Yes	Depends on size of the fund	Depends on annuity purchased	Good
Third tier (voluntary)	Additional voluntary contributions into occ. (AVCs) and pers. (FAVCs) pensions	Typically 0%	No min. required	Depends	Depends on pension plan	Depends	Depends

Note to Table 1: This table describes the different alternatives within the UK pension system.

Table 2: Pension choices of full time employed workers.

Pension	Offered occ.		Not off. occ.	
scheme	Number	Proportion	Number	Proportion
State	6427	0.19	8790	0.73
Occupational	25582	0.74	na	na
Personal	1584	0.05	3171	0.27
Occ./Pers.	1005	0.03	na	na
Total	34598	1.00	11961	1.00

Note to Table 2: This table reports the pension choices of individuals who were offered and who were not offered an occupational pension. The choices for those who were offered an occupational pension are not accepting it and joining instead the Sate Earnings Pension Related Scheme (State), stay within the occupational pension that were offered (occupational), choose instead to set up a personal pension (personal), and stay within the occupational pension but in addition set up a personal pension (occ./personal). For those individuals who were not offered an occupational pension, the table shows the proportion of individuals who stayed within the SERPS only (state) and the proportion who chose to set up a personal pension. The data are from the UK Family Resources Survery for the years 1999 through 2001 with the sample restricted to individuals between the ages of 20 and 65 who were full time employed.

Table 3: Summary statistics (mean and median below) according to pension choice.

Independent		Offered Occupational			Not off. occ.	
variable	State	Occ.	Personal	Occ./Pers.	State	Personal
Labor Income	349.1	503.4	501.2	655.5	319.9	461.0
	293	424	376	495	270	368
Savings	2.00	2.87	2.79	3.38	1.80	2.64
	1	3	3	4	1	2
Homeowner	0.69	0.88	0.88	0.92	0.68	0.87
	1	1	1	1	1	1
Stockholder	0.12	0.28	0.26	0.36	0.10	0.24
	0	0	0	0	0	0
Age	35.6	40.9	40.5	43.3	37.3	40.9
	33	41	39	43	36	40
Job tenure	4.66	11.90	7.62	11.68	5.03	8.24
	3	10	5	10	3	6
Education	17.42	17.89	17.31	18.08	16.97	17.14
	16	17	16	17	16	16
Married	0.56	0.73	0.74	0.76	0.62	0.75
	1	1	1	1	1	1
Female	0.43	0.39	0.32	0.31	0.39	0.26
	0	0	0	0	0	0
Non-white	0.07	0.05	0.05	0.04	0.08	0.03
	0	0	0	0	0	0
Household size	2.82	2.80	2.81	2.74	2.93	2.84
	3	3	3	2	3	3

Note to Table 3: This table reports summary statistics for several variables according to the pension choices of individuals. The table reports both the mean and median. The data are from the UK Family Resources Survery for the years 1999 through 2001 with the sample restricted to individuals between the ages of 20 and 65 who were full time employed. The variables considered are weekly individual income (in pounds), dummy variables that take the value of one for homeowners and stocksholders, age, job tenure which is number of years in the present job, and demograhic variables (dummies that take the value of one for married individuals, female, non-white, and household size). Savings is a rank variable for the value of financial assets (excludes home equity) and it takes the value of 1 if they are less than 1,500 pounds, 2 if above 1,500 and up to 3,000, 3 from 3,000 up to 8,000, 4 from 8,000 up to 20,000, and 5 for values over 20,000.

Table 4: Data on labor income characteristics and pension choice.

		Labor Income Characteristics			Pension choice for full time employed workers					
					Offered occupational				Not offered occupational	
Occupation	Educ.	Growth	Level	Risk	State	Occupational	Personal	Occ./Pers.	State	Personal
Managers & senior off.	1	0.006	6.512	0.247	0.135	0.748	0.073	0.044	0.551	0.449
Managers & senior off.	2	0.015	6.568	0.254	0.122	0.775	0.064	0.039	0.547	0.453
Managers & senior off.	3	0.016	6.736	0.352	0.110	0.791	0.055	0.043	0.517	0.483
Professional occ.	1	0.013	6.299	0.176	0.101	0.825	0.043	0.032	0.571	0.429
Professional occ.	2	0.016	6.473	0.216	0.103	0.809	0.042	0.046	0.574	0.426
Professional occ.	3	0.022	6.556	0.200	0.076	0.845	0.031	0.048	0.567	0.433
Associate prof. & tech. occ.	1	0.015	6.269	0.169	0.120	0.804	0.042	0.033	0.656	0.344
Associate prof. & tech. occ.	2	0.009	6.321	0.197	0.131	0.797	0.039	0.034	0.611	0.389
Associate prof. & tech. occ.	3	0.015	6.589	0.222	0.185	0.742	0.040	0.032	0.672	0.328
Admin & technical occ.	1	0.010	5.901	0.118	0.211	0.723	0.048	0.019	0.738	0.262
Admin & technical occ.	2	0.006	5.981	0.113	0.221	0.715	0.042	0.021	0.736	0.264
Admin & technical occ.	3	0.004	5.986	0.166	0.331	0.640	0.022	0.007	0.831	0.169
Skilled trades occ.	1	0.007	6.310	0.143	0.198	0.686	0.083	0.033	0.641	0.359
Skilled trades occ.	2	0.000	6.287	0.147	0.220	0.678	0.073	0.029	0.701	0.299
Skilled trades occ.	3	0.003	6.234	0.248	0.226	0.606	0.124	0.044	0.742	0.258
Personal service occ.	1	0.006	6.062	0.166	0.206	0.743	0.027	0.024	0.830	0.170
Personal service occ.	2	0.001	6.162	0.178	0.254	0.682	0.048	0.016	0.813	0.187
Personal service occ.	3	0.007	5.950	0.291	0.275	0.685	0.022	0.017	0.859	0.141
Sales & customer service	1	0.004	6.136	0.183	0.321	0.560	0.086	0.033	0.785	0.215
Sales & customer service	2	0.004	6.255	0.208	0.386	0.519	0.072	0.023	0.814	0.186
Sales & customer service	3	0.008	6.114	0.244	0.432	0.486	0.041	0.041	0.772	0.228
Process, plant & mach. oper.	1	0.008	6.027	0.145	0.245	0.651	0.077	0.027	0.769	0.231
Process, plant & mach. oper.	2	0.010	6.097	0.135	0.302	0.613	0.067	0.019	0.772	0.228
Process, plant & mach. oper.	3	-0.001	6.109	0.138	0.304	0.595	0.089	0.013	0.694	0.306
Elementary occ.	1	0.005	5.940	0.153	0.288	0.618	0.063	0.030	0.803	0.197
Elementary occ.	2	0.012	5.777	0.172	0.346	0.617	0.031	0.007	0.871	0.129
Elementary occ.	3	-0.005	5.959	0.164	0.462	0.487	0.051	0.000	0.918	0.082

Note to Table 4: This table reports the labor income characteristics of individuals in different occupation/education groups, including the average level of log income, the average growth rate of income and the standard deviation of income. The data are from the UK Family Resources Survery for the years 1999 through 2001 with the sample restricted to individuals between the ages of 20 and 65 that were full time employed. The labor income profiles for each occupation/education group were obtained by regressing log income on age dummies, controlling for sex, household composition, ethnicity and year fixed effects. The table also shows the proportion of individuals in each education/occupation group who chose each pension arrangement.

Table 5: Regression results for labor income characteristics and pension choice.

	Offered occupational						Not Off. Occ.	
	Specification (a)			Specification (b)			(a)	(b)
	State	Occupational	Personal	State	Occupational	Personal	Personal	Personal
Income level	-0.256	0.173	0.051	-0.179	0.110	0.044	0.390	0.339
	(-3.86)	(2.48)	(2.41)	(-3.39)	(1.74)	(1.98)	(7.83)	(6.82)
Income growth	-7.574	9.452	-2.371	-4.598	7.005	-2.673	4.639	2.651
	(-3.33)	(3.94)	(-3.24)	(-2.49)	(3.17)	(-3.48)	(2.30)	(1.74)
Income risk	0.512	-0.474	-0.057	0.064	-0.105	-0.012	-0.449	-0.149
	(1.94)	(-1.70)	(-0.67)	(0.29)	(-0.39)	(-0.12)	(-3.13)	(-0.74)
Job tenure				-0.018	0.015	0.002		0.012
				(-4.49)	(3.08)	(1.09)		(2.72)
N	27	27	27	27	27	27	27	27
R^2	0.647	0.591	0.304	0.798	0.697	0.334	0.797	0.854

Note to Table 5: This table shows the regression results of the proportion of individuals in each education/occupation group that chose a given pension arrangement on labor income characteristics of the education/occupation group. The labor income characteristics considered were the average level of log income, the average growth rate of income, the standard deviation of income, and average job tenure. The data is from the UK Family Resources Survery for the years 1999 through 2001 with the sample restricted to individuals between the ages of 20 and 65 that were full time employed. The labor income profiles for each occupation/education group were obtained by regressing log income on age dummies, controlling for sex, household composition, ethnicity and year fixed effects. The table shows the results for the proportion of individuals who were offered an occupational pension plan and chose instead to join the state scheme (state), the proportion of those that stayed within the occupational pension that were offered (occupational), those that chose instead to set up a personal pension (personal). The estimation was done using a SUR model. The last two columns show the results for the proportion of individuals who were not offered an occupational pension and chose to set up a personal pension (personal). Robust t-statistics are shown below the estimated coefficients.

Table 6: Multinomial logit regressions for the pension choice of individuals who were offered an occupational pension (individuals who chose occupational pension are the comparison group).

Independent	Specification (a)			Specification (b)		
variable	State	Personal	Pers/Occ	State	Personal	Pers/Occ
Labor Income	-0.001	0.000	0.0001	-0.001	0.000	0.0001
	(-3.19)	(1.37)	(1.77)	(-2.77)	(0.87)	(1.69)
Savings	-0.089	0.044	0.166	-0.085	0.041	0.170
	(-5.82)	(2.29)	(6.78)	(-5.36)	(2.02)	(6.79)
Homeowner	-0.545	0.161	0.280	-0.543	0.143	0.406
	(-13.63)	(2.02)	(2.32)	(-12.72)	(1.73)	(3.12)
Stockholder	-0.318	-0.074	0.017	-0.398	-0.140	0.002
	(-6.54)	(-1.16)	(0.24)	(-7.94)	(-2.11)	(0.03)
Age	-0.250	0.009	0.192	-0.239	0.036	0.199
	(-19.72)	(0.47)	(6.99)	(-17.79)	(1.82)	(7.09)
Age squared	0.003	0.000	-0.002	0.003	-0.000	-0.002
	(20.24)	(0.14)	(-6.15)	(18.48)	(-1.01)	(6.31)
Job tenure	-0.153	-0.082	-0.022	-0.148	-0.078	-0.022
	(-33.04)	(-19.93)	(-6.15)	(-31.23)	(-18.33)	(-5.86)
Married	-0.296	0.018	0.041	-0.310	-0.001	0.031
	(-8.09)	(0.28)	(0.46)	(-8.16)	(-0.02)	(0.35)
Female	0.035	-0.181	-0.272	0.124	-0.061	-0.281
	(0.81)	(-3.03)	(-3.72)	(2.73)	(-0.96)	(-3.67)
Non-white	0.184	0.062	-0.003	0.223	0.062	0.039
	(2.67)	(0.52)	(-0.02)	(2.97)	(0.48)	(0.24)
Household size	0.073	-0.028	-0.092	0.073	-0.028	-0.092
	(5.10)	(-1.18)	(-2.86)	(4.94)	(-1.16)	(-2.83)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Edu/Occ dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	No	No	No	Yes	Yes	Yes
Region dummies	No	No	No	Yes	Yes	Yes
Number obs.	32679			31420		
Pseudo R^2	0.160			0.178		

Note to Table 6: This table shows the regression results of multinomial logit regressions of pension choice on individual variables for the full time employed individuals who were offered an occupational pension. There are four pension alternatives: (i) state includes those who rejected the occupational pension and chose instead the state pension; (ii) occupational includes those

who joined the occupational pension that they were offered; (iii) personal includes those who chose instead to set up a personal pension instead of the occupational pension; and (iv) pers/occ includes those who chose to set up a personal pension but remained within the occupational pension. The data are from the UK Family Resources Survery for the years 1999 through 2001 with the sample restricted to individuals between the ages of 20 and 65 who were full time employed, and who were offered an occupational pension. The independent variables are individual income, financial savings (excluding home equity), dummy variables that take the value of one for homeowners and stocksholders, age, age squared, job tenure which is number of years in present occupation, and demograhic variables (dummies that take the value of one for married individuals, female, non-white, and household size). Pension group (ii) is the comparison group. Specifications (a) and (b) differ in the set of dummies included. Robust t-statistics are reported below the estimated coefficients.

Table 7: Logit regressions of whether individuals who were not offered occupational pension chose to set up a personal pension.

Independent variable	Specification (a)	Specification (b)
Labor Income	0.001	0.001
	(4.29)	(3.79)
Savings	0.215	0.221
	(11.76)	(11.67)
Homeowner	0.746	0.769
	(12.41)	(12.06)
Stockholder	0.212	0.180
	(3.13)	(2.58)
Age	0.272	0.283
	(16.92)	(16.88)
Age squared	-0.003	-0.003
	(-17.10)	(-17.04)
Job tenure	0.056	0.056
	(15.47)	(14.61)
Married	0.209	0.213
	(3.81)	(3.71)
Female	-0.551	-0.508
	(-9.58)	(-8.24)
Non-white	-0.697	-0.606
	(-6.21)	(-5.00)
Household size	-0.137	-0.132
	(-6.65)	(-6.16)
Year dummies	Yes	Yes
Edu/Occ dummies	Yes	Yes
Industry dummies	No	Yes
Region dummies	No	Yes
Number obs.	11450	10794
Pseudo R^2	0.165	0.174

Note to Table 7: This table shows the regression results for logit regressions of pension choice on individual variables for the full time employed individuals who were not offered an occupational pension. The dependent variable is a dummy variable that takes the value of one if the individual chose to contribute to a personal pension. The data are from the UK Family Resources Survery for the years 1999 through 2001 with the sample restricted to individuals between the ages of 20 and 65 who were full time employed and who were not

offered an occupational pension. The independent variables are individual income, financial savings (excluding home equity), dummy variables that take the value of one for homeowners and stocksholders, age, age squared, job tenure which is number of years in present occupation, and demograhic variables (dummies that take the value of one for married individuals, female, non-white, and household size). Specifications (a) and (b) differ in the set of dummies included. Robust t-statistics are reported below the estimated coefficients.

Table 8: Regressions of whether individuals were offered an occupational pension.

Independent variables	Education/Occupation (a)	Individual (b)	(c)
Income level	0.137		
	(1.78)		
Income growth	11.382		
	(4.61)		
Income risk	-0.477		
	(-1.74)		
Job tenure	-0.002		
	(-0.44)		
Labor Income		0.0007	0.001
		(7.38)	(8.24)
Savings		0.033	0.036
		(3.38)	(3.52)
Homeowner		0.308	0.284
		(10.58)	(8.97)
Stockholder		0.267	0.324
		(7.84)	(9.02)
Age		0.085	0.064
		(10.72)	(7.60)
Age squared		-0.001	-0.001
		(-12.44)	(-9.68)
Job tenure		0.077	0.071
		(36.52)	(33.10)
Married		0.021	0.020
		(0.77)	(0.69)
Female		0.054	-0.039
		(1.95)	(-1.26)
Non-white		-0.238	-0.190
		(-4.91)	(-3.50)
Household size		-0.064	-0.069
		(-6.29)	(-6.37)
Year dummies		Yes	Yes
Edu/Occ dummies		Yes	Yes
Industry dummies		No	Yes
Region dummies		No	Yes
Number obs.	27	44136	42221
Pseudo R^2	0.606	0.115	0.165

Note to Table 8: This table shows the regression results of whether individuals were offered an occupational pension. In specification (a) the dependent variable is the proportion of individuals who were offered an occupational pension by education/occupation group. The independent variables are the average level of log income, the average growth rate of income, the standard deviation of income, and job tenure. The data is from the UK Family Resources Survery for the years 1999 through 2001 with the sample restricted to individuals between the ages of 20 and 65 who were full time employed. The labor income profiles for each occupation/education group were obtained by regressing log income on age dummies, controlling for sex, household composition, ethnicity and year fixed effects. In specifications (b) and (c) the dependent variable is a dummy variable which takes the value of one if the individual was offered an occupational pension. The independent variables are individual income, financial savings (excluding home equity), dummy variables that take the value of one for homeowners and stocksholders, age, job tenure which is number of years in present occupation, and demograhic variables (dummies that take the value of one for married individuals, female, non-white, and household size). Robust t-statistics are reported below the estimated coefficients.

Table A1: Calibration of the model

Description	Parameter	Value
Contribution rates		
Basic State Pension	C_{BSP}	0.084
State	C_{State}	0.016
Occupational	C_{Occ}	0.05
Personal	C_{Pers}	0.05
Fixed cost of personal	F	1,000
Replacement rates		
Basic State Pension	P_{BSP}	4,000
State	P_{State}	0.2 $\times$ rev. earn.
Occupational	P_{Occ}	0.67 $\times$ final salary
Personal: annuity per 10,000	a_{Pers}	658
Taxation		
Tax rates	τ_1, τ_2	0.2, 0.4
Exemption level	E	4,500
Primary earnings threshold	PET	4,500
Upper earnings limit	UEL	30,000
Asset returns		
Riskfree rate	$R_{\mathsf{f}} - 1$	0.02
Mean excess stock return	μ	0.04
Stdev stock return	σ_{Rs}	0.16
Preference parameters		
Discount factor	δ	0.98
Risk aversion	γ	5

Note to Table A1: This table reports the parameters that we use in the baseline case of the model.

Table A2: Welfare Gain (Percent) of DB Final Salary and DC Pension Plans Relative to DB Lifetime Salary Pension Plan (State)

	DB Final Salary	DC
Benchmark	1.08	0.23
Higher Income	1.35	1.10
Higher Income Risk	0.20	0.18
Lower Discount Factor	-2.19	-2.64
Lower Risk Aversion	1.18	0.42
Higher Prob. of Job Move	-0.17	0.23
Increasing Income Profile	1.51	0.38

Note to Table A2: This table reports the wefare gain of DB Final Salary and DC plans relative to the DB lifetime salary plan (state) for different parameters. We simulate the model for each pension plan for one thousand individuals and, for each individual, we compute the constant consumption stream that makes the individual as well off in expected utility terms. We then measure the percentage change in this consumption stream across pension arrangements which we report in this table. The parameters in the benchmark case are equal to those in table A1, plus a flat labor income profile equal to fifteen thousand pounds, standard deviation of temporary and permanent labor income shocks equal to 0.10 and 0.5 respectively, a zero probability of moving jobs, a discount factor of 0.98, and a coefficient of relative risk aversion equal to 5. In the remaining cases we do comparative statics by changing only one parameter relative to the benchmark case. In the higher income scenario, the labor income profile is flat, but at a higher level of 20k. In the higher income risk scenario we set the standard deviation of permanent income shocks equal to 0.075 (but hold the income profile at 15k). In the lower discount factor scenario we set this parameter equal to 0.9. In the lower risk aversion case we set γ equal to two. The higher probability of a job move is equal to 0.10 annually. Finally, in the increasing income profile case all parameters are equal to the benchmark case, except that labor income increases by a rate of two percent per year from a level of 15k at the initial age.