Exploring the experimental economics approach in pensions

John D. Hey

A report of research carried out by EXEC, the Centre for Experimental Economics at the University of York on behalf of the Department for Work and Pensions
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The Author

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Glossary

Annuity
Purchased with an individual pension pot built up in a money purchase arrangement to provide a pension that is usually payable for life.

Consumption smoothing
This is the idea that, if income is not constant through time, individuals will seek to avoid abrupt changes in their standard of living and consequently will try and smooth consumption through time in some way – usually by borrowing or saving. For example, where income is unusually high people will realise that this is not permanent and so save correspondingly; where income is lower people may still consume at a higher level by drawing on savings.

Discounting
This refers to the idea that people consider consumption in different periods differently. More precisely, a given consumption received at some point in the future is usually considered less important to the individual than the same consumption received earlier. Therefore, the idea that people discount future consumption relative to present consumption means that they convert an amount of money at a date in the future into an equivalent value at the present date.

Life-cycle theory
This refers to a theory in economics in which people make consumption decisions on the basis of considering their whole life (so-called the life-cycle) and look at their long-run income when deciding how much to consume.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myopia</td>
<td>This refers to the idea that individuals tend to consider (or consider too little) the implications of their present behaviour for their future utility/happiness. In the context of pensions, myopia arises because individuals do not recognise the need to make adequate provision for retirement when they are young, but regret this when they are old, by which time it is too late to do anything about it.</td>
</tr>
<tr>
<td>Risk-aversion</td>
<td>An individual is said to be risk-averse if they are willing to pay money to avoid or minimise risk. The more that the individual is willing to pay, the more risk-averse they are. In the context of pensions, a risk-averse individual saving in a pension will prefer a lower but more certain investment return rather than a higher but less certain return.</td>
</tr>
<tr>
<td>Risk-neutral</td>
<td>An individual is said to be risk-neutral if they are completely indifferent to risk. In the context of pensions, a risk-neutral individual is insensitive to the risk involved in an investment and is only concerned about expected return.</td>
</tr>
<tr>
<td>Treatments</td>
<td>Treatments are essential to the design of economics experiments to compare the behaviour of participants between each treatment. They refer to a particular set of fixed conditions created for an experiment and applied to the participants. The difference from one treatment to another comes down to changing a single variable. For example, an experiment could have two treatments, with treatment A being where participants have no information and treatment B being where participants are provided with some information.</td>
</tr>
<tr>
<td>Utility</td>
<td>In economics, utility is a measure of the relative satisfaction or desiredness from consuming a good or service.</td>
</tr>
</tbody>
</table>
Summary

This is a report on an original research study, using the methodology of experimental economics, and represents the first use of this technique for the Department for Work and Pensions (DWP). Its purpose was twofold: to assess the potential of the experimental approach in assisting the DWP with questions relating to its research and policy agenda; and to explore the applicability of the experimental approach in understanding the possible impact of proposed policy measures within the field of pensions, in particular, the possible impact of proposed pension reforms (like the introduction of auto-enrolment and an employer contribution into a qualifying workplace pension scheme).

The methodology of experimental economics involves the replication, in either a laboratory situation or in the field, of a well-defined economics problem, with participants involved in tackling the economic problem with appropriate incentives. A crucial element of the methodology is control over the conditions of the experiment, so that particular factors of interest can be investigated without confounding effects of extraneous factors.

Whilst the methodology of experimental economics is well-developed in other contexts, its applicability in the field of pensions is relatively under-explored. Therefore, one of the prime interests of this study is how the methods might be adapted to the field of pensions. A major difficulty was the translation of the ‘pension problem’ (how to appropriately smooth consumption over the life course) into a form suitable for examination using experiments. Typically, an economics experiment involves an abstraction of the real life problem into a form replicable in an experimental setting. It also involves an appropriate payment mechanism that replicates, in some sense, the real life incentive of the participants. In the field of pensions, the real life incentive is that of maximising life-time utility\(^1\) or happiness.

This first experiment examined the possible implications of various possible policy measures designed to influence pension saving behaviour. The typical methodology of experimental economics is to run several ‘treatments’\(^2\) of the experiment, one

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\(^1\) See the Glossary for an explanation.

\(^2\) See the Glossary for an explanation.
without the proposed policy measure and one with. The analysis then proceeds by comparing the behaviour of the participants in the two treatments. Clearly one of these two treatments should therefore be the status quo – namely, the situation prior to the introduction of the proposed policy measure.

This is where difficulties with the experimental approach appear – since the status quo, particularly of the target population for these proposed policy reforms – is one of relatively little involvement with pension decisions. To reproduce this situation in an experimental setting is not an easy task. It was clear that the ‘pre-policy measure’ treatment of the experiment would not be an accurate reproduction of the status quo for all participants. A further difficulty is that in experiments, information about the process relevant to the decision task is usually supplied to the participants. There is a clear conflict here – particularly for the target population, for instance in real life individuals may not necessarily request information relevant to making pension decisions due to inertia.

The actual experiment was carried out in the laboratory and lasted a little under three hours. Participants were presented with a version of the ‘pension problem’\(^3\) and were asked to take decisions concerning their contributions to pensions.

An important and relevant innovation of this project was the use of a quota sample of participants from the general UK population on moderate to low incomes (defined as people in work earning between £5,000 and £33,500 a year, aged over 22) who are the target of the Government’s proposed reforms. The design phase included some work on how to present the problem to participants in a user-friendly way. However, it is not clear that all these problems were overcome, though, in a sense this may not be a bad thing – it reproduces the difficulties that the population have in understanding the nature of their real life pension problem.

Three different treatments of the experiment were run – with roughly one-third of the total of 174 participants in each treatment (Treatments 1, 2 and 3). Comparing behaviour in Treatments 1 and 2 was designed to assess the potential impact of introducing a new savings vehicle, into which participants were auto-enrolled with an additional contribution from the experimenter. A comparison of Treatments 2 and 3 helps us to understand the possible impact of the introduction of a risk-free fund on fund allocation decisions. The participants in the experiment were recruited by Ecotec.

In all treatments, allocations to pensions were higher than in the real life status quo of the target population. This is almost certainly the consequence of a feature of the experiment which is not present in real life – the regular prompting for pension decisions over a relatively short timescale. The experiment also showed that there were strong gender effects and these varied from treatment to treatment. In Treatment 1 females allocated considerably more to pensions than males while the reverse was true in Treatments 2 and 3. These gender effects were

\(^3\) Deciding on the level of pension contributions to make in order to appropriately smooth their consumption over the lifetime.
observable with the help of demographic information that we collected from the participants. This information also helped us to identify a strong effect of risk attitude on behaviour – with the more risk-averse participants clearly choosing the least risky pension funds.

The experiment brought up the complexity of the pension problem: First, it was learned that the experimental setting is crucial, and that careful thought needs to be given to this aspect if further experimental work is to be carried out. Using a three-hour laboratory setting is clearly not a perfect way to understand real life pension allocation behaviour and could not replicate the extent to which inertia influences behaviour in the real world, or the impact of auto-enrolment.

Second, the experiment suggested that even in an environment with a limited amount of on-screen decision triggers (relative to the real world), participants can still find it difficult to make some saving decisions. Finally, the experimental economics approach showed that participants tried to maximise their earnings, suggesting that the experimental economics may be most effective in areas where individuals respond to monetary incentives. Participants appeared to have understood the essential objective of the decision task in which they were engaged and tackled it with varying degrees of success.

Compared to the status quo reference point (of almost zero pension allocations), participants performed well, even though they did not quite achieve the allocations that would be implied if they wished to maximise their expected earnings from the experiment (see Section 6.2). In comparing treatments, we saw that individual pension allocations were somewhat lower in Treatment 2 than in Treatment 1 (although overall pension allocations were higher given the presence of the experimenter’s matched contributions in Treatments 2 and 3) and again somewhat lower in Treatment 3 than in Treatment 2 (see Section 6.3). In all treatments, allocations to pensions had a generally downward sloping profile through time – as they should do to take advantage of compound interest.

Nevertheless, in relative terms, in all treatments, pension allocations were generally somewhat too low early in life and too high later in life (compared to the risk-neutral model-optimal strategy which would have maximised earnings from the experiment for an individual not concerned about risk). Females generally allocated less to pensions than males and risk-averse participants allocated significantly less to pensions than those who were less risk-averse. Opting out of the saving scheme was almost minimal with very little variation across treatments, gender or time (see Section 6.4). Comparing Treatments 1 and 2 there was very little difference in fund choice, though the introduction of a risk-free fund in Treatment 3 caused a significant shift to safer funds (see Section 6.6). Risk-averse participants chose safer funds, as did females.

One clear message is that targeting pension information at young people and better communication of the effects of compound interest seem important. Findings also showed that risk aversion may be a significant factor in both participants’ fund choice and in their savings decisions, suggesting that carefully explaining risk to the target population seems of importance.
1 Policy background: pension reforms

In December 2002 the Government set up the independent Pensions Commission to review the longer-term challenges faced by the pensions system and make recommendations for reform. The Commission published its conclusions in November 2005, setting out its proposals for meeting the challenge of providing a fair and adequate retirement income for all. Concurrently, the National Pensions Debate invited the public to comment on the emerging options for reform, culminating in the National Pensions Day in March 2006 in which members of the public across the UK were asked to consider and vote on the framework of the Pensions Commission’s proposals.

Building on the Commission’s report and the findings of the National Pensions Debate, the Government published proposals for pension reform in May 2006 in the White Paper ‘Security in retirement: towards a new pensions system’. These proposals were designed to meet the five tests of personal responsibility, fairness, simplicity, affordability and sustainability and set out a new structure for the UK pension system for the long-term. The proposed reforms include changes to the State pension system, primarily: increasing the State Pension age to 68 for both men and women, streamlining the contributions conditions, and changing uprating to be calculated in line with earnings rather than prices.

The second major aspect of the proposed reforms involves the introduction of automatic enrolment (also known as auto-enrolment) and an employer contribution to a qualifying workplace pension scheme, to make it easier for more people to save more for their retirement. The introduction of auto-enrolment is based on partial evidence of its effectiveness for the target group. Therefore, any additional data the experiment could yield on that aspect would be informative.

These reforms are particularly targeted at people who are not saving enough to provide retirement incomes they are likely to consider adequate. This group tends to be on moderate to low incomes. They are also likely to be part-time workers and/or work for small employers.
There are persistent and powerful barriers to people taking long-term saving decisions, including inertia, financial myopia\(^4\), the cost of pension saving and the complexity of the decisions involved. These reforms are designed to tackle these barriers by providing good incentives to save. In future, individuals will be automatically enrolled into a personal account scheme or qualifying workplace pension scheme, if they are employees aged between 22 and State Pension age and earning above approximately £5,000 a year.

The key items of interest that motivated the implementation of the experiment in this particular form include:

- What factors determine the decision to opt-out of a workplace pension scheme?
- Is there any pattern to the choice of funds by the participants\(^5\)?
- What is the effect of introducing a risk-free fund?
- Is there an influence of risk-aversion\(^6\) on behaviour?
- Are there any significant demographic variables influencing behaviour – such as gender, age and income?
- Do participants come close to showing behaviour that might be considered rational economic behaviour?
- Did participants make as much money out of participating in the experiment as they could have done?

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\(^4\) See the Glossary for an explanation.

\(^5\) Whilst the investment policy for personal accounts is still to be agreed, it would be interesting to understand the potential interactions between participation, saving and investment options in the target group. This is one of the reasons for recruiting participants from the UK general population.

\(^6\) See the Glossary for an explanation.
2 Developing an experiment in the field of pensions

2.1 Introduction

This project was initiated following discussions within the Department for Work and Pensions (DWP) as to the possible use of experimental economics as an evaluation tool within its Social and Economic Research function. It is the first time the DWP has used this technique and the objective of the research was to analyse the feasibility and effectiveness of conducting experimental economics in DWP research. It was thought that experiments might complement other methods of enquiry. This section describes the methodology of experimental economics in general and the challenges of applying them in the field of pensions in particular.

2.2 Background on the methodology of experimental economics

Experimental economics is a well-defined methodology, which can be summarised as follows: participants are recruited and presented with some kind of decision problem. They are usually paid for their participation, with their payment related to their performance in the experiment. This latter is intended to provide participants with some kind of ‘appropriate’ incentive for taking the decision problem seriously. Usually, different sessions of the experiment are run (normally with different participants in the different sessions). In the different sessions the problem presented to the participants differs. The experimenter can compare behaviour across the different sessions. This enables the experimenter to understand how changing the nature of the problem changes the way that participants respond to it. This, in turn, enables inferences to be made as to how participants are solving the decision problem posed to them. In addition, when the problem posed to the participants has a unique ‘best’ solution, the experimenter can see how close the participants are getting to this ‘best’ solution.
In experimental economics, the problem posed to participants is usually an economics problem – the intention being that of seeing how participants solve that problem. The information can be used to test economic theories or to generate new theories, that is, new explanations of behaviour. Applications of the experimental approach have been made across the whole field of economics, from individual behaviour, through games to markets; from microeconomics, through macroeconomics to international trade. In the field of pensions, however, experiments are only just beginning to be run. Some of the reasons for this will become apparent as this report proceeds. They include the following:

- the inherent difficulty of the pension problem;
- the difficulty of replicating, in a laboratory experiment that lasts a few hours, a decision problem which lasts over a lifetime;
- the difficulty in conveying information to the participants in a form that is reasonably easy to digest.

One main advantage of using experimental economics is that the problem presented to the participants can be posed in controlled conditions – the experimenter can control other factors that may influence the decisions of the participants (such as variations in the individual’s employment status or income). Control is a key feature of the experimental approach. It enables the experimenter to investigate behaviour under controlled conditions thus, eliminating other factors which may influence behaviour. In a sense, it allows testing of theories under the conditions underlying the derivation of those theories.

Usually, in order to maintain this control (over the conditions under which experiments are run), experiments are typically implemented in an experimental laboratory. Such a laboratory is, in essence, a room with computer terminals at which the participants sit and perform the experiment. Usually, participants are screened from one another, so that there are no uncontrolled interactions between the participants. However, and particularly so in recent years, experiments have been increasingly run outside the laboratory – the term used is ‘in the field’, though the extent to which it is actually in the field varies from experiment to experiment. Such field experiments have certain advantages – they may be nearer to the real world – but they also have disadvantages, particularly that some of the control crucial to experiments may be lost.

### 2.3 Applying experimental economics in the field of Pensions

Before discussing the abstractions required for the experiment, it is important to note that there is a clear distinction between: 1) controlling for factors that might vary over time, which is appropriate and useful in the experimental context; and 2) capturing the actual differences that already exist between participants (eg age, income, gender) which might well influence choices during the experiment. Data collected in the experiment will be influenced by the latter but not the former.
In order to simplify this section, we split up the process of applying the methodology of experimental economics in the field of pensions into three broad stages: (1) a first abstraction (eliminating some extraneous considerations); (2) a second abstraction (pinning down the details of the experimental implementation); (3) financial incentives (that is, how do we pay the participants to give them an appropriate incentive to take the experiment seriously?).

2.3.1 Our first abstraction – reducing the complexity of the problem

In essence, investigating some economic phenomenon using experimental economics involves replicating the decision problem in the laboratory or in the field. We study behaviour in the experiment and this enables us to understand behaviour in that context in real life. Of necessity, a replication must involve some kind of abstraction – we must take the key elements of the decision problem and replicate them in the experiment. This is, of course, exactly what theory does. So experiments follow theory in terms of its methodological abstraction. Let us examine this in the field of pensions.

The real life pension problem is very complicated. People can put money into pensions at any stage of their working life; they can choose when and how to put money into pensions; they usually also have to decide when to retire and then in what form to take their pension entitlements. Economists necessarily abstract from this problem, and frame it in a stylised way that seems, to the economist, to capture the key elements. Let us consider one such abstraction.

The usual starting point is to assume that life consists of a number of discrete periods – like years or months. In practice, of course, life is continuous and decisions about pensions can be made at any stage, but a discrete model is easier to handle and to describe. The number of periods in any person’s life is necessarily random – as the date of death is not known. In each of the periods of a person’s life, they may receive an income, and this income could be either determined by the individual or by outside forces. Before retirement (which itself could be decided by the individual) they must decide how to allocate their income – between saving in various forms (including pensions) and consumption in various forms. After retirement, the individual receives an income (which will partly depend on their past decisions about savings and pensions) and must decide once again how to allocate this between various forms of saving and various forms of consumption. If we are interested solely in pensions, we can further abstract from this problem, by proceeding as follows: we can assume that income and the retirement date are determined by outside forces, and that the only decision that the individual can make is how to allocate their income between consumption and pension allocations in the periods preceding retirement. This is the abstraction on which we based this experiment. We think that it captures the key elements of the pension decision. Clearly, if it does not, then our experiment will depart from the problem faced by real people in their real life.
2.3.2 How do we implement this in the laboratory?

We now have an abstraction on which we can base our experiment. However, at this point we encounter a major problem – in real life the ‘pension decision’ occupies a whole life. How do we reproduce this in an experiment? Clearly, in practical terms this is impossible, so we once again need to make an abstraction. Crucial to this is whether the passage of real time has an effect on the decisions. Economists would say that this is one important element – as it is clear that individuals evaluate differently incomes and expenditures at different points in time: individuals discount\(^7\) incomes and expenditures in the future relative to incomes and expenditures in the present. If we want to incorporate such a feature in our experiment we need to implement an experiment which continues over a sufficiently long period of time – if not necessarily a lifetime. This necessarily makes a laboratory experiment lasting a few hours impossible. The alternatives are either to run an experiment in which participants return to the laboratory on several occasions over a period of time or one in which participants carry out the experiment at their homes over a period of time. Both these alternatives imply a loss of control: both of them because the circumstances of the participants change in an uncontrolled way over time, and the second because the experimenter does not know exactly who is responding to the experiment on the various occasions. However, both these alternatives have one clear advantage: one could set the experiment up in such a way that participants were not forced to take active decisions at any stage thus, more accurately reflecting the real life pension allocation decision.

An alternative abstraction starts from the premise that the passage of real time is not the only key element in the pension decision – another is the allocation of income across the lifetime. Irrespective of whether individuals discount the future, they still have to decide how much of their incomes to allocate to pensions. This decision is usually necessary because income after retirement is typically lower than income before retirement and, therefore, the provision of a pension is necessary to smooth consumption over the lifetime: if individuals do not make an adequate pension provision then their consumption after retirement is less than they would wish it to be. So, even if we ignore discounting, we still pick up an important element of the pension decision – that of providing the appropriate smoothing of consumption over the lifetime\(^8\). This is the element that we focused on in this experiment, and we decided to ignore the issue of the passing of real time and hence, avoid the complications involved in running an experiment extending over a significant period of real time.

We, therefore, arrived at the following abstraction: individuals would live a random number of periods. Before retirement they would receive a given income and their decision problem would be that of deciding how much to allocate to pensions and how much to consumption; after retirement they would receive an income in

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\(^7\) See the Glossary for an explanation.

\(^8\) Readers who are interested in pursuing the technical aspects of this consumption smoothing exercise might find it helpful to refer to Appendix G.
the form of a pension (partly determined by their contributions to pensions before retirement and partly consisting of a basic pension), all of which would be devoted to consumption. During their working life all participants were given the same income in every period, and the basic pension in retirement was the same for all participants. This was to make all participants equal in terms of their incentives. There would be no significant passage of real time and hence, no discounting.

2.3.3 Financial incentives – how do we get the participants to take the experiment seriously?

At this stage, we should note that the abstraction at which we have arrived is very similar in some respects to what economists term the life-cycle model of consumption and savings. There have already been experiments on this model: see, in particular, Ballinger et al. (2003), Carbone (2005), Carbone and Hey (2004) and Hey and Dardanoni (1998). These, however, were not set specifically in a pension context and hence, our experiment differs in certain respects from these earlier experiments; we will explain the differences shortly. However, we borrow one key aspect from these earlier experiments – the payment or incentives structure. It will be recalled from the discussion above that economics experiments usually involve a payment to the participants – which provides an appropriate incentive to take the experiment seriously.

What does that mean in this context? To answer this we must go back to the key issue involved in the life-cycle model – the smoothing of consumption over the lifetime. Why do individuals want to smooth consumption? The economist’s answer is as follows: consumption provides happiness (or utility, to use the economist’s term); moreover, the more an individual consumes the happier they are; however, while happiness (or utility) increases with consumption it does so at a decreasing rate: an increase in consumption from £600 in a year to £700 in a year increases an individual’s happiness, as does an increase in consumption from £700 in a year to £800 in a year – but the increase in happiness implied by

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9 An extended comment is relevant at this stage: even though an experiment may not last a significant amount of real time, it is still possible to include discounting in the experiment – by having an increased probability of the experiment finishing at the end of any one period. This was implemented in Hey and Dardanoni (1988), but introduces extra complexity into an already complex experiment.

10 See the Glossary for an explanation.

11 We should note that we have used ‘happiness’ in this paragraph rather than the economists’ term ‘utility’ merely to give an intuitive idea of what economists mean by this term. In essence it is simply the thing that people are trying to maximise.

12 It is not being asserted that this is a fact – merely an empirical observation: if you repeatedly give an individual increases (of the same amount) in their consumption, most report that each increase makes them happier, but for each one the increase in happiness is less than for the one before.
the latter increase is less than the increase in happiness implied by the former increase. The implication of this is that individuals want to smooth consumption: if presented with a choice between consuming £600 in one year and £800 in the following year, or consuming £700 in each of the two years, individuals prefer the latter. They prefer to smooth fluctuations in consumption.

How do we implement this in an experiment, particularly an experiment that lasts a short time in the laboratory? While we can divide the experiment up into periods and give the participants some income in each of the periods, we cannot actually push participants to spend their income on consumption goods and have them consume these consumption goods during the experiment. The problem is simply that the time spent by the participants in the laboratory is too short. Hence, we adopt an alternative procedure. We pay the participants an amount of money for participating in the experiment – that depends, in a way that we will explain shortly, on the decisions that they take. We tell them that their objective is to make as much money as they can out of the experiment and we set up the payment mechanism in such a way that their payment is the experimental analogue of the lifetime utility (or happiness). Accordingly, we say that, in each period, the amount of their income that they ‘consume’ will be converted into real money and we will pay them the total of the money equivalents of their consumption in all the periods for which the experiment lasts.

So real money earned in each period of the experiment is the analogue of the ‘happiness’ that the individual experiences in that period (from consumption), and the total amount of money earned in the experiment is the analogue of the lifetime happiness of the individual. To make the analogy complete we need this conversion (from consumption in the experiment to real money paid to the participant) to be exactly like the conversion of consumption (as stated in economic theory) to happiness: the more the individual converts (or consumes) in the experiment, the more real money they earn for that period in the experiment, but with real money increasing at a slower rate with consumption. Thus, for example: 600 units of income in the experiment converted into real money become 82 pence, 700 units become £1.17 and 800 units become £1.48. Thus, an increase in conversion (or consumption) from 600 to 700 increases earnings in the experiment by 35 pence, while an increase in conversion/consumption from 700 to 800 increases earnings by 31 pence. Thus, according to economic theory, participants have an incentive to smooth their conversion/consumption over their lifetime. One of the purposes of the experiment is to see whether they do.

The experiments referred to above have all implemented this particular version of the life-cycle model of consumption/saving – using this payment mechanism. Although the results are not directly relevant to the pension version, which we describe in more detail shortly, there are some features that are of interest. In particular, it was noted that consumption generally was too sensitive to fluctuations in income – so that participants did not achieve the appropriate amount of
consumption smoothing. It has been interpreted as a sort of myopia – in that participants are not able to understand the full opportunities for consumption smoothing. Rather than look at their lifetime as a whole, participants seem excessively concerned with the short-term future. This type of myopia, it seems, is also at work in pension decisions. We should, however, note that there may be other reasons why participants in experiments do not achieve the consumption smoothing predicted by economic theory.

The experiments we have referred to above were primarily concerned with investigating the life-cycle model of consumption and savings. In these experiments, savings were a general and flexible way of transferring income through time and hence of smoothing consumption. In a pension context we need to restrict savings to be of a particular form. Accordingly, in our experiments money saved, that is, money allocated to pensions, could not be withdrawn until after retirement – and then only in the form of an annuity. We also imposed the constraint that, once allocated to a particular fund, the allocation for that particular period would remain in the fund throughout the remaining working lifetime of the participant. These latter constraints constitute further simplifications of reality. However, in these pension experiments we supplied different funds in which pension allocations could be made – which differed in terms of their rates of interest. The DWP were particularly interested in the issue of the fund choice of individuals.

This completes the basic design of the experiment: a discrete random period world in which the individual receives a fixed and known income in every period before retirement; in which individuals have to decide how much of their income to ‘consume’ (convert into real money) and hence, how much to allocate to pensions; in which there is a choice of pension funds into which to allocate any pension contributions; and in which the objective of the participants is to maximise the amount of money they earned from participating in the experiment. We now discuss the details of the experiment that we conducted.

2.4 The specific details of the experiment

There are usually different experimental groups involved in an experiment. In the different groups, there are different ‘rules of the game’ imposed. This enables us to see how the rules influence behaviour. In addition, of course, within any experimental group we can see how close behaviour is to what may be considered to be ‘best’ (as defined by economic theory) behaviour. We return to this latter point later, after we have described the various experimental groups that we implemented. In experimental economics jargon we refer to these different types of group as different treatments. In the experiment as actually implemented, we had three treatments. Table 2.1 lists these various treatments; it may be found

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13 The appendices give more detail on consumption smoothing as viewed by economists.

14 See the Glossary for an explanation.
helpful at this stage to refer to this table. The next few paragraphs explain the entries in the table.

The different treatments in an experiment are usually determined by the objectives of the experimenters: different treatments enable us to see how behaviour changes when we change the ‘rules of the game’ of the experimental problem. As Chapter 1 of this report makes clear, the experiments were being designed in the context of a possible introduction of auto-enrolment into a qualifying workplace pension scheme and employer contribution. As a consequence, certain features were of interest, including the effect of automatic enrolment on behaviour, the fund choice of individuals and the effect of the introduction of a risk-free fund. It is normally considered to be good experimental practice to have only one element different between two different treatments.

Our basic treatment, which we call **Treatment 1**, is one in which participants are regularly prompted to take conscious decisions (by the simple fact that they are sitting there in the laboratory), and in which the decision problem is that outlined above. More specifically, their pre-retirement working life consisted of 15 periods in each of which they received an income of 1,000 experimental units. In each of these periods they had to decide how much to allocate to pensions and in which fund to allocate it. We need now to add a little detail about the funds in which participants could invest their pension allocations. As we were particularly interested in the choice of funds, yet at the same time wanted to keep things as simple as possible, we allowed participants a choice of three funds which differed in their riskiness. All three funds had two possible rates of interest (each equally likely) and were as follows:

- **Fund 1**: either 1.0% or 5.2% (average 3.1%)
- **Fund 2**: either 1.5% or 4.3% (average 2.9%)
- **Fund 3**: either 2.0% or 3.4% (average 2.7%)

It will be noted that as the average rate of interest rises going from Fund 3 to Fund 2 and then to Fund 1 and so does the riskiness of the fund (Fund 3 has rates of interest ±0.7% around its average, Fund 2, ±1.4% around its average and Fund 1, ±2.1% around its average). Considerable discussion took place at the design stage of this experiment as to whether we should include funds with possibly negative rates of return, but it was decided in the end that it was **relative** riskiness of the various funds that was of interest – rather than their **absolute** riskiness. In addition, given that we had promised participants that they would take away at least their participation fee of £30 from the experiment, we did not want to leave open the possibility that participants might lose money on the experiment itself. This ruled out negative interest rates.

After retirement, participants received a basic pension of 100 experimental units plus an extra pension arising from their pension allocations during their working life. The basic pension implies a replacement ratio of just 10% – we note that
this is unrealistically low for a median earner, but was designed so as to provide a strong incentive for allocating money to pensions.

**Treatment 2** involved the introduction of a stylised version of a possible variant of auto-enrolment into a workplace pension scheme – which we termed the ‘savings scheme’. The key elements that we wanted to introduce were the following: (1) that participants would be, by default, enrolled into the scheme (and hence, that they had to take a conscious decision to opt out); (2) that there would be a certain minimum pension allocation if they wished to remain in the scheme; and (3) that there would be a matching contribution made from elsewhere – if the participants remained in the scheme. The details of these elements were less crucial than their existence: we choose a minimum contribution rate of 10% (of income) and a matching contribution of 75% from elsewhere\textsuperscript{15} reflecting the employer contribution under the reform proposals.

Finally, **Treatment 3** introduced a further element of interest for the DWP – the possible effect of the inclusion of a risk-free fund in the set of available pension funds. This treatment, therefore, was exactly the same as Treatment 2 with the addition of an extra fund (Fund 4) with a certain rate of interest of 2.2%. Note that this rate of interest is lower than the average rate of interest on any of the other funds.

As a reference point for the subsequent discussion, we introduce a fictitious treatment which might be deemed as representing the status quo. This is a situation in which participants are not regularly prompted to take decisions. We call this fictitious treatment **Treatment 0** – the ‘0’ signifying that we did not, in fact, implement it – for the reasons which we have already explained above. Given this regular prompting it is clearly not possible to replicate the inertia that may exist in the behaviour of certain participants. If, instead, we had carried out the experiment ‘in the field’ without such regular promptings, the inertia that exists in certain sections of the population (as regards taking active decisions about pensions) might have been present in the experimental setting.

The main experiment was preceded by three pilots: two with student subjects and the third with a sample of participants from the same target audience as the main experiment. The main experiment itself involved a total of 174 participants, each

\textsuperscript{15} A word about this figure of 75% and the treatment of tax is necessary at this stage. Pension allocations are subjected to tax relief. Therefore, if the income of experimental units is considered as \textit{post-tax} then the following implications would flow: participants opting into the pension scheme in Treatment 1 would have 25% added to their pension allocations (the tax rebate) while participants opted in under Treatments 2 and 3 would have 100% (25% from the tax rebate and 75% from the augmentation) added to their pension allocations. For simplicity, we decided to treat the income of experimental units as \textit{pre-tax}, so that no tax rebate would be forthcoming in either case. Hence, zero would be added if out of the scheme and 75% added if in the scheme for Treatments 2 and 3.
of whom was paid a participation fee of £30 plus their actual earnings from the experiment itself.

In each group of the experiment, participants were greeted by a member of EXEC, reminded that they would be paid the participation fee of £30 plus any earnings that they made from the experiment and then taken to the laboratory. There they were given a set of written instructions. After they had read these, a PowerPoint presentation was played on their individual screens, after which they were given a set of control questions to ensure that they understood the instructions. Any wrong answers were discussed with them and any questions they had were answered. They could then begin the experiment, carrying it out at their own speed (subject to a certain minimum time). At the end, they completed a brief questionnaire, asking for demographic information and risk attitudes, were paid their earnings and were free to leave.
Table 2.1 Differences between treatments

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| Treatment 0              |        |        |        |        |
| Scenario which          |        |        |        |        |
| simulates a status quo   |        |        |        |        |
| of individuals not       |        |        |        |        |
| saving (note that       |        |        |        |        |
| this treatment was      |        |        |        |        |
| not implemented)        |        |        |        |        |
|                         | ✔      | ✔      | ✔      | ✔      |

| Treatment 1              |        |        |        |        |
| Scenario where          |        |        |        |        |
| participants make saving |        |        |        |        |
| allocation and fund      |        |        |        |        |
| choice decisions without |        |        |        |        |
| auto-enrolment into      |        |        |        |        |
| a workplace pension      |        |        |        |        |
| scheme                  |        |        |        |        |
|                         | ✔      | ✔      | ✔      |        |

| Treatment 2              |        |        |        |        |
| Scenario where          |        |        |        |        |
| participants are         |        |        |        |        |
| auto-enrolled into       |        |        |        |        |
| a workplace pension      |        |        |        |        |
| scheme and make saving   |        |        |        |        |
| allocation and fund      |        |        |        |        |
| choice decisions         |        |        |        |        |
|                         | ✔      | ✔      | ✔      | ✔      |

| Treatment 3              |        |        |        |        |
| Scenarios where          |        |        |        |        |
| participants are         |        |        |        |        |
| auto-enrolled into       |        |        |        |        |
| a workplace pension      |        |        |        |        |
| scheme, make saving      |        |        |        |        |
| allocation and fund      |        |        |        |        |
| choice decisions with    |        |        |        |        |
| the choice of an         |        |        |        |        |
| additional fund offering |        |        |        |        |
| a guaranteed rate of     |        |        |        |        |
| return                   |        |        |        |        |
|                         | ✔      | ✔      | ✔      | ✔      | ✔      |
3 Main findings and conclusions from the experiment

3.1 Introduction

We divide this chapter into two sections:

• what this particular experiment tells us about pensions;
• how it might assist the Department for Work and Pensions (DWP) in understanding pension behaviour and the possible impact of policy measures.

3.2 Conclusions concerning the experiment that we conducted: what this experiment tells us about pensions

Our main conclusions under this heading are:

• We implemented in the laboratory a stripped-down version of the pension problem, replicating some of the key features but necessarily omitting others.

• We managed, in general, to brief the participants sufficiently and provide appropriate incentives, though we note that the experiment that we implemented does not necessarily replicate their actual involvement with, and knowledge about, the pension problem.

• Generally, participants responded well to these incentives, though some participants found it difficult to abstract from their own personal circumstances.

• We observed a certain amount of inertia in behaviour, perhaps correctly replicating the real life situation.

• There were strong gender effects and also strong effects of risk-attitude on behaviour.
We have reproduced in the experimental economics laboratory an abstraction of the pension problem facing a typical individual. We have implemented this experiment on a quota sample of the general UK population which is in work earning between £5,000 and £33,500 and aged over 22. We implemented three different versions of the pension problem – with different specifications of the options open to the participants in the experiment. We have not only analysed the behaviour of the participants in absolute terms but have also compared behaviour across the different versions of the experiment and with two possible theoretical accounts of behaviour.

The abstraction that we implemented was a stripped-down version of the generic pension problem, in which participants received a constant income up to retirement and a basic pension after retirement, and in which participants were required to allocate their income before retirement between consumption and saving (towards an augmented pension). Participants could choose between various funds in which to put their pension allocations; most of these funds were risky, as was the length of life of the participants in the experiment. Two of the versions of the experiment (Treatments 2 and 3) had, in addition, a savings scheme in which allocations made by the participants were matched with a 75% contribution from the experimenter. One of these versions (Treatment 3) had a risk-free fund as one of the fund options. Treatment 1 had neither of these features.

Although it was not particularly simple for participants to work out what they ‘should’ be doing, they were provided with information and instructions although the latter do not accurately reflect the information in real life.

Participants in the experiment were given an incentive to consider their allocations seriously – with their payment for participation depending upon their decisions. One of the theoretical accounts of behaviour, with which we compared actual behaviour, was an allocation strategy which maximised the expected payment to the participant for their participation in the experiment (we call this the risk-neutral model-optimal strategy because a risk-neutral individual is interested in maximising their expected return and is not concerned about risk). The other theoretical account was one in which participants made no allocations to pensions throughout their lifetime (we call this the status quo strategy). This latter might be considered close to the real life actual behaviour of the target population who will be eligible for auto-enrolment into a qualifying workplace pension scheme or a personal account scheme. We found that actual behaviour in the experiment was much closer to the first of these two theoretical accounts than the second. However, it is not a surprising result since doing an experiment in the laboratory environment meant that we could not replicate inertia with regards to long-term saving behaviour in the experiment.

See the Glossary for an explanation.
If we compare behaviour across the various treatments we find that absolute earnings were highest in absolute terms in Treatment 2 and lowest in Treatment 1, both for males and for females. However, relative to the maximum possible earnings from the experiment, earnings for males were highest in Treatment 2 and lowest for Treatment 3. For females, earnings in these relative terms were roughly constant across treatments, though slightly higher in Treatment 1 and slightly lower in Treatment 3. These give some indication of how close participants came to maximising their ‘lifetime happiness’ in the underlying pension problem.

The actual allocations to pensions, in all treatments and for both males and females, declined slightly through time – as they should do to take advantage of the effects of compound interest. However, they did not decline as fast as they do in the risk-neutral model-optimal strategy. We took this to be evidence of a type of myopia – but of quite a subtle kind – not one that ignores the need to make pension provision, but one that does not consider the full life-time effects of pension accumulation. Interestingly, in all treatments and for both males and females, pension allocations were considerably higher than both those implied by the risk-neutral model-optimal strategy and the status quo strategy (see the technical volume for further details). We partly suspect that this may have been a consequence of the risk attitude of the participants, and also a consequence of the experimental design – in that participants were forced to take conscious decisions about their pension provision – unlike in real life. Indeed, this latter is one of the striking features of the experiment: prompting them to take active decisions on screen, implied that participants took decisions that were remarkably good. Indeed, we found that participants responded to the experiment’s monetary incentives and tried to maximise their earnings. However, the time factor of a three-hour laboratory experiment combined with a limited number of decision triggers on screen (relative to real life) and explanations about the process supplied by the experimenter will have removed some inertia relative to the real world. A further possible reason for the rather modest decline in pension allocations through time could be the effect of learning: as time passed, participants became more aware of the need and importance of making pension contributions. However, it is difficult to know how to test this learning hypothesis and how to disentangle it from other factors influencing behaviour.

In the treatments with the saving scheme (in which participants were automatically enrolled into the scheme and had to take a conscious decision to opt out) we noticed a certain amount of inertia in behaviour to the extent that few participants decided to opt-out. However, this comment should be set against the risk-neutral model-optimal strategy which says that it is never rational to opt out in the context of the experiment. Given that in the experiment participants opted out 4.4% of the time in Treatment 2 and 8.6% of the time in Treatment 3, it is not clear how to interpret this evidence. On the one hand, 4.4% and 8.6% are significantly greater than 0%; on the other hand, 4.4% and 8.6% are small and hence, the stay-in rate is high. Moreover, given that the participant is obliged to contribute at least 10% of their income when not opted-out, this means that a high proportion of the time
in Treatments 2 and 3, participants were allocating at least 10% of their income to pensions (excluding the 75% matched contribution from the experimenter). This should be contrasted with the fact that in Treatment 1 participants were allocating less than 10% of their income 28.8% of the time. Nevertheless, mean contributions were higher in Treatment 1 than in Treatments 2 and 3. So the 10% floor in the saving scheme may not only have been a minimum but also a target.

Fund choice was quite clearly influenced by the risk-attitude of the participants with the more risk-averse (and hence more of the females than the males – see Cox and Harrison 2007) choosing the less risky funds. With the introduction of a risk-free fund in Treatment 3, there was a significant number choosing that fund and a general shift towards the less risky funds. A formal analysis shows strong treatment effects - with the safer funds chosen more often in Treatment 2 than in Treatment 1 and (rather obviously) much more often in Treatment 3 than in Treatment 2. Older participants were more likely to choose safer funds, as were those who were risk-averse, independently of the treatment.

In all treatments there was a default fund17, and it was noticed that participants were more likely to stay in the default fund in Treatment 2 than in Treatment 1 (56% as compared with 45%), and that they were less likely to stay in the default fund in Treatment 3 than in Treatment 2 (52% as compared with 56%). As time passed participants were more likely to stay in. Older participants were also more likely to stay in as well as those with higher incomes (in real life). Those that were more risk-averse were more likely to move out of the default fund (some to a safer fund and others to a more risky fund). It is not clear what implications these findings have for policy.

3.3 Conclusions which might assist the DWP in understanding Pension behaviour and the possible impact of policy measures

Our main conclusions under this heading are the following:

- To reproduce more accurately the true nature of the ‘pension problem’ as perceived by the target population might require a different experimental setting – one in which participants were less actively prompted to participate.

- It seems that many participants brought to the experiment their own personal circumstances; it is not clear how one can eradicate this, or indeed, whether one wants to.

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17 The default fund is Fund 2 (as it is set in that fund in period 1 for all treatments) or the fund in which the participant made the allocation in the preceding period.
• The experiment was successful to the extent that participants actively took on-screen pension decisions over 2 to 3 hours with explanations about the process.

• While appreciating the need to allocate money to pensions, participants did not seem to take on board fully the implications of the compounding of interest, and hence the necessity to make pension allocations sooner rather than later. In terms of policy implications, this would suggest that information about the effect of compound interest should be targeted to the young in particular.

In trying to draw some conclusions about the success or otherwise of the experiment, we should begin by deciding our criteria for judging success. It was clear from the outset that the experiment was ambitious both in its design and in its basic intentions: those of reproducing in the laboratory the ‘pension problem’, and expressing it in such a way that it was accessible to the general UK population. The experiment could then be judged as to how successful it was in doing that; this may be considered the first of the criteria for judging its success or otherwise. On the other hand it could be judged on the basis of how well it answered the key questions of the research (concerning opting-out behaviour, fund choice, the effect of the different treatments and so on).

The experiment also had a further aspect – the collection of some self-reported demographic data, and its use in analysing the data from the experiment. While the results of the analyses of the experimental data suggest that demographic effects (with some clear exceptions) are not significant, these results would not have been available if the demographic data had not been available. It follows then the collection of the data was a useful exercise.

We should note at this stage that the experiment, by its very nature, was unable to start from the true status quo of the target population. This was because the experiment was conducted in the laboratory and lasted only between two and three hours, inevitably implying that participants were forced to take active decisions – they could simply sit there and do nothing but this would be very unlikely. We have already discussed how we might go round this problem – by conducting the experiment over an extended period of time with the participants having to take some positive action (like logging onto the internet) in order to take decisions. This is a possibility that might be considered for the future but which would require serious design considerations to be resolved.

Although we gave as much relevant information as possible for participants to solve the pension problem, the provision of simple instructions was not an easy task. Indeed, we cannot claim that the information was easily digestible to all the participants. However, we may be able to able to claim that that the limited amount of on screen decisions combined with explanations about the process may have helped guiding participants throughout the experiment in an easier way than in real life.
The experiment did not aim to test the provision of information and its format. However, this could be the feature of another experiment – one could organise the software so that participants had to ask for information and had to specify the form in which it was provided. But it is worth noting that there are technical problems with writing the software in such a way that this would be possible, and there are also conceptual issues.

We should also make a comment about the context of the experiment. In this experiment, we consciously used the word ‘pensions’. In addition, the participants were aware that the project was funded by the DWP. Inevitably, therefore, participants were invited to think about and concentrate on pensions. We could have made the experiment totally context-free – by telling them that they received an income every period and could allocate this either to A or B. Income allocated to A would earn them money directly, while income allocated to B (or some fund within B) would yield them money only from periods 16 onwards (if they survived that long). In other words, we could have completely stripped the context from the experiment – and never mentioned the word ‘pensions’. **This may well have led to different behaviour** (though, of course, we cannot test this proposition without carrying out such a further experiment). Indeed, one of the major modifications at the design stage was to reduce the emphasis on pensions, though not removing it completely. The idea of having such a context-free design might be considered for future experiments – though, of course, whether such a design would be a good idea or not does depend upon the objectives of the experiment.

There is another important issue. We presented the participants with a problem to solve – and one that was the same, within any given treatment, for all the participants in that treatment. However, it is clear from the results that we present in the report, and particularly in our analysis of the effects of demographic variables on behaviour, that **participants were importing their own personal circumstances into the laboratory**. This may have partly been for ‘solving’ the decision problem and also partly for understanding it in the first place. For some of these variables, for example risk aversion, this is clearly something that will affect someone’s decisions about pensions. Others are more subtle – like age. We appear to be observing a form of myopia where participants did not appear to realise that making allocations early in life (early in the experiment) were more effective than making allocations later in life (later in the experiment). One may possibly conclude that participants did not understand the effect of compound interest rates. If this supposition is true, it suggests (all other things being equal, of course) that policy-makers should carefully consider or tailor messages to different age segments and communicate better to the target population the effect of compound interest rates.

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18 With long and potentially confusing instructions, participants may well have interpreted the instructions based on their own experience.
In conclusion, it may be useful to summarise what have we learned from the experiment about the behaviour of people with respect to their pensions.

• We start by noting that behaviour, as judged by the actual earnings of the participants in the experiment, was reasonably close to that suggested by economic theory, indicating that participants were tackling the problem in a not unreasonable way. However, we also note that some improvements in earnings were possible. We comment on these below.

• First, we observe some kind of myopia (especially amongst the younger participants – this myopia seems to decrease with the real age of the participant). We infer this from the relative under-allocation of income to pensions early in the working life and the relative over-allocation in later working life. This may be due to an incomplete understanding of the effect of compound rates (though we cannot claim that this is an unambiguous result of this experiment). If this supposition is true, it suggests (all other things being equal) that policy-makers should carefully consider or tailor messages to different age segments and communicate better to the target population the effect of compound interest rates.

• Second, we note that the real life pension problem is very complex. Even in the simplifying world of the laboratory, the problem is difficult for the experimenter to present and explain, and is difficult for the participants to understand and ‘solve’. The experiment showed that, even when presented in a more ‘simplified’ setting with ready-to-hand information within a three-hour laboratory session, participants still found it difficult to make some saving decisions. We note that some evidence suggested that participants found it difficult to abstract from their personal characteristics – partly in terms of understanding the long and apparently complex instructions, but also in terms of responding to and ‘solving’ the pension problem posed to them. Therefore, the experiment reflected the complexity of the pension problem individuals face in real life.

• Third, we note that the experiment, by its very nature of prompting participants to make on-screen decisions over a three-hour period removing inertia, involved the participants in engaging with the pension decision: except for the three people who said that they could not understand the decision task, all the other participants completed the experiment. Clearly the experiment was an artificial way to engage participants, but they were actively prompted to make decisions and were rewarded with a financial incentive and a participation fee.
The issue of risk and of risk-aversion is a difficult one and the message emerging from the experiment is mixed. Risk-aversion appeared to have a strong effect on behaviour, with the more risk-averse participants allocating less to pensions (presumably because they saw investment in pensions as a risky activity while the returns from consumption were immediate and safe). Moreover, the introduction of a risk-free asset in Treatment 3 highlighted lower pension allocations relative to Treatment 2. In addition, and perhaps rather obviously, the more risk-averse participants allocated relatively more money to the safer pension funds.

We should note that the information on risk attitude was obtained from the answers to the questionnaire – which was self-reported data. We used that data to construct a risk-aversion index – measuring the risk attitude of the participant (details of the construction are given in the Appendix I). It is clear, from the analyses that we have carried out, that the risk aversion index so obtained contains useful information.

Penultimately, we should comment on inertia in behaviour and whether this could be useful in building pensions policies. Unfortunately, no clear pattern emerges from the experimental data. While there are participants who chose roughly the same allocation to pensions each period and stuck largely with the same pension fund, there were many participants whose pension allocations changed markedly from period to period, as did the fund they chose in which to invest their allocations. Moreover, the evidence on the tendency of participants to stay in the default fund does not appear to be particularly strong and does not give any clear direction for policy.

Finally, we should note that the other experimental implementations may have shed more light on certain aspects of behaviour. While the experiment has shown how people ‘solve’ the pension problem while being provided with directly relevant information and actively engaged with it, the experiment sheds no light on what people do in other circumstances. This suggests that other experiments – with less prompted involvement and with information less readily available – may help us understand how the target population are currently responding to their pension problem.

In conclusion, what have we learnt? As far as running experiments in the field of pensions, we have learnt that these are possible, but there are numerous challenges to overcome, not least in replicating, in an experimental situation, the ‘pension problem’, and in briefing the participants ‘appropriately’. In the experiments that were implemented, we feel that we overcome some of these challenges and our experience suggests how we might overcome other challenges in any future experiments. As far as the objectives of this particular experiment are concerned, we have learnt that participants can understand and respond to the ‘pension problem’ in a way that is not perfect but is a good first pass at the problem. We have also learnt that there are strong gender effects as well as those of risk aversion. So, providing information whilst carefully explaining risk to the target population seems important.
4 Implementation of the main experiment

4.1 Challenges with implementing the experiment

The preceding chapters of this report described the basic structure of the experiment and the various treatments that we implemented. We now turn to some practical challenges involved with its implementation. Later, in Section 5.2, we will describe the practicalities of its execution.

One immediate problem is the complexity of the experiment, not necessarily in terms of the practicalities of taking decisions, but rather in conveying information to the participants about the experiment. Indeed, describing the experiment turned out to be a difficult matter: the instructions went through numerous iterations before we finally converged onto the instructions which we used in the experiment itself – those for Treatment 3 are reproduced in Appendix C. The difficulty was in explaining quite complicated concepts to the participants in a language that would be understandable to them. In addition, considerable efforts were made to reduce the sheer volume of the information contained in the instructions though it may well have been the case that some participants found the instructions too long.

Particularly difficult was explaining to the participants the implications for their future pension of any proposed allocation to pensions. The main problem was that interest rates were, in general, risky and therefore, that the implied pension was not certain. How does one describe a risky pension? Of course, given that we knew the possible rates of interest on each of the pension funds, we could work out mathematically the probability distribution of the future pension. But we still had to convey this information to the participants. There are different

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19 In essence all the participants had to decide in each of the periods before retirement were: (1) how much of the income to allocate to pensions; (2) whether to opt out or stay in the savings scheme (in Treatments 2 and 3); (3) and in which fund to make the allocation.
ways that one can do this: (1) in words, for example, ‘there is a 0.125% chance that your pension may be 100 per period, a 0.25% chance that it may be 110 per period….’; (2) graphically in the form of a histogram; or (3) in various summary forms – giving the mean, median, mode, standard deviation and so on. Because of the large number of possible values it was decided that form (1) was simply impractical; form (2) was more practical but we realised that some participants may not know how to interpret a histogram; form (3) was perhaps the simplest but we still had to decide which summary statistics to provide. In the end we provided both forms (2) and (3) and restricted the summary statistics to be the quartiles\(^{20}\) of the distribution. An example can be seen in the ‘Main Decision Screen in the Experiment’ which can be found in the instructions in Appendix C.

An additional problem was the fact that the future pension would not only depend on the allocations that the participant had made in the past, but would also depend on the allocations that were made in the future. We decided, therefore, to give information about the distribution of the future pension in two scenarios: Scenario 1, in which the participant made no contributions to pensions in the future; and Scenario 2, in which it was supposed that the participant made exactly the same allocation to exactly the same fund in all remaining periods before retirement.

We should note that, while we had to provide this information for the benefit of the participants in the experiment, the provision of the information in this form differs from what would be normally received in real life (for instance information may be difficult to obtain or not spontaneously requested by individuals). In this respect, participants in the experiment were at a considerable advantage of receiving some guidance about the process. This should be taken into account when interpreting the results of the experiment. Nevertheless, it remains true that some participants found the instructions sufficiently long to cause confusion.

We also had to decide on the conversion scale – from consumption to real money – that we would use in the experiment. We have already explained that it has to be increasing, but at a decreasing rate. The reason for this has been explained elsewhere. In essence the conversion scale (from experimental units to money) mimics the utility function (from consumption to utility) of the economic theory. It is usually assumed that this utility function is increasing at a decreasing rate (that is, marginal utility is declining) hence, the reason for this particular shape for the conversion scale. The actual scale used in the experiment is shown in Figure 4.1. It should be noted that the vertical scale – and particularly the existence of negative earnings – was chosen to satisfy a number of criteria: first to reproduce the idea of a subsistence level of consumption, second, to ensure an appropriately strong incentive for the participants; third, to guarantee (as far as possible) that no participant lost money in the experiment.

\(^{20}\) The quartiles are as follows: (1) the lowest possible pension; (2) the value below which the pension will be with a 25% chance; (3) the value below which the pension will be with a 50% chance; (4) the value below which the pension will be with a 75% chance; (5) the highest possible pension.
Before we implemented the main experiment, we carried out a pilot experiment with student participants. In the light of the results from this pilot experiment a number of modifications were adopted. Most of these involved simplifying the instructions and the presentation of the experiment. A further pilot was carried out with 30 participants selected from the general UK population. Further minor modifications were implemented as a consequence. Then the main experiment was carried out. This section concentrates on the main experiment.

4.2 The main experiment

The main experiment involved a total of 174 active participants. They were recruited by Ecotec, and constituted a quota sample from the general UK population – namely individuals in work, aged over 22 with annual earnings of between £5,000 and £33,500. Details are provided in Appendices A and B. It should be noted that, typically, participants in experiments are normally recruited from the student population, so that the use of participants from the general UK population represents a major innovation in the implementation of an experiment. However, the use of these participants added further problems (which we had anticipated during the design of the experiment), not least the problem of ensuring that the participants understood the nature of the problem and what they were meant to be doing (if not how they should be doing it). As a consequence we made great efforts to ensure that the experimental task was explained in the clearest possible way. To this end, we proceeded as follows.
When the participants were gathered in the laboratory one of the experimenters made a brief statement, telling the participants about who was financing the experiment and what the participants could earn. We made a point of reminding the participants that they were guaranteed a £30 participation fee and that they could earn considerably more as a consequence of their decisions during the experiment. We emphasised that their objective should be maximising the amount of money that they took away from the experiment. The participants were seated at separate screened terminals, with the males on one side of the room and the females on the other. The reason for this is that the males and the females had different life tables. They were asked to read the written instructions and then call over an experimenter when they had finished.

4.3 The written instructions

The instructions for Treatment 3 are attached in Appendix C. Despite considerable efforts to make these as simple as possible, the nature of the experiment itself means that the experiment is difficult for anyone. We note that, while many participants reported difficulties with fully understanding the written instructions, most admitted that things became clearer once the experiment started. However, it should be borne in mind in interpreting the results, that some of the behaviour may have been caused by confusion in the minds of the participants, not necessarily in terms of what their objective was (making as much money as possible from participating in the experiment) but rather in how they should achieve this objective. One could argue that this confusion reflects their real life confusion concerning what they should do concerning their pensions.

In taking such decisions they not only need to decide how much to allocate to pensions but also how they should allocate it. The experiment captures the essence (though not the detail) of these real life decisions.

4.4 The PowerPoint presentation

To help participants further with the instructions, we prepared a PowerPoint presentation which the participants viewed after reading the written instructions. The PowerPoint presentation was played at a pre-determined speed. Both before and after the presentation, experimenters were available to answer any questions that the participants may have had. The response of the participants to the instructions and to the presentation varied from participant to participant: some said that they felt that they understood the instructions well, some said that they had some doubts which they expected to be resolved once they started the experiment and some expressed considerable doubts and confusion. Three of the participants were so confused by the instructions that they decided not to participate in the experiment.
4.5 The control questions

To satisfy ourselves that the participants truly understood the instructions we asked the participants to respond to a set of control questions. Those for Treatment 3 are attached in Appendix D. We have kept a record of their answers to these control questions. A summary is presented in Appendix E. After the participant had answered the control questions, one of the experimenters went through, with the participant, all the questions answered incorrectly until the participant said that they were happy with the correct answer. At this stage, after answering any further questions that the participant had, they were allowed to start the experiment. During the experiment, the participants could ask for clarification from an experimenter at any stage. This process of both checking participants’ understanding of what they should expect from the experiment and providing some clarification, is often standard in experimental economics.

The PowerPoint presentation lasted about ten minutes. The time for answering and discussing the control questions varied from participant to participant. Some participants answered very quickly and had all their answers correct. Others took longer and made mistakes. We spent time explaining the correct answers to them. We did not monitor the time taken.

4.6 The experimental software

This was developed and written in Visual Basic. The core of the programme, as seen by the participants, is the ‘Main Decision Screen’ – which for Treatment 3 can be seen in Appendix C (the Main Decision Screen for the other treatments was almost identical – just omitting features that were not present in these other treatments). Via this screen, participants could enter their decisions regarding their (proposed) allocation to pensions and the fund in which they wished to allocate it. In Treatments 2 and 3 they could also indicate their decision as to whether to stay in the savings scheme or opt out of it. The screen also told them how much real money they had earned up to that point in the experiment and how much they would earn that period from the amount of experimental units that they were considering converting into real money. We should reiterate that the income of the participants in the experiment was denominated in experimental units – which had no value in and of themselves. Experimental units became valuable only when they were converted into real money. The reason, as we have explained before, is that ‘experimental units’ in the experiment are the equivalent of ‘consumption’ in the economic theory while ‘real money’ in the experiment is the equivalent of the ‘utility’ of the theory. Moreover, we used ‘experimental units’ rather than ‘francs’, or some other currency, to avoid framing effects.

Preliminary analyses suggest that there is no relationship between the number of correct answers to the control questions and the performance of the participants.
Also, the screen provided information about the participant’s likely future pension. As we have already discussed, this future pension is uncertain (due to the riskiness of the rates of interest) and therefore, we had to find ways of presenting the information to the participants about the distribution of their pension in a form that was easy to understand. We did this in two ways: (a) by providing a histogram displaying the distribution of the pension visually; and (b) by giving them a table providing information on: (1) the lowest possible pension; (2) the 25% quartile; (3) the median; (4) the 75% quartile; and (5) the highest possible pension. We tried to ensure that the information was phrased in a way that would be understandable to the participants. Again, as we have already noted, because their likely future pension not only depends on their past allocations but also on their future allocations, we gave this information (on the distribution of their pension) under two different scenarios, which we called ‘Scenario 1’ and ‘Scenario 2’.

We should note that participants were allowed between three and five minutes to take decisions in each of the 15 periods prior to retirement – they could not move on to the next period until three minutes had elapsed and they had to move on after five minutes had elapsed. After retirement, when no further decisions were required, each period lasted just a few seconds. Overall, including the reading of the instructions, the watching of the PowerPoint presentation, answering and correcting the control questions, and doing the experiment lasted between two and three hours.

4.7 The questionnaire

After the participants completed the experiment, they were asked to fill in a brief questionnaire. This is reported in Appendix F. This provides us with useful demographic information as well as information on the participants’ attitudes to risk – though we should note that all this information is self-reported.

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22 As described earlier, ‘Scenario 1’ refers to the case in which the participant made no contributions to pensions in the future; and ‘Scenario 2’ represents the case in which the participant made exactly the same allocation to exactly the same fund in all remaining periods before retirement.
5 Possible reference points?

5.1 The model optimal strategy for a risk-neutral participant

As we noted in Section 3.2, experimental economists usually like to have a reference point for behaviour – against which to compare the actual behaviour of the subjects. If there is a uniquely ‘best’ way to respond to the experiment, this is taken as the reference point. In this experiment, however, there is no unique ‘best’ strategy, and we, therefore, have to make further assumptions to deduce some reference point.

The objective of the participants in this experiment was ‘to make as much money as possible’ from the experiment. However, their actual payment was not certain: it was inevitably risky. There are two sources of risk in the experiment: the interest rates and the length of life. Participants could influence, to a certain extent, the amount of risk from the first source (through their fund choices) but had no control over the length of their life (which was determined by the computer using the Government Actuary’s Department’s Life Tables). Hence, whatever strategy participants adopted, their actual payment was not certain – it was risky. Thus, the idea of ‘maximising their payment from the experiment’ has to be more precisely defined. One way to do this is to interpret it as maximising their expected payment from the experiment. This implicitly assumes that the participant is risk-neutral – that is, does not take into account any risk involved in the strategy. Crucially, however, ‘maximising the expected payment from the experiment’ is a well-defined objective and we can find the strategy which achieves this objective. We do so in Appendix G. We call this strategy the risk-neutral model-optimal strategy in the experiment. It provides a reference point against which to compare the actual behaviour of the participants. This strategy is illustrated in Figure 5.1. This shows what a risk-neutral participant should do (in terms of pension allocations) in the various periods before retirement, in order

\[ \text{Model-optimal} \] because it assumes that the objective of the participant is the same as in the model which we are using to describe behaviour.
to maximise their expected payment from participating in the experiment. In the experiment there were 15 such periods. It will be noted that this risk-neutral model optimal strategy is different for males and females (because females live longer than males) and is different in Treatment 1 compared to Treatments 2 and 3.

We note that participants in practice had to decide three things: (1) how much to allocate to pensions; (2) (in Treatments 2 and 3) whether to stay in or opt out of the savings scheme; (3) in which fund to place their pension allocations. It can be shown that it is never optimal to opt out of the scheme (basically because the optimal allocation is always more than the minimum 10% required). Moreover, a risk-neutral individual will always invest in the fund with the highest expected return. Hence, this section considers only the allocation decision – for someone who is concerned only with maximising the expected earnings from the experiment.

Some comments may be useful. It will be seen that this strategy involves allocating most to pensions early in the working life (a little under 400 of the income of 1,000 for females and somewhat over 300 for males), and then decreasing the allocation through the working life until close to retirement. The generally downward sloping shape of this strategy results from the fact that early in the working life, survival probabilities are high but they fall as retirement approaches (the actual survival probabilities are in the Life Tables in the instructions). Of course, it is also a consequence of the fact that interest rates are positive. Money saved in early life earns interest at a compound rate: so a certain amount of money saved early leads to a bigger increase in the pension than the same amount of money saved later in life. As this point it is important we should repeat it: for a risk-neutral participant, that is one who wants to maximise their expected earnings from the experiment, they should have a pension allocation profile which generally declines through time24.

We also note that the profiles for males are below the profiles for females; this is simply a consequence of the fact that females live longer.

Finally, we note that the risk-neutral model-optimal strategy for both males and females is slightly lower in Treatments 2 and 3 than in Treatment 1. This is a consequence of the fact that, in Treatments 2 and 3, pension allocations are augmented by 75%.

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24 We should note that income in each period before retirement for all participants was 1,000 experimental units. It was the same for all participants to remove individual differences and was the same in each period to simplify the decision problem of the participants.
This risk-neutral model-optimal strategy is one possible point of reference against which we could compare the actual behaviour of the participants. However, we should be careful in so doing. If a particular participant is not risk-neutral, then their model-optimal behaviour is not that illustrated in Figure 5.1. For example, if a participant is averse to (does not like) risk then they would prefer a strategy which may have a lower expected payment but implies less risk. The precise implications depend on the participant’s actual aversion to risk and we cannot calculate the appropriate model-optimal strategy without knowing more about the participant’s risk aversion. The difficulty is that ‘risk-aversion’ is not uni-dimensional and that attitude to risk may depend on the source of that risk. For example, it may be argued that a risk-averse participant would want to allocate less to pensions than a risk-neutral participant – because consumption is a safe activity while pension allocation is risky. However, a counter-argument might say that a risk-averse subject might want to allocate more to pensions so as to ensure that their future pension is sufficiently high. Indeed, the precise implications are not clear – in principle we would have to compute a model-optimal strategy for each participant – given
knowledge of their attitude to risk. Unfortunately, we do not know their precise risk attitudes. So we must simply conclude: if a particular participant is not risk-neutral then their model-optimal behaviour is not that illustrated in Figure 5.1. However, we might be tempted to argue that the shape of the profile should be similar – that is, generally downward sloping through time. This is a conclusion that depends on positive interest rates and high survival probabilities and appears to have nothing to do with the individual’s attitude to risk. Indeed, it is difficult to see how one could argue that the profile should be flat or upward-sloping. However, we should stress that this is a tentative conclusion.

We also note that this proposed reference point not only assumes that the participant is risk-neutral, but it also assumes that the participant’s objective is that of maximising their (expected) payment from the experiment. If, however, the participant has some other objective, then this strategy is not the strategy that is optimal for them – given their actual objective. Of course, we as the experimenters do not know what the true objective of the participants in our experiment was. This is always the case in experiments: while the experimenter may assume that the participants want to earn as much money as they can from participating, this may well not be the case. Psychologists who do experiments are familiar with this and can provide many examples of different objectives: to please the experimenter; to finish the experiment as soon as possible; to do what they think that they ought to do; and so on. Economists argue that one should make the monetary incentive sufficiently high to outweigh all these other possible incentives – but one can never be sure that one has done so. The problem, however, is simple: if the participants have some other objective, then, unless the experimenter knows what that is, there is simply no reference point against which one can compare the behaviour of the participant.

5.2 The status quo?

A second possible reference point is what we might call the status quo of the target population. The reason for the concern of the Department for Work and Pensions (DWP) for this target population is that they allocate little or nothing to their pension provision. While in no sense can this be considered optimal behaviour, it does provide a useful point of reference from an academic perspective. Accordingly, when we refer to the status quo strategy, we will be referring to participants who allocate nothing to pensions and hence, retire with just a basic pension of 100 units.

25 The problem here is that the very concept of risk-attitude is difficult to define and to measure. Though we do have some useful information on risk-attitude via the questionnaire, this is not sufficient to identify precisely the risk-attitude of the participants.

26 We should note that this is the worst-case scenario and some in the target population are, in fact, making some, if perhaps too-modest, allocations to pensions. Furthermore, in reality the replacement rate would be likely to be higher than 10%.
6 Findings from the experiment

6.1 Introduction

In this chapter, we provide some descriptive statistics of behaviour in the experiment; some more formal analysis of behaviour, including an analysis of demographic effects; a comparison of behaviour across treatments; a comparison of behaviour with the two ‘reference points’ introduced and defined in Chapter 2. The material is divided by the variables of interest. We start with earnings; then we consider pension allocations; then the decision concerning opting out of the saving scheme (the stylised version of the auto-enrolment into a workplace pension scheme); then opting out of the default fund; and finally, the fund choice. The main items of interest should be kept in mind, namely:

- Did participants maximise their earnings from the experiment?
- How much did they allocate to pensions?
- How close was their behaviour to the risk-neutral model-optimal strategy?
- How close was it to the status quo strategy?
- In which funds did they make their allocations?
- In Treatments 2 and 3, did they opt out of the savings scheme?
- Were there any demographic effects?
- Was there evidence of inertia?

6.2 Earnings

Recall that participants were instructed to try and maximise their earnings from the experiment. Thus, achieved earnings are a crude measure of the extent to which they did this. Table 6.1 shows the mean and standard deviation of earnings over
all the (relevant\textsuperscript{27}) participants. These earnings do not include the participation fee of £30 which all participants received.

Table 6.1  Mean (standard deviation) of earnings from the experiment

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment 1</td>
<td>26.28 (9.89)</td>
<td>27.89 (10.77)</td>
</tr>
<tr>
<td>Treatment 2</td>
<td>31.95 (13.25)</td>
<td>34.41 (9.28)</td>
</tr>
<tr>
<td>Treatment 3</td>
<td>28.29 (13.62)</td>
<td>34.03 (9.72)</td>
</tr>
</tbody>
</table>

It can be seen that earnings were highest in Treatment 2 for both males and females; earnings were second highest in Treatment 3 and lowest in Treatment 1. However, it should be remembered that in Treatments 2 and 3 the participants could choose not to opt out of the savings scheme, and staying in meant that their pension allocations were increased by 75\% by the experimenter. As a consequence, potential earnings were higher. Additionally, females could earn more than males because of their longer life expectancy. One way to standardise these figures is to compare them to earnings under our two reference points: the risk-neutral model-optimal strategy and the status quo. The maximal expected earnings under the first of these are: Treatment 1: £28.10 (males) and £28.93 (females); Treatments 2 and 3: £33.63 (males) and £35.88 (females). The earnings under the second of these are £14.93 (males) and £14.03 (females). The results of these comparisons are shown in Table 6.2.

Table 6.2  Mean earnings as a percentage of earnings in the two reference point strategies

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual earnings as a percentage of those under the risk-neutral model-optimal strategy</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Treatment 1</td>
<td>93.5</td>
<td>96.4</td>
</tr>
<tr>
<td>Treatment 2</td>
<td>95.0</td>
<td>95.9</td>
</tr>
<tr>
<td>Treatment 3</td>
<td>84.1</td>
<td>94.8</td>
</tr>
</tbody>
</table>

Note that of the 207 participants who completed the experiment, 27 have been excluded from all the analyses because they did not fit with the recruitment profile. Details are given in Appendices A and B. The analysis that we present is, therefore, based on the responses of 174 participants.
This is an informative table. We note a number of things, most notably that generally, participants did well compared to the risk-neutral model-optimal strategy. Recall that under this strategy expected earnings are maximised – and we see that in all except one case, participants achieve more than 93.5% of this maximum. We also note that they do very well compared to the status quo – often achieving earnings of twice those under the status quo. As to the treatment effects we note that males do best (relative to both reference points) in Treatment 2, but rather worse in Treatment 3 as compared with both Treatments 1 and 2. Females, in contrast, show modest decreases in earnings relative to the risk-neutral model-optimal strategy from Treatment 1 to Treatment 2 and again from Treatment 2 to Treatment 3, but relative to the status quo strategy earn most in Treatments 2 and 3. This latter result, of course, stems from the fact that the status quo strategy does not take advantage of the savings scheme (the stylised version of the auto-enrolment into a workplace pension scheme). It is not clear why we observe these treatment effects. The experiment can really only shed light on what happens and not on why it happens. We would need a differently designed experiment to shed light on the latter.

It should, however, be noted that there is considerable variation in individual earnings. As is clear from Table 6.1, the standard deviations are large. A histogram of earnings is given in Figure 6.1: along the horizontal axis are the observed values of earnings (going from a small negative earning to almost £60) over and above the participation fee of £30; on the vertical axis is the frequency density of the observations. The histogram shows the distribution of actual earnings. The variable ‘es’ denotes earnings.

Table 6.3 gives summary statistics and for instance shows that earnings for male participants in Treatment 1 varied between a maximum loss of seven pence and a maximum earning of £42.87. It is important to note that losses made by participants were not enforced such that no-one left the experiment with less than the £30 participation fee.

28 We note that the status quo strategy – implying, effectively, no involvement with the pension decision – is almost bound to lead to very low earnings compared with any strategy of active involvement.
Figure 6.1  The distributions of earnings from the experiment

![Graph showing the distributions of earnings for males and females.]

Note: the variable on the horizontal axis is measured in £s sterling and the variable on the vertical axis is a frequency density representing the proportion of participants in each band of values of the variable es.

Table 6.3  Minimum/maximum earnings in the experiment

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<tr>
<td>Treatment 1</td>
<td>-0.07</td>
<td>42.87</td>
</tr>
<tr>
<td>Treatment 2</td>
<td>-0.98</td>
<td>54.75</td>
</tr>
<tr>
<td>Treatment 3</td>
<td>-4.24</td>
<td>50.57</td>
</tr>
</tbody>
</table>

A comment on the distribution of earnings in the experiment is relevant here, particularly in the light of the statements about the risk-neutral model-optimal earnings in the experiment. These earnings are the expected earnings following the risk-neutral model-optimal strategy as viewed from the beginning of the experiment. Actual earnings will deviate from this because of the randomness in the experiment. There are two sources of this: first, the randomness in the realised interest rates and secondly, randomness in the date of death. If we look at those participants who received very high earnings, they were either those who were lucky in their realised interest rates, or were those who built up higher pensions and survived quite far in the experiment. For example, those participants who had built up a pension of more than 2,000 experimental units would receive over £3.59
for every period that they survived in retirement. If they lived for the maximum 12 periods after retirement they would thus earn over £43.08 whilst in retirement – pushing up their earnings considerably. In Treatments 2 and 3 achieving a pension of over 2,000 was not difficult to the extent that the participants received a 75% augmentation from the experimenter. On the other hand, those participants who received very low earnings either were those who were unlucky with interest rates or those who died very young. To achieve negative earnings they would have had to save on average more than 600 each period while alive and experimentally die before retirement. There were some who did.

The above descriptive statistics are confirmed by a more formal analysis – in which we try and explain earnings in terms of potential explanatory variables. These include treatment effects and demographics. To incorporate the former we introduce dummy variables $dt_1$, $dt_2$ and $dt_3$, which are such that $dt_i$ takes the value 1 in Treatment $i$ and the value 0 elsewhere. The demographic information is obtained from the questionnaire. The key variables are gender and rac – a risk aversion index calculated from the answers to questions 10, 11 and 12 in the questionnaire filled in by participants after completing the experiment. It takes values between 0 and 1, with 0 indicating the lowest risk aversion and 1 the highest. Details of the construction of this index are given in Appendix I.

We carried out a number of (ordinary least-squares) regressions to explain earnings. None of the demographics was statistically significant except for gender which was on the borderline of statistical significance at 5%. The risk aversion coefficient was also not statistically significant. However, the treatment dummies were statistically significant. We report the results of a regression explaining earnings in Table 6.4. In this and subsequent tables reporting the results of regression analyses, we indicate significance at 1% with ** and significance at 5% with * attached to the t-statistic.

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29 The allocations necessary to achieve a pension of over 2,000 depend on when the allocations were made and on the rates of interest that were realised – as well as on the gender of the participant. To give an example, if the rate of interest averaged 2.5% then a male would have to allocate 302 of his income of 1,000 every period to achieve a pension of 2,000 (including the basic pension of 100).

30 There were seven participants who died before retirement who earned less than £5 from the experiment, and five participants who died before retirement who earned a negative amount (excluding the participation fee). We should note that we did not enforce these losses on these five participants and hence, no-one left the experiment with less than the £30 participation fee.
Table 6.4 The determinants of earnings

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Standard error</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>$dt_2$ (T1=0, T2=1, T3=0)</td>
<td>6.04</td>
<td>2.15</td>
<td>2.81**</td>
</tr>
<tr>
<td>$dt_3$ (T1=0, T2=0, T3=1)</td>
<td>3.92</td>
<td>2.10</td>
<td>1.87</td>
</tr>
<tr>
<td>gender (male=1 female=2)</td>
<td>3.30</td>
<td>1.74</td>
<td>1.90</td>
</tr>
<tr>
<td>constant</td>
<td>22.16</td>
<td>2.98</td>
<td>7.43**</td>
</tr>
</tbody>
</table>

These simply corroborate the results from Table 6.1 (though note that we have excluded any interaction terms involving gender and the two treatment dummies – they were not significant). So earnings are higher in Treatment 2 than in Treatment 3 and in Treatment 3 than in Treatment 1. Gender has a moderate effect – implying increased earnings by £3.30 for females compared with males. We also note that earnings generally are not too far below those implied by the risk-neutral model-optimal strategy. This could be taken as an indication that participants were at least trying to maximise their earnings from their participation. This might be considered a possible indication of one aspect of the success of the experiment (though the latter is multidimensional).

6.3 Pension allocations

We begin with some descriptions of the pension allocations31 before more formal analyses. The main items of interest in this section are: (1) what were the pension allocations of the participants? (2) how close were they to the risk-neutral model-optimal allocations? (3) how close were they to the status quo allocations? (4) how did they appear to be determined? (5) were there treatment effects? (6) were there demographic effects?

One of the more obvious features of our data is that there is a lot of noise in it. Some of the noise is between subjects and some within subjects. By the former we mean that different subjects behaved differently. By the latter we mean that, for some participants, pension allocations fluctuated considerably during the experiment. However, for some subjects their behaviour was smoother. Some idea of this noise can be gleaned from Figures 6.2 and 6.3, in which we present scatter graphs (Figure 6.2 with males on the left and females on the right, and Figure 6.3 by treatment). Plotted on the vertical axis is the individual mean pension allocations and, on the horizontal axis, the standard deviation of their pension allocations. The graphs for males and females are similar but there are clear treatment effects. There is generally a tendency for higher means to be associated with higher standard deviations. To give some point of reference we present, in Table 6.5, the means and standard deviations of pension allocations under the risk-neutral model-optimal strategy – though these figures obscure the fact that the risk-neutral model-optimal strategy is downward sloping through time.

---

31 We note that the only constraint on pension allocations was that they could not be negative and had to be less than the experimental income of 1,000 units.
Table 6.5  Means and standard deviations of actual allocations and allocations under the risk-neutral model-optimal strategy

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual</td>
<td>Risk-neutral model optimal</td>
</tr>
<tr>
<td>Standard Mean</td>
<td>deviation</td>
<td>Mean</td>
</tr>
<tr>
<td>Treatment 1</td>
<td>316</td>
<td>287</td>
</tr>
<tr>
<td>Treatment 2</td>
<td>318</td>
<td>244</td>
</tr>
<tr>
<td>Treatment 3</td>
<td>304</td>
<td>236</td>
</tr>
</tbody>
</table>

Figure 6.2  Mean and standard deviation of pension allocations by gender

Graphs by gender.

Note: the variables on both axes are measured in £s sterling. The left hand graph is for males and the right hand graph for females. mpa denotes the mean pension allocation and sdpa the standard deviation of the pension allocations.
In addition to the considerable variability between participants, there is also considerable variation within participants – particularly in terms of their pension allocations through time. As can be seen from Figure 5.1, the risk-neutral model-optimal strategy involves a decline through time in the allocations (except in the final one or two periods). Indeed, we have argued that this is necessarily the case even for participants who were not risk-neutral, though we should emphasise that we have not proved that this is so. There were some participants who realised that this declining allocation was a necessary feature of what appears to be a good strategy but there were many who did not realise this. Some had a roughly constant strategy while some increased their allocations through time. Others had an allocation strategy with large variations in pension allocations. Figure 6.4 shows an example of a participant who had a strategy with a profile similar to that of the risk-neutral model-optimal strategy. This shows the pension allocations that participant 1101 made in the 15 pre-retirement periods in the experiment – starting off from around 600 in period 1 and declining to around 200 in period 15.
At the top of the graph is indicated the fund\textsuperscript{32} in which the savings were made. Although the savings are generally in excess of the risk-neutral model-optimal savings, the general shape is in accordance with that strategy.

We do not have the space to include graphs of the behaviour of all the participants in the experiment, but we think it important to give some idea of the types of behaviour exhibited by the participants. A preliminary classification is as follows:

- participants who broadly had a downward sloping profile;
- participants who broadly had a constant profile;
- participants who broadly had an upward sloping profile;
- participants who broadly had an oscillating profile;
- participants who had a wildly fluctuating profile or who appeared to be totally confused.

In Figures H.1 to H.6 (see Appendix H), we give examples of each of these types. A formal separation of the participants into these various categories is, however, not easy – and the above list is given merely to indicate the range of different kinds of behaviour. It might be interesting, if any further analyses were to be conducted on this data, to try and separate the participants into different categories and examine separately the behaviour within each category.

\textsuperscript{32} With Fund 1 being the most risky fund followed by Fund 2 and finally Fund 3 which is the least risky fund in both Treatments 1 and 3.
Figure 6.5 (males) and Figure 6.6 (females) show the average pension allocations through time by treatment. These figures also show the risk-neutral model-optimal allocations.

**Figure 6.5 Pension allocations – males**

![Figure 6.5 Pension allocations – males](image)

Some of the noisiness in the data may be due to learning effects. If this is true then we would expect that noisiness would be reduced in the later periods of the experiment relative to the earlier periods. To investigate this possibility we carry out two comparisons of allocations in the first and second halves of the pre-retirement period: First, in Table 6.6 we show the standard deviation of allocations in the first and second halves with $t<8$ representing the first seven periods of the experiment and $t>7$ for the second half of the experiment from period 8 to period 15. Second, in Table 6.7 we show the mean absolute deviations of the actual allocations relative to the risk-neutral model-optimal ones and in the first and second halves. These tables shows some modest reduction in the noise relative to the risk-neutral model-optimal strategy in the later periods of the experiment but...
there is no strong evidence of convergence – either to a constant strategy or to the risk-neutral model-optimal strategy.

**Figure 6.6 Pension allocations – females**

![Graph showing pension allocations for females across different periods and treatments.]

**Table 6.6 Standard deviations of actual allocations**

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t&lt;8</td>
<td>t&gt;7</td>
<td>t&lt;8</td>
<td>t&gt;7</td>
</tr>
<tr>
<td>Treatment 1</td>
<td>313</td>
<td>249</td>
<td>285</td>
<td>260</td>
</tr>
<tr>
<td>Treatment 2</td>
<td>246</td>
<td>239</td>
<td>206</td>
<td>193</td>
</tr>
<tr>
<td>Treatment 3</td>
<td>239</td>
<td>232</td>
<td>183</td>
<td>167</td>
</tr>
</tbody>
</table>
Table 6.7  The mean absolute deviation of actual from risk-neutral model-optimal allocations

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(t&lt;8)</td>
<td>(t&gt;7)</td>
</tr>
<tr>
<td>Treatment 1</td>
<td>258</td>
<td>197</td>
</tr>
<tr>
<td>Treatment 2</td>
<td>194</td>
<td>191</td>
</tr>
<tr>
<td>Treatment 3</td>
<td>199</td>
<td>189</td>
</tr>
</tbody>
</table>

Apart from the noisiness in the data, there are a number of features that emerge from this descriptive analysis: First, the males tend generally to allocate more to pensions than they would be doing if they were following the risk-neutral model-optimal strategy. This could be due to all sorts of reasons: risk aversion (though interestingly, the females, who are more risk-averse, do something different); myopia; learning and so on, though we can only speculate at this stage. We do note that in Treatment 1 there is some sign of a decline in contributions through time. On the other hand, the females have a flatter strategy but are somewhat closer to the allocations that would be optimal if they were following the risk-neutral model-optimal strategy (we have already seen this from Table 6.1). There is also clear evidence of a treatment effect on the pension allocation of the females though there is very little obvious effect in the males’ allocations. This is shown more clearly in Table 6.8.

Table 6.8  Mean (standard deviation) of pension allocations

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment 1</td>
<td>315 (286)</td>
<td>340 (273)</td>
</tr>
<tr>
<td>Treatment 2</td>
<td>318 (243)</td>
<td>275 (200)</td>
</tr>
<tr>
<td>Treatment 3</td>
<td>303 (235)</td>
<td>208 (174)</td>
</tr>
</tbody>
</table>

The mean male allocation is modestly highest in Treatment 2 and lowest in Treatment 3, while for females much less is allocated in Treatment 3 relative to Treatment 2 and much less in that relative to Treatment 1.

Table 6.8 refers to the means (and standard deviations) of the participants’ allocations. In Treatments 2 and 3 these are augmented by the 75% added by the experimenter. We can calculate the means (and standard deviations) of the augmented allocations. These are given in Table 6.9.
Table 6.9  Mean (standard deviation) of augmented pension allocations

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment 1</td>
<td>315 (286)</td>
<td>340 (273)</td>
</tr>
<tr>
<td>Treatment 2</td>
<td>556 (425)</td>
<td>481 (350)</td>
</tr>
<tr>
<td>Treatment 3</td>
<td>530 (411)</td>
<td>364 (304)</td>
</tr>
</tbody>
</table>

With the augmentation of the 75% from the experimenter, both male and female allocations are highest in Treatment 2; they are next highest in Treatment 3. If the objective was to maximise (augmented) pension allocations then participants in Treatment 2 did better to achieve that objective than the participants in the other treatments. The lower allocations in Treatment 3 might result from the feeling of security generated by the existence of a risk-free fund.

The implied pensions and the pensions under the risk-neutral model-optimal strategy are shown in Table 6.10.

Table 6.10  Mean actual pensions and pensions under the risk-neutral model-optimal strategy

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean actual (percentage of model-optimal)</td>
<td>Risk-neutral model-optimal</td>
</tr>
<tr>
<td>Treatment 1</td>
<td>1,635 (186)</td>
<td>867</td>
</tr>
<tr>
<td>Treatment 2</td>
<td>2,139 (150)</td>
<td>1,429</td>
</tr>
<tr>
<td>Treatment 3</td>
<td>1,967 (139)</td>
<td>1,429</td>
</tr>
</tbody>
</table>

It is clear that participants in all treatments had higher pensions than under the risk-neutral model-optimal strategy, except for females in Treatment 3. Indeed, generally, females were closer (on average) to those implied by the risk-neutral model-optimal strategy, while the ratio between the mean actual and that under the risk-neutral model-optimal fell from Treatment 1 to Treatment 2 and again to Treatment 3. All things being equal, participants’ pension allocations in Treatment 3 were closer to the pension allocations in the risk-neutral model-optimal strategy than the participants’ allocations in Treatments 1 and 2.

Table 6.7 summarises the total allocations to pensions made by the participants. We now explore the impact of the various demographic variables on allocations, by carrying out tobit regressions of the total pension allocations on various possible explanatory variables. Table 6.11 was the result after following the usual procedure of eliminating statistically insignificant variables. With the exception

33 We note that the dependent variable is truncated between 0 and 15,000, hence making an ordinary least-squares regression inappropriate.
of income (in real life) and risk aversion (rac), none of the demographics was statistically significant. The treatment effects were also not statistically significant (probably because of the noise in the data) but we include them in Table 6.11 to avoid distortions.

Table 6.11  The determinants of total pension allocations

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>dt2</td>
<td>-326.7</td>
<td>476.7</td>
<td>-0.69</td>
</tr>
<tr>
<td>dt3</td>
<td>-796.4</td>
<td>477.1</td>
<td>-1.67</td>
</tr>
<tr>
<td>Income</td>
<td>315.6</td>
<td>103.5</td>
<td>3.05**</td>
</tr>
<tr>
<td>Rac</td>
<td>-2783.5</td>
<td>1019.4</td>
<td>-2.73**</td>
</tr>
<tr>
<td>Constant</td>
<td>5134.2</td>
<td>867.1</td>
<td>5.92**</td>
</tr>
</tbody>
</table>

The coefficient on the risk aversion variable is interesting – indicating that the more risk averse participants allocate significantly less to pensions than those less risk averse – but it could be explained by the fact that putting money into pensions is a risky activity, partly because of the risk on the rates of interest and partly because of risk concerning the date of death, while converting or consuming is a certain activity. Thus, the more risk-averse participants put relatively more experimental money into the safe activity (conversion or consumption) and relatively less money into the risky activity (pensions). The income variable is also of interest – suggesting that participants with a high income in real life allocate more than those with a low income. This may be because participants could not abstract from their personal characteristics. The problem posed to them was independent of their real life income.

The effect of risk aversion, if not of income, also appears in a tobit\(^{34}\) regression analysis of pension allocations through time. Here the important variables are \(t\) (the period number), rac, gender and the treatment dummies, as Table 6.12 shows. This table reports the results of a tobit analysis in which the dependent variable is individual pension allocations through time. We note that the extra explanatory variables are interaction variables.

---

\(^{34}\) This type of regression is appropriate when the dependent variable is truncated – in this case between 0 and 1,000.
Table 6.12 Individual pension allocations through time

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>-71.4</td>
<td>22.5</td>
<td>-3.17**</td>
</tr>
<tr>
<td>dt2</td>
<td>-111.8</td>
<td>27.2</td>
<td>-4.10**</td>
</tr>
<tr>
<td>dt3</td>
<td>-156.0</td>
<td>27.3</td>
<td>-5.70**</td>
</tr>
<tr>
<td>t</td>
<td>-21.3</td>
<td>4.27</td>
<td>-4.98**</td>
</tr>
<tr>
<td>dt2*t</td>
<td>9.84</td>
<td>3.03</td>
<td>3.24**</td>
</tr>
<tr>
<td>dt3*t</td>
<td>11.4</td>
<td>3.04</td>
<td>3.73**</td>
</tr>
<tr>
<td>Gender*t</td>
<td>6.23</td>
<td>2.50</td>
<td>2.49*</td>
</tr>
<tr>
<td>Rac</td>
<td>-210.7</td>
<td>28.1</td>
<td>-7.49**</td>
</tr>
<tr>
<td>Constant</td>
<td>656.9</td>
<td>41.1</td>
<td>16.0**</td>
</tr>
</tbody>
</table>

Here we observe a strong influence of risk aversion on savings: the most risk averse allocate, on average over 210 per period less to savings than the least risk averse. This effect is not only strongly significantly statistically but it also has a strong economic significance – given the magnitude of the coefficient, moving from the least risk averse to the most risk-averse decreases allocations by over 210 each period. Set against the risk-neutral model-optimal values of pension allocations (see Figure 5.1), 210 is a large decrease. The table also shows the gender effect (as is clear from Figures 6.2 and Figure 6.3): at the start, females allocate less but the decline in their contributions through time is also less than the males. We also note the strong treatment effects: in Treatment 2 allocations start out below those in Treatment 1 but decay less rapidly with time; in Treatment 3 allocations start out below those in Treatment 2 (and hence, below those in Treatment 1) but they decay less rapidly than those in Treatment 2 (and hence, less rapidly than those in Treatment 1). The fact that females are generally more risk-averse than males should be kept in mind when interpreting these effects.

The magnitude of the time coefficients should also be noted. Table 6.13 gives the details. In general, allocations fall much less than under the risk-neutral model-optimal strategy. Moreover, the allocations made by females go more strongly against the latter strategy than do those for males.

Table 6.13 Actual and risk-neutral model-optimal average per period changes in allocations

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual</td>
<td>Risk-neutral model-optimal</td>
<td>Actual</td>
<td>Risk-neutral model-optimal</td>
</tr>
<tr>
<td>Treatment 1</td>
<td>-13.56</td>
<td>-10.8</td>
<td>-8.10</td>
<td>-15.0</td>
</tr>
<tr>
<td>Treatment 2</td>
<td>-4.16</td>
<td>-10.8</td>
<td>+1.20</td>
<td>-15.1</td>
</tr>
<tr>
<td>Treatment 3</td>
<td>-2.69</td>
<td>-10.8</td>
<td>+2.67</td>
<td>-15.1</td>
</tr>
</tbody>
</table>
This all provides confirmation of the fact that participants allocate relatively little at the start of their lifetime and relatively a lot at the end. This could be referred to as evidence of the existence of a form of myopia, but we should be careful about the use of this word. One could argue that a totally myopic person would not allocate anything to pensions. Clearly, this is not the case for our participants. Indeed, they were making substantial allocations to pensions and much more than under the status quo. So we may be observing a form of myopia where participants did not appear to realise that making allocations early in life (early in the experiment) were more effective than making allocations later in life (later in the experiment). One may possibly conclude that participants did not understand the effect of compound interest rates.

If this misunderstanding of the effects of compound interest is true, then it seems to be the case that this lack of understanding is constant across treatments.

6.4 Opting out of the savings scheme

We now explore the determinants of the decision as to whether to stay in or opt out of the savings scheme. This is one of the features of interest in this experiment. This section addresses whether, given that participants are automatically enrolled into the savings scheme, they then stay in the scheme. Note that we cannot check, given the experimental design, whether they are more likely to stay in with the automatic enrolment than without it35, but we can still analyse the possible reasons for staying in and opting out.

Opting-out is relevant only to Treatments 2 and 3. In the risk-neutral model-optimal solution participants should never opt out – as the risk-neutral model-optimal pension allocation is always in excess of the 10% of salary required for staying in the scheme. In the experiment, only on very few occasions – just on 56 out of 840 occasions in Treatment 2 and just on 77 out of 900 occasions in Treatment 3 – did a participant opt out. Moreover, 82 out of the 116 participants in Treatments 2 and 3 never opted out, while 11 opted out at most in five periods. Note that it follows that the higher the rate of opt out, the lower will be the earnings in the experiment.

We begin with a simple descriptive table showing the numbers staying in the savings scheme and opting out of it, by period, treatment and gender. This is given in Table 6.14. There are some slight fluctuations, but, given the small number of observations in each cell, there seems to be nothing of statistical significance out of which inferences might be made.

35 In order to have achieved this we would have had to have an experimental design in which there were two treatments, both with the savings scheme, and such that in one treatment participants were automatically in the scheme (unless they opted out) while in the other, participants were not in the scheme unless they opted in.
Despite the fact that very few participants decided to opt out, it is possible, in principle, to carry out probit analyses of the decision to opt out, though, in practice, nothing of any statistical significance seems to emerge. A process of elimination of the least statistically significant variable leads to the estimates in Table 6.15.

Table 6.15 The determinants of the decision to stay in (1) or opt out (0) of the savings scheme

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>dt3</td>
<td>-0.14</td>
<td>0.09</td>
<td>-1.55</td>
</tr>
<tr>
<td>t</td>
<td>-0.01</td>
<td>0.01</td>
<td>-1.4</td>
</tr>
<tr>
<td>Constant</td>
<td>1.61</td>
<td>0.11</td>
<td>14.74**</td>
</tr>
</tbody>
</table>

Neither the treatment dummy $dt3$ or the period variable $t$ are significant, though there is slight evidence of more opting out in Treatment 3 and a slight increase in opting out through the periods of the experiment. It might be inferred that those opting out were those who did not understand the implications of the saving scheme and hence, their behaviour might be rather unpredictable.

36 A probit analysis is appropriate when the dependent variable just takes the values 0 and 1.
Looking at the data, we note that there is an increase in opting out as the experiment progresses, not a fall.

Finally, we note a consequence of the savings scheme on contributions: in Treatments 2 and 3 there is a noticeable spike at 10% of income. This 10%, of course, is the minimum allocation consistent with remaining in the savings scheme. See Figure 6.7.

**Figure 6.7** Histogram of pension allocations by treatments

![Histogram of pension allocations by treatments](image.png)

Note: the variable on the horizontal axis is measured in units of experimental money while that on the vertical axis is a density, measured in numbers per unit of experimental money. The horizontal axis for Treatment 1 is the same as that for Treatment 3 - at the foot of the graph.

6.5 Opting out of the default fund

This section analyses the decision to opt out of the default fund, thus looking for signs of possible inertia in participants’ behaviour.

The default fund is Fund 2 (as it is set in that fund in period 1 for all treatments) or the fund in which the participant made the allocation in the preceding period. If participants stay in the default fund (whether it is the default fund as provided by the experiment or the default provided by their past
behaviour) then this is some sign of inertia in behaviour. Of course, we cannot
tell whether the decision to stay with the default fund is an indicator of inertia or
an indicator that the participant is choosing what they think is the best fund; a
change to the design of the experiment would be needed to distinguish between
these two possibilities.

We analyse the determinants of the variable $idf$ which takes the values 1 if the
participant is in the default fund and 0 if the participant is in some other fund
(including no fund). This variable is a possible indicator of inertia in the behaviour
of the participant, though it could also (as we have indicated in the paragraph
above) simply be an indication that the participant is choosing what they think is
the best fund. We begin with a simple description of the data; this is presented in
Table 6.16. If participants were changing funds at random, we would see entries
of 33% in Treatments 1 and 2, and of 25% in Treatment 3.

Table 6.16  Percentage of time participants stay in the default fund

<table>
<thead>
<tr>
<th></th>
<th>Males %</th>
<th>Females %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment 1</td>
<td>44</td>
<td>46</td>
</tr>
<tr>
<td>Treatment 2</td>
<td>60</td>
<td>52</td>
</tr>
<tr>
<td>Treatment 3</td>
<td>56</td>
<td>47</td>
</tr>
</tbody>
</table>

There is some modest evidence here that participants are more likely to stay in the
default fund than choose at random amongst the available funds. There is more
evidence of this for males in Treatment 2 than in Treatment 3 and more there
than in Treatment 1. There is a similar pattern for females but the evidence is not
as strong. More formal analysis yields similar results. We carry out a time series
analysis, using $idf$ as the dependent variable. This just takes values 0 or 1, so, once
again, a probit analysis is appropriate. We obtain the results in Table 6.17 after the
usual process of eliminating the least significant variables.

---

37 Recall that there are three funds in Treatments 1 and 2 and four funds in
Treatment 3.

38 Starting with all potential explanatory variables included and then successively
eliminating the least significant (those with the smallest t-statistic) until just
the most significant variables are left.
Table 6.17  The determinants of the decision to stay in (1) or opt out (0) of the default fund

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>dt2</td>
<td>0.29</td>
<td>0.06</td>
<td>4.62**</td>
</tr>
<tr>
<td>dt3</td>
<td>0.18</td>
<td>0.06</td>
<td>3.01**</td>
</tr>
<tr>
<td>t</td>
<td>0.01</td>
<td>0.01</td>
<td>2.26*</td>
</tr>
<tr>
<td>gender</td>
<td>-0.13</td>
<td>0.05</td>
<td>-2.55*</td>
</tr>
<tr>
<td>constant</td>
<td>-0.27</td>
<td>0.10</td>
<td>-0.50</td>
</tr>
</tbody>
</table>

Here we find that participants are more likely to stay in the default fund in Treatment 2 compared to Treatment 1, and that they are also more likely to stay in the default fund in Treatment 3 compared to Treatment 1, but here the effect is less strong. Males seem to show somewhat more tendency than females to stay in the default fund. Interestingly, we see here no effect of the other demographic variables. As time passes they are more likely to stay in the default fund – though the magnitude of the effect is small.

6.6  The fund choice

Here we present results on the fund choice. The questions of particular interest to us are the following:

- Which funds do participants choose?
- Is there a time effect?
- Are there treatment effects (particularly in Treatment 3)?
- Are there demographic effects?

Overall, we want to understand what determines the fund choice.

Figure 6.8 represents a histogram (with the frequency density on the vertical axis) of the fund choice by gender (all treatments together) while Figure 6.9 represents a histogram (with the frequency density on the vertical axis) of the fund choice by treatment (both genders together). Note that ‘Fund 0’ refers to a situation in which the pension allocation is zero, and hence in which there is no fund choice to be made. Figure 6.8 shows some minor differences between males (the left hand graph) and females (the right hand graph): the modal fund for males is Fund 1 while that for females is Fund 2 – which is less risky. This seems to be consistent with the fact that females tend to be more risk-averse than men. Figure 6.10 gives histograms by both gender and treatment, showing a stronger movement by females into Fund 4 in Treatment 3.

The differences between Treatments 1 and 2 seem to be minor (shown in Figure 6.9), while naturally the distribution in Treatment 3 is different – with the inclusion of Fund 4. Somewhat over 14% of the allocations in the latter treatment were
in Fund 4, and its existence also seems to have changed the distribution over the other three funds – in that Fund 2 was the modal choice in Treatments 1 and 2 while Fund 1 is the modal choice in Treatment 3. The introduction of the risk-free fund has moved some people into it and others into Fund 1.

**Figure 6.8 Histograms of the fund choice by gender**

Graphs by gender.

Note: the variable on the horizontal axis is just the number of the fund, while that on the vertical axis is unit-less, representing the proportion of participants choosing that fund. The left hand histogram is for males and the right hand histogram for females.
Figure 6.9 Histograms of the fund choice by treatment

Graphs by treatment.

Note: the variable on the horizontal axis is just the number of the fund, while that on the vertical axis is unit-less, representing the proportion of participants choosing that fund. The horizontal axis for Treatment 1 is the same as that for Treatment 3 - at the foot of the graph.
A more formal analysis shows some interesting demographic effects. After following the usual procedure of eliminating the least statistically significant variables, we arrive at Table 6.18 (note that we have left $t$ and $dt1$ in the equation, despite their statistical insignificance, as they are economically of interest). The dependent variable in this table is the number indicating the fund choice.

**Table 6.18  The determinants of fund choice**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>$dt2$</td>
<td>0.06</td>
<td>0.05</td>
<td>1.23</td>
</tr>
<tr>
<td>$dt3$</td>
<td>0.31</td>
<td>0.05</td>
<td>6.41**</td>
</tr>
<tr>
<td>$t$</td>
<td>0.00</td>
<td>0.00</td>
<td>0.69</td>
</tr>
<tr>
<td>Age</td>
<td>0.09</td>
<td>0.02</td>
<td>5.10**</td>
</tr>
<tr>
<td>Income</td>
<td>-0.04</td>
<td>0.01</td>
<td>-3.47**</td>
</tr>
<tr>
<td>Rac</td>
<td>0.61</td>
<td>0.11</td>
<td>5.7**</td>
</tr>
<tr>
<td>Constant</td>
<td>1.23</td>
<td>0.10</td>
<td>12.18**</td>
</tr>
</tbody>
</table>

Graphs by treatment and gender.

Note: the variable on the horizontal axis is just the number of the fund, while that on the vertical axis is unit-less, representing the proportion of participants choosing that fund. The top row is for the males and the bottom row for the females; Treatment 1 is on the left and Treatment 3 on the right. The horizontal axis for the top row is the same as that for the bottom row - at the foot of the graph.
Treatment 3 induces a less risky fund choice (recall that going from Fund 1 through to Fund 4, the riskiness of the fund is decreasing), and there is a modest (but statistically insignificant) increase in Treatment 2. The passage of time in the experiment has no effect while age increases the fund choice – the older participants choose the safer funds. Participants with higher income in real life choose riskier funds. Finally, the risk aversion variable has a statistically significant positive effect: the more risk-averse, the less risky the fund chosen.

Table 6.19 presents results when restricting the above analysis to Treatments 2 and 3 (in which there was the savings scheme).

### Table 6.19 The determinants of fund choice in Treatments 2 and 3

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>dt3</td>
<td>0.25</td>
<td>0.05</td>
<td>4.94**</td>
</tr>
<tr>
<td>t</td>
<td>0.00</td>
<td>0.01</td>
<td>0.47</td>
</tr>
<tr>
<td>Age</td>
<td>0.08</td>
<td>0.02</td>
<td>3.63**</td>
</tr>
<tr>
<td>Income</td>
<td>-0.03</td>
<td>0.01</td>
<td>-2.30*</td>
</tr>
<tr>
<td>Rac</td>
<td>0.76</td>
<td>0.14</td>
<td>5.31**</td>
</tr>
<tr>
<td>Constant</td>
<td>1.20</td>
<td>0.13</td>
<td>9.03**</td>
</tr>
</tbody>
</table>

The results are similar: time (in the experiment) is not significant; older people are more likely to choose the less risky funds; the people with higher income (in real life) are more likely to choose the riskier funds; more risk-averse people are more likely to choose the safer funds; in Treatment 3 there is the obvious move into Fund 4. Note that we are talking about the participants’ real age and real income and not their age or income in the experiment. The fact that demographic variables such as age and income appear (as important explanatory variables in explaining behaviour) reinforces the point made earlier on several occasions: these variables are irrelevant to the solution of the problem in the laboratory and hence, the fact that they are significant has two implications: first that these variables actually influence the ability of the participants to tackle the experiment; second, that these variables somehow activate personal heuristics. We cannot distinguish between these two possibilities given the information at our disposal.

An analysis using dummy variables reinforces the above analysis. If we define the variable $df1$ as taking the value 1 if the allocation is made in Fund 1 and 0 otherwise, and we define $df2$ and $df3$ similarly, then we get the results in Table 6.20. (Note that in this table we are just reporting the estimated coefficients and whether they are significant (** at 1%. * at 5%). Note also that we are including in the reported equation the demographic variables gender and rac – because we found them important elsewhere.)
Table 6.20  The determinants of individual fund choice

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>df1</th>
<th>df2</th>
<th>df3</th>
<th>df4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>-0.07</td>
<td>-0.36</td>
<td>0.11*</td>
<td>-0.03</td>
</tr>
<tr>
<td>Age</td>
<td>-0.08**</td>
<td>0.07**</td>
<td>-0.01</td>
<td>0.27**</td>
</tr>
<tr>
<td>Rac</td>
<td>-0.02</td>
<td>0.02</td>
<td>0.25**</td>
<td>-0.12</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.04</td>
<td>-0.54**</td>
<td>-1.06*</td>
<td>-1.62**</td>
</tr>
</tbody>
</table>

What is particularly interesting about this table, in addition to the obvious move out of Funds 2 and 3 in Treatment 3, is the strong influence of age on fund choice: older people are much more likely to choose Fund 4.
Appendix A
Sampling

A.1.1 Methodology

This experiment used quota sampling. We used this method in order to select as broad a range of the target population as possible. Accordingly we used the following sampling variables: income, age, gender, and employment pattern (i.e., full-time or part-time). Appendix B gives our target and achieved quotas. The remaining variables, household composition, marital status, employment sector (e.g., public, private) and pension contribution, were monitored and considered in the analysis.

Participants were recruited by the consultancy Ecotec.

A.1.2 The target group

The target population for this study is the target group for auto-enrolment into a workplace pension scheme. This group is discussed in the Department for Work and Pensions (DWP) White Paper (December 2006) ‘Personal accounts: a new way to save’. Broadly, the group consists of employees from 22 to State Pension age (currently 65 for men and 60 for women) earning between £5,000 and £33,500 a year and not in a private pension scheme.

We did not specify pension provision in the recruitment since employees who already had a private pension might, in future, be auto-enrolled into a personal account or other qualifying workplace pension scheme, for example, by a change of employer. We did, however, specify that participants should not be self-employed: although it is intended to allow the self-employed to opt in to personal accounts, the design of the employer’s contribution in the experiment is not appropriate for this group. Similarly, we excluded from the sample the economically inactive, for example, those who are caring for children and not doing paid work.

39 Based on the personal accounts earnings band where contributions will be made on a band of earnings between around £5,000 and £33,500 a year.
Appendix B
Target and achieved quotas

Some of those recruited had to be excluded from the analysis because they fell outside the target group. Three of those recruited attended an experiment session but withdrew from the experiment. The following table gives details of the participation rates.

Table B.1 Participation rates

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number sampled</td>
<td>204</td>
<td></td>
</tr>
<tr>
<td>Ineligible (not population of interest)</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Opt-outs (attended session but declined to participate)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>In scope of experiment:</td>
<td>201</td>
<td>100</td>
</tr>
</tbody>
</table>

Ineligible cases
- Participant self-employed | 17
- Participant outside earnings band | 10
  | 27

In scope of analysis: | 174 | 87
Participation rate | 99

Table B.2 summarises our specified and achieved sample. The variables were monitored using the questionnaire in Appendix F.
Table B.2  Target and achieved quotas

<table>
<thead>
<tr>
<th></th>
<th>Target</th>
<th>Achieved</th>
<th>Ineligible</th>
<th>In scope of study</th>
<th>In scope of study %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>105</td>
<td>102</td>
<td>13</td>
<td>89</td>
<td>85</td>
</tr>
<tr>
<td>Female</td>
<td>105</td>
<td>98</td>
<td>14</td>
<td>84</td>
<td>80</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22 to 34</td>
<td>70</td>
<td>83</td>
<td>9</td>
<td>74</td>
<td>106</td>
</tr>
<tr>
<td>35 to 44</td>
<td>70</td>
<td>46</td>
<td>4</td>
<td>42</td>
<td>60</td>
</tr>
<tr>
<td>45 to 64</td>
<td>70</td>
<td>70</td>
<td>13</td>
<td>57</td>
<td>81</td>
</tr>
<tr>
<td><strong>Income (£ 000)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 to 20</td>
<td>108</td>
<td>114</td>
<td>9</td>
<td>105</td>
<td>97</td>
</tr>
<tr>
<td>20 to 33</td>
<td>102</td>
<td>72</td>
<td>8</td>
<td>64</td>
<td>63</td>
</tr>
<tr>
<td><strong>Work pattern</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part-time</td>
<td>at least 54</td>
<td>52</td>
<td>15</td>
<td>37</td>
<td>-</td>
</tr>
<tr>
<td>Full-time</td>
<td>at least 54</td>
<td>142</td>
<td>11</td>
<td>131</td>
<td>-</td>
</tr>
</tbody>
</table>

Note that subtotals may not add up to the sample size in the scope of the experiment because not every participant completed all parts of the questionnaire.

The final table in this section shows how the participants were distributed across the three treatments.

Table B.3  Distribution of participants across treatments

<table>
<thead>
<tr>
<th></th>
<th>Treatment 1</th>
<th>Treatment 2</th>
<th>Treatment 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Achieved in sample</td>
<td>In scope of study</td>
<td>Achieved in sample</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>33</td>
<td>30</td>
<td>34</td>
</tr>
<tr>
<td>Female</td>
<td>33</td>
<td>28</td>
<td>31</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22 to 34</td>
<td>27</td>
<td>27</td>
<td>30</td>
</tr>
<tr>
<td>35 to 44</td>
<td>13</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>45 to 64</td>
<td>26</td>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td><strong>Income (£ 000)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 to 20</td>
<td>37</td>
<td>34</td>
<td>39</td>
</tr>
<tr>
<td>20 to 33</td>
<td>23</td>
<td>21</td>
<td>24</td>
</tr>
<tr>
<td><strong>Work pattern</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part-time</td>
<td>13</td>
<td>8</td>
<td>22</td>
</tr>
<tr>
<td>Full-time</td>
<td>50</td>
<td>47</td>
<td>43</td>
</tr>
</tbody>
</table>
Appendix C
Instructions for Treatment 3

Note: those for Treatments 1 and 2 are the same except that neither contain a reference to Fund 4 and Treatment 1 does not contain any reference to the auto-enrolment into a workplace pension scheme.

Welcome to this experiment. The Department for Work and Pensions (DWP) of the UK Government has provided the funds to finance this research. Depending on your decisions you may earn a considerable amount of money which will be paid to you in cash immediately after the end of the experiment. This sum will be in addition to the £30 that you have been promised.

There are no right or wrong ways to complete the experiment, but the decisions that you take will have implications for what you are paid at the end of the experiment. This depends partly on the decisions that you take during the experiment and partly on chance. So you will need to read these instructions carefully.

At the end of the experiment you will be asked to complete a brief questionnaire and to sign a receipt for the payment that you received, and to acknowledge that you participated voluntarily in the experiment. The results of the experiment will be used for the purpose of academic and governmental research and will be published and used in such a way that your anonymity will be preserved.

How these Instructions are organised

We begin with a brief overview and then we give you all the details that you need.
OVERVIEW

• You should try and maximise your payment from participating in this experiment.
• This you can do by the decisions that you take.
• The experiment lasts a random number of periods.
• In each period you get an income denominated in units of experimental money.
• You have to decide each period how much of this income you want to convert into real money.
• Your payment for participating (in addition to the £30 that you have been promised) is the sum of the amounts of real money that you have converted from experimental money over all the periods of the experiment.

DETAIL

Periods

The experiment simulates a life from the age of 22 to the age of death. This time is divided up into three-year blocks, which we call periods. The experiment starts with you at age 22, in period 1, and continues until you experimentally die. At this point the experiment is over for you. The number of such periods is random, as is the length of life in practice. We will use life tables to simulate your experimental date of death; we will describe this process shortly.

Retirement

If you reach age 67, that is, if you reach period 16, you retire. Thus, periods 1 through 15 are before retirement and periods 16 onwards are after retirement.

Your income

In each period before retirement, you will receive an income of 1,000 units of experimental money. After you retire you receive a pension, also denominated in units of experimental money. This pension will consist of a guaranteed basic pension of 100 units of experimental money per period, plus an additional pension that depends on any savings that you have made before retirement.

Your decisions

In each period before retirement, you have to decide how much of your income of 1,000 units of experimental units you want to convert into real money and how much you want to save. If you decide to save some of your income, you will have a choice of different Funds in which you can put these savings. After retirement you have no further decisions to make – your pension is automatically converted from units of experimental money into real money.
Converting experimental money into real money

The Conversion Scale (that is, the rate at which experimental money is converted into real money) is shown in the Tables in the other document that you have in front of you. You might like to refer to this now. If the amount consumed in any individual period is below 400 you actually earn a negative amount – that is, you lose money. So, for example 100 units consumed become – 157p in real money (that is, a loss of £1.57); 400 units become 0p; 700 units become 117p (that is, a gain of £1.17); and so on.

An example

Suppose that you convert your entire income every period before retirement and thus you save nothing. Then your pension would just be the basic pension of 100 units per period. Suppose the experiment lasts for you a total of 23 periods (15 before retirement and eight after retirement) then your conversions in these 23 periods would be:

<table>
<thead>
<tr>
<th>period</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>income</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>period</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>income</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

and hence your corresponding earnings would be, all in pence:

<table>
<thead>
<tr>
<th>period</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>earnings</td>
<td>203</td>
<td>203</td>
<td>203</td>
<td>203</td>
<td>203</td>
<td>203</td>
<td>203</td>
<td>203</td>
<td>203</td>
<td>203</td>
<td>203</td>
<td>203</td>
</tr>
<tr>
<td>period</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td></td>
</tr>
</tbody>
</table>

Thus, your earnings from the experiment itself would be £17.89 (that is 203 pence for 15 periods minus 157 pence for eight periods). You would be paid this in addition to the £30 that you have been promised – implying a total payment of £47.89. Note carefully that it follows that what you are paid (over and above the promised £30) depends on the decisions that you take during the experiment.

The Number of Periods in the Experiment

The number of periods that the experiment lasts for you depends upon chance. We will use life tables to simulate a lifetime. The life table in the other document that you have in front of you shows, for men and women separately, the chances of surviving to the various ages in the table from the age of 22. You might like to refer to this now. The older a person gets the less likely they are to survive.

We have assumed that no-one survives to age 103 or more. So the maximum number of periods in retirement is 12. The number before retirement is 15. We will tell you throughout the experiment the chance of you surviving to future periods.
Surviving to the next Period in the Experiment

Survival to the next period will be determined by the computer using the life table.

Your Savings

In each period before retirement you will be asked to decide how much of your income of 1,000 units of experimental money you want to convert into real money and how much you want to save. You will also be asked if you want to stay in or opt out of a Saving Scheme. This will be described below. Once allocated to pensions, you will not be able to access any units allocated until you retire. If you decide to save some of your income, then you will also be asked in which of three different Funds you want to make the saving. The default fund is either Fund 2 or the Fund in which you put your savings in the preceding period. If you do not want to make a decision about the Fund your saving will be put into the default fund. These Funds differ in the rates of interest on money saved in them. We shall describe these differences below.

The Saving Scheme

Unless you choose otherwise you will be opted into a Savings Scheme. This obliges you to save a minimum of 10% of your income. If you stay in the Savings Scheme then any savings that you make will be increased by 75% with a contribution paid by the experimenter. You can, however, choose to opt out of the Saving Scheme, and make lower savings. If you do opt out, your savings are no longer increased by 75%. You will be asked each period if you want to stay in the Saving Scheme or opt out of it. Membership of the Saving Scheme makes no difference to the rate of interest you get on funds invested.

The Rate of Interest

This specifies how money saved grows in value between periods. If, for example, the rate of interest is 2%, then the value of savings grows by 2% between periods: 100 this period becomes 102 next period, 200 this period becomes 204 next period, and so on; if the rate of interest is 4%, then the value of savings grows by 4% between periods: 100 this period becomes 104 next period, 200 this period becomes 208 next period, and so on.

The Different Funds

If you save some of your income of 1,000 units of experimental money, then these savings will earn interest through time. You will be asked to state into which of four Funds you want to put these savings. Three of these Funds are risky – in the sense that the rate of interest on them is not certain – and they differ in terms of their riskiness. Fund 1 is the most risky, Fund 2 the next, and Fund 3 the least risky. Each of them has two possible rates of interest – each equally likely – with possible values are as given below. In contrast, Fund 4 is certain and has a known rate of interest. Each of the risky Funds has two possible rates of interest – each
equally likely – with possible values as follows; in contrast the rate of interest on Fund 4 is certain:

Fund 1: either 1.0% or 5.2% (average 3.1%)
Fund 2: either 1.5% or 4.3% (average 2.9%)
Fund 3: either 2.0% or 3.4% (average 2.7%)
Fund 4: certain to be 2.2%

So with Fund 1, units saved in the Fund either grow in value by 1.0% or grow by 5.2% in a period. With Fund 2, units saved in the Fund either grow in value by 1.5% or grow by 4.3% in a period. With Fund 3, units saved in the Fund grow in value by either 2.0% or grow by 3.4% in a period. With Fund 4, units saved in the Fund are certain to grow by 2.2%. So, if you save 100 units in Fund 1, they either grow in value to 101 or grow to 105.2 by the following period; if you save 100 units in Fund 2, they either grow to 101.5 or grow to 104.3 by the following period; if you save 100 units in Fund 3, they either grow to 102.0 or grow to 103.4 by the following period. If you save 100 units in Fund 4, they are certain to grow to 102.2 by the following period. The rate of interest on any one Fund in any one period is independent of its value in any other period and of its value in any other Fund. So whether a fund grows in value by a higher or a lower amount is a matter of chance, and it is not affected by the fund’s growth in the previous period, or by growth in the other funds at any time.

It is important to note that you will not be able to change your choice of fund for past savings decisions. For example, if you decide to save 100 units in period 1 in Fund 2, those 100 units saved in period 1 will remain invested in Fund 2 in periods 2, 3, 4, and so on, until retirement. If you decide to save 200 units in period 2 in Fund 3, those 200 units saved in period 2 will remain invested in Fund 3 in periods 3, 4, 5, and so on, until retirement.

**Your Pension**

When you retire at the age of 67, you will be given a basic guaranteed pension of 100 units of experimental money per period, to which will be added an extra pension determined by your savings. The savings that you have made before retirement, plus the accumulated interest, will determine the amount of your pension over and above the basic pension of 100 units per period. Every period in retirement you will get this pension, and, as we have noted above, it will be automatically converted into real money. This will form part of your earnings from this experiment – if you survive past the age of 67.

As the formula used to convert your savings during your working life into the pension you receive each period during retirement is rather complicated, we will simplify things for you by providing, every period before retirement, a prediction of the likely pension that you will get. Because the rate of interest on savings is not certain the prediction will not be precise. However, we can tell you the
distribution of your likely pension, and, in particular, the lowest and highest pension that you might receive.

We do this for two different scenarios, Scenario 1 and Scenario 2.

**Scenario 1:** we tell you the distribution of your future pension given the savings that you have already made and that which you are considering making for this period, under the assumption that you will make no further savings in the future.

**Scenario 2:** we tell you the distribution of your future pension given the savings that you have already made and that which you are considering making for this period, **under the assumption that you will make exactly the same saving in exactly the same Fund in all the remaining periods until retirement.**

We will provide this information in the form of a graph (showing the distribution) and in the form of a table. Both the table and the graph contain the same information, though they show the information in different formats. An example is shown in the other document that you have in front of you which contains a screen shot of the main decision screen in the experiment. You might like to refer to this now. At the right of the screen can be seen the two Scenarios. In Scenario 1 (in this case when you save 100 in Fund 2 only in this period), the pension is certainly not going to be less than 143, and is certain to be less than 164. In Scenario 2 (in this case when you save 100 in Fund 2 in all periods before retirement), the pension is certainly not going to be less than 680 and is certain to be less than 831. The graphs show the same information in a different format.

On retirement, you will be told the precise value of your pension. You will receive this amount every period on and after retirement until you experimentally die. This will be automatically converted into real money each period using the Conversion Scale that we have already described.

**Summary**

In essence, the experiment is simple. Each period from the age of 22 until retirement you receive an income of 1,000 units of experimental money. You have to decide whether to stay in or opt out of the Saving Scheme, and whether you want to save some of your income, and, if so, in which Fund you want to save it. If you stay in the Saving Scheme any savings that you make will be increased by 75% by a contribution from the experimenter. Any units that you do not save will be converted into real money, which will contribute to your payment for taking part in this experiment. Every period in retirement, assuming you have survived to retirement, you will receive, until you experimentally die, a pension which will be automatically converted into real money, again part of your payment for participating in this experiment.
More Instructions

As your payment for participating in this experiment depends upon the decisions that you take, it is vitally important that you fully understand these instructions. Therefore, after you have read these instructions, we will show you a PowerPoint Presentation which repeats these instructions and gives you more detail. After this Presentation, if you have any questions, there will be an opportunity for you to ask these questions to one of the Experimenters.

Timing

As we want you to think carefully about the various decisions, we will give you a predetermined time to take the decisions in each period; you will see that you cannot speed the process up. Each period before retirement, we have programmed the software to allow between three and five minutes for the decision-making; thus the 15 periods before retirement will take up to one hour and 15 minutes to complete. The periods after retirement, involving no further decisions, will be completed relatively rapidly. The PowerPoint presentation, which plays at a predetermined speed, is programmed to take ten minutes – so expect the experiment to last around one hour and 30 minutes from the time that the PowerPoint presentation starts.

Control Questions

As we want to satisfy ourselves that you have understood these instructions, we will ask you to respond to some Control Questions. When you have correctly responded to these Control Questions you will be free to start the experiment.

In Conclusion

At the end of the experiment, when you experimentally die, we will ask you to complete a short questionnaire and to sign a receipt for the payment which you have earned. We will then pay you this amount in cash and you will be free to leave.

We thank you on behalf of EXEC and the DWP for your participation in this experiment
## Life Table

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<th>% chance of surviving from age 22</th>
<th>Number surviving</th>
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Conversion Scale

Please note that a negative amount (for example, -170) means that you lose money (in this example 170 pence) while a positive amount (for example, 43) means that you earn money (in this example 43 pence). Please note that the computer will tell you at any stage how much you will lose or earn for any conversion that you are contemplating.

### Amounts between 0 and 100 experimental units

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<th>60</th>
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### Amounts between 0 and 1,000 experimental units

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### Amounts between 0 and 10,000 experimental units

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You may choose to use or not use the graph below which presents the conversion scale in a different format.

**Figure C.1** The conversion table
Figure C.2  The Main Decision Screen in the experiment

You are currently 22 and you retire at the age of 67 (in 15 periods).
Up to this period you have earned nothing.
If you convert 900 units this period, you will earn an additional £1.77

Click here when you are happy with your decision.

You have 8 seconds left to confirm.
Appendix D
Control questions for Treatment 3

Note: those Treatments 1 and 2 are the same except that neither contain a reference to Fund 4 and Treatment 1 does not contain any reference to the auto-enrolment into a workplace pension scheme.

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Control Questions

In order to satisfy ourselves that you have fully understood these instructions, we would like you to answer some simple questions. Just tick the answer that you think is correct. Call over an experimenter when you have answered all the questions. When the experimenter agrees that you have answered these correctly, you may start the experiment.

1) If you convert 400 units in a particular period, how much real money have you earned for that period?
   - You lose 221 pence
   - You earn nothing
   - You earn 203 pence

2) If you convert 0 (zero) units in a particular period, how much real money have you earned for that period?
   - You lose 221 pence
   - You earn nothing
   - You earn 203 pence
3) If you convert 1,000 units in a particular period, how much real money have you earned for that period?

- You lose 221 pence
- You earn nothing
- You earn 203 pence

4) If you do **NOT** opt out of the Saving Scheme, what is the minimum savings that you can make?

- 5% of your income
- 10% of your income
- 20% of your income

5) What happens to your saving if you do **NOT** opt out of the Saving Scheme?

- The experimenter adds 10 units to your saving
- Nothing – your saving remains unchanged
- The experimenter adds 75% of your saving to your saving

6) What happens to your saving if you **DO** opt out of the Saving Scheme?

- The experimenter adds 10 units to your saving
- Nothing – your saving remains unchanged
- The experimenter adds 75% of your saving to your saving

7) If you same some of your units, how many Funds can you chose between?

- 1
- 3
- 4

8) Which is the least risky Fund?

- Fund 1
- Fund 2
- Fund 4

9) If you DEFINITELY want a rate of interest of at least 2.2% which Fund should you chose?

- Fund 1
- Fund 3
- Fund 4

10) If you want the POSSIBILITY of a rate of interest of at least 5.0% which Fund should you chose?

- Fund 1
- Fund 2
- Fund 3
11) What happens to the rates of interest on the various Funds if you do **NOT** opt out of the Saving Scheme?

- Nothing
- The rates of interest are all doubled
- The rates of interest are all halved

12) What happens to the rates of interest on the various Funds if you **DO** opt out of the Saving Scheme?

- Nothing
- The rates of interest are all doubled
- The rates of interest are all halved

13) What is the basic guaranteed pension that you get whether or not you made any savings?

- 0 units
- 100 units
- 200 units

14) If your pension amounts to 400 units, how much real money do you earn in each period in retirement?

- You lose 221 pence
- You earn nothing
- You earn 203 pence

15) If your pension is the basic pension of 100 units, how much real money do you earn in each period in retirement?

- You lose 157 pence
- You earn nothing
- You earn 203 pence
Appendix E
Summary of responses to the control questions

(Note that different questions appear in the different treatments.)

This table reports the percentage of correct responses.

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<th>Treatment 3</th>
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Appendix F
The questionnaire

EXEC Centre for Experimental Economics at the University of York

We would be grateful if you could answer a few questions about yourself. Your answers will remain anonymous but will be useful to us when analysing the results of the experiment.

1. What is your gender?
   [ ] Male
   [ ] Female

2. Which age group do you belong to?
   [ ] 16-24
   [ ] 25-34
   [ ] 35-44
   [ ] 45-54
   [ ] 55-64
   [ ] 65+
3. What is your marital status?
   - [ ] Never married
   - [ ] Married/Civil Partnership
   - [ ] Cohabiting
   - [ ] Separated
   - [ ] Divorced
   - [ ] Widowed

4. Do any of the following live with you in your household? (Please tick all that apply)
   - [ ] Child under the age of 18
   - [ ] Child over the age of 18
   - [ ] Parent or grandparent
   - [ ] Other relative
   - [ ] Other non-relative (dependent or otherwise)
   - [ ] None of the above

5. Which of these applies to you?
   - [ ] Working full time (30 or more hours per week)
   - [ ] Working part time (8 to 29 hours per week)
   - [ ] Working part time (Less than 8 hours a week)
   - [ ] Full time student
   - [ ] Retired
   - [ ] Unemployed
   - [ ] Other not working

6. If you are in work, please tell us which type of organisation you currently work for. Otherwise please go to Question 7.
   - [ ] Self-employed
   - [ ] Private sector firm or company (e.g. limited companies, and PLCs)
   - [ ] Nationalised industry or public corporation (e.g. post office, BBC)
   - [ ] Other public sector employer (e.g. local government, Civil Service, LEA, NHS, Police, armed forces)
   - [ ] Charity/voluntary sector (e.g. charities, churches, trade unions)
   - [ ] Other
   - [ ] Have never worked

7. What would you say best describes your current pension arrangements (pensions to which you are currently paying into)? Please tick all that apply.
   - [ ] Employer pension scheme
   - [ ] Personal pension scheme
   - [ ] Do not currently belong to a pension scheme
   - [ ] Don’t know
9. What is your personal gross basic wage/salary? (gross wage/salary is before tax deductions)

- Less than £5,000 a year (less than £100 a week)
- £5,000 to £9,999 a year (£100 to £199 a week)
- £10,000 to £14,999 a year (£200 to £299 a week)
- £15,000 to £19,999 a year (£300 to £399 a week)
- £20,000 to £24,999 a year (£400 to £499 a week)
- £25,000 to £29,999 a year (£500 to £599 a week)
- £30,000 to £39,999 a year (£600 to £799 a week)
- £40,000 to £49,999 a year (£800 to £999 a week)
- £50,000 a year or more (£1,000 a week or more)
- Don’t know

10. How do you see yourself:
Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?
Please tick a box on the scale, where the value 1 means: ‘not prepared to take risks’ and the value 5 means: ‘fully prepared to take risks’.

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11. People can behave differently in different situations.

How would you rate your willingness to take risks in the following areas?
Please tick a box in each line of the scale.

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| in financial matters?     |                             |
| 1                         | 5                           |
| [ ]                       | [ ]                         |
| 2                         | 4                           |
| [ ]                       | [ ]                         |
| 3                         | [ ]                         |
| [ ]                       | [ ]                         |
| 4                         | [ ]                         |
| [ ]                       | [ ]                         |
| 5                         | [ ]                         |
| [ ]                       | [ ]                         |

| during leisure and sport? |                             |
| 1                         | 5                           |
| [ ]                       | [ ]                         |
| 2                         | 4                           |
| [ ]                       | [ ]                         |
| 3                         | [ ]                         |
| [ ]                       | [ ]                         |
| 4                         | [ ]                         |
| [ ]                       | [ ]                         |
| 5                         | [ ]                         |
| [ ]                       | [ ]                         |
in your occupation?

1 2 3 4 5
[ ] [ ] [ ] [ ] [ ]

with your health?

1 2 3 4 5
[ ] [ ] [ ] [ ] [ ]

– with your faith in other people?

1 2 3 4 5
[ ] [ ] [ ] [ ] [ ]

12. Please consider what you would do in the following situation:

Imagine that you had won £100,000 in the lottery. Almost immediately after you collect the winnings, you receive the following financial offer from a bank, the conditions of which are as follows:
There is the chance to double the money within two years.
It is equally possible that you could lose half of the amount invested.
You have the opportunity to invest the full amount, part of the amount or reject the offer.

What share of your lottery winnings would you be prepared to invest in this investment?

[ ] £100,000
[ ] £80,000
[ ] £60,000
[ ] £40,000
[ ] £20,000
[ ] Nothing, I would decline the offer.
Many thanks for your participation.
Before you leave we would like you to complete and sign this receipt.

EXEC
Centre for Experimental Economics at the University of York

This is to certify that I received a payment of £……………. for my participation in this experiment. I participated voluntarily. I understand that the results of this experiment will be used anonymously for the purposes of academic and governmental research.

Number...............................................................................................................
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Appendix G
Analytical solution of the risk-free case

Let us begin by denoting by $k$ the treatment effect. In Treatment 1, $k=1$, and in Treatments 2 and 3, $k=1.75$. The parameter $k$ indicates by how much allocations are increased – in Treatment 1 they are not increased while in Treatments 2 and 3 they are increased by 75% (assuming that they are above 10% of income – which they always are in the optimal solution). The conversion scale is denoted by $u(.)$ – so that $c$ converted becomes $u(c)$ – in money (payment to the participant).

Denoting by $S_t$ the saving in the $t$th period, $Y$ the income (always equal to 1,000 in the experiment), $p_t$ the probability of surviving from period $t$ to period $t+1$ and by $P$ the pension, the problem of the individual is to maximise the following expression:

$$u(Y - S_t) + \sum_{t=2}^{t=15} \left[ \prod_{s=1}^{t-1} p_s \right] u(Y - S_t) + \sum_{t=16}^{t=22} \left[ \prod_{s=1}^{t-1} p_s \right] u(P)$$

(1)

In this equation the first term is the amount of money earned in the first period; the second term is the expected earnings from the remaining periods before retirement and the final term the expected earnings from the post-retirement periods.

We know that $P$ is such that:

$$F = (P - P_0)A$$

where

$$A = \{1 + \sum_{t=16}^{t=22} \left[ \prod_{s=16}^{t} p_s / R \right] \}$$

(2)
where $R$ is the rate of return after retirement (equal to 1.025 in the experiment), $F$ is the pension fund on retirement and $P_0$ the guaranteed basic pension (always equal to 100 in the experiment). This equation simply states that the pension is such that its expected discounted value (over and above the guaranteed pension) is equal to the pension fund. From equation (2) we have that:

$$P = F / A + P_0 \quad (3)$$

Of course, the pension $F$ is given by the savings. We have:

$$F = k \sum_{t=1}^{15} S_t \mu^{16-t} \quad (4)$$

Here we assume that all allocations are greater than the minimum required by the saving scheme. In this equation $r$ is the rate of return before retirement (which in the experiment varies according to the fund, and which we put equal to its Fund 4 rate (1.002) in this risk-free computation).

From the equation (1) we can find the first order conditions. We have simply for $S_t$ the condition:

$$u'(Y - S_t) = k \prod_{s=t}^{15} p_s \frac{\mu}{A} r^{16-t} u'(P)$$

where $a = 1 + \sum_{t=16}^{27} \prod_{s=16}^{t} p_s$

These equations are true for all $t = 1, ..., 15$.

From equation (5) we obtain immediately that for any $t = 1, ..., 14$ we have:

$$u'(Y - S_t) = p_t r u'(Y - S_{t+1}) \quad (6)$$

Now if we take the utility function:

$$u(x) = A - B \exp(-\alpha (x - y))$$

where $y$ is subsistence consumption, it follows that:

$$u'(x) = B \alpha \exp(-\alpha (x - y)) \quad (8)$$

The term $B \alpha$ outside the exp clearly is going to cancel out in what follows.

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40 This utility function is unique only up to a linear transformation, so that the coefficients $A$ and $B$ can be chosen arbitrarily. In the experiment $A$ and $B$ both took the value 459 and $\alpha$ the value 0.001.
We thus have:

\[
\exp(-\alpha(Y - S_t - y)) = p_r \exp(-\alpha(Y - S_{t+1} - y))
\]  

(9)

From this it follows, taking logs, that:

\[
-\alpha(Y - S_t - y) = \ln(p_r) - \alpha(Y - S_{t+1} - y)
\]  

(10)

and hence:

\[
S_t = S_{t+1} + \frac{\ln(p_r)}{\alpha}
\]  

(11)

This gives us the differences between the savings in the various periods.

To simplify what follows we denote by \( \gamma_t = \frac{\ln(p_r)}{\alpha} \) for \( t = 1, \ldots, 14 \). Then we have that \( S_t = \gamma_t + S_{t+1} \).

Further, denoting by \( \beta_t = \sum_{s=t}^{14} \gamma_s \) (for \( t = 1, \ldots, 14 \)) and \( \beta_{15} = 0 \), it follows that:

\[
S_t = \beta_t + S_{15} \quad \text{for} \ t \text{ from 1 to 15}
\]  

(12)

Equation (12) tells us the relative levels of the optimal savings in the various periods. It remains to find the absolute level.

If we take the first order condition for the optimal level of saving in period 15, \( S_{15} \), we have:

\[
u'(Y - S_{15}) = \frac{kp_{15}ar}{A} - u'(P)
\]  

(13)

From this we obtain:

\[
\exp(-\alpha(Y - S_{15} - y)) = \frac{kp_{15}ar}{A} \exp(-\alpha(P - y))
\]  

(14)

\[
= \frac{kp_{15}ar}{A} \exp(-\alpha(\frac{F}{A} + P_0 - y))
\]

Hence, taking logs, we obtain:

\[
-\alpha(Y - S_{15} - y) = -\alpha(\frac{F}{A} + P_0 - y) + \ln(\frac{kp_{15}ar}{A})
\]  

(15)
From this, after a bit of rearranging, we obtain:

\[ F + AS_{15} + AP_0 = AY + \frac{A}{\alpha} \ln \left( \frac{kp_{15}ar}{A} \right) \]  

(16)

Now recall the equation for \( F \). From this we have:

\[
F = k \sum_{i=1}^{15} S_i \rho_i^{16-t} = k \sum_{i=1}^{15} (\beta_s + S_{15}) r_i^{16-t} \\
= k \left( \sum_{i=1}^{15} \beta_i r_i^{16-t} + S_{15} \sum_{i=1}^{15} r_i^{16-t} \right) \\
= k(\beta_s + S_{15} r_s)
\]

(17)

using an obvious notation, namely \( \beta_s = \sum_{i=1}^{15} \beta_i r_i^{16-t} \) and \( r_s = \sum_{i=1}^{15} r_i^{16-t} \)

Hence we have:

\[
k\beta_s + kS_{15} r_s + AS_{15} + AP_0 = AY + \frac{A}{\alpha} \ln \left( \frac{kp_{15}ar}{A} \right)
\]

(18)

and so:

\[
S_{15} (kr_s + A) = AY + \frac{A}{\alpha} \ln \left( \frac{kp_{15}ar}{A} \right) - k\beta_s - AP_0
\]

(19)

from which we can obtain the \textbf{model-optimal} value for \( S_{15} \).

In order to calculate the earnings under the \textbf{model-optimal} strategy we need to evaluate the following expression:

\[
\max u = u(Y - S_1) + \sum_{i=2}^{15} \prod_{s=1}^{x-1} p_s u(Y - S_i) + \sum_{i=16}^{27} \prod_{s=1}^{x-1} p_s u(P)
\]

(20)

This is used to calculate the expected earnings of a participant following the \textbf{model-optimal} strategy and is used as the point of reference in Section 6.1.
Appendix H
Examples of the different types of behaviour

Figure H.1  Treatment 2 participant 2075
Figure H.2  Treatment 2 participant 2016

Figure H.3  Treatment 2 participant 2065
Figure H.4 Treatment 1 participant 1108

Figure H.5 Treatment 1 participant 1140
Figure H.6  Treatment 2 participant 2097

[Graph showing the saving behavior over periods for participant 2097]
Appendix I
Description of the variable on risk aversion

Introduction

‘Risk’ is a situation in which the outcome is not known with certainty. Risk attitude may then be defined as an individual’s propensity or preference for engaging in risky behaviours. According to psychology (Rohrmann, 1994), attitude to risk is a stable personality trait which can predict risk-taking behaviour across a variety of domains, from social and recreational behaviour to financial and occupational decisions.

Risk attitudes can be illustrated with respect to financial decision-making. For example, suppose that an individual is given the choice of a bet with equal chances of winning £100 and nothing or, alternatively, receiving some fixed payment with complete certainty. The expected reward for choosing to bet is £50 in this case. We say that the individual is risk-averse if they would rather accept a certain payment of less that £50, risk-neutral if they would have no preference between the bet or a certain payment of £50, and risk-loving if they would require the certain payment to be more than £50 before declining to bet. We refer the reader to the standard economics literature on risk aversion for formal definitions, e.g., of the ‘Arrow-Pratt measure of relative risk-aversion’.

There are many measures of risk attitudes in the economics literature (see, for example, Eichberger et al. (2003), Fellner and Maciejovsky (2002), and Wärneryd (1996)). In this report, we establish a numerical measure of an individual’s risk aversion and investigate its usefulness, for example, in helping to predict which people are likely to opt-out of the scheme for auto-enrolment into a workplace pension and how risk aversion affects the choice of fund.
Calculation of the risk-aversion coefficient

We used participants’ responses to questions about their risk preferences to calculate the risk-aversion coefficient (rac). Please see Questions 10 to 12. The questions were taken from the literature (Dohmen et al., 2005).

The respondent is asked to rate their likeliness to take risks on a scale of 1 to 5 for Question 10 and Question 11. In Question 12 the respondent is asked a hypothetical question about a lottery and the responses are numbers from 1 to 6. For this question lower numbers indicate a higher preference to take risks.

To compute the rac, the responses to these eight questions were first normalised so that they took values between 0 and 1 (with 0 indicating the most risk-averse response and 1 indicating the most risk-loving response). The rac is then defined to be 1 minus a weighted sum of these normalised responses. Thus, the rac takes values between 0 and 1 and is 0 if and only if all the participants’ responses were the least risk averse and the value is 1 if and only if all the responses were the most risk averse.

The weights chosen for our analysis of the data were as follows:

<table>
<thead>
<tr>
<th>Weight</th>
<th>Question</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5%</td>
<td>10</td>
<td>General attitude to risk.</td>
</tr>
<tr>
<td>5%</td>
<td>11 i</td>
<td>Prepared to take risks while driving.</td>
</tr>
<tr>
<td>25%</td>
<td>11 ii</td>
<td>Prepared to take risks in financial matters.</td>
</tr>
<tr>
<td>5%</td>
<td>11 iii</td>
<td>Prepared to take risks during leisure and sport.</td>
</tr>
<tr>
<td>10%</td>
<td>11 iv</td>
<td>Prepared to take risks in occupation.</td>
</tr>
<tr>
<td>5%</td>
<td>11 v</td>
<td>Prepared to take risks with their health.</td>
</tr>
<tr>
<td>5%</td>
<td>11 vi</td>
<td>Prepared to take risks with their faith in other people.</td>
</tr>
<tr>
<td>40%</td>
<td>12</td>
<td>Amount prepared to invest if given £100,000 lottery win and equal chances of doubling and halving the stake.</td>
</tr>
</tbody>
</table>

Further remarks on the rac

The weights were chosen to reflect the importance of financial decision making in the experiment. Although it may be a criticism that these weights are arbitrary, sensitivity analysis shows that the resulting versions of the rac do not vary much for reasonable choices of weights.

We should note that the rac is not the same as the ‘coefficient of relative risk aversion’ (CRRA) or the ‘coefficient of absolute risk aversion’ both of which appear in the economics literature. Some other measures depend on an individual’s wealth while our statistic ignores this. On the other hand, the values in the lottery question we used are all high relative to the incomes of the participants in our
sample. Furthermore, the following factors suggest that it is not appropriate to use the information on income available to us in the questionnaire responses:

- individuals’ debts are not known;
- individuals’ household composition may affect their income; and
- understanding of the lottery question was not monitored.

Having said this, our rac may be interpreted as a proxy for (a rescaled version of) CRRA. The rac agrees with results in the literature about what variables affect CRRA (see, for example, Dohmen et al., 2005). For example, the rac is significantly higher for women than it is for men in our sample. The rac also varies in a similar way to the CRRA with respect to other variables, for example, age and income, but the results here and in the literature are less clear-cut.

An important validation of the coefficient is that it has a significant effect (see Section 6.6) on fund choice: participants with high values of rac were more likely to have chosen less risky funds.
References


Deaton, A. (1992), Understanding Consumption, Oxford University Press.


