

Does Means Testing Exacerbate Early Retirement?*

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It is quite clear that the message has gone out to all too many of our constituents that savings can damage their retirement income. We cannot explain the collapse in savings in this country in any other way than by saying that people are being very rational and that about 40 per cent of working people cannot now save to make themselves a penny better off – let alone substantially better off – through forgoing income now and trying to push it into their retirement.

Frank Field, MP for Birkenhead, Commons Hansard Debates, 4 June 2003.

1 Introduction

Means testing of pension benefits has been heavily criticised for discouraging savings and work effort, and consequently creating a dependence on the welfare state. Yet means testing does enable the government to target welfare benefits on those who need the benefits most, and consequently to achieve a more equal society. This study considers the trade-off. The analysis presented here reveals that, although targeting of pension benefits does generate disincentives to save and to work, it need not lower aggregate saving and employment participation. This is because the incentive effects of means testing vary across the income distribution.

The Government's motive for its reliance on means testing is obvious; it promises a way of ensuring that everyone has an adequate income, while at the same time controlling costs by reducing eligibility to benefits. Means testing of pension benefits is also an effective way of redistributing income. By focussing state pensions on poorer households, the aggregate costs associated with pension provision can be limited, which enables a more generous state pension to be offered – money that is, in effect, taken from richer households. The more precise the focus of pension provision, the smaller the associated burden on the public's purse. As the costs of pension provision are set to increase with the aging of the population, it is likely that means testing will remain an integral part of pension policy for the foreseeable future.

A means tested pension policy does, however, introduce incentive traps that could both increase reliance on benefits and exacerbate the problems of early retirement. This is because means testing of pension benefits erodes

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the returns to saving, which reduces incentives to save for retirement. Reduced self provision for retirement is described by both lower personal savings during the working lifetime, and by the decision to take early retirement, exhaust all personal savings by the state pensionable age, and to live off the state pension and means tested benefits thereafter. It is important to take these incentive effects into consideration when attempting to evaluate pensions policy alternatives, which is the focus of the current paper.

The analysis presented here attempts to quantify the trade-off between the desirable and undesirable consequences of means testing – the trade-off between redistribution and economic distortions. This is done with reference to the recent introduction in the UK of earnings related public pensions, and the Pension Credit, which reduced the taper rate on private income of state pensions from 100 to 40 per cent. The analysis undertaken suggests that these policy initiatives may strike an acceptable balance between economic distortions and redistributive social objectives.

The principal innovation of the study is the use of a structural microsimulation model of the household labour/leisure and consumption/savings decisions to determine the effects of pension policy reform. This is in contrast to the econometric techniques that are commonly used to analyse retirement behaviour in the literature, and to the statistical microsimulation models that are considered by the companion papers reported in this journal. Each analytical framework has particular strengths and weaknesses, which are worth discussing here.

Econometric analyses of retirement behaviour serve to clarify the relations that are exhibited by survey data. Such studies are, however, limited by the data that are available for estimation, and by the complexity of the retirement decision. Most econometric studies consequently report estimates for reduced form models, or for structural models that exclude household savings – neither of which are particularly adequate for inferring the likely behavioural responses of savings and retirement to policy counterfactuals. The current study is designed to address these limitations. Given the predominant use of the econometric framework for analysing retirement behaviour, extended comment regarding the approach is presented in a dedicated section of the paper (see Section 2).

Microsimulation models of the household – models that generate data for individual households – were first applied in an economic context by Orcutt (1957), and are usually classified as either dynamic or static.¹ Static models are designed to consider the impact effects of policy counterfactuals, usually with regard to an existing population cross-section. The study by Sutherland (2004) that is also reported in the current volume considers a static microsimulation model. In contrast, dynamic microsimulation models are designed specifically to take into consideration temporal effects. This is done by aging each individual described by a reference database to build up a synthetic data panel for analysis. The current study, and the companion study by Falkingham (2004) use dynamic microsimulation methods.²

¹For macro-based models that study the impact of policy changes, see Dervis *et al.*(1982), Taylor (1990), and De Janvry *et al.* (1991). These are examples of Computable General Equilibrium models. Most micro-based models are constructed using a partial equilibrium framework. For examples of micro-based models that use a general equilibrium framework, see Meagher (1993), and Congneau and Robilliard (2000).

²Computational limitations have meant that most microsimulation models to date have been static. For useful surveys, refer to Zaidi

In addition, microsimulation models are also distinguished by how they model the effects of policy counterfactuals. If behavioural response is taken into consideration, then it is usually by imposing a reduced form regression model estimated from survey data (see Sutherland, 2004, and Falkingham, 2004). This method is relatively easy to apply, but suffers from inherent inconsistencies that are discussed at length in the following section. Alternatively, behavioural response can be simulated by explicitly considering how individual decisions are made – usually via the constrained maximisation of an assumed objective (utility) function. This is the approach considered by the current paper – it is the most complex computationally, and therefore used only rarely.

The computational burden of a fully behavioural microsimulation model is purchased at the expense of simulated population heterogeneity. As a consequence, the model that is used by this study does not include the demographic diversity that is characterised by the models adopted by Falking (2004), and by Harding (2004). *** paragraph highlighting the relative strengths of the alternative models ***

Section 2 discusses at greater length the reasons for using a dynamic microsimulation model to consider household retirement behaviour. Section 3 provides useful background information regarding UK pension policy, including a brief description of the current pension system, an outline of recent pension policy reforms, and some official projections for the future. Analysis based upon observations drawn from survey data is presented in Section 4, with particular emphasis placed upon the behaviour responses to means testing. The model of household behaviour is briefly described in Section 5, before presenting analysis based upon output from the model in Section 6. The analysis presented in Section 6 focuses upon the trade-off between the distortionary effects, and the redistributive effects of means tested pension policy. Conclusions are summarised in Section 7.

2 Why use a Microsimulation Model to Analyse Retirement Behaviour?

Most of the literature that explores retirement behaviour is based upon econometric estimates of reduced form models. Three forms of variation described by survey data are commonly exploited to estimate reduced form models of retirement: variation observed at a point in time for a single country due to heterogeneity of individual circumstances³; variation observed through time for a single country due to a policy experiment⁴; and variation observed between the policies of alternative countries⁵. Estimates obtained using country specific data differ substantially between

and Rake (2001), Sutherland (1995), and Merz (1991). Advances in computing power, analytical techniques, and the availability of increasingly detailed survey data have, however, led to an increase in both the number and sophistication of dynamic microsimulation models.

³See, for example, Pellechio (1981), and Gordon and Blinder (1980). Recent research in this vein has focussed upon the influence of a retirement Option Value (OV), following the analysis by Stock and Wise (1990). See, for example, Samwick (1998), Coile and Gruber (2000), Blundell and Emerson (2003), and Chan and Stevens (2004).

⁴See, for example, Burtless (1986), Anderson *et al.* (1986), Krueger and Pischke (1992).

⁵See, for example, Gruber and Wise (1999), Blöndal and Scarpetta (1998), and Burtless (2004).

studies.⁶ Nevertheless, the general conclusion of this literature is that there exists a significant, though modest, negative relation between public pension policy and the timing of retirement.⁷ In contrast, studies that consider cross-country data usually find that public pension policy has a substantial effect on retirement behaviour.⁸ This difference between the within country and cross-country analyses can be attributed to the subtlety of the policy variation that is usually described by country specific data, and to delays in the behavioural response to policy change (see Burtless, 2004, pp. 12-13).

A common critique of the reduced form approaches to analysing retirement behaviour is that the reported estimates are affected by collinearity and omitted variable bias. In the case of studies that consider cross-sectional data for a single country, the variation of public pensions is often strongly correlated with other characteristics, such as individual income histories, which may relate to tastes for retirement. Studies of retirement behaviour that consider time-series data for a single country are often complicated by the fact that the policy variation described by data is slight, or exhibits a stable temporal trend. And cross-country studies of retirement behaviour usually suffer from undesirable population heterogeneity, in the form of institutional differences between countries.

More fundamentally, however, analyses of retirement behaviour that use reduced form models are susceptible to the Lucas Critique. As noted by Rust (1995, pp. 3082-3083), “Reduced-form estimation methods can be viewed as uncovering agents’ decision rules or, more generally, the stochastic process from which the realisations were “drawn”, but are generally independent of any particular behavioral theory.” Hence, although reduced form regression estimates can provide useful information regarding retirement behaviour *given* existing pension policy, they are usually inappropriate for considering the behavioural response to policy counterfactuals. Results presented by Lumsdaine *et al.* (1992) support this conclusion. Lumsdaine *et al.* (1992) compare the in-sample and out-of-sample predictive power of three models of retirement, using data that describe a policy experiment. The principal conclusion of this study is that: “the option value and dynamic programming models are considerably more successful than the less complex probit model in approximating the rules individuals use to make retirement decisions” Lumsdaine *et al.* (1990, p. 31).

In response to the short-comings of reduced-form models for analysing retirement behaviour, a number of studies have considered structural models of retirement. The most commonly cited of these include Burtless (1986), Burtless and Moffitt (1984), Gustman and Steinmeier (1985, 1986), Berkovec and Stern (1991), and Rust and Phelan (1997).⁹

⁶Krueger and Pischke (1992), for example, note that widely diverging conclusions are reached by various reviews of the literature.

⁷See, for example, review by Krueger and Meyer (2002), and Mitchell and Fields (1981) for a summary of the early literature. Blau (1994) is an interesting example of a reduced form analysis, which suggests that both social security benefits have large effects on labour force transitions, and that changes in benefits over time account for only a small part of observed variation in labour force participation.

⁸See, the volume edited by Gruber and Wise (1999) for a prominent example.

⁹The model by Stock and Wise (1990), is also structural, but does not conform to the dynamic programming framework that is the focus here. As noted in Section D of Stock and Wise (1990), the Option Value model assumes that individuals consider the value of future utility in terms of the maximum of the expected value of future alternatives, rather than the expectation of the maximum of future alternatives. This essentially means that an individual fails to take into consideration the fact that they can adapt their choices to new information obtained in the future when evaluating their expectations regarding the utility value of future options. Stern (1997) shows that this simplification can exhibit poor properties. Nevertheless, Lumsdaine *et al.* (1992) suggest that the simplification has a minor

These models are comprised of three elements: a single period utility function, a discount factor, and a transition probability density. Individuals are assumed to select their chosen action at any time t , from their range of possible options to maximise their expected discounted value of utility derived over all future periods. Estimation of the model progresses in three stages. First, the assumed beliefs regarding probable future outcomes – as embodied by the transition probability density – are estimated from survey data, subject to the additional assumption of rational expectations. Second, given the expectations estimated in the first stage, the Dynamic Programming problem is solved numerically by backward induction. And third, a likelihood function is formulated from the numerical solution to the Dynamic Programming problem, which is used to estimate the unknown discount factor and utility function parameters.¹⁰

The general finding of studies that are based upon econometric estimates of structural models is that public policy has a strong (negative) effect on labour supply. The structural analysis reported by Gustman and Steinmeier (1986), for example, suggests that the US retirement peaks at ages 62 and 65 can be motivated entirely by social security, pensions and mandatory retirement. Rust and Phelan (1997) extend upon the analysis of Gustman and Steinmeier (1986), by adding the incentive effects of Medicare for an analysis of male retirement behaviour in the US.¹¹ Like Gustman and Steinmeier, the analytical results reported by Rust and Phelan (1997) capture the retirement peaks described by survey data. In the case of the peak at age 65, however, the results presented by Rust and Phelan depart from those reported by Gustman and Steinmeier, by suggesting that medical insurance plays an important role.

The analytical complexity of a structural model is usually purchased at the expense of the detail that is used to describe population heterogeneity. Perhaps the most important simplifying assumption that is commonly made is that households consume all of their income immediately, which omits consideration of the consumption/savings decision. The principal justification cited for this omission is the lack of accurate wealth data that are available for estimation. Furthermore, an appeal can be made to statistical and theoretical evidence that downplays the role of wealth in the retirement decision (see, for example, Samwick, 1998, and Deaton, 1991). Nevertheless, such qualifications may fail to allay concerns regarding the results obtained.

A recent study by Blundell and Emerson (2003) highlights the potential importance of wealth in determining the timing of retirement. Blundell and Emerson estimate a reduced form probit model that describes retirement in terms of an individual's wealth, their age, and their option value (following Lumsdaine *et al.*, 1990). Importantly, Blundell and Emmerson (2003, p. 12) report that the coefficients on wealth “are always strongly significant and suggest that the restrictions underlying the standard option value model need to be relaxed to allow saving and borrowing against future pension wealth.” These results suggest the intuitive conclusion that an early accumulation of wealth tends

effect on the predictive power of the Option Value model.

¹⁰See Rust and Phelan (1997) for a detailed discussion.

¹¹The analysis by Rust and Phelan (1997) focuses upon the subpopulation that do not have a private or occupational pension.

to encourage early retirement. Notably, the coefficient on the OV variable estimated by Blundell and Emmerson (2003) ceased to be significant (at any reasonable confidence interval) following the addition of wealth to the probit regression.

Rust (1987) was one of the first studies to suggest a method for estimating structural models of retirement that incorporate the consumption/savings decision. Nevertheless, practical applications have been frustrated by the implied computational burden. For example, one of the most recent attempts to estimate a structural model of the consumption/savings decision is by Gourinchas and Parker (2002), who use an optimal consumption model to account for the life-cycle spending pattern described by the United States' Consumer Expenditure Survey. Although Gourinchas and Parker choose the parameters of the utility function to minimise an econometric criterion, they do not fit their model to the whole cross-section of data. Rather, they optimise for mean consumption as a function of age, and do not account for differences of behaviour between consumers of the same age. Their model does not address the labour/leisure margin and, as far as we are aware, no researcher to date has suggested a method for making this problem computationally tractable (given the limitations of current state-of-the-art personal computing technology).

The model considered here is specified to simulate endogenously the labour/leisure and consumption/savings decisions. Calibration of the model closely follows the existing literature that considers structural models of retirement. Specifically, the required transition probability density is estimated from survey data. The retirement decision is formulated as a dynamic programming problem, which is solved numerically by imposing the estimated transition probability density. However, unlike the method of likelihood estimation that is commonly adopted in the literature, the discount rate and utility function parameters are calibrated manually to reflect broad observations drawn from survey data regarding consumption, employment status, and wealth. This side-steps the immense computational burden that is associated with econometric estimation.

It would, however, be disingenuous to suggest that there are no disadvantages to using the type of model that is described here. Behavioural models need to assume that households behave in some well defined manner. Though it is possible to test the assumptions inherent in the behavioural framework assumed – and a great deal of work has been devoted to this (see Deaton, 1993) – the validity of such models can never be verified positively (we might reject, but can never accept). Consequently, the predictions made by behavioural models always remain subject to the uncertainty that underlies the analytical framework adopted. Furthermore, these models are complicated to solve, and so remain highly stylised (subject to existing computing technology). Importantly, this computational complexity means that it is difficult to describe statistically the uncertainty that is associated with the observations derived from such models (unlike common econometric analyses). Finally these models do not realistically capture the learning process as people adjust to a new policy environment. They are therefore better at modelling the long

term impact of a policy change.

3 Pensions in the UK

In its first term of office, between 1997 and 2001, the newly elected Labour Government of the UK created a highly redistributive, and highly distortionary pension system. Later policy reforms can be seen an attempt to ameliorate the distortionary incentives of the pension system, firstly by reducing taper rates on private income, and secondly by increasing the generosity of earnings related pension benefits. This section provides a brief review of current pension policy in the UK, the pension policy reforms that have been undertaken during New Labour's period of government, and associated budgetary projections for the future.

3.1 The Current UK Pension System

The UK pension system is often classified into three tiers. The first tier consists of the basic state pension; the second tier of all government run contributory pensions benefits (the State Earnings Related Pension Scheme, SERPS, and the Second State Pension, S2P); and the third tier of all private pension schemes.

All retired individuals who satisfy a set of contributory requirements are eligible for a basic state pension. The maximum amount payable depends on the proportion of the working lifetime that National Insurance Contributions have been paid (or credited). Other than this contributory requirement, the basic state pension is a flat rate benefit that is currently worth £ 75.50 per week to a single person. If a spouse does not have their own pension entitlement, a dependant premium is payable (currently £45.30 per week), and the spouse will continue to be entitled to a single person's benefit after the death of their partner.

The second tier state pension is a defined benefit pension. Until recent reforms, the benefit payable was entirely related to the contributor's average earnings over their working lifetime. Membership to the second tier state pension is compulsory for all employees (but not the self-employed), unless the employee has contracted out into a private pension scheme. The second tier system, was administered under the SERPS until April 2002, when it became the S2P. The S2P is more generous to those on low-incomes. Unlike SERPS, individuals with incomes below the lower earnings threshold (currently £11,200 per year) earn S2P entitlements as if their income was at the lower earnings threshold. Furthermore, when S2P was introduced, the generosity of the entitlements was doubled for those earning the lower earnings threshold. This extra entitlement is subject to a taper rate so that those earning above the upper earnings threshold (currently £ 25,592 per year) receive entitlements at their previous SERPS level.

The third tier of the pension system is comprised of private pension schemes, of which there are two types: occupational pensions and personal pensions. Contributions into these schemes are made out of pre-tax income, so that contributions are effectively subsidised (at the basic tax rate) by the Government. An occupational pension can usually be classified as either a 'defined benefit' scheme (where the benefits are earnings related), or as a 'defined

contribution' scheme (where the benefits are related to the value of the accumulated contributions). Personal pensions are always run on a defined contribution basis.

3.1.1 Principal Means Tested Retirement Benefits

In addition to the state pension system there are a number of retirement benefits that are target toward those with low income. There are four principal benefits that are means tested.

- *Minimum Income Guarantee (MIG)*: The MIG ensures that each retired household receives a minimum level of income. Currently, this level of income is equal to £102.10 per week for a single pensioner, and £155.80 per week for a couple. Any private income, including benefits received from private pensions and earnings, is entirely deducted from the benefit - in other words, MIG is subject to a taper rate of 100%. Furthermore, benefits paid under the MIG are also withdrawn in proportion to any accumulated non-housing capital. Specifically, the first £6,000 of assets are ignored, after which £1 is withdrawn from the benefits paid under the MIG for every £250 of capital or part thereof, up to the maximum assets threshold of £12,000. Those households with assets greater than £12,000 receive no benefits. For individuals in residential care, the thresholds are £10,000 and £16,000, respectively.
- *The Pension Credit*: In October 2003, the Pension Credit is to be introduced. This reform effectively reduces the taper rate on the MIG to 40% of gross private income for those who have a full basic pension. Households will receive their additional benefits partly as an income support payment (the pension guarantee element) and partly as a tax credit. The income support payment is the amount required to top-up household income to the MIG. The tax credit component is the additional payment required to reduce the taper rate from 100% to 40%.¹²
- *Housing Benefit*: Low income households living in rented accommodation may be eligible for housing benefits. The level of these awards will generally cover the rent paid by the household up to a given threshold, which is set by the local authority; but on average they are worth in the region of £3,000 per year. Housing benefits are withdrawn at a rate 65% for any other net income over the MIG (some disability payments are ignored).

There is also an asset-based test which is almost identical to the asset based test operating for the MIG.¹³

¹²The asset-based test on the MIG is also to be reformed. As is currently the case, the first £6,000 of assets will be ignored, but thereafter an income is imputed to any savings above this threshold at a rate of 10% a year (this is approximately half the rate of the current MIG asset based test).

¹³With the introduction of the Pension Credit in October 2003, there will be a substantial increase in the level of income allowances before which housing benefits are withdrawn. This is to 'ensure that pensioners who benefit from the (pension) credit do not see their gains clawed back through a reduction in their Housing Benefit or Council Tax Benefit'. This pledge can be interpreted as meaning that any household with a private income, that includes their basic state pension but not any income support, less than the pension guarantee income receives full housing benefits. For any income above this, housing benefit is withdrawn at a rate of 65p for every £ 1 of net income. The asset based test remains unchanged.

- *Council Tax Rebates*: Low income households are eligible for a 100% council tax rebate. These rebates are withdrawn (simultaneously with housing benefits) at a rate of 20% for any other net income over the MIG. The asset-based test is identical to the asset-based test operating for housing benefit.

3.2 Historical Background

Improving the living standards of poorer pensioners has been a major objective of government policy since Labour came to power in 1997; “The Government’s first priority has been to help those in greatest need. ...Too many pensioners have not shared in the rising prosperity of the country.”¹⁴ The Labour Government has consequently introduced a series of policy initiatives that have significantly altered pension provision in the UK. In their earlier reforms, the Government developed the idea of means tested pension guarantee that ensured every pensioner would have an adequate income in retirement, but limited the cost to the taxpayer by targeting the resources at low income households; this is the redistributive element. However, these reforms created significant incentives for individuals not to save for retirement and possibly to retire early; this is the economic efficiency or, more accurately, inefficiency element. Therefore, the later reforms - the Second State Pension and the Pension Credit - can be understood as attempts to counter the distortions induced by the pension guarantee, by increasing the incentives to work and to save.

The Labour Chancellor, Gordon Brown, made his intentions clear in his first Comprehensive Spending Review (July 1998), when he announced an above inflation increase in (means tested) income support for pensioners as a first step to establishing a *means tested* Minimum Income Guarantee (MIG).¹⁵ Every budget since then has seen large rises in the level of the MIG until, by April 2003, the gap between the level of the basic pension and the MIG for a single pensioner had risen to £26.60 per week (from £5.75 in April 1998). Furthermore, in his Pre-Budget Speech in 2001, the Chancellor announced his pledge to increase the MIG at least in line with earnings for the rest of the current Parliament, and has made it a Government aim that it should remain indexed with earnings thereafter. As the basic pension is set to rise in line with prices, the gap between it and the MIG will continue to grow in the future. The withdrawal rate for MIG, as with all other income support, is 100%, or £1 for every £1 of private income. Therefore an individual with a weekly private pension income of less £ 26.60 is no better off than an individual with no private income. There is, therefore, no incentive for families on low incomes to save.

To respond to the disincentive effects on savings of the MIG the Chancellor also announced, in the same Pre-Budget speech of 2001, the introduction of a Pension Credit from October 2003. This credit effectively reduces the withdrawal rate of the MIG from 100% to 40%. Given the Pension Credit, a single pensioner with a private income of £26.60 will be £ 15.96 better off than one with no private income. Although this has increased the incentive to

¹⁴Pre-Budget Report 2001, Section 5.42: Tackling Pensioner Poverty.

¹⁵Nearly all individuals who have spent the majority of their working years in employment will receive a full basic pension, worth £75.50 per week to a single pensioner in April 2003. Those pensioners with no additional private income are eligible to claim further income support, to increase their total pension income to £102.10 per week.

save, the effective rates of return to savings are still low and can be negative. Since 1997 the Chancellor has moved the system of basic pension benefits from one based on universality (the contributory requirements were not very stringent, at least since 1978) to one increasingly based on means testing.

The Pension Credit is one attempt to reduce the distortionary or inefficiency effects of means testing by reducing the taper rate. Another approach is to ensure that those who have paid a sufficient number of years of compulsory National Insurance Contributions have a second tier or earnings related pension, which is too high for them to be eligible for means tested benefits. This is the approach adopted by the later set of reforms to the second tier contributory pension schemes. In December 1998 the Government published their green paper “A New Contract for Welfare: A Partnership in Pensions” which proposed a complete reform of this contributory component of the pension system. The idea was that the second tier system would be designed to pay out a flat rate State Second Pension (S2P) to everyone who had paid a sufficient number of years of contributions. Each person’s S2P was funded from forced contributions out of their income during their working life, with those on low incomes having their contributions ‘topped-up’ annually so that, in effect, there was enough in their notional fund to pay the flat rate S2P. In April 2002, the ‘top-up’ element of the State Second Pension was introduced. The transition to flat rate benefits was originally set to be in 2006/7 but this date was postponed indefinitely in the 2002 Pension Green Paper, pending further consultation.

The State Second Pension is designed to ensure that all those with a long work history are guaranteed a pension that is sufficient to maintain an adequate standard of living. These individuals would not, therefore, be reliant on means tested benefits in retirement. But, by breaking any link between the size of the contributions paid and the size of the pension received, the contributions paid look more like a tax. Someone on a low income who decides to work longer hours, or receives a small pay rise, will pay a greater amount in contributions but receive the same amount in pension benefits when they retire.¹⁶ Therefore, for those on low incomes, the only contributory component remaining in this system is the link between the number of years worked and size of the pension received.¹⁷ The recent changes made to the state second pension are consequently similar to an alternative policy of raising taxes to pay out a more generous universal basic pension

3.3 Projections for the Future

Projections of Government expenditure on the different pension benefits provide a measure for assessing the shift in Government policy towards means tested benefits. Figure 1 consequently plots current best estimates of projected

¹⁶Individuals who earn more than the Upper Earning Limit for National Insurance Contributions do not pay higher contributions for any increase in income. National Insurance Contributions are consequently subject to a regressive rate structure.

¹⁷Only those earning more than the National Insurance Lower Earnings Limit will be considered as making a contribution to their S2P. Until the S2P goes flat rate, it can be regarded as a direct substitute for private savings. In fact, the implicit rates of return make the S2P look a very attractive substitute for private savings.

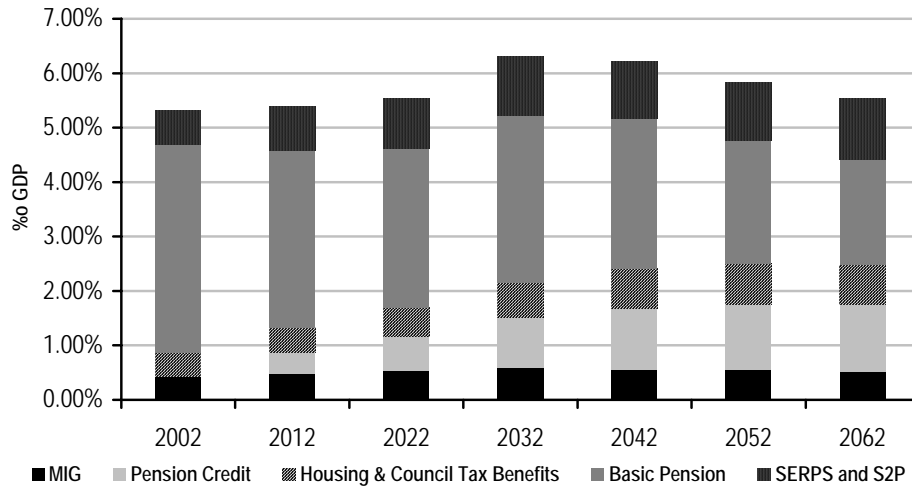


Figure 1: Projected Government Expenditure on Selected State Benefits - Basic State Pension Indexed to Prices.

Government expenditure on pension benefits in the long term.¹⁸ These estimates are based on the assumption that the Government will adhere to its policy of increasing the Basic Pension, and the National Insurance Lower and Upper Earnings Limits, in line with prices, and increasing the level of the pension guarantee in line with wages. These projections estimate that expenditure on means tested retirement benefits will rise from 0.4% to 1.7% of GDP, or from 9% to 37% of total pension expenditure over the next 60 years. If we include housing benefits and council tax rebates paid to retired households as part of state pension expenditure, then expenditure on means tested benefits is expected to rise from 16.5% to 44.7% of total pension expenditure. This dramatic rise in the percentage of expenditure on means tested pension benefits is the result of two trends; the decline in the expenditure on the universal basic pension, and the rise in expenditure on the Pension Credit as a percentage of GDP.

From Figure 1, it can be seen that total pension expenditure on pension benefits is not projected to rise over the next 30 to 40 years, despite the well publicised increases in the dependency ratio.¹⁹ In fact, if it were not for the recent reforms, total expenditure on pension benefits as a percentage of GDP would actually be projected to fall.

If total expenditure is expected to remain roughly a constant proportion of GDP, where do all the doomsday predictions about mushrooming pension expenditures caused by the ageing of the population come from? And if the doomsday predictions are fundamentally inaccurate, does the government have any justifiable reason for not providing a universal (rather than means tested) state pension? In fact, the principal reason that the UK is considered to be one of the developed countries least exposed to rising fiscal pressure from ageing is the result of the projected

¹⁸These estimates are sourced from the National Institute Generational Accounting Model, which was built in conjunction with HM Treasury. The model uses a range of sources, the principal for pension expenditure projections being the long term projections of the Government Actuary Department.

¹⁹The dependency ratio is the number of people over the age of 65 to the number of people of working age, ages 16 to 65. For the UK this rate is expected to rise from 25% to nearly 45% over the next 30 years.

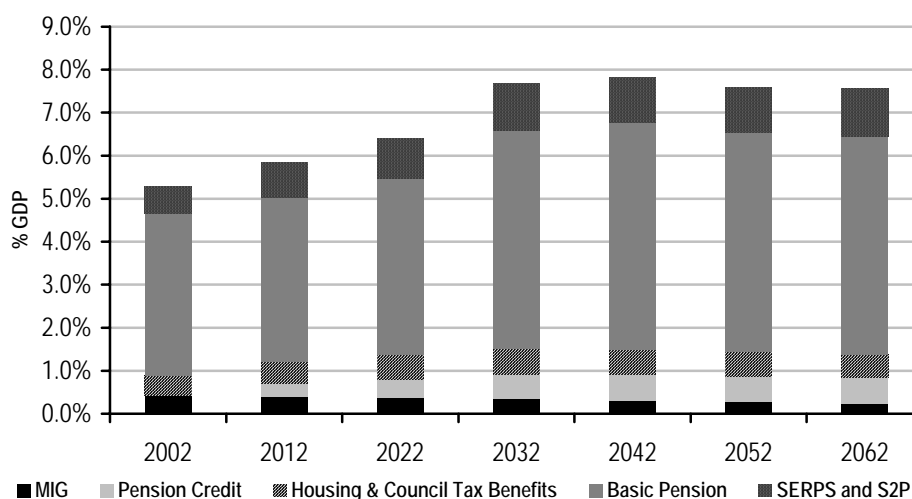


Figure 2: Projected Government Expenditure on Selected State Benefits - Basic State Pension Indexed to Wages.

increase in dependence on means testing.²⁰ The targeting of pensions on low income households will significantly reduce total Government pension expenditure. If, instead, we assumed that Government policy was to increase the basic pension in line with average earnings (rather than prices) - to ensure that the retired population share in the country's growth - then the best estimates of projected expenditures look very different. Figure 2 reproduces Figure 1 under the assumption that the basic pension is indexed to wages rather than to prices. Now expenditure on means tested benefits rises only from 16.5% of total expenditure to just over 18%. However, total Government expenditure on pension benefits rises from just over 5% to just under 8% of GDP.

Pensions expenditure provides an incomplete story of the support that the Welfare State provides to the retired. In particular, approximately 40-45% of government expenditure on health and long term care is spent on the elderly, and this expenditure is expected to rise sharply as the population ages.²¹ There are, of course, enormous uncertainties surrounding any projections on health expenditure due, for example, to uncertainties in estimating future morbidity rates, and the impact of any new treatments. Nevertheless, health expenditure is currently 7.2% of GDP (this figure includes long term care as well as NHS expenditure), and is projected to rise to anything between 10% (HMT, Long Term Fiscal Sustainability Report) and 11% (Wanless Report) of GDP by 2022.²² Furthermore, this figure is likely to continue to rise thereafter and, even under very conservative assumptions, is projected to account for 12% of GDP by 2050 (HMT).

Aggregating these two scenarios - pension expenditure rising in line with earnings and the increase in health

²⁰It is also partly because UK fertility rates have not dropped as low as in some developed countries. The fertility rate in the UK is about 1.6 (average number of children per woman over their lifetime) compared to 1.3 in Italy or 1.1 in Spain.

²¹This figure was sourced from the Personal Social Services Research Unit at the London School of Economics as 42.6% in 1998.

²²The Wanless Report projects expenditure under three different scenarios. We have taken the average and made an adjustment to these figures to remove private sector spending and to include government spending on long term care.

expenditure - it easy to understand the Government's concerns regarding the potential for ballooning demands on the public purse associated with an aging population. Overall spending in just these two areas could rise by nearly 8% of GDP, requiring a rise in the basic rate of tax of the order of 23p per £1.²³

4 Incentive Effects of Means Testing - evidence from survey data

Almost all individuals have some entitlement to the Basic State Pension when they reach state pensionable age, as a result of either their own, or their spouse's National Insurance Contributions. In addition, approximately 80% of retired households²⁴ have some private pension income, either from a private pension or the SERPS. The pension income of many households, however, is below the level that is required to sustain an adequate standard of living (we shall define this level as the MIG). Households with pension income below the MIG are eligible to claim additional support - principally through means tested benefits - though a significant minority do not.

In Figure 3 we have used data from the 2001/2 Family Resource Survey (FRS) to represent graphically the redistributive consequences of mean-tested pension benefits. Figure 3 divides the population of single retired adults described by the FRS into quintile groups, based upon their private income (defined as the sum of private pension income, earnings and investment income). The bars displayed in Figure 3 indicate the average income received by each quintile group, distinguished by income source. The aggregate of these components gives gross household income. 'Total Net Income', obtained after the deduction of associated taxes, is also reported in the figure.

Figure 3 dramatically demonstrates the effects of means testing, revealing that total disposable (net) income is approximately constant for 80% of the population, despite large differences in average private income. The fourth quintile receives an average private income of £118 per week, compared with an average of £0 for the lowest quintile - nevertheless, the average disposable income earned by the fourth quintile is only £5 more per week than the lowest quintile.²⁵ It is clear that these effects represent a large disincentive to save. The figure also shows the relative importance of the different means tested benefits in deriving this result. The income support award is calculated as the amount required to bring household income up to the level of the MIG; £98 in 2001/2 for a single pensioner. Therefore a household with some private income, though still below the MIG, loses £1 of income support for every £1 of private income; a 100% taper rate. In Figure 3, the aggregate of income from private sources, the basic state pension and the MIG, are equal to approximately £100 for the first three quintiles. Low-income households, living in rented accommodation, will be eligible for help towards their rental payments. If they receive a MIG payment it

²³A rise of in the basic income tax rate of 1p is estimated to raise about £3.5 Bn. The estimate of 23p is a simple scaling up of this figure and does not take into account the effects on the economy of such a large increase in income tax rates.

²⁴This figure was calculated from 2001-02 Family Resource Survey. For the younger of these retired households, where all member adults were under the age of 70, the figure was slightly higher at 83.6%.

²⁵Of the £118 of private income earned on average by households in the fourth quintile, £103 is attributable to private pension income, £11 to investment income and the remaining £4 to earnings.

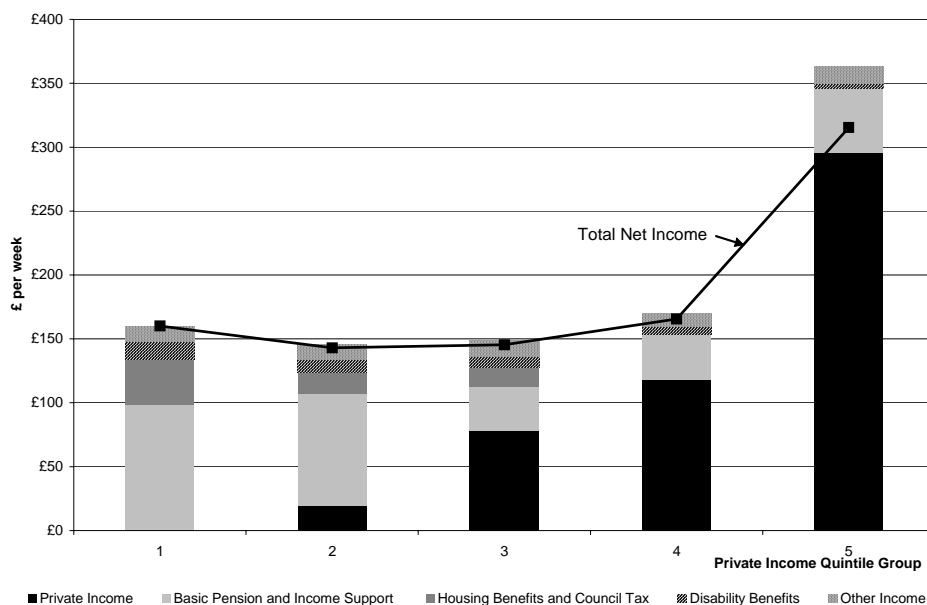


Figure 3: Breakdown of Total Income for Single Retired Adults, by Private Income Quintile

is likely this would cover their entire rental costs and they would probably receive a council tax rebate.²⁶ Both these benefits are means tested, and are withdrawn for any household whose net income is above the MIG at a rate of 65% for housing benefits and 20% for council tax rebates. The 1st quintile income group receives an average of £36 per week from these benefits whereas the 2nd and 3rd receive only about £13, and the 4th quintile receive nothing.

Figure 4 restates Figure 3 for households comprised of two retired adults (rather than single retired individuals). The results displayed in Figure 4 suggest that retired couples are less severely affected by means testing than singles, which is partly because two adult households have a higher private income on average, and partly because a far greater percentage do not live in rented accommodation. However the results are qualitatively the same. Households with significantly more private income only have a marginally higher total net income.

The analysis presented above is based upon data drawn from the 2001/2 Family Resource Survey. In October 2003 the Pension Credit reform will be introduced. This effectively reduces the taper rate on the MIG from 100% to 40%. Consequently, it is reasonable to suspect that survey data for subsequent years will indicate a less extreme effect of means testing than the observations reported here. However, taper rates for some of the retired population who receive housing benefits, council tax rebates and the Pension Credit, will remain at approximately 93%. Furthermore, a larger proportion of the population will receive means tested benefits, as those with higher incomes are made eligible. Consequently, it is not clear how effective the Pension Credit will be at reducing the impact of means testing for the retired. Another consideration is that the short run effects of the reform are likely to be very different to the

²⁶75% of households in the lowest quintile live in rented accommodation, and 66% receive housing benefit.

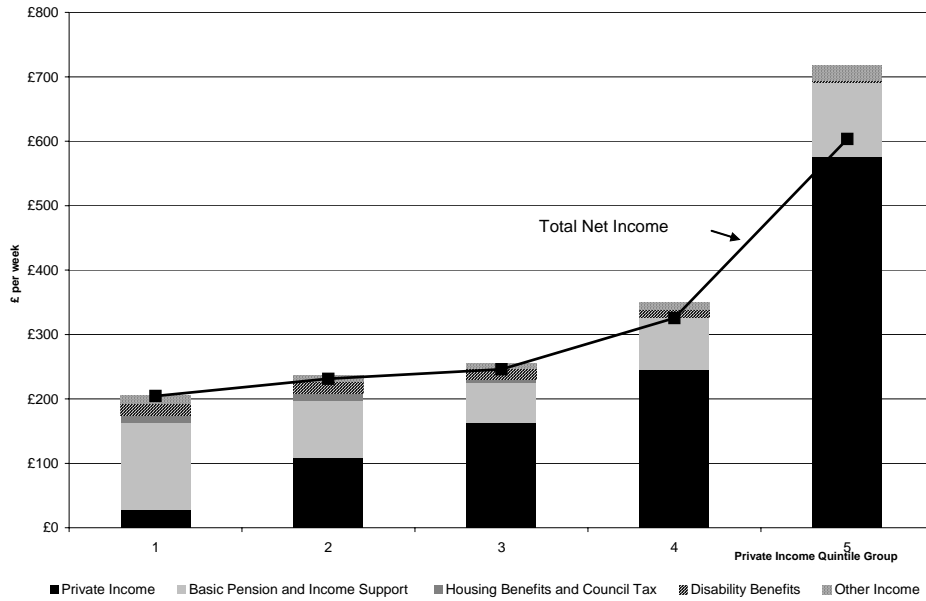


Figure 4: Breakdown of Total Income of Two Adult Retired Households by Private Income Quintile

long run effects. In the short run, there will be no significant change to the amounts retired households have saved, and so the effects of the reform will be more predictable. In the long run, however, individuals are likely to change the way they save. The difficulty associated with predicting the savings response to the introduction of the Pension Credit means that it is a much harder job to predict the long-term consequences of the policy change. In Section 6, we use the National Institute household behavioural model to analyse the possible long-term outcomes.

This section has clearly demonstrated the advantages of means testing. It targets resources at low income households, and so reduces levels of poverty amongst the retired population whilst retaining some restraint on costs. It can also be seen as providing insurance for all against adverse lifetime income shocks. An individual starting their working life is insured to some extent against poverty in retirement, whatever the outcome during their working life. In this sense it must also reduce lifetime income uncertainty for all and, given the weak assumption that we prefer less uncertainty, is associated with consequent welfare benefits. Unfortunately these redistributive and insurance benefits come at a cost. They create disincentives to both work and to save. In the next two subsections we use observations drawn from survey data to develop a feeling for the importance and size of these economic distortions.

4.1 Means Testing and the Incentives to Save

One of the principal motives for saving is to make provision for retirement. Means testing retirement benefits reduces the benefits to this saving. At the extreme, it can remove these benefits entirely. If an individual saves a modest amount so as to have an extra £20 per week in retirement income, but loses £20 in benefits, then the net gain from

this savings is zero. This individual would have been better off not saving at all and consuming more during their working lifetime. Therefore, means testing of benefits creates disincentives to save and it could be expected that these disincentives would be particularly strong for low-income households approaching retirement.

This section uses survey data from the British Household Panel Survey (BHPS) to search for evidence that low income households have a lower propensity to save than higher income households. Perhaps unsurprisingly, we do find strong evidence to support this prediction. It is important to recognise, however, that there are reasons other than the incentive effects of means testing that can explain why low-income households save less relative to high-income households, some of which are:

1. If households like to sustain their standard of living, then the universal basic pension provides a far greater proportion of desired retirement income for low-income households than it does for high-income households. Low-income households would therefore save proportionally less.
2. If we accept that a certain income is required to sustain a minimum non-discretionary level of consumption, then low-income households have less flexibility to save.
3. If the access to funds of low-income households is limited (or prohibitively expensive), then the possibility of suffering an adverse shock may imply that low-income households will be less willing to tie up their funds in a long term savings account - they might rather keep their savings liquid in case of such an event. This is conceptually equivalent to a lower effective rate of return on their savings.

Hence, observing that low-income households save less is not overwhelming evidence for the power of the disincentive effects of means testing. Nevertheless, the absence of such evidence would present a strong case against the practical relevance of means testing incentive effects. With respect to this last point, however, it is important to bear in mind that the massive expansion of means testing has been a recent phenomenon, and so it may take many years before the full behavioural effects are observable in wealth data.

The BHPS has followed a representative sample of about 7000 households over the past 12 years. Every year these households are interviewed in detail about, amongst other things, their earnings and pension arrangements in the previous year. Furthermore, in both 1995/6 and 2000/1, they were asked detailed questions about their assets (both housing and financial). From this information it is possible to estimate the total net wealth of each household in 2001 - see van de Ven and Sefton (2003) for details.

In Figure 5 we display the distribution of wealth for households, in which the reference person is a single adult aged between 45-55. As before we have split this sample up into five quintile groups based on their gross take home pay, which includes any labour earnings plus benefit income. For each quintile group we calculate the percentages that have total wealth less than £10,000, between £10,000 and £50,000, between £50,000 and £100,000, and between

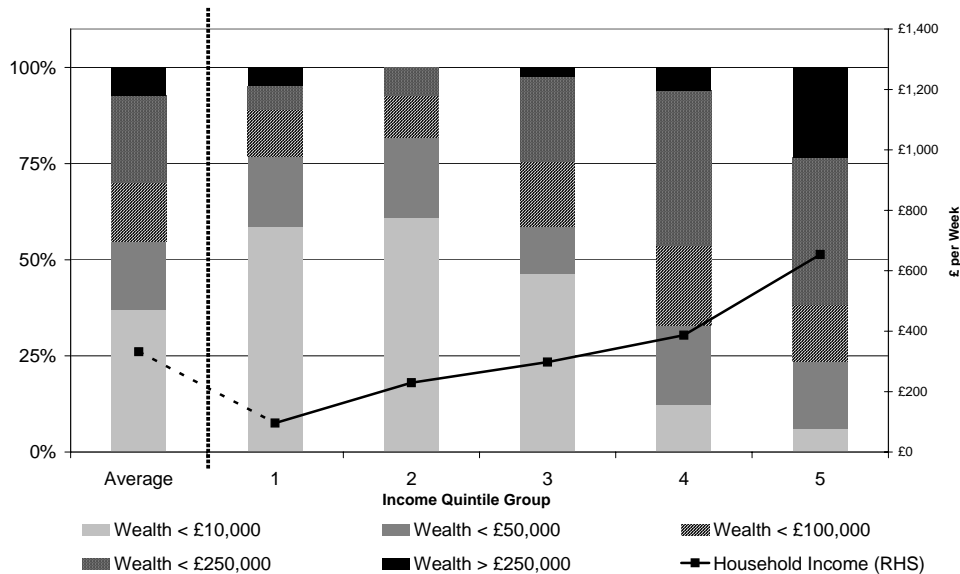


Figure 5: Distribution of Wealth by Income Quintile for Single Adult Households Aged between 45 and 55

£100,000 and £ 250,0000 respectively. We also calculate the average total net household income - take home pay plus any investment and transfer income - for this group. All this information is plotted in Figure 5, with the wealth percentages plotted against the left hand axis and the net income variable against the right hand axis. We have also plotted the same information for the entire sample in the column marked ‘Average’.

Of the sampled households, 37% have aggregate wealth below £10,000, and almost all of the households with assets less than £10,000 (90%) are concentrated in the bottom 3 income quintiles. The households with aggregate assets worth less than £10,000 have an average wealth of only £500, which is comprised of approximately £1,000 of pension wealth and £500 of debt. Similarly 30% of the sample have assets in excess of £100,000, of which 90% are concentrated in the top three income quintiles. Of these households approximately half of their assets are in housing and half in pensions. Only a very small percentage of aggregate household wealth is held in other financial assets (less than £4000 on average). Figure 5 also suggests that low-income households save proportionally less than high income households. Comparing the 2nd and 5th quintiles, the ratio of average incomes is just approximately 1:3, but the ratio of median wealth is 1:64. Although caution should be exercised when attempting to use cross-sectional wealth data (a stock variable) to infer measures of saving (a flow variable), the size of the difference between these two ratios is difficult to explain if the savings rate does not increase with income.²⁷ These results are plotted more clearly in Figure 6.

Figure 6 plots the ratio of median wealth to average income for income quintiles. It is necessary to look at the

²⁷This is particularly the case, given the restrictive age demographic considered in Figure 5, and the strong positive correlation that is typically observed for individual income data from one year to the next.

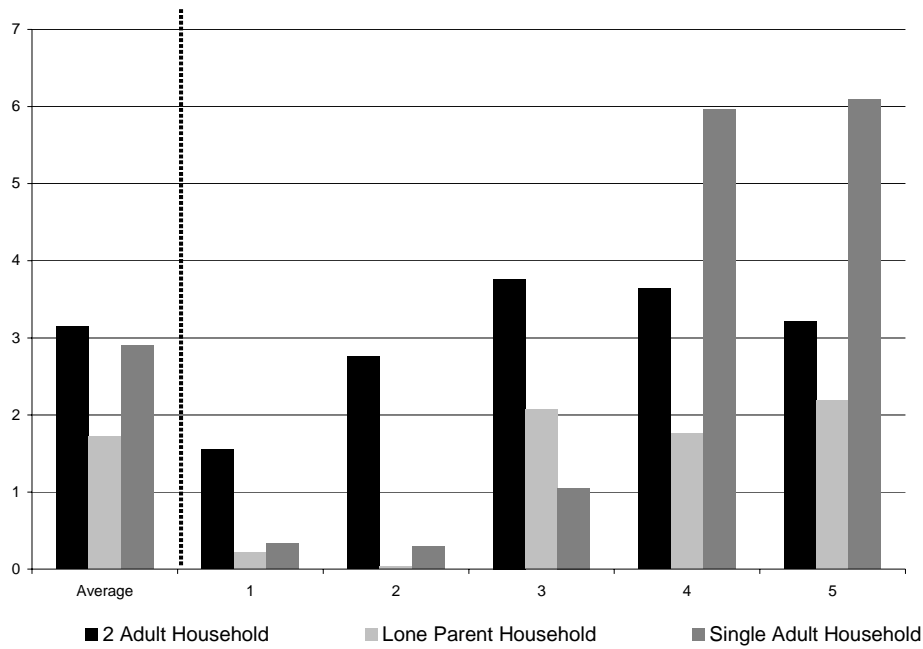


Figure 6: Median Wealth to Average Income Ratio by Income Quintile for Households aged between 45 and 55

median wealth levels, rather than the average, as the wealth distributions are very heavily skewed (one rich family can have an enormous impact on the average wealth of the group, but only a small affect on the median). The choice of reporting this figure relative to average income, rather than median income makes little difference ($< 5\%$) as the households are sorted by income. Furthermore, the sample of single adult households has been split into two, those with dependant children and those without. The behaviour of these two types is slightly different for the high-income quintiles. The figure clearly reveals that lower ratios of wealth to income are observed for the lower income quintiles, which suggests that low-income households save proportionally less than high-income households. In fact low-income single adult households appear to save very little.

In Figure 6, similar results are plotted for two adult households.²⁸ Figure 7 reports wealth distributions for two adult households in the same format as Figure 5. As was observed at the beginning of the current section, the results are less marked for couples than for single adult households, which is expected given that two adult households have far higher incomes on average. The differences between the income of couples and singles is made clear by comparing Figures 5 and 7, from which it can be seen that the average income of the 3rd quintile for single adult households is approximately equal to the average income of the 1st quintile for two adult households. Despite the need to take into consideration the greater needs of larger households, the income differences discussed here suggest that two adult households earn higher incomes than single adults. Again, with regard to couples, the low-income households save

²⁸In the 2001/2 Family Resource Survey there are about 1000 single males, 1500 single females, and 2500 couples aged between 45 and 55.

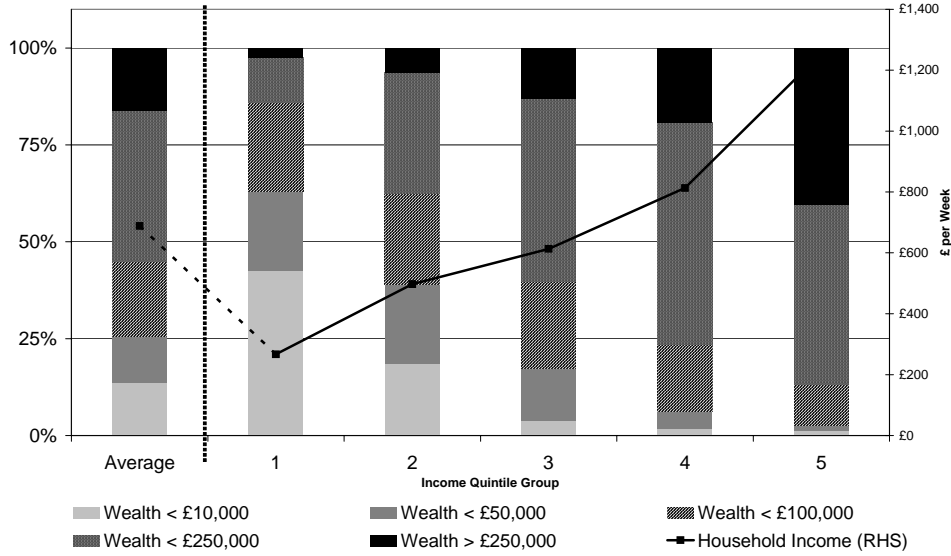


Figure 7: Distribution of Wealth by Income Quintile for Two Adult Households aged between 45 and 55

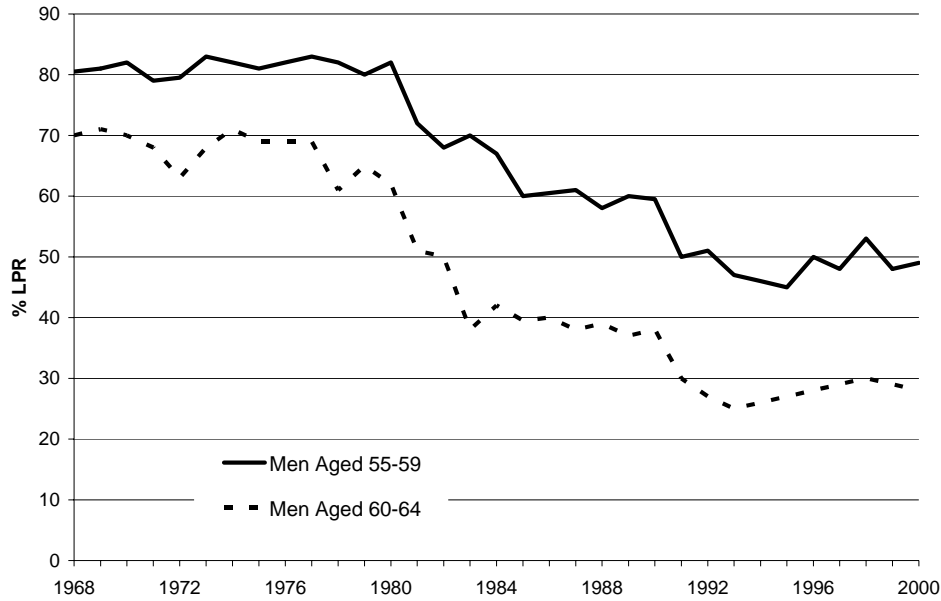
proportionally far less than high-income households.

4.2 Means Testing and Incentives to Work

The means testing of retirement benefits reduces the return, and therefore the benefits, of saving. This is likely to encourage individuals on low-incomes to consume more while of working age, and to save less for their retirement. Alternatively they could retire early, consume their savings before retirement and live off retirement benefits later. This, economically, can be seen as equivalent to consuming more - rather than consuming additional goods, individuals who retire early are consuming additional leisure.

Figure 8 indicates how male participation rates in full-time employment have changed over the last 30 years for the age bands of 55-59 and 60-64 year olds. This figure reveals that there has been a dramatic downward trend in employment rates for males in both age groups, with reductions of over 30% observed between 1980 and 2000. The largest falls are observed during the two recessionary periods, 1980-84 and 1990-1993 with employment rates remaining relatively constant outside of these periods. In contrast female employment rates have remained constant over the whole period at about 35% for women aged between 55-59 and at about 15% for those aged 60-64. This is possibly because the trends towards early retirement have been offset by the trend towards greater female labour market participation.

The concern is that these increases in early retirement are likely to be economically costly. If individuals are leaving the labour market to move onto benefits, then this in itself will impose a large fiscal burden. Furthermore, these individuals, once out of the labour market, are unlikely to be saving for their retirement after 65. In fact they



Source: Figure 3.1, Banks et al. (2002) - reproduced with kind permission from the authors

Figure 8: Male Labour Participation Rates by Age

are more likely to be dissaving. It is therefore also more likely that they will be eligible for and receive additional income support benefits once they are over the state retirement age, imposing a more substantial burden on the welfare state.

Consequentially it is important to determine the reasons why individuals are retiring earlier. Is it those individuals who have saved throughout their working life so as to ‘buy’ some leisure at the end? Is it individuals with relatively low levels of savings, ‘buying’ leisure in their last few working years in the knowledge that they will be supported by means tested benefits in retirement? Or is it individuals that lose their jobs through forced redundancy or ill-health and are unable to find suitable further employment? It is difficult to determine which of these alternatives is the ‘true’ reason for any individual. Asking people directly is fraught with difficulties; the most pertinent being that there is a tendency for people to answer such questions with an ex-post justification for their current condition rather than their ex-ante reasons. To attempt to estimate the reason from observed data, would require one to observe an individual’s wealth, income and consumption over the years up to early retirement and during retirement. Unfortunately no such data set exists. In our paper “Playing the Generation Game” (Kirsanova *et al.*, 2002), we built on the work of Banks *et al.* (1998) to try and answer this question, not for individuals, but for a cohort of individuals sharing common characteristics.²⁹ The following figures attempt to illustrate the findings of that research.

²⁹This work applies the cohort approach of Deaton (1985) to the issue of early retirement. In the UK, the only survey that ask individual’s about their entire expenditure in any given period is the Family Expenditure Survey (FES). This survey is repeated annually, but each year a different representative sample is interviewed. Deaton’s idea is to trace cohorts who share common characteristics such as age, sex, educational qualifications through these series of cross-sectional surveys. By averaging the responses of individuals in the

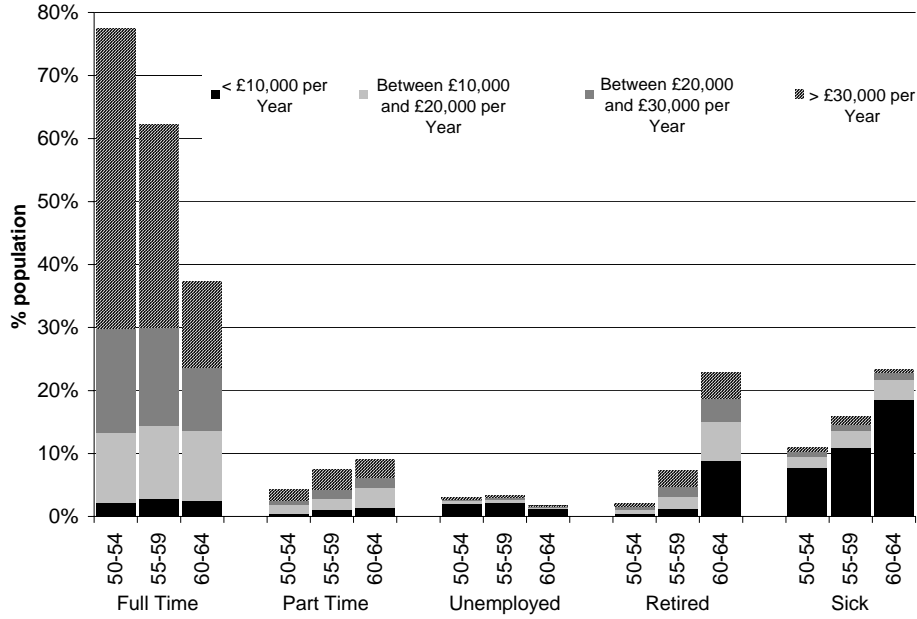


Figure 9: Male Employment Status in 2001 by Household Income and Age Bands

The Family Resource Survey breaks down the employment status of individuals into five broad categories; those who are in full time work (either employed or self-employed), those in part-time work, those who are receiving invalidity benefits (the ‘sick’), those who are receiving unemployment benefits, and the retired.³⁰ In Figure 9 we record the percentage of men aged 50-54, 55-59 and 60-64 in each of these employment status groups. We also divide each of these groups into sub-groups according to their total household income; the sum of earnings, benefits, investment income and pensions to all members of the household.³¹ The income groups are defined as those with a household income less than £10,000 per year, between £10,000 and £20,000 per year, between £20,000 and £30,000 per year and above £30,000 per year.

The percentage of men in full time work with a household income less than £20,000 per year is relatively constant across the age groups. There is a large fall of roughly 30%, however, in the percentage earning more than £30,000 per year and a less pronounced fall in the percentage with an income between £20,000 and £30,000 per year over the age groups. There is a corresponding increase in the percentage retired and ‘sick’ across the age groups, with a small increase in the number of part time workers. It would, of course, be wrong to say that this implies that it is only those with an income greater than £20,000 who leave the labour market as they get older. It could, for example, be that those on higher incomes change their jobs to ones less well-paid, and that it is those on low-incomes who retire

cohort the aim is to attenuate the idiosyncratic elements in any one individual’s behaviour.

³⁰There is also a small ‘others’ category.

³¹Whilst it might be thought preferable to sort the sample by their own income, in practise the results would be very sensitive to how one chose to allocate any joint incomes. Further, individual retirement decisions are as likely, if not more, to be based on the total household income.

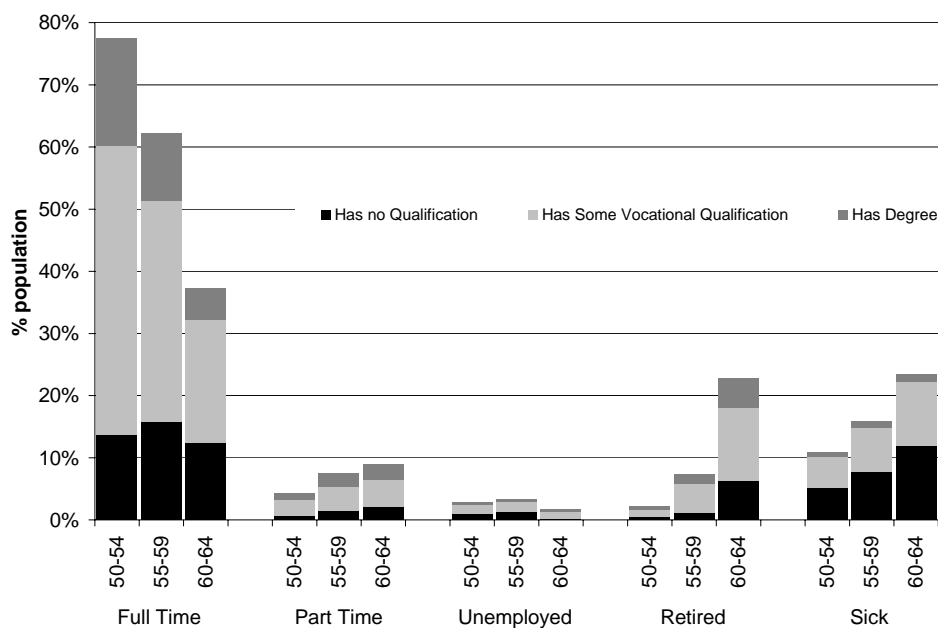


Figure 10: Male Employment Status and Highest Educational Qualification by Age Bands

or become long-term sick.³² However it is suggestive - especially as there is only weak evidence that an individual's hourly wage rate falls as they get older if they remain continually in employment (see Campbell (1999) and Gregg, Knight and Wadsworth, (1998)).

Figure 10 distinguishes the population by their highest educational qualification attained, rather than their household income (as discussed with regard to Figure 9). We differentiate here between three groups; those with a degree level qualification, those with some vocational qualification, and those without any vocational qualification. This has the advantage that one is now tracing a permanent characteristic across the age bands, rather than one that changes over time such as income. Furthermore, this characteristic is highly correlated with lifetime income - an individual with a degree earns 60% more than one without on average, and one with some vocational qualification earns about 25% more than one without. However the disadvantage is that there has been a significant trend since the 1940s in the percentage participating in tertiary education.³³ In our sample, 15% have a degree in the 60-64 year old band, 16.5% of the 55-59 year olds and just over 20% of the 50-54 year olds.

Nevertheless, the picture revealed by Figure 10 is relatively clear. Those with a degree are the most likely to retire. About 60% of individuals with a degree in full-time work at age 50-54 leave full time work by age 60-64, with

³²The data are all taken from the year 2001. Consequently, it could be that the large differences in the behaviour of alternative cohorts is a reflection of the different economic times that they lived through - the so called 'cohort-specific' effects. However drawing similar figures using data from the 1996 survey gives an almost identical picture. There are some differences using data from the 1991 survey, but this is because aggregate labour participation rates were changing rapidly then - see Figure 8.

³³The Dearing Report (Report 6, Section 1) estimates that the Age Participation Index (API), the percentage of 18 year olds participating in Higher Education, rose from 1.8% in 1940 to 5.4% in 1960 and then to 12.4% in 1980.

the majority retiring or moving into part-time employment; only a very small fraction are likely to become long-term ‘sick’.³⁴ Of those individuals with some vocational qualification and in full-time work at age 50-54, 50% are likely to leave work by 60-64. Roughly two thirds of these will retire or take up part-time work and a third will receive invalidity benefits. Finally of those with no qualification and in full-time work at age 50-54, only 40% are likely to leave work by 60-64. Again two thirds of these will retire or take up part-time work and a third will receive benefits.

The data on retirement behaviour are consequently less homogeneous than the data on savings behaviour. This suggests that a number of factors are important in determining retirement age, such as pension arrangements, household composition and job tenure. We have tried to focus here on probably the most important single determinant, lifetime income. In doing so, we have highlighted some clear trends in the data; those with higher incomes are likely to retire earlier. Those with lower incomes are likely to leave full-time work later, and a significant proportion of these are likely to move onto invalidity benefits.

What does this imply about the likely effects of changes in the degree of means testing of pension benefits on retirement behaviour? Those households on higher incomes are unlikely to be dependent on these benefits, and so their behaviour is unlikely to change dramatically. Those on low incomes have very low savings, so again their behaviour is unlikely to be dramatically affected since they are likely to be eligible for full benefits regardless of the means testing criteria. Therefore, changes to the means test are likely to have the most substantial effect on middle incomes households. Increases in the severity of the means test is likely to make these individuals work longer, and save more. However, quantifying the impact is difficult. In the next section, we describe briefly the National Institute of Economic and Social Research Retirement Model, and in Section 5.1 we use observations drawn from this model to infer the likely distributional impact of alternative pensions policies.

5 The NIESR Retirement Model

Microsimulation models were first used for economic analysis by Orcutt (1957), and are now commonly employed to undertake policy analyses in many countries around the world. The feature that distinguishes microsimulation models from their macro based counterparts is that each micro-unit (also referred to as agent) from a given population is individually represented.³⁵ This property facilitates an understanding of the influences that contribute to simulated outcomes, and makes microsimulation particularly useful for undertaking distributional analyses.

Microsimulation models are traditionally classified as either dynamic or static, depending upon how (and whether) the population is aged. Static microsimulation models, as their name suggests, determine the impact of counterfactual

³⁴These observations were made after adjusting for trends in higher education participation rates.

³⁵For macro-based models that study the impact of policy changes, see Dervis *et al.*(1982), Taylor (1990), and De Janvry *et al.* (1991). These are examples of Computable General Equilibrium models. Most micro-based models are constructed using a partial equilibrium framework. For examples of micro-based models that use a general equilibrium framework, see Meagher (1993), and Congneau and Robilliard (2000).

conditions upon a population of agents at a point in time. They usually consist of two parts; a reference database that details the characteristics of each agent in a population, and a procedure for calculating the impact on each agent of counterfactual conditions. Consequently, the range of policies that can be analysed by static microsimulation models is limited only by the degree of detail that is provided by the reference database used. Given the demographic and income characteristics of families, for example, static microsimulation models are often used to determine the impact effects of alternative benefits policies on the income distribution, and upon the budgetary cost of the transfer system.

Static microsimulation models ‘age’ a population by reweighting the reference database using statistical projections to reflect an alternative time period. In contrast, dynamic microsimulation models age each individual described by the reference database in response to stochastic variation and an accumulated history. For example, a dynamic microsimulation model that is designed to consider the effects of fiscal policy may generate characteristics that include marital status, parenthood, income, and mortality at annual intervals for each person described by a reference database. The income of each individual at any given year is often simulated based on characteristics such as the individual’s past income, their demographic characteristics, and upon a stochastic term that accounts for unexplained variation. This type of procedure builds up a life history for each individual in a population, which significantly increases the range of questions that can be explored, relative to (standard) static models. Most dynamic microsimulation models are designed specifically to consider the intertemporal and long term effects of counterfactual conditions, rather than the impact effects with which static models are concerned.

Most microsimulation models that are currently in use are static. Prominent examples of these include, STINMOD (Australia; refer to the STINMOD Technical Series, NATSEM, Australia), POLIMOD (UK; see Redmond et al., 1998), EUROMOD (15 member states of the European Union; see Sutherland, 2001), TRIM2 (US; see Giannarelli, 1992), SPSP (Canada; refer to Statistics Canada), SWITCH (Ireland; see Callan et al., 1996), LOTTE (Norway, see Fjærli et al., 1995), and FASIT (Sweden; refer to the Swedish Ministry of Finance).³⁶ Advances in computing power, analytical techniques, and the availability of increasingly detailed survey data have led to an increase in both the number and sophistication of dynamic microsimulation models. Some recent examples of these include ASPEN (US; see Basu et al., 1998), CORSIM (US; see Caldwell, 1997), DYNACAN (Canada; refer to Statistics Canada, based on DYNASIM, see Orcutt et al., 1976), HARDING (Australia; see Harding, 1993), MICROHUS (Sweden; see Andersson et al., 1992), and SESIM (Sweden; refer to the Swedish Ministry of Finance).

In addition to the static-dynamic dichotomy, microsimulation models can also be distinguished by the extent to which they incorporate agent specific behavioural responses. Given the ageing populations and reduced rates of economic growth observed in many industrialised countries, attention has been focused in recent years on the

³⁶For useful surveys, refer to Zaidi and Rake (2001), Sutherland (1995), and Merz (1991).

responsiveness of labour supply, savings, and fertility to alternative tax and benefit systems.³⁷ Behavioural response may be modelled using statistical projections estimated from survey data (see, for example, CORSIM), or an explicit consideration of how individual decisions are made. The latter of these methods usually involves assuming that reference units make their decisions to maximise an assumed objective (utility) function, subject to various practical constraints (such as the available funds that a household can spend). It is the most complex computationally, and therefore used only rarely.

The model described by this paper falls into the last of the categories described above. Specifically, household decisions regarding labour and consumption are simulated by assuming that the household maximises an intertemporal utility function, subject to a budget constraint. In our view, this approach is of particular importance for an analysis of the relationship between government fiscal policy, and household savings and retirement behaviour. This is because it does not assume that households behave in a given way, such as saving a given proportion of their income. Rather households adapt their behaviour so as to make the most of the current policy environment. In that sense, the model meets the Lucas critique. Thus in a behavioural model, if the level of the basic pension is raised, households will reduce their level of savings during their working life and maybe retire earlier. By adapting their behaviour in this way, they are able to sustain both a more stable and higher level of consumption over their entire life. In contrast in a non-behavioural model, households will continue to save the same amount and therefore enjoy a higher standing of living in retirement but not a better standard during their working life.³⁸ If the objective is to investigate the incentive effects of different pension policies, there really is no alternative but to use a behavioural model.

It would, however, be disingenuous to suggest that there are no disadvantages to using the type of model considered here. Specifically, behavioural models need to assume households behave in some well defined manner. Though it is possible to empirically test the assumptions inherent in the model considered here, and a great deal of work has been devoted to this (see Deaton 1993), it is never possible positively to verify them. Consequently, the predictions made by behavioural models always remain subject to the uncertainty that underlies the analytical framework adopted. Furthermore, these models are complicated to solve, and so need to remain highly stylised. For this reason, we assume away a great deal of household heterogeneity. Finally these models do not realistically capture the learning process as people adjust to a new policy environment. They are therefore better at modelling the long term as opposed to the short run impact of any policy change.

The following subsection provides a brief description of the simulation model used here. Further details of the model, including a detailed description of its calibration, are provided in Sefton *et al.* (2003).

³⁷See Macunovich (1998), and Hotz *et al.* (1997) for surveys of the fertility literature, Auerbach (1997) on savings, and Debelle and Swann (1998) on trends in the Australian labour market.

³⁸We have ignored here that higher pension must imply higher level of taxes. In this case, in a non-behavioural model, households will have a higher standard of living in retirement at the cost of a lower standard earlier.

5.1 The Current Model

A partial equilibrium dynamic microsimulation model has been constructed to explore household savings and retirement decisions in the UK. The decision unit in the model is the household. Each household is aged by annual increments, from 20 to 90 based upon the age of the household's reference person.³⁹ In every year, the household decides whether to work full-time, part-time or not at all (households are treated as having an aggregate labour supply), and how much to consume given its economic situation, under the constraint that its net worth must remain positive. We assume a broad definition for the economic situation of a household that includes the household's age, its size, the wealth that it has managed to accumulate, the interest rate, the level of means tested income support available, and the wage that it can command for its labour. This wage rate evolves stochastically.

At age 65 the household is forced to retire if it has not already chosen to do so. In retirement the household pays for its consumption either out of its savings or from a state pension. This pension is characterised by its generosity (the replacement rate) and the degree to which it is withdrawn for every pound of private income earned (the taper rate).

Simulated households are described by 6 characteristics:

1. the number and age of household members
2. the human capital of the household
3. the labour supply of the household
4. household consumption
5. household wealth
6. time of death

Demographic Size and Composition: The size of each household varies with time to reflect the coupling of individuals, and the birth and aging of children who eventually leave home. Household size is, however, modelled in a pre-determined fashion, and consequently behavioural effects are not considered in this dimension. For models of endogenous fertility, see Nerlove *et al.* (1984), and Barro and Becker (1989).

Human Capital: A household's labour income is equal to their human capital multiplied by their labour supply. The human capital of a household is simulated as a stochastic process using a regression toward the mean model that adjusts for a learning-by-doing effect. The learning-by-doing effect is required to ensure that individuals supply

³⁹See The *Family Expenditure Survey 2000-2001 User Guide*, Vol. 1 for the definition of a household reference person.

some labour during the early years of their working lifetimes. See Sefton *et al.* (2003) for a detailed description the model used to simulate human capital.

Labour Force Status, Consumption, and Wealth: Household decisions regarding labour supply, consumption and saving are endogenous to the model. As this is a fundamentally important aspect of the simulation model, a detailed description of the methods involved is provided in Subsection A.1.2.

Household Mortality: Each household is selected to die, based upon an exogenously defined survival function that is calibrated from cross-sectional statistical mortality rates for 2000/01 in the UK.⁴⁰ The use of data from a single cross-section implies that temporal trends in mortality rates are not captured by the model. In this sense, the model generates a cohort of individuals who are born in 2000/01 and live for up to 90 years in a world that remains exactly as it was in their birth year. On this approach to microsimulation model calibration, see Harding (1993).

For details of the model please refer to the Appendices.

6 Inferring the Long Term Impact of Changes to Pension Policy

In this section we investigate the distributional impact of changes to pensions policy. In particular, we are interested in the effects on the average retirement age, and on the level of savings across the income distribution. We consider these effects with regard to changes in the severity of the pensions means testing, and to alternative state pensionable ages.

The results from the model are reported relative to a baseline scenario. In this scenario the model is calibrated to capture the features of the UK tax and benefits system as of October 2003. Non-retired working households on low incomes receive working tax credits, and those with children receive child tax credits. Retired households with low private pension incomes receive both the pension guarantee (MIG) and Pension Credits. Other elements of the welfare system such as income support, and particularly housing and council tax benefits have been adapted in line with recent policy changes.⁴¹ The analysis presented below is based upon a simulated population of 30,000 households.

Figure 11 displays male participation rates near retirement age for lifetime income⁴² quintiles, which are predicted by our model under the baseline scenario. It is preferable to divide the population into quintiles using lifetime income rather than cross-sectional income (which is considered in Section 4), because cross-sectional income is more volatile, and is a less adequate indicator of economic advantage. The consideration of lifetime income is made possible here by the longitudinal aspect of our simulation model. However, the use of lifetime income quintiles does mean that the results presented here are not directly comparable with the analysis that is presented in Section 4. Furthermore,

⁴⁰The mortality rates used are calculated using the proportion of female reference people by age recorded in the 2000/01 Family Expenditure Survey (FES), and mortality rates by age and sex recorded in the *Annual Abstract of Statistics*, Table 5.21, The Stationary Office. Mortality rates after the age of 84 are subject to manual adjustment.

⁴¹See Sefton (2003) for details.

⁴²Lifetime income, as it is used here, defines income earned before the age of 50.

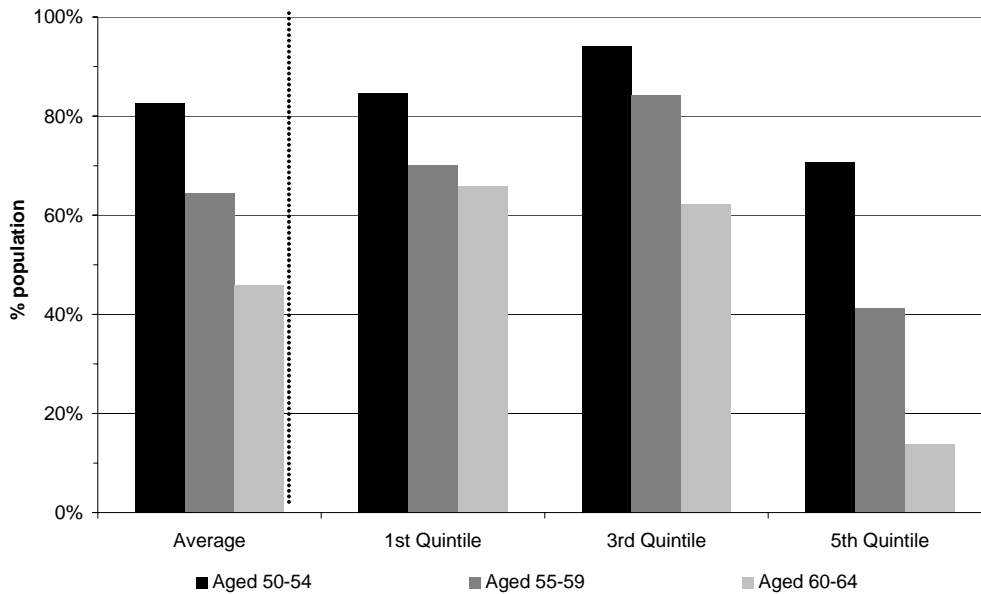


Figure 11: Predicted Full Time Employment Rates by Age Group and by Average Lifetime Income Quintile

comparisons between the observations made here, and those discussed in Section 4 are complicated by the fact that it is extremely unlikely that the cross-sectional population described by the survey data considered in Section 4 will have adapted to the recent changes to the pension system (even though they were announced a couple of years ago). Nevertheless, the model does appear to capture the principal observations of the previous chapter. Firstly, individuals in the higher income quintiles are more likely to retire, and to retire early. Secondly, those in the third income quintile who are identified as working at age 50, are more likely to leave work after the age of 60 than those in bottom quintile group, but those in the bottom quintile group are more likely to be out of work before 60. Finally the average participation rates by age band look almost identical to those in Figures 9 and 10.

In Figure 12 we report the wealth to income ratios for our representative households at the age of 50 by average lifetime income quintile. Comparison of this figure with Figure 6 reveals that the calibrated model is able to produce a reasonably accurate reflection of the wealth to income ratios observed in survey data.

6.1 Changes in the Severity of Pensions Means Testing

In October 2003 the Pension Credit will be introduced. This effectively reduces the taper rate on the MIG from 100% to 40%. As the Government said, this was to reduce the:⁴³

tension between the need to ensure there is a level below which pensioner incomes do not fall, and the need to ensure that today's workers have a clear incentive to save. The Pension Credit will ensure that

⁴³The Pension Credit: The Government's Proposals, DWP, 2001.

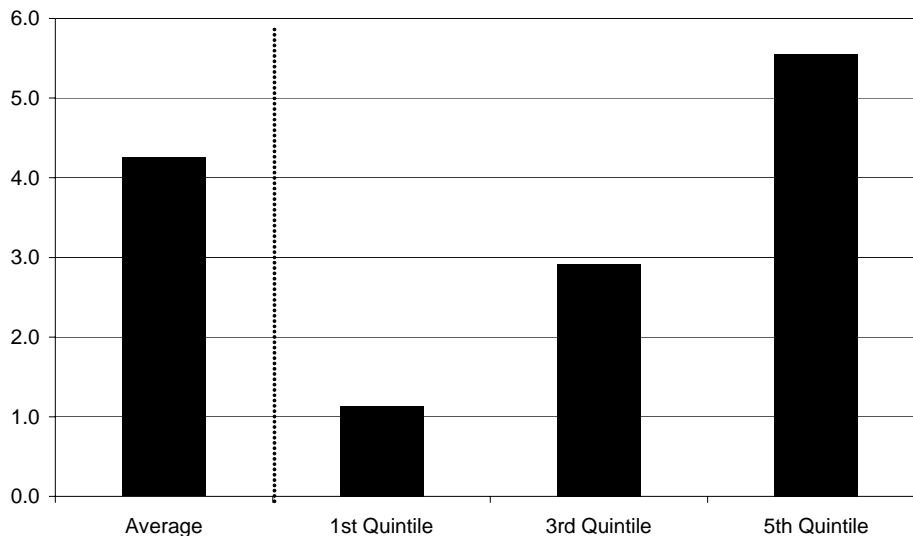


Figure 12: Predicted Household Wealth to Income Ratio at 50 by Lifetime Income Group

we can both tackle poverty amongst today’s pensioners, and boost the incentive for future pensioners to save for their own retirement. The Pension Credit will make sure that it pays to save.

To the best of our knowledge, the Government has not made clear what it believes will be the long run impact on the labour market of introducing the Pension Credit. In Figure 12 we have plotted our estimates of the long term impact on labour market participation. In particular, we consider the effects observed if the Pension Credit is *removed* from our base scenario (which includes the Pension Credit) - to consider the effect of *introducing* the Pension Credit it is consequently necessary to reverse the sign on the statistics displayed in Figure 12.

Though in aggregate there is surprisingly little change in labour market participation (see the population averages reported in Figure 12), this masks some important distributional effects. The introduction of the Pension Credit encourages those on low incomes to work longer, increasing participation rates by up to 6% - given a higher return to saving, the poor choose to work longer and save a little more. In contrast those on middle incomes, now find themselves significantly better off. Consequently, they take some of this benefit in the form of increased leisure, and so retire earlier. The offsetting nature of these two effects means that aggregate participation rates for the population is approximately zero.

Do the increased incentives to save encourage people to save more? Figure 14 plots the absolute average household wealth to income ratio at age 60 under the base scenario on the left axis, as well as plotting the long run predicted changes to this ratio if the Pension Credit was removed on the right axis. Although removing the Pension Credit reduces the incentives to save, the net effect on aggregate savings levels is negligible. This is because the reduced

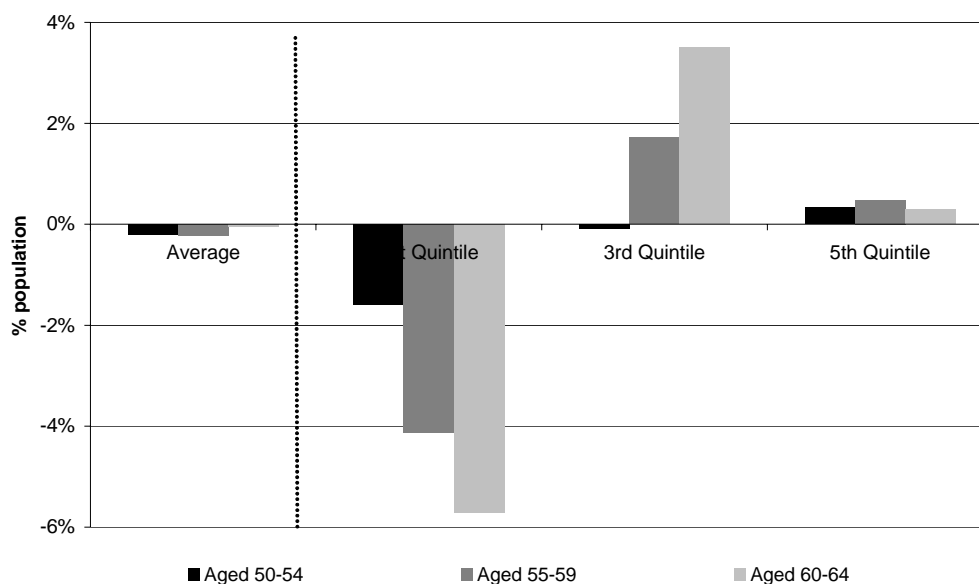


Figure 13: Predicted Long Term Change in Full Time Employment Rates by Age Group for each Lifetime Income Quintile if the Pension Credit was Withdrawn

savings of those on low incomes is offset by the increased saving of those on middle incomes who find themselves worse off after withdrawal of the Pension Credit.⁴⁴ Given the adverse shock caused by the withdrawal of the Pension Credit, middle income households adjust their behaviour to spread the burden during their working lifetime (by increasing their savings rate).⁴⁵

The Government introduced the Pension Credit to reduce the disincentive effects for saving of the MIG. Some commentators felt that the Government should have gone further, and removed taper rates all together by raising the level of the basic pension to the level of the MIG⁴⁶. In Figure 15, we plot the estimated long run impact on labour market participation of raising the level of the basic pension in line with the MIG, and Figure 14 also reports the coincident impact on the average wealth to income ratio for lifetime income quintiles. This policy change is generous to all income groups, but particularly so for those on higher incomes (the lower income groups receive the MIG regardless of the means testing applied). Across all income groups, it is possible to observe individuals adapting their behaviour. All groups take the increased gains in the form of earlier retirement, and in increased consumption prior to retirement (hence lower savings). The effects, though, are most dramatic for those on higher incomes.

⁴⁴The parameters adopted for the model imply that an increase in the marginal interest rate will see increased savings. This is not only because of the textbook trade-off between the substitution and income effects. It also arises because a significant proportion of lifetime household income is received during retirement in the form of pension income, which dampens the size of the income effect.

⁴⁵Middle income households effectively see a rise in their marginal interest rate following withdrawal of the Pension Credit, because they move out of a means testing environment.

⁴⁶ignoring for the moment, taper rates associated with housing and council tax benefits.

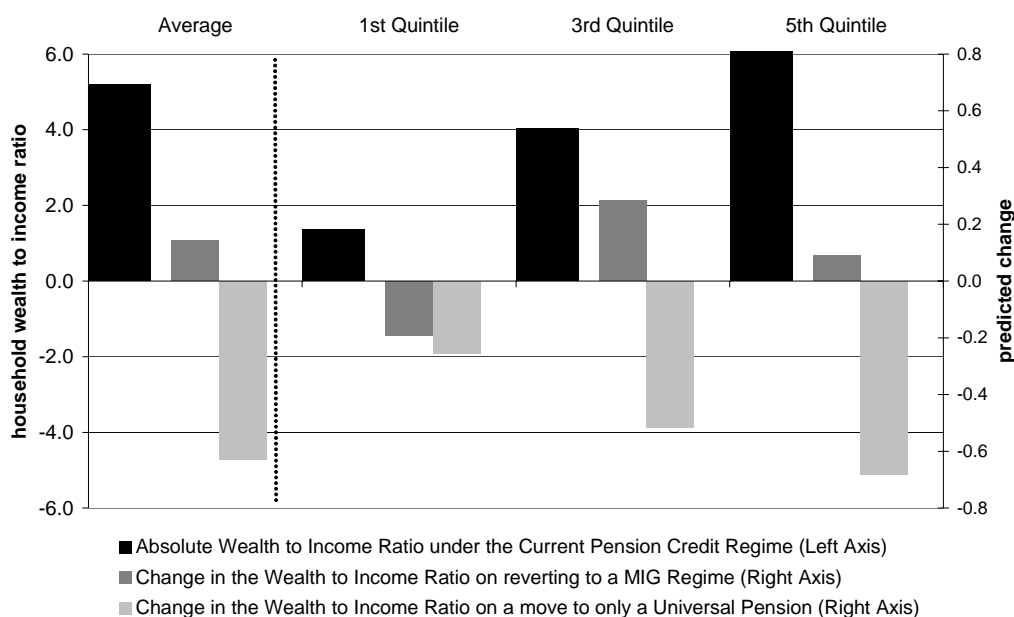


Figure 14: Predicted Changes to the Wealth to Income Ratio at Age of 60 for Lifetime Income Quintiles

If the Pension Credit were revoked in preference for a Universal Pension, it would inevitably require rises in income tax to pay for the increased fiscal burden. These tax rises would offset the gains to individual households of the increased pension generosity. However, the net effects of coincident tax rises would presumably be different for the different income groups. Assuming that the additional tax burden is imposed by an equal increase in all tax rates, those on low incomes would be worse off under the net changes. These households would have received the MIG despite the means test, but would be subject to a higher level of tax to pay for the Universal Pension. Those on very high incomes would also be worse off; the increase in their pension benefit would be small, relative to the increase in their tax bill. Consequently, middle income households would benefit from the counterfactual pension policy considered here - at the expense of households at the distributional extremes (assuming a budget neutral policy change).

Following these considerations it seems natural to ask whether there is some optimal taper rate. A very high taper rate creates large disincentives to save and work for those on low incomes. This in turn creates a greater demand for benefits, and so inevitably is highly inefficient from an economic perspective. Removing the taper rate altogether, forces those on low incomes to face much higher marginal income tax rates and so reduces their standard of living, and therefore increases inequality, which may be undesirable from a social perspective.

Miles and Sefton (2003) investigate this trade off between economic efficiency and redistribution using a highly stylised model. They consider the issue as a social engineering problem and ask what taper rate would achieve the best compromise between these objectives. They found, as Patrick Minford put it in the Daily Telegraph on 1st

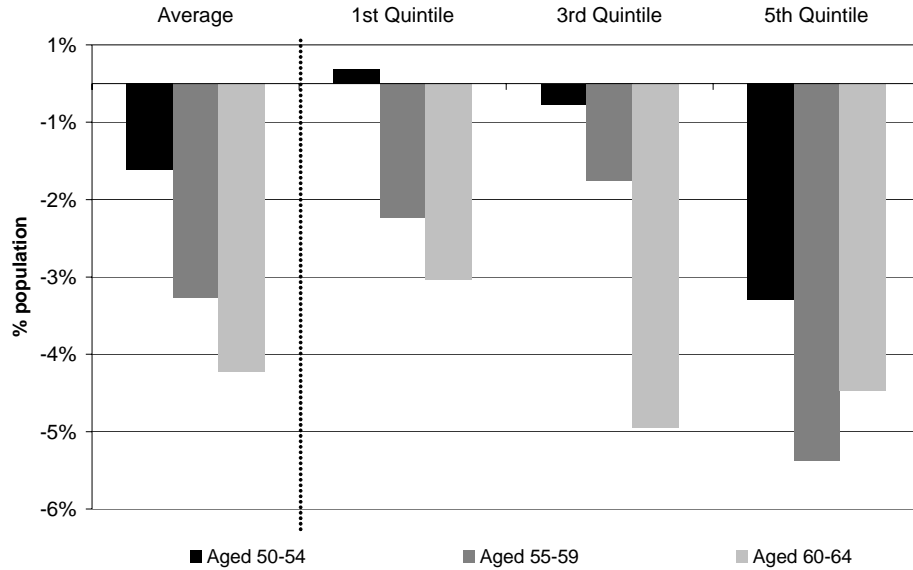


Figure 15: Predicted Long Term Change in Full time Employment Rates by Age Group for each Lifetime Income Quintile if the Basic Pension Rate is Increased to the level of the Pension Guarantee

July 2002, “there is such a political demand within each generation to subsidise less well-off pensioners that people will put up with a much less efficient economy to achieve it.” Under a range of fairly broad assumptions, taper rates between 30-50% appear to achieve the most desired trade-off.

6.2 Analysis of Pension Policy Alternatives

We consider the following policy alternatives:

- Phasing out the Second State Pension in favour of a new universal Citizen’s Pension that is not means tested but universally available;
- Raising the amount for single pensioners from £75 a week to £100 a week in today’s terms (in other words, subsuming the MIG and the Pension Credit) and indexing this amount with earnings;
- Raising the State Pensionable Age (SPA) to 70 over the decade from 2020 to 2030.

These proposals were suggested by the National Association of Pension Funds (NAPF) in their document, “Pensions: Plain and Simple” (October, 2002). The NAPF proposals were costed by the Government Actuary Department (GAD), which reported that over both the short and long run, the budgetary cost of these changes would be broadly neutral with respect to current policy as of October 2003. Table 1 reports a similar calculation from output of the NIESR Retirement model. This table also reports the estimated expenditure on pension benefits under all the

Table 1: Budgetary Cost of Alternative Pension Policies

Policy Regime	Net Annual Expenditure on Pension Benefits in 2002 Prices
Current Policy including the Pension Credit (Policy as of October 2003)	£49.8 Bn
Minimum Income Guarantee (100% Taper) (Policy prior to October 2003)	£46.6 Bn
Increase in the level of the Basic State Pension (to the level of the current pension guarantee)	£70.6 Bn
Increase in the State Pension Age to 70	£36.3 Bn
Increase in the State Pension Age and the level of the Basic State Pension (NAPF recommendation)	£50.6 Bn

different policy regimes considered. The expenditure on benefits includes expenditure on the Basic Pension, Income Support or Pension Credit, and Housing and Council Tax Benefits. Also when the SPA is raised, we include the net spending on benefits (all non-retirement benefits less taxes) on those aged between 65 and 70 to ensure comparability. The results must be interpreted as counterfactual experiments, what would have been spent this year if the proposed policy had been in place for a considerable time. Although our assumptions are different from those of the GAD costings, our conclusion is in very close agreement; the policy alternatives are budgetary neutral with respect to current policy.

Figure 16 plots the expected changes in male labour market participation if the SPA is increased to 70 and the basic universal pension is increased to the level of the current pension guarantee. In the figure, we have included a new age band for the 65 to 69 year olds.

Unsurprisingly an increase in the SPA increases average participation rates, though the changes are relatively small for all age bands below 65. However the startling conclusion from these experiments is that it is those on low incomes who work for more years. Those on middle incomes work only 1 to 2 years more, whilst those on the highest incomes retire at much the same time as before. As we noted earlier, the policy change is roughly budgetary neutral. Hence the same amount of money is transferred in pension payments as before. However as the pension is now universal, those on higher incomes are now getting a larger share of these payments. Therefore if anything, they retire earlier. For those on middle income, the story is similar though less marked as they tended to receive some means tested benefits under present policy. In contrast, those on low incomes now receive a smaller share of the transfer. Under current policy they tended to receive the full pension guarantee amount anyway because they had only minimal savings; so that after the policy change they receive the same pension but only after age 70, rather than 65. Furthermore, because they relied almost exclusively on this state pension after 65, they are forced to work until age 70.

Figure 17 shows how this policy shift affects the level of aggregate savings for those in the age band 65-69. In the figure we have decomposed the observed changes into those which are due to the increase in the SPA, and those

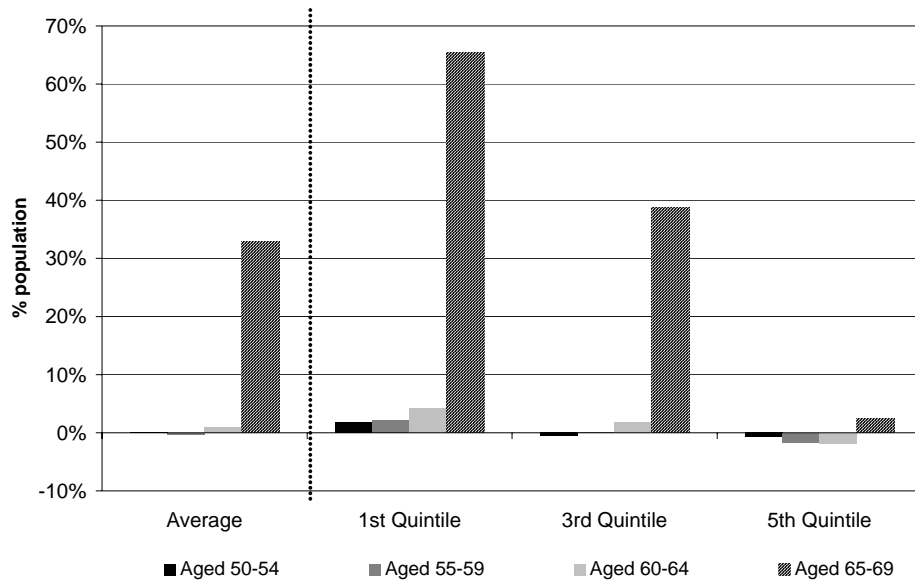


Figure 16: Predicted Long Term Change in Full time Employment Rates by Age Group for each Lifetime Income Quintile should the Pension Policy Alternatives be Adopted

which are due to the combined change in the SPA and the increased basic state pension. Increasing the SPA only, increases the level of aggregate savings. Those on middle and higher incomes, now need to save more so as to retire earlier because they receive a state pension for a shorter period. Those on low incomes, work longer and retire later so they save slightly less. However increasing the SPA and the level of universal basic pension, decreases the level of aggregate savings. The savers, those on middle and higher incomes now receive more on average over their period of retirement from state pension payments, and so need to save less. Those on low incomes save less too as they work substantially longer.

In these simulations, we have assumed that the observed gentle decline in the hourly wage of 59 year olds relative to 55 year olds and 64 year olds relative to 60 year olds continues after 65, should the SPA be increased. If this is not the case, or if the pay of older workers rise relative to younger workers, then our counterfactual experiments will underestimate the increase in labour market participation amongst the middle or higher income workers. However, the conclusion that this policy change redistributes pension transfer payments from those on low incomes to those on higher incomes - and so is likely to increase labour market participation of the less well paid more than the better paid - is robust to significant changes in our assumptions. Consequently, although this policy is economically efficient in the sense that it encourages greater labour market participation, it is redistributionally regressive with respect to current pensions policy.

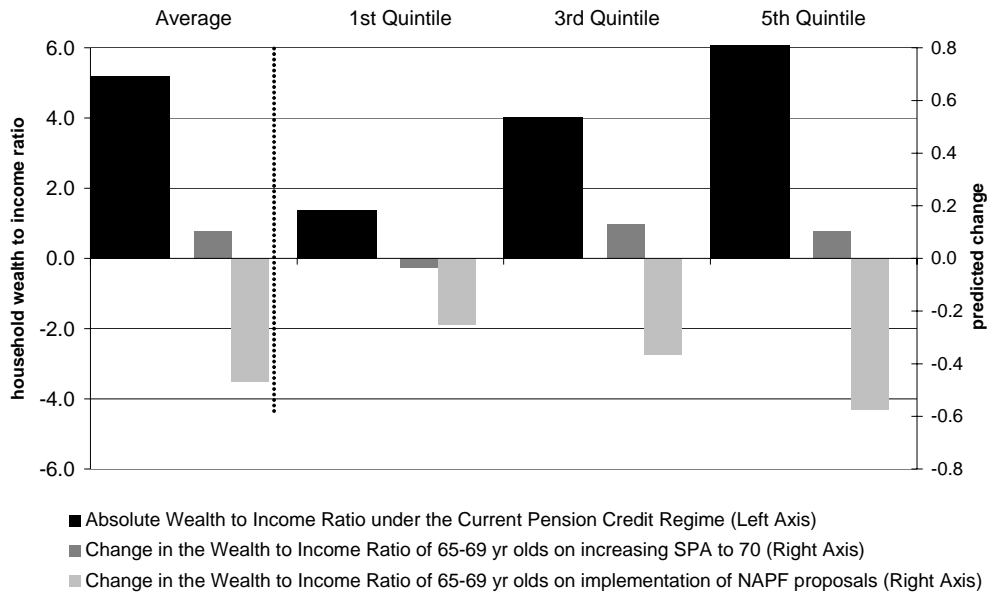


Figure 17: Predicted Changes to the Wealth to Income Ratio by Age Group for each Lifetime Income Quintile

7 Conclusions

Changes in pension policy can have important distributional consequences. These are often neglected by the public debate, which usually focuses upon associated budgetary implications. This paper has aimed to redress this balance.

Means testing does create disincentives to work and to save. However, these costs are presumably offset by the redistributive advantages of focussing state benefits on poorer households. Means testing provides a method for ensuring that everyone has an adequate standard of living in retirement, while limiting the associated costs to the taxpayer. This consideration is critical, given the projected ageing of the population. Furthermore, it is certainly not clear that means testing reduces the level of aggregate savings. This is because the more affluent parts of society, who generate most of the country's savings, are not subject to means testing, but are affected by the consequent tax rises that would be required to fund any move to a universal pension.

There are always losers in any policy change, and increases in the severity of the means test usually imposes a burden on middle income households. The analysis presented in this paper suggests that the introduction of the Pension Credit achieves a reasonable balance between the benefits and costs of means testing. A more severe means test would hit the middle income bracket too hard, any less and the redistributive benefits would be lost.

Table 2: The values of the demographic constants for a two person household with a tertiary education

Household age at period end, t	5	10	15	20	25	30	35
Age of adults	25	30	35	40	45	50	55
Probability of dying, ψ	0	0	0	0	0	0.001	0.002
Average number of adults, na	2	1.994	1.988	1.98	1.963	1.953	1.927
Average number of children, nc	0.137	0.579	1.161	1.589	1.471	0.977	0.429
McClements family size, m	1.003	1.051	1.155	1.284	1.359	1.3	1.152
Household age at period end, t	40	45	50	55	60	65	70
Age of adults	60	65	70	75	80	85	90
Probability of dying, ψ	0.006	0.016	0.04	0.087	0.173	0.313	1
Average number of adults, na	1.884	1.817	1.715	1.581	1.427	1.273	1.142
Average number of children, nc	0.107	0.011	0	0	0	0	0
McClements family size, m	1.017	0.939	0.89	0.837	0.777	0.716	0.665

A Appendix A: Description of the model

A.1 The Representative Household

A.1.1 A description of the household unit

We treat the household as the basic economic unit in our partial equilibrium model. In this section we shall describe the characteristics of representative households, indexed by i . There are two household types, distinguished by whether or not they are regarded as having a tertiary education qualification.⁴⁷ The education attribute of household i , denoted by a_i , is equal to e if a household has a tertiary qualification, and u if it does not.

Each household begins life at $t = 0$ when its ‘reference adult’ is 20 years old. The household dies when the reference adult dies. The life of the household is uncertain, but we assume a maximum age of 90 ($t = 70$). We denote the conditional probability of the household dying at the end of period t , given that it has survived to the beginning of that period, as ψ_t implying that $\psi_{70} = 1$.⁴⁸ It therefore follows that the probability that a household will survive for another n years from period t , $\phi_{n,t}$, is the cumulative product of the conditional probabilities $\phi_{n,t} = \prod_{j=t}^{t+n-1} (1 - \psi_j)$.

During its life, the size of the household varies with the birth and aging of children, and the marriage and dissolution of a simulated partner for the reference person. We estimate the average number of children per household by type and age of household from the Family Expenditure Survey, and convert these numbers to an adult equivalent using the McClements equivalence scale⁴⁹, which takes into account economies of scale in household management. Table 2 displays McClements scales, m_t , for the base demographic that was used to calibrate the model. The number of equivalent adults influences the utility that the household derives from any particular level of consumption.

⁴⁷For the purposes of calibration a two adult household is regarded as having a tertiary education qualification if any of its adult members have such a qualification.

⁴⁸The mortality rates used are calculated using the proportion of female reference people by age recorded in the 2000/01 Family Expenditure Survey (FES), and mortality rates by age and sex recorded in the *Annual Abstract of Statistics*, Table 5.21, The Stationary Office. Mortality rates after the age of 84 are subject to manual adjustment.

⁴⁹For further details, see McClements (1977) and *Households Below Average Income, A Statistical Analysis*, published by The Stationary Office. The Before Housing Costs McClements equivalent scale is used by the UK Department of Social Security in all of their Household income statistics. The scale is normalised so that a two adult household has a value of one. To calculate the scale add the following scores: 0.61 for the first adult, 0.39 for the second, and for each dependent aged 0-1 add 0.09, aged 2-4 add 0.18, aged 5-7 add 0.21, aged 8-10 add 0.23, aged 11-12 add 0.25, aged 13-15 add 0.27 and for each dependent over 16 add 0.36.

A.1.2 Labour Force Status, Consumption, and Wealth

Households choose their labour supply and consumption in every period. These choices are made as if they are maximising their expected utility subject to a budget constraint. The expected lifetime utility is described by the additively separable function:

$$U = E \left(\sum_{i=t}^{70} u \left(\frac{c_t}{m_t}, l_t \right) \delta^{i-t} \phi_{i-t,t} \right) \quad (1)$$

where $c_t \in R^+$ is household consumption, $m_t \in R^+$ is the household's adult equivalent size, and $l_t \in [0, 1]$ is household leisure at time t .⁵⁰ The parameter δ is the discount factor (which is assumed to be time independent). In the current specification of the model, labour choice is restricted to full-time employment, part-time employment, and not employed, such that $l_t \in (0.7, 0.85, 1)$. After the State Pensionable Age (SPA) of 65 (the present SPA for males), the household is forced to retire - that is $l_t = 1$ for all $(t + 20) > SPA$.

A Constant Elasticity of Substitution (CES) utility function is assumed, which is defined by:

$$u(C_t, l_t) = \frac{1}{\left(1 - \frac{1}{\gamma}\right)} \left(C_t^{\left(1 - \frac{1}{\rho}\right)} + \alpha^{\frac{1}{\rho}} l_t^{\left(1 - \frac{1}{\rho}\right)} \right)^{\frac{1 - 1/\gamma}{1 - 1/\rho}} \quad (2)$$

where γ is the inter-temporal elasticity of substitution and ρ is the elasticity of substitution between $C_t = c_t/m_t$ and l_t . The higher the value of ρ , the higher the proportional change between consumption and leisure for a given proportional change in prices. Similarly, the larger the value of γ , the higher the proportional substitution between consumption today and consumption tomorrow for a given change in interest rates. Wealth in any period, w_t , is constrained to be non-negative, and is given by:

$$w_{t+1} = w_t - c_t + y_{it}^{DI}(w_t, y_t, r, m_t) \quad (3)$$

where $y_{it}^{DI}(w_t, y_t, r, m_t)$ is the disposable post-tax and benefit income obtained by a household of age t given wealth w_t , labour income y_t , equivalence size m_t , and the real pre-tax interest rate r . Labour income is equal to the household's level of human capital, h_t times labour supply; $y_t = h_t(1 - l_t)$. The stochastic evolution of household human capital and the stylised model of the UK tax and benefit system are discussed in Section A.3.

A.2 Model Solution

This subsection provides a brief summary of the model solution procedure; see Sefton (2000) for a detailed description. The procedure uses backward induction to solve the required inter-temporal Bellman equation. Starting in the last possible period of the household's life, T , we can solve relatively simply for the optimising consumption behaviour given wealth w_T . Given this level of consumption we can denote the maximum achievable utility, the value function, by $V_T(w_T, h_T)$.⁵¹

⁵⁰See, for example, Balcer and Sadka (1986), and Muellbauer and van de Ven (2003) on the use of this form of adjustment for household size in the utility function.

⁵¹The human capital variable, h_T , is included in $V_T(w_T, h_T)$ for completeness - it plays no part in the household's consumption decision at age 90.

At time $T - 1$ the problem now reduces to solving the Bellman equation

$$V_{T-1}(w_T, h_T) = \max_{c_{T-1}, l_{T-1}} (u(c_{T-1}/m_{T-1}, l_{T-1}) + \delta \phi_{T,T-1} E_{T-1}(V_T(w_T, h_T)))$$

This is a convex optimisation problem. As the labour choices are discrete, we can optimise the right hand side with respect to consumption for each of the three possible labour supply choices. The optimal consumption-labour choice is then the maximum of these three alternatives. Having solved for $T - 1$ the process can be repeated for $T - 2, T - 3$, etc. In this way we are able to solve for a household's entire lifetime.

Though relatively easy to describe, this process is numerically difficult to implement. To our knowledge, our work is the first to solve such a problem for both consumption and labour supply choices.

A.3 Household Income

A.3.1 Evolution of human capital

The household is considered as a single unit when simulating human capital, labour supply, and consumption. The evolution of human capital is described by:

$$h_{it} = \beta h_{it-1} + \theta l_{it-1} + f(t) + \varepsilon_{it} \quad (4)$$

where h_{it} defines (log) human capital of household i at age t , l_{it} is labour supply, and ε_{it} is an individual specific error term. In each period, human capital consequently depends upon human capital in the preceding period (where β accounts for some depreciation), labour in the preceding period (to include a learning-by-doing effect), an underlying age trend (that is the same for all simulated households), and a random disturbance term. The formulation of this model for human capital has the advantage that it depends only upon state variables that characterise the larger simulation model (t, h_{it-1}, l_{it-1}). The model of human capital described by equation (4) also bears close similarities to alternative models that have been developed in the literature. For example, the model is similar to a simple “regression-toward-the-mean” (RTM) model of human capital evolution that is studied in detail by Atkinson (1992), and used by Huggett (1996) in his equilibrium model of the US economy.⁵²

Specifically, the simple RTM model of human capital is described by:

$$z_{it} = \beta z_{it-1} + \varepsilon_{it} \quad (5)$$

where $z_{it} = (h_{it} - \bar{h}_t)$ is the deviation of household i 's human capital from the population's geometric mean ($\bar{h}_t = \sqrt[n]{\prod h_{it}}$). Including a learning-by-doing effect into the model defined by equation (5) and rearranging, we obtain:

$$\begin{aligned} h_{it} &= \beta h_{it-1} - \theta l_{it-1} + (\bar{h}_t - \beta \bar{h}_{t-1} + \theta \bar{l}_{t-1}) + \varepsilon_{it} \\ &= \beta h_{it-1} - \theta l_{it-1} + g(t) + \varepsilon_{it} \end{aligned} \quad (6)$$

⁵²See also, Kalecki (1949) and Creedy (1985).

where l_{it} is the leisure taken by household i at age t , \bar{l}_t is the population average leisure at age t , the learning-by-doing effect is described by $\theta(\bar{l}_t - l_{it})$, and $g(t)$ defines the bracketed term in the first line of equation (6). Comparison of equation (4) with (6) reveals the similarities between the model used to generate the evolution of human capital and the RTM model described by equation (5). Furthermore, van de Ven (1998) suggests that there exists a close relationship between the RTM model of human capital, and the classical model of income dynamics advocated by Mincer (1974).

Note, however, that the RTM model described by equation (6) and the model used to simulate the evolution of human capital (described by equation (4)) are not equivalent. Importantly, equation (6) reveals that augmenting the model described by equation (5) to include a learning by doing effect implies that the specification of $g(t)$ depends upon the policy regime. This complication means that a learning by doing effect is omitted by studies that use the specification of equation (5). If a learning by doing effect does exist, then, from equation (6), the age trend implicit in the specification described by equation (5) will equal $-\theta l_{it-1} + g(t)$, and equation (4) will - in a sense - reduce the unexplained evolution of human capital. In adopting this model, it is important to draw a clear distinction between the population average effects that are described by $g(t)$ in equation (6), and the (policy invariant) age effects that are described by $f(t)$ in equation (4).

A.4 A Stylised Model of the UK Tax and Benefits System

To incorporate the existing UK tax and benefits system within the model, we need to develop a stylised representation. This section provides a brief description of the model adopted to reflect the UK transfer system - see Sefton (2000) for further details.

If no member of a household works, then the household is eligible for a number of benefits under the present UK transfer system. Table 3 records the typical level of these benefits⁵³ for families of differing size. We shall refer to the aggregate of the benefits that are described in Table 3 as the guaranteed household income. This level of income ranges between 20% and 50% of mean household income. As both income support and housing benefit include a wealth test, which effectively imputes a rate of return of 21% to any capital assets, we assume that the rate of return on liquid (risk and non-risky) assets for any household earning less than the guaranteed income level is equal to the pre-tax rate of return minus 21%.

The relationship between equivalent family size and guaranteed income is approximately linear. We therefore use a linear approximation to the values in the table, estimated by a least squares regression on the data presented in Table 3.

Once a member of the household works for more than 16 hours per week (or part-time in our model), a household no longer receives Income Support but becomes eligible for the Working Tax Credit. The maximum tax credit award

⁵³We have ignored all disability benefits and other benefits where eligibility is dependent on factors other than income and assets.

Table 3: Guaranteed Level of Weekly Income by different Household Type

Family Type	Single Adult No children	Single Adult One Child	Single Adult Two Children	Two Adults No children	Two Adults Two Children
Approx. Equivalent Family Size	0.61	0.86	1.11	1	1.5
Income Support	£54.65	£54.65	£54.65	£85.75	£85.75
Working Tax Credit	£0.00	£0.00	£0.00	£0.00	£0.00
Child Tax Credit	£0.00	£38.27	£66.06	£0.00	£66.06
Child Benefits	£0.00	£16.05	£26.80	£0.00	£26.80
Housing Benefit	£60.00	£60.00	£60.00	£60.00	£60.00
Council Tax Rebates	£10.00	£10.00	£10.00	£10.00	£10.00
Total Guaranteed Income - $y(GI)$	£124.65	£178.97	£217.51	£155.75	£248.61
% of Mean Household Income	24.46%	35.12%	42.68%	30.56%	48.78%
Effective Marginal Tax Rate	100.00%	100.00%	100.00%	100.00%	100.00%
Effective Return on Assets	r-0.21	r-0.21	r-0.21	r-0.21	r-0.21

is received by any household whose income is less than a lower income threshold. Table 4 records both the maximum award and the income threshold by (equivalised) family size.

The tax credit and housing benefits are withdrawn for every pound of private income (capital and non-capital) above the lower income threshold. In Figure 18, we have plotted how the benefits are withdrawn as a function of their household earnings for our representative 2 adult 2 children household. We have also marked the level of gross income, y_{UT} , at which all the means tested household benefits have been withdrawn. Any earnings above y_{UT} are taxed at 33% (22% income tax and 11% National Insurance), and any capital income at 22%. Table 4 records both the level of the upper income threshold and the household's disposable income for this level of gross income by household type. In our stylised model, benefits are assumed to be withdrawn linearly between the lower and upper income thresholds, which imply the effective marginal tax rates and post-tax rates of return recorded in the final two rows of the table. We have also plotted in Figure 18, the resultant approximation of the tax and benefits system for a 2 adult 2 child household.

The Income Model for Working Households

Based on the above description we can summarise our stylised model of the tax and benefit system. We shall denote a household's labour income as y_{it} , and a household's disposable income as y_{it}^{DI} . Further, if the pre-tax rate of return on assets is denoted r , then the post-tax rate of return will be denoted r^{NET} . Tax rates are written as τ_y where y is the percentage tax rate, or as τ_x where x refers to the marginal tax rates in the penultimate row in Table 4. The notation y^+ is used as shorthand for $\max(y, 0)$.

If a household chooses not to work, $l_{it} = 1$, it receives the guaranteed minimum income in benefits. These benefits

Table 4: The level of benefits and effective tax rates for low- income working households.

Family Type	Single Adult No children	Single Adult One Child	Single Adult Two Children	Two Adults No children	Two Adults Two Children
Approx. Equivalent Family Size	0.61	0.86	1.11	1	1.5
Income Support	£0.00	£0.00	£0.00	£0.00	£0.00
Working Tax Credit	£41.10	£69.90	£69.90	£69.90	£69.90
Child Tax Credit	£0.00	£38.27	£66.06	£0.00	£66.06
Child Benefits	£0.00	£16.05	£26.80	£0.00	£26.80
Housing Benefit	£14.75	£6.67	£13.65	£19.70	£40.71
Council Tax Rebates	£0.00	£0.00	£0.00	£0.00	£4.07
Maximum Award - $y(MA)$	£55.85	£130.89	£176.41	£89.60	£207.54
Lower Income Threshold - $y(LT)$	£97.31	£97.31	£97.31	£97.31	£97.31
Minimum Hh Income = $y(LT)+y(MA)$	£153.16	£228.20	£273.72	£186.91	£304.85
% of Mean Household Income	30.05%	44.78%	53.71%	36.68%	59.82%
Upper Income Threshold - $y(UT)$	£228.00	£408.00	£480.00	£300.00	£480.00
Disposable Income (a)	£187.06	£325.72	£385.43	£236.23	£385.43
% of Mean Household Income	36.71%	63.91%	75.63%	46.35%	75.63%
Effective Marginal Tax Rate - $\tau(x)$	74.10%	68.60%	70.80%	75.70%	78.90%
Effective Return on Assets	0.37r	0.42r	0.4r	0.35r	0.32r

(a) The precise level of post tax earnings depends on the split between capital and non-capital income. Here we have assumed that all income was non-capital and therefore liable for National Insurance.

Figure 18: Household Disposable Income as a Function of the Gross Earnings for a Household with 2 Adult Members and 2 Dependent Children.

are withdrawn at a rate of 21% for any capital. Thus, if $l_{it} = 1$, then:

$$\begin{aligned} y_{it}^{DI} &= y_{GI} \\ r^{NET} w_{it} &= rw - \tau_{22} r w_{it}^+ - \min(0.21(1 - \tau_{22}) w_{it}, y_{GI}) \end{aligned}$$

If households work, and their income is less than the upper income threshold, then they are eligible for tax credits which partially offset any tax they pay. For this range of incomes ($l_{it} < 1$ and $rw_{it} + y_{it} < y_{UT}$), disposable incomes are defined as:

$$\begin{aligned} y_{it}^{DI} &= y_{MTC} + y_{LT} + (1 - \tau_x)(y_{it} - y_{LT}) \\ r^{NET} w_{it} &= rw_{it} - (\tau_x - \tau_{11}) r w_{it}^+ \end{aligned}$$

If income is greater than upper earning threshold ($y_{UT} \leq rw_{it} + y_{it} \leq y_{UTB}$), then disposable income is simply income net of basic taxes:

$$\begin{aligned} y_{it}^{DI} &= (1 - \tau_{33})(y_{it} - y_{LT}) + y_{LT} \\ r^{NET} w_{it} &= rw_{it} - \tau_{22} r w_{it}^+ \end{aligned}$$

A.4.1 A stylised model for the retired

The benefits available to the retired are easier to model. Those pensioners with no private pension receive the full pension guarantee plus a passport to full housing and council tax rebates. Table 5 records the average value of these awards. All benefits, except the basic pension, are withdrawn as the retired household private pension income increases. Figure 19 plots disposable income as a function of private pension for a two adult retired household. The figure also indicates the upper income threshold, above which a household will receive no benefits other than their basic pension. As before, we assume that benefits are withdrawn linearly for private incomes below the upper income threshold. Figure 19 shows the implied tax schedule for our two adult household and Table 5 records the levels of the upper income threshold and the implied marginal effective tax rates for private incomes less than this threshold.

As there are only two values in the table, there is no need to estimate an approximate linear relationship between family size and the variable of interest. We shall assume the following model of household disposable income for those over the state pensionable age. If private income is less than the upper income threshold ($y_{it} + 0.1w_{it} < y_{UT}$), then:

$$\begin{aligned} y_{it}^{DI} &= y_{BP} + (y_{MA} - y_{BP}) - \tau_x (y_{it} + 0.1w_{it}) + y_{it} \\ r^{NET} w &= rw_{it} - \tau_{22} r w_{it}^+ \end{aligned}$$

Table 5: The level of benefits, thresholds and effective tax rates for Retired households.

Family Type	Single Adult	Two Adults
Equivalent Family Size	0.61	1
Basic Pension - $y(BP)$	£75.50	£120.80
Pension Guarantee	£26.60	£35.00
Housing Benefit	£50.00	£50.00
Council Tax Rebates	£10.00	£10.00
Tax Paid	£0.00	-£2.87
Maximum Award - $y(MA)$	£162.10	£212.93
% of Mean Household Income	31.81%	41.78%
Upper Income Threshold - $y(UT)$	£144.00	£180.00
Disposable Income - $y(MDI)$	£221.24	£266.93
% of Mean Household Income	43.41%	52.38%
Effective Marginal Tax Rate - $\varphi(x)$	58.90%	70.00%
Effective Return on Assets	0.41r	0.3r

Figure 19: Household Disposable Income as a Function of the Gross Earnings for a Household with 2 Retired Adults.

Otherwise, if $(y_{it} + 0.1w_{it} \geq y_{UT})$:

$$\begin{aligned} y_{it}^{DI} &= y_{BP} + y_{LB} + (1 - \tau_{22})(y_{it} - y_{LB})^+ - \tau_{18}(y_{it} - y_{UTB})^+ \\ r^{NET} w_{it} &= r w_{it} - \tau_{22} r w_{it}^+ - \tau_{18}(r w_{it} - (y_{UTB} - y_{it})^+)^+ \end{aligned}$$

B Appendix B: Calibration

A number of model parameters were adjusted to minimise three test statistics that relate the simulated output to labour force and consumption profiles derived from FES survey data. The model variables concerned are:

- the real rate of return, r
- the depreciation rate, δ
- the elasticity of substitution between consumption and leisure, ρ
- the intertemporal elasticity of substitution, γ
- the weight on leisure, α
- the learning by doing parameter, θ
- the wealth allocated to 20 year old households, w_0
- the proportion of the full-time wage earned by part-time workers, q .

Two of the three test statistics used to calibrate the model compare labour force trends, and the third statistic compares consumption profiles. We begin by describing the labour test statistics.

Define $l_{ft,t}$ as the proportion of households at age t that are full-time employed, $l_{pt,t}$ as the proportion part-time employed, and $l_{ne,t}$ as the proportion not employed, where the simulated statistics, \tilde{l} , are compared with the associated statistics derived from survey data, l^{54} . Then the two labour based test statistics are defined, respectively, by:

$$l_test1 = \sum_{t=t_0}^{64} |l_{ft,t} - \tilde{l}_{ft,t}| \quad (7)$$

$$l_test2 = \sum_{t=t_0}^{64} |l_{ft,t} - \tilde{l}_{ft,t}| + |l_{pt,t} - \tilde{l}_{pt,t}| + |l_{ne,t} - \tilde{l}_{ne,t}| \quad (8)$$

where $t_0 = 20$ for the lower educated, and 25 for the higher educated.⁵⁵

⁵⁴average labour status by age observed in FES data

⁵⁵Absolute differences have been used to limit the influence of extreme values.

Table 6: Total Household Expenditure

α_0	-201.5520	(33.207)
na	155.0280	(5.342)
nc	53.6695	(9.342)
nc ²	-10.0958	(2.703)
age	13.4661	(1.529)
age ²	-0.1490	(1.69E-2)
edn*na	27.4911	(16.486)
edn*age	6.0746	(1.277)
edn*age ²	-0.0671	(1.53E-2)
ret	-331.4540	(79.544)
ret*na	-42.1201	(9.145)
ret*age	5.2702	(1.224)
R Squared	0.331294	
Eqn Std Error	237.423	

Standard Errors in parentheses

A statistical model of household consumption was required for the consumption based test statistic used to calibrate the model. Following analysis of alternative specifications, the FES data were used to estimate (via Ordinary Least Squares) the following regression of household consumption:

$$\begin{aligned}
x_i = & \alpha_0 + \alpha_1 na_i + \alpha_2 nc_i + \alpha_3 nc_i^2 + \alpha_4 age_i + \alpha_5 age_i^2 \\
& + \alpha_{11} edn_i na_i + \alpha_{12} edn_i age_i + \alpha_{13} edn_i age_i^2 \\
& + \alpha_{14} ret_i + \alpha_{15} ret_i na_i + \alpha_{16} ret_i age_i + \varepsilon_i
\end{aligned} \tag{9}$$

where x_i denotes total expenditure for household i (FES code p550tp), nc_i denotes the number of children in the household, and ret_i is a dummy variable that identifies household reference people over the age of 59 who are not employed. Regression statistics are displayed in Table 6.

The consumption based test statistic is the sum of absolute differences between the simulated consumption profiles, and the profiles implied by the regression statistics displayed in Table 6. Specifically, simulated household characteristics are used to calculate an estimate, \hat{x}_{it} of consumption for each household i at each age t , based on equation (9) and the parameter values displayed in Table 6, \hat{x}_{it} . The estimates of consumption obtained are aggregated over the entire life of each household, and the percentage at each age calculated:

$$p(\hat{x}_{it}) = \frac{\hat{x}_{it}}{90 \sum_{j=20} \hat{x}_{ij}} \tag{10}$$

The statistics $p(\hat{x}_{it})$ are then compared against $p(x_{it})$, where x_{it} denotes the consumption generated for household i at age t by the simulation model:

$$test_c = \sum_{i=1}^N \sum_{t=20}^{90} |p(\hat{x}_{it}) - p(x_{it})| \tag{11}$$

for simulated population size N .

Having observed that the relationships between the various model parameters and the three test statistics are highly non-linear, a trial-and-error search was used to identify the calibrated parameter values. A sample of the three test statistics, obtained for parameter values in the vicinity of those selected for the simulation model is presented in Table 7. Figure 20 presents associated employment profiles by age.

Table 7: Simulation Model Calibration Statistics

	α	δ	θ	w_0	R	q	l test 1	l test 2	c test
Base Case	0.034	0.98	0.015	200	1.06	0.45	1.8458	12.4362	91.9534
trial 1	0.032						2.1599	14.2191	90.3900
trial 2	0.036						2.9532	13.1589	91.4656
trial 3		0.99					4.2438	14.0474	118.7260
trial 4		0.96					2.8654	14.4821	50.0261
trial 5			0.016				1.9604	12.4859	91.4409
trial 6			0.014				1.9077	12.6757	90.5764
trial 7				250			1.8568	12.4131	92.0628
trial 8				300			1.9214	12.3499	91.7103
trial 9				150			1.8640	12.7350	91.6831
trial 10				400			1.9785	12.4593	90.9310
trial 11					1.08		5.7294	15.1673	133.4187
trial 12					1.04		3.9063	17.5984	58.8251
trial 13						0.35	1.9117	12.6550	91.8565
trial 14						0.55	2.6708	16.0703	86.8390

Parameter values set as described under the "base case" unless otherwise stated

Simulated population size = 500

$\gamma = 0.5$ and $\rho = 0.4$ set exogenously

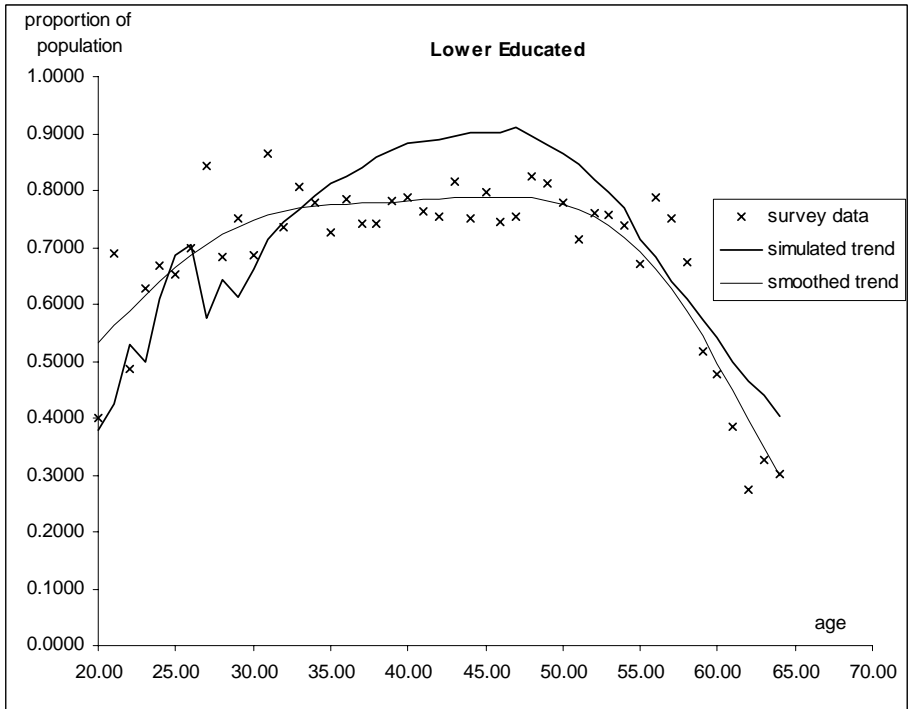
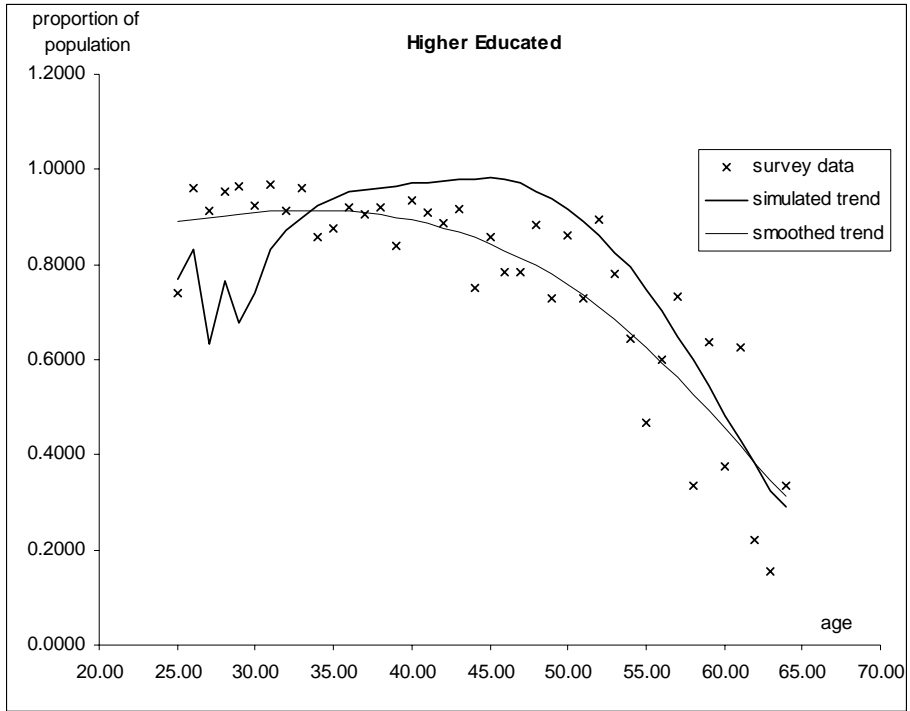


Figure 20: Average Employment by Age

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