Working Paper

Analysis of pension reform scenarios in a rational world

An application of the NIBAX behavioural micro-simulation model

by Justin van de Ven

DWP Department for Work and Pensions

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Foreword

Analysis of Pension Reform Scenarios in a Rational World

This research was commissioned in June 2011 so the assumptions for the single-tier scenario were based on the model set out in the Green Paper consultation document, A State Pension for the 21st Century, which can be found at: http://www.dwp.gov.uk/docs/state-pension-21st-century.pdf. The Department has since built on the Green Paper policy proposal as set out in the White Paper publication, The single-tier pension: a simple foundation for saving, which can be found at http://www.dwp.gov.uk/docs/single-tier-pension.pdf.

Where the working paper references DWP (2011) the reader should note that the current policy proposal has developed further as set out in, The single-tier pension: a simple foundation for saving. The main difference for the NIBAX modelling is that the proposal for the number of qualifying years required to receive the full state pension has been increased from 30 to 35 years. Under 35 qualifying years the modelling may suggest that households work and save for a little longer on average than this report suggests. It should also be noted that NIBAX does not model transition between one system and another, comparing one long term policy with another.

Summary

Aims and methodology

This study explores the long-run effects of policy reform scenarios based on those set out in the Green Paper, *A State Pension for the 21st Century*, DWP (2011).

The analysis is based upon simulations conducted using a structural model of savings, labour supply, and investment decisions called NIBAX, which has been developed by the National Institute for the Department for Work and Pensions (DWP) and Her Majesty's Revenue and Customs.

The NIBAX model is based upon the life-cycle framework, which is the standard economic approach for exploring decisions that involve some aspect of planning for the future.

- This framework assumes that individuals make decisions to maximise a utility function, which aggregates consumption and leisure enjoyed over all prospective time periods. Individuals in the model make rational economic decisions based on perfect information, and the simulated behaviour reflects both wealth (income) and substitution (price) effects.[1]
- The utility function assumed for analysis assumes that individuals are averse to risky options and prefer to smooth their consumption over time:
  - Households with high earnings have a relatively strong savings motive in the model because the fall in their income stream upon retirement is larger than a household with low earnings due to the presence of state pensions and means-tested support, which ensure a minimum level of income in retirement and which is a larger proportion of lower earnings.

Parameters of the NIBAX model were calibrated to match the characteristics of a simulated cohort to contemporary survey data.

- Two sets of model parameters are considered for analysis, which vary over how prospective consumption is discounted when evaluating utility in any given period:
  - the base set of parameters assume time-consistent exponential discounting, which is standard in the economic literature.
  - sensitivity analysis is conducted with respect to quasi-hyperbolic discounting, which assumes a present bias in consumption, and is used to describe myopia in the economic literature.

In both sets of parameters, individuals are considered to be 'self-aware' in the sense that they take their decisions based on a complete understanding of the temporal consistency of their preferences.

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[1] Reference is made throughout the text to two principal influences on simulated behaviour. **A wealth effect** (also referred to as an **income effect**) describes the impact that increased financial resources have on incentives to work and to save – the richer people are, the less likely they are to engage in 'painful' work or postponed consumption. A **price effect** (also referred to as a **substitution effect**) describes the impact that a change in the relative terms of trade between any two goods has on their respective expenditure shares – an increase in (real) wages, for example, increases the cost of leisure relative to consumption goods, so that the associated price effect acts to increase labour supply (reduce leisure) and increase expenditure on consumption goods.

The NIBAX model does not include a range of considerations that are likely to be important in determining behaviour over the short-to-medium term[2], but rather is adapted to exploring the long-run effects of changes from policy environment A to policy environment B:

- This analysis involves comparing the simulated experience of a hypothetical population cohort that is assumed to spend its entire life under policy environment A with the simulated experience of an otherwise identical cohort that spends its entire life under policy environment B.[3]
- Analysis focuses upon the long-run implications of raising the State Pension age to 68 and two policy scenarios similar to those defined in DWP (2011): (i) a flat-rated State Second Pension (S2P) as envisaged by existing legislation and, (ii) replacing the basic State Pension and the S2P with a single-tier flat-rate pension. The detail of these two policy options were not available at the time this analysis was undertaken so results are hypothetical and would change depending on the exact details of the policy.

The analysis sets out the long-run implications of three scenarios (and also conducts sensitivity analysis of results using a sophisticated form of myopia):

- Policy broadly based on the current system today with a State Pension age of 68 compared to policy broadly based on the current system with a State Pension age of 65
- A two-tier flat-rated scenario compared to policy broadly based on the current system (both with a State Pension age of 68)
- A single-tier flat-rated pension scenario compared with a flat-rated State Second Pension scenario (both with a State Pension age of 68)

No attempt is made to explore the dynamics of policy transitions, in regard to either behaviour or budgetary effects, as the current specification of the NIBAX model is not designed for this.

- The report does not, therefore, provide quantitative projections for the effects of accelerating the transition to a flat-rate state pensions system, as embodied by one of the two policy reforms defined in DWP (2011).
- Results are, however, reported with the objective of providing qualitative detail of the incentives embodied by policy scenarios over the long-run, and which – it is reasonable to assume – would be amplified if the rate of policy transition were increased.

Other important caveats to consider when interpreting the results in the report are:

- The simulations suggest no households will receive the means-tested Standard Minimum Guarantee in retirement under a flat-rate two-tier system or a single tier. However, this will not be the case in reality and DWP expects that the single tier will lift some pensioners out of means-tested benefits. The disparity is attributable to the fact that the simulation model does not reflect variation over health and disability, imperfect rates of benefits take-up, or extremely fragmented work-histories.

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2 NIBAX does not, for example, account for the bearing that complexity of the decision problem may have on decisions taken in practice, and which are cited as one of the motivating concerns underlying the proposals set out in DWP (2011).

3 This exercise is sometimes referred to as **comparative statics** in the economic literature.

- The simulations do not assess the impact of simplifying the pensions system. This reduction in complexity could encourage saving, but NIBAX assumes that individuals are rational and have perfect information so are unaffected by the complexity in the pensions system. The assumption of (perfect) rationality may also mean that the model overstates responses to the saving incentives of the current system.
- Results are only partial in that they do not account for the effects of tangential policy changes that might be made necessary were the reforms that are considered here not implemented.
- Final DWP policy proposals could differ to the scenarios outlined here which would affect the reported results.

Headline results

The simulations suggest that individuals will, in general and in the long-run, prefer to make up the short-fall in state benefits, that is the product of raising the State Pension age by increased saving and lower consumption, rather than by extending their respective working lives.

- The simulations imply that raising the State Pension age from 65 to 68 will have the following long-run effects:
  - increase the total duration of the average working life by just over one year
  - increase the proportion of adults employed between ages 65 and 67 by ten percentage points, equivalent to 0.4 years on average, with increased participation heavily skewed toward the bottom of the income distribution
  - increase the net wealth of households averaged over ages 65 to 67 by 12 per cent due to the increase in work and saving over the life course
- Although these results rely upon a range of factors (including those shown above), four stand out:
  - wage parameters in the model are projected forward from currently observed data and consequently reflect the existing labour market opportunities of older workers, and increases in the State Pension age could change labour market conditions.
  - labour market experience is assumed to provide a benefit in terms of higher prospective wages, which encourages early labour market participation in anticipation of future rewards. However, because households work more early in life they get wealthier and this depresses labour market participation later in life (through an associated wealth effect).
  - the long-term nature of the analysis assumes individuals know their retirement age at the start of their working life (at age 20 in the simulations) and increase saving to offset prolonging their working lives. This may not be the case in practice, particularly when the government raises the State Pension age for individuals who are part way through their working lives.
  - the State Pension age is being raised because of increased longevity and if it was not raised, then higher taxes might be required to cover the associated pension costs. These tax increases would also affect incentives to work (and save).

The flat-rated S2P (removing the earnings link), which is implied by existing pensions legislation by the early 2030's and which would be accelerated forward to 2020 by proposals set out in DWP (2011), is not projected to have substantial behavioural consequences. It is projected to encourage additional private pension saving early in the simulated lifetime and discourage private saving slightly from age 50 onwards.

- Reforming the S2P so that the link to earnings is abolished and an individual's eligible S2P entitlement increases at the flat-rate of £1.60 for each contribution year (2010/11 prices), is projected to increase total household savings by around one per cent by State Pension age in the long run, with the proportional adjustment skewed toward households in the top of the income distribution who would previously have been the group tending to gain more from the earnings link in state pensions.
- These results are driven by variation of simulated savings motives and behaviour over the income/wealth distribution:
  - Households at the bottom of the distribution are not much affected by the policy reform, but are projected to accrue slightly lower wealth.
  - Households in the middle of the distribution receive lower state pensions under the flat-rated scheme, and have the capacity to make up the loss from slightly increased saving in liquid assets and slightly lower consumption.
  - Households at the top of the distribution react to a wealth effect and have some capacity to increase their private pension participation, save more in liquid assets, but consume slightly less to increase their total wealth slightly by the State Pension age.

Similarly, the single-tier pension scenario based on DWP (2011) is not projected to result in large changes in behaviour, relative to the system based on a flat-rated S2P that is referred to above. The projections to age 50 suggest higher private saving in both pensions and liquid wealth. Households are simulated to use their increased balances of liquid wealth to finance withdrawal from employment from age 50. By age 68 (State Pension age), simulated private wealth shows a slight decline, which masks a shift from liquid into pension wealth. Consumption rises into late retirement, driven by increased private and State Pension income. Households on lower incomes are projected not to change their saving and labour supply behaviour appreciably.

- Private saving is projected to rise by approximately two per cent on average between ages 20 and 49, with a disproportionate increase in liquid wealth.
  - The rise in liquid wealth permits households to finance the decline in employment later in the working life that is referred to below.
- Employment rates are projected to fall by 0.5 per cent on average between ages 50 and 64, by 1.5 per cent between ages 65 and 69, and by 0.2 per cent between ages 68 and 79.
  - The decline in rates of employment late in life is consistent with the lower number of qualifying years required to obtain the maximum State Pension payable under the single-tier State Pension, relative to the two-tier flat-rated state pensions system.
- Consumption is projected to rise steadily into retirement, from just 0.2 per cent on average between ages 68 and 79 to 1.0 per cent for ages 80 and over.
  - This rise in consumption is consistent with the increased pension income that is simulated under the single-tier pension scenario, due to both increased saving in private pensions and the higher indexing that is described for the single-tier pension, relative to the two-tier flat-rated state pensions system.

Accommodating a present-bias in household preferences tends to exaggerate the behavioural effects of the simulated policy reforms in general, and incentives to participate in private pensions in particular.

- Present-biased preferences:
  - reduce the capacity for households to offset changes in state pensions policy by altering their liquid savings – this is particularly relevant for responses to the State Pension age
  - provide an added motive to contribute to private pensions, where the time-inconsistency of present-biased preferences is well understood – this is because individuals who understand the time inconsistency of their preferences will value pensions as a way to commit savings for retirement.

1 Introduction

Current government proposals for reform of the UK pension system are predicated, in part, on the view that simplification of the policy environment will help individuals take responsibility for their own retirement needs.[4] This view currently enjoys widespread public support due to the complexity of the contemporary system of retirement provisions in the UK. Yet, in attempting to simplify the pensions system, it is important not to lose sight of the incentives that are generated by policy alternatives, and their implications for prospective savings and retirement decisions. In this study I consider the long-run incentive effects of policy scenarios based on those set out in the consultation paper *A State Pension for the 21st Century*, published in April 2011 by the Department for Work and Pensions (DWP, 2011). The report discusses a number of reasons why the results should be treated with a degree of caution, particularly because final DWP policy proposals could differ to the scenarios outlined here.

At present, the system of state retirement provisions in the UK is comprised of three principal schemes. The first is a flat-rate basic State Pension (BSP), rights to which are accrued in respect of National Insurance (NI) contributions accredited during the working lifetime. The second is the earnings related State Second Pension (S2P), rights to which are also accrued in respect of accreditation for NI contributions. And the third is a means-tested welfare safety-net, the Pension Credit (PC), which is designed to insure against pensioner poverty.

A great deal of the public debate regarding the future of the pensions system has focused upon how the alternative state administered retirement schemes influence private incentives to save, and the retirement planning problem more generally. In this debate, the central role that is currently played by means-tested benefits has been singled out for criticism for weakening incentives to save (by reducing effective returns to investment), and for discouraging private engagement in the retirement planning problem (by exaggerating its complexity).[5]

Reforms introduced by the Pensions Act 2007 were consequently designed to simplify the pensions system and reduce the role played by means-testing in the delivery of retirement benefits. Three aspects of the reforms enacted in 2007 are of note. First, the link between the S2P and an individual's earnings during the working lifetime was scheduled to be unwound by differential indexing, so that the pension would provide a flat-rate benefit (in addition to the BSP) from the early 2030's. Secondly, eligibility conditions for the accrual of rights to both the BSP and the S2P were to be made more inclusive so that a broader proportion of the population would eventually be made eligible to the full BSP and higher amounts of S2P, which would reduce the number of people reliant on the Standard Minimum Guarantee to primarily those with fragmented work histories[6]. And thirdly, differential rates of benefits indexing for Savings Credit would see the relative value of means-tested retirement benefits fall over time.

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4 DWP (2011, pp. 7-8) sets out four guiding principles for reform: personal responsibility; fairness; simplicity; and affordability and sustainability.

5 See, for example, criticism of means-tested benefits set out by Frank Field, MP for Birkenhead, Commons Hansard Debates, 4 June 2003. For related economic analysis, see Sefton *et al.* (2008), and Sefton and van de Ven (2009).

6 NIBAX doesn't model disability.

The two alternative proposals for reform that are set out in the DWP (2011) consultation paper are designed to extend the reforms introduced by the 2007 Pensions Act. The first (I) proposal involves accelerating the rate of policy change that is embodied by the reforms implemented in the 2007 Pensions Act, so that S2P will be made flat-rate by 2020 rather than the early 2030s. The second (II) reform involves replacing the BSP and the S2P with a single-tier flat-rate state pensions scheme. The single-tier pension will pay a full benefit that lies between the current full BSP and the maximum aggregate of the BSP and the S2P, and will be indexed to prices, wages, or 2.5 per cent (whichever is the highest). This indexing is in common with current plans for the BSP, but is more generous than the indexing of the S2P while in payment, which is indexed to prices (the Consumer Price Index) only.

This study explores the behavioural implications of three policy scenarios, two based on the proposals for policy reform that are referred to above, and one that carries the policy environment as it was at the time of writing forward indefinitely. A formal (structural) model of how people make their savings, labour supply, and pension decisions is formulated, and its parameters are calibrated to match behaviour described by contemporary survey data. This formal behavioural model is then used to explore the long-run effects of each policy alternative on savings and labour supply decisions, and on individual circumstances more generally.

The behavioural model upon which the analysis is based is designed to explore the long-run effects of policy change. The implications of accelerating the transition to a flat-rate S2P, based on the first of the two proposals set out in the DWP (2011) consultation paper referred to above, is considered here by comparing the long-run implications of policy broadly based upon the terms that applied in 2010/11 against the long-run implications of policy following transition of the S2P to a flat-rate benefit.[7] Care is also taken to draw out the incentives embodied by each policy alternative, which are relevant for policy evaluation over the shorter term.

The analytical methodology is described in Chapter 2, including a brief description of the model upon which the analysis is based. Chapter 3 sets out details of the policy alternatives considered for analysis, and results of the analysis are reported in Chapter 4. Chapter 5 concludes.

[7] The principal departure between the model and the policy environment that applied in 2010 is that the assumed terms of the S2P reflect the way that that scheme will be applied in 2012, rather than 2010. From 2012, the amount of S2P will change over time to become a simple, flat-rate weekly top-up to the basic State Pension. Contracting out through defined contribution schemes (i.e. money purchase, personal pension and stakeholder arrangements) is to be abolished from 6 April 2012. Anyone contracted out of a defined contribution scheme at that time will automatically be contracted back into the S2P.

2 Analytical methodology – the NIBAX model

This section provides a brief overview of the NIBAX model; for a detailed non-technical description, see van de Ven and Weale (2009), and for a technical description please refer to van de Ven (2011).

The NIBAX – the National Institute Benefit and Tax – model has been developed at the National Institute for UK civil servants to allow them to explore behavioural responses to policy change. The model simulates savings, investment and labour supply decisions for a population with heterogeneous demographic and financial circumstances.

NIBAX is a **structural** model, in the sense that it is based upon a formal description of how people make their decisions. This is important because it ensures that the model provides an internally consistent basis for exploring behavioural responses to policy change. If past behaviour is used to inform how we anticipate people to respond to policy change in the future, then we must assume some form of persistence in decision making. Where this is the case, it is necessary to identify those aspects of the decision process that are considered to be stable through time. Explicitly distinguishing between features that are assumed to be 'structurally stable' from features that vary with the policy environment is the distinguishing feature of a structural model.

The behavioural foundation of NIBAX is the life-cycle framework, which represents current best practice in the economic analysis of behavioural responses to pension policy, and intertemporal decision making more generally.[8] This analytical framework is the product of almost 75 years of development by the economics profession, and is structured around the assumption that individuals use saving to smooth their consumption through time, relative to fluctuations in their available financial resources.[9]

Some details of the NIBAX model are provided in Section 2.1. Section 2.2 discusses how the model is appropriately used to analyse the behavioural implications of policy change. Interested readers can refer to Appendix A for associated technical details.

2.1 NIBAX in brief

The decision unit in the model is the household, defined as a single adult or adult couple and their dependent children. NIBAX generates data for the entire life course of a population of households drawn from a single birth cohort. The life course is divided into annual increments, and data are generated for each age, from 20 to a maximum of 120. At each age, households can be 'asked' to choose their labour supply, consumption, liquid savings, pension contributions, and their portfolio allocation between safe and risky assets.

As discussed above, NIBAX generates decisions based upon the life-cycle framework of behaviour, which is the standard economic approach for analysing dynamic (intertemporal) decision making. There are three principal components to the life-cycle model: preferences described by a utility function that converts observable measures of consumption and leisure into a single (unobservable) measure of welfare; a set of constraints that define the range of alternatives from which a decision must be selected, and expectations that define beliefs about the future. The life-cycle model

8 Intertemporal decision making refers to any decision that is inherently dynamic in nature.

9 For further detail regarding the life-cycle framework, see van de Ven and Weale (2010), Section 2.

assumes that decisions are selected from the range of permissible alternatives to maximise expected lifetime utility, given an individual's circumstances and expectations about the future.

The **preferences** that are adopted for the NIBAX model – described by the assumed utility function referred to above – are standard in the economic literature, and assume that people prefer averages to fluctuating extremes. As a consequence of this, the model predicts that saving and dissaving is used to average over lean and prosperous years. These preferences also imply that households have an aversion to risk, so that they will only choose to hold assets with uncertain returns if adequately compensated (in expectation) to do so.

A crucial aspect of the **constraints** that are assumed by the model concerns the access that people have to credit. In this respect, the model is designed to reflect important features of the practical reality: people can borrow up to an age specific credit limit, where the interest charged on an unsecured loan is an increasing function of the ratio of the loan value to a household's labour income.

Furthermore, NIBAX assumes that the belief structure is perfectly rational, which means that expectations are consistent with the processes that generate intertemporal variation. This assumption is made because it seems the most sensible basis upon which to evaluate policy alternatives; it would hardly be appropriate to design policy that only functioned as planned if the decision-making environment was systematically misunderstood.

The circumstances of a household are considered to be fully described by (up to) nine characteristics:

- age;
- number of adults;
- number of children;
- wage rates;
- liquid assets;
- private pensions;
- basic State Pension rights;
- State Second Pension rights; and
- time of death.

Of the nine characteristics that define the circumstances of a household, three are considered to be uncertain (number of adults, wage rates and time of death), and six are deterministic (non-random). In the terminology of the dynamic programming[10] literature, consumption, labour supply, and private pension contributions are control variables, selected to maximise the value function described by a time separable utility function, subject to nine state variables, three of which are uncertain (stochastic), and six deterministic.

A model simulation involves two distinct stages, which are described separately below.

[10] The NIBAX model is based upon the dynamic programming method of solving intertemporal optimisation problems.

2.1.1 First stage of a simulation – solving the decision problem

The first stage of the model simulation involves using numerical methods to solve for household behaviour and welfare, given any permissible combination of characteristics considered for analysis. For example, suppose decisions are limited to consumption and labour supply, taking into consideration a household's age, its number of adults, its potential wage rate (should it choose to work), and its accrued wealth (assumed to be liquid and to accrue a risk free rate of return). Then, given any household's age (say 36), its relationship status (single adult), its potential wage rate (£315 per week), and its accrued wealth (£21,232), the first stage of the model will predict the household's consumption (£253 per week), its labour supply (full-time employment), and its welfare.

This may sound like an implausible undertaking. Nevertheless, it is made possible by modern computing technology. The first stage of a simulation proceeds by dividing all of the permissible characteristics that a household may have into a series of grids. In the above example this would involve constructing a four dimensional grid in age (single years between ages 20 and 120), number of adults (1 or 2), the range of permissible wage rates (£0 – £10,000 per week), and wealth (£0 – £5,000,000). Solutions are then obtained for utility maximising decisions at each intersection of the grid via a process that is often referred to as backward induction.

Starting at the last possible age (120), there is no probability of a household surviving into the subsequent year (age 121). This simplifies the problem of solving for utility maximising decisions, because the impact that current decisions have on future circumstances is made irrelevant. It is consequently fairly straightforward to solve for decisions and welfare at all of the intersections of the grid in the last possible age simulated by the model.

The model solution then proceeds to the penultimate potential age considered by the model (119). Solving for utility maximising decisions at the penultimate age is made more complicated than solving for decisions at the last potential age, because such decisions often affect both utility in the penultimate period, and circumstances (and therefore utility) in the following period. For example, increasing consumption at age 119 increases the utility enjoyed at age 119, but reduces wealth, and, therefore, the consumption that can be enjoyed at age 120. The trade-off between current utility and expectations regarding future utility is evaluated by referencing the measures of welfare previously calculated for the grid in the last possible age simulated by the model. This permits utility maximising decisions and expected lifetime welfare to be evaluated at all points of the grid in the penultimate age.

Solutions for decisions in all preceding ages are then obtained recursively in a similar fashion to that described for the penultimate age.

2.1.2 Second stage of a simulation – projecting a population through time

In the second stage of a simulation, NIBAX generates panel data at annual intervals over the entire life course for a population of 10,000 households, representing a single birth cohort. This involves 'running households forward through the grids' that are evaluated in the first stage of the simulation.

At the youngest age simulated by the model (20), the characteristics of the population are randomly allocated by taking random draws from a joint distribution (of wealth and wage potential in the example discussed above). Given the characteristics of each household, the grids that are constructed in the first stage of the simulation are used to evaluate the decisions that each household will make and their respective measures of expected lifetime utility. Each household is then projected forward one year, given their simulated decisions, and the processes that are assumed to govern the intertemporal evolution of their characteristics.

Where the evolution of a characteristic is deterministic, projecting forward through time is straightforward. In the case of liquid wealth, for example, next period's wealth is equal to this period's wealth, plus disposable income, less consumption. Where the evolution of a characteristic is uncertain, then projecting forward through time involves taking a new random draw for each individual. In the case of wages, for example, the wage next period is described as a function of age, wage in the current period, labour supply, and a random 'shock' that is assumed to have a log-normal distribution. Projecting wages forward through time consequently involves taking a new random draw at each period for each individual from the assumed log-normal distribution. This analytical approach is often referred to as Monte Carlo simulation.

Having 'aged' the population one year, the process begins again, and is repeated until the final age that is considered by the model, or until the household is identified as dying (whichever comes first). The panel data that are derived from this process form the basis for secondary analyses.

The parameters of the model were calibrated on the assumption of the policy environment as it was applied in 2010/11, to survey data reported by the 2009 Living Costs and Food Survey. Further details are reported for the interested reader in Appendix A; these details may otherwise be skipped over without handicap.

One point of note, however, is that the time constraint to which the analysis was subject meant that two of the model parameters (governing the inter-temporal and intra-temporal elasticities of consumption) were assumed from previous work and not re-calibrated to match contemporary survey data. While I do not expect that this will affect the qualitative nature of the results obtained, it may alter the quantitative measures reported in the analysis. This aspect of the analysis is likely to be most important in relation to the population averages that are reported in the analysis, and less so where behavioural variation is distinguished by an individual's age and position in the income distribution. This 'partial health warning', should be borne in mind.

2.2 Analysis of behavioural responses to policy change

NIBAX can be used to explore the behavioural implications of policy change in a number of ways. The analysis reported in this paper focuses upon comparisons between the characteristics of simulated cohorts, where each simulated cohort is comprised of 10,000 households that are assumed to spend their entire lives within a single policy environment, and where the only differences between simulated cohorts concern the policy environments within which each is assumed to live. This form of analysis is often referred to as an exercise in comparative statics, as the characteristics of each simulated cohort are taken to be representative of the long-run implications of their respective policy environment, so that comparisons between any two simulated cohorts indicate the effects of moving from one equilibrium state to another.

It is very important to stress that the long-run behavioural variation between alternative policy environments that is reported here may consequently bear very little resemblance to short-run effects. The 'long-run' time horizon that is most appropriate to keep in mind when interpreting the quantitative projections of behavioural variation that are reported in this study can reasonably be taken to extend over very many generations. This would be the case, for example, if we assume that each generation has an imperfect understanding of its policy environment, and that the understanding of the policy environment improves with each successive generation through a process of accumulated inter-generational experience.

Although the long-run time horizon referred to above provides an interesting policy perspective – particularly where reform is associated with long time lags (as in the case of pensions) – it sits uncomfortably with much of the wider contemporary policy debate. It is consequently of note that, although the structure of NIBAX is designed to provide **quantitative** projections for **long-run** behavioural responses to policy reform, these projections can reasonably be interpreted as giving a **qualitative** indication of the **short-run** incentive effects of policy change.

Beyond this, it is difficult to say whether the short-run responses to a policy change are likely to be stronger or weaker than those in the long-run. On the one hand, it seems reasonable to suppose that the hysteresis that characterises behaviour in general will result in dampened responses in the short-run. On the other, population average characteristics can shift substantially over the long-run, and these may dampen the impact of a policy change on some behavioural margins. An increase in the State Pension age by one year, for example, may result in a nine-month delay in the age of retirement for most people in the near term, if the policy change is unanticipated. In the long-run, however, the higher retirement age will be anticipated right from the start of the working lifetime, and people may choose to accumulate sufficient additional private wealth to offset entirely the implied reduction in state benefits, so that the average retirement age is left virtually unaffected.

In context of a complex policy environment, where incentives are highly opaque and context specific, it is desirable to find a tool that is capable of highlighting the implications for incentives of a policy change. NIBAX is designed to be one such tool.

3 Policy scenarios

This report explores the implications of scenarios similar to those set out in DWP (2011). Given the long-run focus of the model upon which the analysis is based (discussed in Section 2.2), the study abstracts from transitions between policy environments, to focus upon the steady-state implications of the respective proposals for reform.

The analysis is set out around four principal policy scenarios. The first broadly reflects policy as it was in 2010/11 (subject to the caveats outlined in footnote 12), which provides both a natural starting point for the counterfactual policy analysis, and a basis for calibrating the model parameters (discussed in Appendix A). The second is the same as the first but with a State Pension age of 68 rather than 65: moving the State Pension age to 68 was already legislated for, but this was a change that would not have occurred for a number of years, so it represents an alternative long-term scenario worth consideration.

The third policy scenario is based on the pensions system as it will be from 2046 under the 2007 Pensions Act, and as is implied by one of the two central proposals for reform set out in DWP (2011). This environment includes two flat-rate state pensions that are payable in parallel, but which have different bases for accruals. Comparisons between this policy environment and the first described above indicate both the projected long-term effects of the currently scheduled transition of the pension's environment, and behavioural incentive effects that are likely to be exaggerated by accelerating that transition under the associated proposal for reform described by DWP (2011).

The fourth policy scenario is based on the second principal policy option set out in DWP (2011), where the basic State Pension (BSP) and the State Second Pension (S2P) are replaced by a single flat-rate pension. A detailed account of the first of these four policy environments is provided in Section 3.1. The distinguishing terms considered for each of the last two policy alternatives are then described in Section 3.2, noting that the policy counterfactual that involves only a change to the State Pension age requires no further explanation here.

3.1 Policy broadly based on the terms applied in 2010/11 (current system scenario) – extending the NIBAX model

The terms of the policy environment considered for analysis were carefully chosen with two competing objectives in mind: to provide a reasonable representation of the prevailing policy environment, particularly in relation to the reform proposals set out in DWP (2011); and to limit the associated computational burden implied by the decision-making problem. As discussed in the introduction, the first of these objectives puts emphasis upon reflecting the terms of the BSP, the S2P, and means-tested retirement benefits. The second objective motivates the exclusion of household specific characteristics that are not intimately related to our subject of concern.

3.1.1 Model extensions

The NIBAX model included a detailed description of means-tested retirement benefits in the UK before the analysis reported in this study was envisaged; see, for example, Sefton *et al.* (2008), and Sefton and van de Ven (2009) for associated analysis. The model specification described in van de Ven (2011) was consequently extended for the current analysis to include a detailed account of both the BSP and the S2P, including an explicit consideration of the contributory nature of each pension scheme.

The option to 'contract out' of the earnings-related element of the State Pension has been a feature of the policy environment since 1978. Initially only available through a Defined Benefit (DB, final salary) occupational pension scheme, the option was extended to Defined Contribution (DC, money purchase) schemes, both personal and occupational, in 1988. From the mid 1990's there has been a sustained trend away from contracting out. In DC schemes the reason has largely been the reduction of the financial incentive (National insurance (NI) rebate). In DB schemes it is simply the move away from occupational pension provision via a salary-related scheme and large numbers of such schemes closing: this trend is motivated by a variety of factors that are essentially unrelated to the NI rebate.

Eligibility to contract out of the S2P was withdrawn for all DC pension schemes on 6 April 2012.[11] Furthermore, the reform proposal to replace the BSP and the S2P with a single flat-rate pension scheme would also involve scrapping the option to contract out of state administered pensions since there would be no second (or earnings-related) pension to contract out of. To allow for policy alternatives in this regard, the NIBAX model was consequently extended to distinguish between alternative classes of private pension scheme, as is discussed in more detail below.

3.1.2 Details of the policy scenario

The terms of the 'current system' (CS) scenario considered for analysis were designed to broadly reflect the policy environment as it was in 2010/11[12]. The simulation focuses upon real effects denoted in 2010/11 prices. As the model does not distinguish individuals by sex, the State Pension age was set to 65 in the CS scenario to reflect the policy environment for men in 2010/11. The model was parameterised on the assumption of real wage growth of 1.5 per cent per annum, and threshold rates applied by the transfer environment were also adjusted by 1.5 per cent per annum to avoid widespread tax bracket creep. In contrast, welfare benefits were uprated by 0 per cent per annum (in real price terms) to reflect the slower growth that has typically been observed for these, relative to wages.[13]

Taxes and benefits during the working lifetime (prior to the State Pension age), were designed to reflect the Tax Benefit Model Tables (TBMT) for April 2010 produced by the Department for Work and Pensions (DWP) (see http://research.dwp.gov.uk/asd/index.php?page=tbmt). As this aspect of the policy environment is predominantly independent of our focus of concern, no further detail is provided here. The remainder of this section describes modelling of taxes and benefits from the State Pension age.

Income taxation

Income taxation in the UK was traditionally applied to individual (not household) income, and takes a standard multi-step form where marginal tax rates are non-decreasing with taxable income. Taxable income is obtained from an individual's gross income (employment income + investment income + pension annuity income) after deducting their respective personal allowances. This simple structure has been complicated somewhat in recent years by policy reforms that now see an individual's personal allowance also decline with their gross income, with the consequence that the effective marginal rate of tax reaches a peak and then declines as income rises.

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11 Contracting out will continue to be allowed for DB schemes after April 2012, to mitigate disruption to the existing system of private sector pensions.

12 This system would, as a result of legislation already in place, evolve over time to a two-tier flat-rated system with a State Pension age that incrementally increased to 68. We have modelled the system as it stood in 2010/11 rather than that it would evolve into.

13 The Office of Budget Responsibility (2011) has assumed earnings uprating of working-age benefits in its analysis.

Income taxes for households from the State Pension age were based upon the rates and thresholds applicable in 2010/11. Although the personal allowances for Income Tax in 2010/11 distinguished individuals aged 65 to 74 from those aged 75 and over, the analysis was simplified by drawing no distinction between these two age groups. Rather, the CS scenario assumes the arithmetic mean of the rates and thresholds for the personal allowances of the two age groups for analysis. The associated policy parameters are reported in the top panel of Table 3.1.

The Pension Credit

The Pension Credit is a means-tested welfare benefit payable to people from the State Pension age. It is comprised of two components, the Standard Minimum Guarantee and the Savings Credit. The Standard Minimum Guarantee, as its name suggests, is designed to ensure that all people of sufficient age receive a minimum income. Consistent with other Income Support schemes, benefits payable under the Standard Minimum Guarantee are subject to a taper rate of 100 per cent, so that £1 is lost for each £1 of private income until the benefit is exhausted.

The Savings Credit was introduced to mitigate the disincentive to private savings that is due to the 100 per cent taper rate on private income applied by the Standard Minimum Guarantee. For each £1 of private income in excess of a savings credit threshold, the savings credit initially provides a benefit of 60p up to a maximum potential benefit, before withdrawing the benefit again at a 40 per cent taper rate. The combination of the Standard Minimum Guarantee and the Savings Credit imply that the Pension Credit, in aggregate, provides a maximum benefit equal to the Standard Minimum Guarantee, which is reduced at a 100 per cent taper rate on private income up to the savings credit threshold, and then a 40 per cent taper rate thereafter, until the benefit is exhausted.

The CS scenario assumes the rates and thresholds for the Pension Credit as these were applied in 2010/11 and assumes eligibility from age 65. No allowance is made for eligibility to the Standard Minimum Guarantee from age 60, as was the case in 2010/11, because the model is not designed to analyse policy transitions. Uprating of Pension Credit does not take into account uprating changes announced in the Spending Review 2010 and Autumn Statement 2011. Associated policy parameters are reported in the middle panel of Table 3.1.

Housing and Council Tax Benefits

Although housing is not explicitly included in the model, Housing Benefit and Council Tax Benefit are two important means-tested benefits for which retirees are commonly eligible, and allowance is consequently made for these. Housing Benefit provides a means-tested welfare payment to cover the eligible rent charged for accommodation, and the Council Tax Benefit provides a similar benefit to cover associated Council Tax charges. Housing Benefit and Council Tax benefit are each withdrawn in respect of private income net of most other taxes and benefits. Importantly, the taper rates[14] applied to each scheme are applied coincidentally, resulting in high effective marginal tax rates for some people.

The modelling in this regard is based upon the approach adopted for 'Private Tenants' in the TBMTs, with exogenous assumptions regarding the 'eligible rent' for calculation of Housing Benefit, and the cost of 'Council Tax' for calculation of the Council Tax Benefit. The policy parameters adopted for analysis are reported in the bottom panel of Table 3.1.

[14] Of 65 per cent in Housing Benefit and 20 per cent in Council Tax Benefit.

Basic State Pension

The BSP is a flat-rate contributory pension, rights to which are accrued through accreditation in respect of NI contributions during the working lifetime. The specification adopted for the BSP in the CS scenario reflects the rates and thresholds that were applied in 2010/11, including reforms to the eligibility criteria that came into force in April 2010. These reforms, which were legislated for in 2007, widened the criteria for accreditation in respect of NI contributions, and reduced the number of contribution years required for the full BSP to 30 for both men and women (previously 44 years for men, and 39 years for women).

NIBAX simulates the accrual of rights to the BSP – and to all other pension types that are treated within the model – on the basis of the individual earnings histories of each adult household member. Furthermore, as the model explicitly accounts for involuntary unemployment (see Appendix A.2), it was possible to take this into account when evaluating rights to the BSP. At State Pension age, all households are assumed to apply for any BSP to which they are entitled; no allowance is made for either imperfect take-up of pension rights, or for delayed pension receipt.

The bearing that relationship transitions have on accrued rights to the BSP was complicated by two factors. First, where a household is identified as forming a co-habitating relationship, then the new adult is assumed to be drawn from 'outside' the simulated cohort, so that no information is held regarding their previously accrued liquid wealth or pension rights. Secondly, it was not possible to keep separate account of the pension rights accrued by each household member, as to do so would impose an excessive computational burden. Additional assumptions were consequently required to model the effects on pension rights of relationship transitions. To maintain a consistent basis for comparison, changes in relationship status are assumed to affect all types of accrued pension rights in the same way, doubling in the case of relationship formation, and halving in the case of relationship dissolution.

A departure from the 2010/11 policy environment that was considered for the CS scenario is that the BSP was assumed to be indexed by the triple guarantee of earnings growth, price growth (measured by the Consumer Price Index), or 2.5 per cent p.a., whichever is the highest. It was assumed that the triple lock was worth 1.7 per cent p.a. in real price terms – this is larger than earnings growth, reflecting the expectation that, at some stages (such as observed in 2010/11), earnings may not be the largest of the three factors. This reform will come into effect from April 2011, and its inclusion here reflects the forward looking nature of the behaviour simulated by the NIBAX model.

From April 2010, an adult caring for a dependent child up to the age of 12 and receiving Child Benefit was eligible for both the BSP, and the (minimum contribution) S2P. The model does not, however, distinguish between the ages of dependent children. This aspect of the policy environment was consequently accommodated by assuming that one adult from each household could claim accreditation for NI contributions during the 15 years between ages 31 and 45, spanning the peak child-rearing period of the life-course.

The rates and thresholds assumed for the BSP in the CS scenario are summarised in the top panel of Table 3.2.

State Second Pension

The terms of the S2P considered for the CS scenario reflect the terms of the scheme as it will be applied from April 2012. This scheme includes a flat-rated element worth £1.60 per week in retirement for each year during the working lifetime that earnings exceed the Lower Earnings Limit. Furthermore, for every £1 per week of NI paid on earnings between the Lower Earnings Threshold

and Upper Accrual Point, rights to the S2P increase by 10/44p in retirement. Rights to the S2P are uprated by wage growth during accrual, and by price inflation when in payment (as measured by the Consumer Price Index). Furthermore, credits toward the flat-rated element of the S2P are also made in respect of individuals caring for dependent children to age 12.

S2P has inheritance rights where the surviving spouse receives half of their deceased spouses S2P. The NIBAX model doesn't allow for this. It assumes that all household pension wealth is doubled on marriage and then halved on marital dissolution (which includes death). This assumption was made to ease the computational burden. Also the modelling assumes that individuals do not plan to leave specific bequests, but the model does generate bequests due to the uncertainty of the timing of death and we would not anticipate that including specific bequests would alter the results significantly.

Statistics in relation to the terms assumed for this scheme are reported in the lower half of Table 3.2.

Private pensions[15]

Given the differential incidence of contracting out of earnings-related state pensions observed between DB occupational pensions and DC pension schemes, three types of private pension are distinguished in the CS scenario. A number of assumptions help to simplify the model in this respect. First, the model assumes that investment returns and age specific mortality rates are certain. These assumptions imply that the terms of a DC pension can be restated as a career average DB pension, and vice-versa. All three private pensions considered for analysis are consequently modelled as (notional) DC schemes. It is further assumed that the only factors distinguishing between the three private pensions relate to their respective contribution rates from employers and employees, and the associated impact that pension membership has on participation in the S2P. The simulations take account of automatic enrolment by assuming that the proportion of households expected to be automatically enrolled contribute to DC schemes in the model. However, auto-enrolment, in itself, doesn't lead to an increase in take-up of private pensions saving as, in NIBAX, individuals are simulated as being rational and free from the inertia effects that have been cited as a motivation for introducing auto enrolment for pension schemes.

Households are considered to be eligible to participate in only one private pension scheme in any year, where eligibility to each scheme is identified stochastically with reference to income dependent probabilities that assume an 85 per cent probability that pension eligibility carries over from one year to the next. Where a household chooses to participate in a private pension, then pension contribution rates are defined as exogenous percentages of (total) household labour income, implying that pension membership requires employment participation. Pension dispersals are drawn at State Pension age, at which time a fixed percentage of the accrued pension pot is taken as a tax free lump-sum, and the remainder used to purchase an actuarially fair inflation-linked life annuity.

The assumption that pension wealth is used to purchase an inflation adjusted annuity may act as a disincentive to pension participation to the extent that the resulting income stream fails to accommodate demand for consumption at the outset of retirement. As we will see in Section 4.4, this consideration can be particularly important in context of myopic preferences that describe a present-bias in consumption.

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15 The term 'private pension' is used to refer to both 'personal pensions' taken out with a private-sector pension provider, and 'occupational pensions' provided by an individual's employer.

Specifics regarding the terms of the respective private pension schemes are summarised in Table 3.3, where private pension (1) is a styled specification that reflects pensions which attract no employer pension contribution, (2) is designed to account for DC occupational pension schemes, and (3) DB occupational pension schemes.

Table 3.1 Terms of income taxes and means-tested benefits from State Pension age

Income Tax		
Personal allowance		
basic value	6,475	P.A.
age premium	3,090	P.A.
age premium taper threshold	22,900	P.A.
age premium taper rate	50%	
basic value taper threshold	10,000	P.A.
basic value taper rate	50%	
20% basic rate threshold	6,475	P.A.
40% higher rate threshold	37,400	P.A.
50% additional rate threshold	150,000	P.A.
Pension Credit		
Value of Standard Minimum Guarantee (singles)	132.60	P.W.
Value of Standard Minimum Guarantee (couples)	202.40	P.W.
Standard Minimum Guarantee taper rate	100%	
Savings Credit threshold (singles)	98.40	P.W.
Savings Credit threshold (couples)	157.25	P.W.
Savings Credit accrual rate	60%	
Savings Credit taper rate	40%	
Housing and Council Tax Benefits		
Eligible rent	127.00	P.W.
Council Tax (singles)	14.00	P.W.
Council Tax (couples)	19.00	P.W.
Personal allowance	132.60	P.W.
Couples allowance	202.40	P.W.
Housing Benefit taper rate	65%	
Council Tax Benefit taper rate	20%	

Notes: All monetary values specified in 2010/11 prices, before indexation Income Tax calculated on personal income in excess of relevant personal allowance taper thresholds for personal allowance applied to personal income until relative allowance exhausted.
Pension Credit effectively applies Standard Minimum Guarantee taper rate to personal income up to the Savings Credit threshold and the Savings Credit taper thereafter until the value of the benefit is exhausted.
Eligible rent for calculation of Housing Benefit based on rent for a single bedroom flat on the private market, as assumed by the 2010 TBMTs.
Housing Benefit and Council Benefit taper rates applied coincidentally on private income in excess of the relevant allowance until the respective benefit is exhausted.

Table 3.2 Terms of state pensions considered for analysis

Basic State Pension		
Full pension (personal)	97.65	P.W.
Full pension (couples)	195.30	P.W.
Contribution years to obtain full pension	30	Years
Earnings threshold for accreditation	97.00	P.W.
Accreditation for invol. unemployment	Yes	
Accreditation for child rearing	Yes	
minimum age for child rearing	31	Years
maximum age for child rearing	46	Years
Growth rate of benefit pre State Pension age	1.7%	p.a.
Growth rate of benefit post State Pension age	1.7%	p.a.
State Second Pension		
Lower Earnings Limit	97.00	P.W.
Upper Accrual Point (UAP)	770.00	P.W.
Accrual rate to Lower Earnings Threshold	40%	
Accrual rate between Lower Earnings Threshold and Upper Accrual Point	10%	
Accreditation for invol. unemployment	No	
Accreditation for child rearing	Yes	
minimum age for child rearing	31	Years
maximum age for child rearing	47	Years
Growth rate of benefit pre State Pension age	1.5%	P.A.
Growth rate of benefit post State Pension age	0.0%	P.A.

Notes: all monetary values specified in 2010/11 prices, before indexation.
* If both members of the household have a full work or crediting history they can each qualify for the full BSP. If one member of the couple is entitled to less than 60 per cent of the full BSP and is over State Pension age they may be able to increase their pension to 60 per cent of the full rate.

Table 3.3 Terms of private pensions considered for analysis

	Personal pension scheme		
	1	2	3
	DC	DC	DB
Representative pension type	Private	Occupational	Occupational
Proportion of households with pension by type	31%	47%	22%
Employer contribution rate	2%	10%	13%
Employee contribution rate	5%	5%	5%
Contracted out of S2P (Yes/No)	No	No	Yes
Contracted out rebate (employee)	0%	0%	1.6%
Annual return on pension pot	4%	4%	4%
Age of pension dispersals (years)	SPA	SPA	SPA
Share of pot taken as lump-sum	25%	25%	25%
Capital cost of annuity purchase	4.7%	4.7%	4.7%

Notes: Probabilities for scheme eligibility based on data from waves 2005/06 and 2007/08 of the Family Resources Survey, wave 2009 of the Annual Survey of Hours and Earnings and consultation with DWP.
Pension contribution rates based on the 2007 Employers' Pension Provisions Survey reported by Forth and Stokes (2008), Tables 5.1 and 5.3.
Contracted out rebate received on income between the Primary Threshold and the Upper Earnings Limit, when contracted out of the S2P.
Capital cost of annuity purchase based on data reported by Land, Clark and Peacock (2008) for a 65 year old man.
SPA = State Pension age.
The contracted out rebate will be 1.4 per cent from 2012/13.

3.2 Policy reform scenarios

This section details the adjustments that were made to the CS policy environment to reflect scenarios similar to those set-out in DWP (2011). It should be noted that these scenarios could differ from DWP's final policy proposal. A summary of how the various policy counterfactuals that are considered for analysis compare with one another is provided in Table 3.4.

3.2.1 Flat-rate State Second Pension and basic State Pension – reform scenario 1

This scenario, hereafter referred to as reform scenario 1, is based on the policy environment as it is scheduled to become in the medium term under the reforms set out in both the 2007 Pensions Act and one of the two proposals for reform described in DWP (2011). The innovation of the associated reform proposal described in DWP (2011) is to bring forward the timing of the S2P flat-rating, from the early 2030's to 2020. As noted at the beginning of this section, no separate allowance is made for the accelerated flat-rating of the S2P due to the long-run focus of the NIBAX model upon which the analysis is based.

Reform scenario 1 involves two key changes, relative to the 'current system' scenario described in Section 3.1. The first is that the State Pension age is projected to increase from 65 in 2010/11 (for men) to 68 by 2046 (for both men and women). The second is the specification of the S2P as a flat-

rate pension, worth approximately £1.60 per week (in 2010/11 prices) for each qualifying year. To assess the impact of this scenario, two sub-scenarios are actually explored, one in which the State Pension age is raised to 68 in isolation (as noted at the beginning of this section), and another that considers the impact of flat-rating the S2P while holding the State Pension age fixed at 68.

3.2.2 A single-tier flat-rate state pension – reform scenario 2

This scenario (hereafter referred to as reform scenario 2) is based on the second principal policy reform set out in DWP (2011). This involves replacing the BSP and the S2P with a single-tier flat-rate pension (STP). Relative to reform scenario 1, this proposal involves five principal changes to policy:

- The STP represents a smaller maximum State Pension, but will provide a higher rate of pension indexing from State Pension age
  - In the long run, the full STP will have a lower maximum value at State Pension age then the maximum State Pension payable under reform scenario 1. Everyone would qualify for the STP individually so it will not allow for a higher pension payment to retired couples where one partner has received accreditation for insufficient National Insurance (NI) contributions on their own behalf.
  - However, we assume the STP will be uprated by the triple guarantee throughout life under the STP, in contrast to pensions provided by the S2P, which are uprated by prices from State Pension age.
- The STP will end the opportunity to contract out for DB pension schemes
- The STP will extend eligibility of accreditation for NI contributions in relation to unemployment
  - S2P does not recognise periods of unemployment
- The STP will alter the contributions history required to obtain the State Pension
  - Eligibility to the full State Pension under the STP is obtained in respect of 30 years' NI contributions, whereas individuals can continue to accrue S2P beyond 30 years.
  - Eligibility to any State Pension will be limited under the STP to those with at least seven years' NI contributions, whereas the BSP and S2P are allocated on a pro-rata basis based on work or crediting history with no lower bound (S2P is not paid for periods of self-employment).
- The STP will eliminate the savings credit

Table 3.4 Variation of policy components between policy scenarios

Policy component	Current system	Counterfactual policy scenario		
		Increasing State Pension age to 68	Reform 1	Reform 2
State Pension age	65	68	68	68
BSP modelled	Yes	Yes	Yes	No
S2P modelled	Yes	Yes	Yes	No
STP modelled	No	No	No	Yes
Savings credit modelled	Yes	Yes	Yes	No
S2P accrual rate between LET and UAP	10%	10%	0%	NA
Personal pension contracted out	Yes	Yes	Yes	No

Table 3.5 Variation of model parameters between basic State Pension and the single-tier scenario

	STP	BSP	
Full pension (personal)	140.00	97.65	P.W.
Full pension (couples)	280.00	195.30*	P.W.
Contribution years to obtain full pension	30	30	Years
Earnings threshold for accreditation	97.00	97.00	P.W.
Accreditation for invol. unemployment	Yes	Yes	
Accreditation for child rearing	Yes	Yes	
Minimum age for child rearing	31	31	Years
Maximum age for child rearing	46	46	Years
Minimum contribution history for benefit	7	0	Years
Growth rate of benefit pre-State Pension age	1.70%	1.70%	P.A.
Growth rate of benefit post-State Pension age	1.70%	1.70%	P.A.

Notes: all monetary values specified in 2010/11 prices, before indexation.
* If both members of the household have a full work or crediting history they can each qualify for the full BSP. If one member of the couple is entitled to less than 60 per cent of the full BSP and is over State Pension age they may be able to increase their pension to 60 per cent of the full rate.

4 Results

Two central policy scenarios are set out in DWP (2011), which are the focus of analysis here. Under both of these alternatives the State Pension age would be 68 by 2046. Discussion consequently begins in Section 4.1 by exploring the effects of increasing the State Pension age from 65 to 68, holding all other aspects of the policy environment fixed in terms that broadly match those that were applicable in 2010/11 (the 'current system' (CS) scenario defined in Section 3.1). Section 4.2 then considers the effects of omitting the earnings-related component of the State Second Pension (S2P) when the State Pension age is 68 (reform scenario 1 defined in Section 3.2), and Section 4.3 reports the effects of replacing the flat-rated two-tier State Pension (reform scenario 1) with a single-tier flat-rated State Pension (STP) when the State Pension age is 68 (reform scenario 2 defined in Section 3.2). Sensitivity of results to a present-bias in preferences is discussed in Section 4.4.

The analysis focuses upon statistics disaggregated by age band and lifetime income quintile[16], as these provide sufficient detail to identify the most important incentive effects generated by the policy alternatives.

4.1 Raising the State Pension age from 65 to 68

The simulations reported here confirm most intuitive priors regarding the effects of raising the State Pension age, but also throw up some surprises and contradict some popular notions set out in the contemporary policy debate.

Given the focus of this policy counterfactual, employment participation is a natural subject to start discussion; related statistics are reported in Figure 4.1. The population average statistics reported here indicate that rates of employment tend to increase throughout the simulated lifetime in response to the rise in the State Pension age. This is an intuitive household response to the reduced generosity of state-administered retirement provisions.

Rates of employment participation are only appreciably affected in the period of life immediately preceding the revised State Pension age, and increase precipitously between the old and new State Pension ages. Even in the period between ages 65 and 67, however, the increase in the proportion of adults employed rises by only 12 percentage points on average; equal to an average delay in retirement of 0.4 years. In aggregate, the simulations suggest that increasing the State Pension age by three years will increase the average duration of life in employment by a shade over one year. This is notably less than the increase in employment that is commonly assumed to result from an increase in the State Pension age (e.g. Barrell *et al*., 2011, DWP, 2011b, p.11, para. 28).

Raising the State Pension age does not lead to an equivalent increase in the simulated duration of life spent in work because households higher up the distribution can afford to retire without recourse to state benefits, underscoring the regressive nature of the policy reform. Whereas adults in the lowest lifetime income quintile are projected to extend their time spent in employment by 1.7 years on average following the rise in the State Pension age from 65 to 68, adults in the middle of the lifetime income distribution increase their time spent in employment by 1.1 years, and those in the top income quintile work just 0.4 years longer following the rise in the State Pension age. Hence, the model suggests that individuals will, in general, and particularly those on middle and higher incomes, prefer to make up the short-fall in state benefits that is the product of raising the State

[16] Lifetime income of each household is calculated as the present discounted value of net income to State Pension age.

Pension age out of their own pockets – by increased saving and employment early on in the working lifetime – rather than by extending their respective working lives.

When interpreting this result, it is important to bear in mind four considerations. First, the quantitative effects of increasing the State Pension age that are reported here are those that could be expected over the long-run, and may bear little relation to short-run effects. One important reason why the long-run and short-run effects of a change in the State Pension age will differ is that long-run effects allow for behavioural changes well in advance of retirement. Individuals who face a higher State Pension age from the beginning of their economic lives may, for example, choose to save more from a very young age to offset the impact that the policy change has on their timing of retirement.

Secondly, the model does not account for the 'signal' effect that the State Pension age may have on individual expectations and planning in practice. And third, the model is calibrated to declining wages later in the working lifetime, and this decline is projected on current work profiles, so that these profiles may feed indirectly into work incentives in the policy counterfactual. Although the general approach used to calibrate the model parameters is designed to take endogenous account of selection effects, it may do so imperfectly. Fourth, the State Pension age is being raised because of increased longevity and if it was not raised higher pension costs may have to be paid for from higher taxes and these could affect incentives to work (and save).

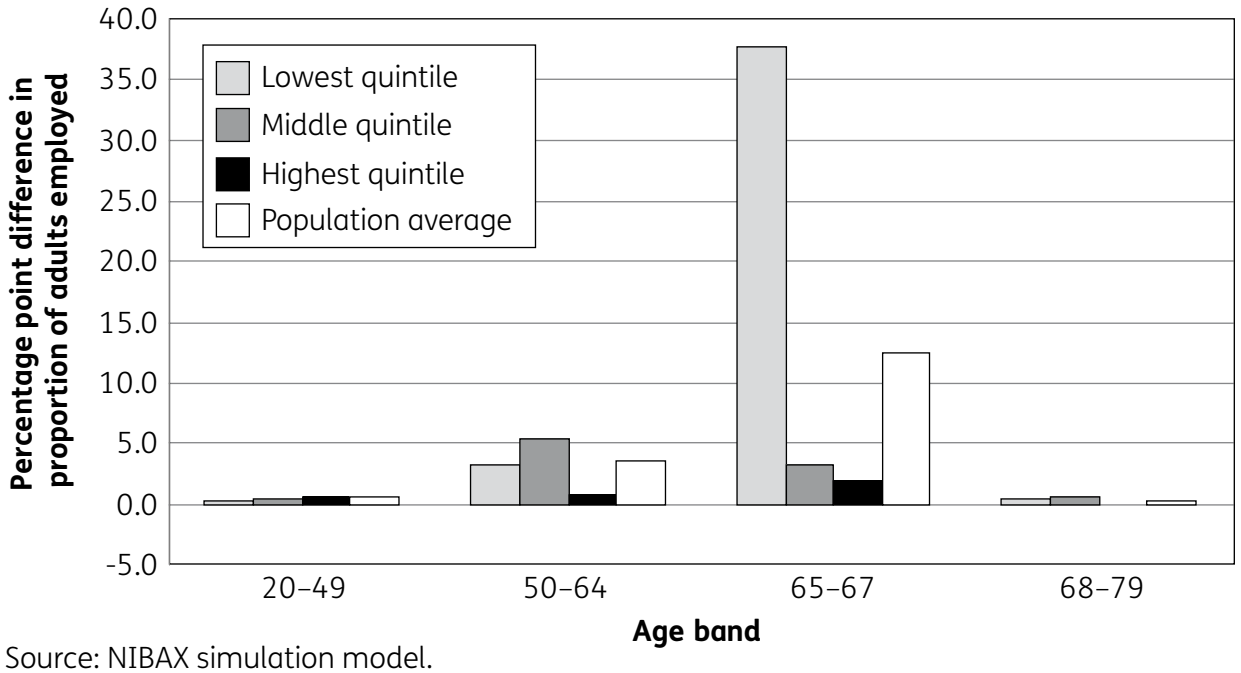
The model takes account of rising longevity by focusing on the circumstances of the birth cohort that was aged 20 in 1992. Between ages 20 and 35, the mortality rates assumed for analysis are based upon observed data. From age 36, they are based upon ONS projections for improvements in the target cohort's longevity. Life expectancy has historically been consistently underestimated, so it may be that individuals live longer than the projections considered here suggest.

Figure 4.2 reports the impact of increasing the State Pension age on simulated rates of participation in private pension schemes. This figure indicates that pension participation falls early in the simulated lifetime when the State Pension age is increased, and increases late in the simulated working life. This behavioural variation is due to the fact that individuals are assumed to be able to invest in private pensions only up to the State Pension age, so that increasing the State Pension age gives them more time to build up their pension wealth. As household wealth tends to be most constrained early in the simulated lifetime, it makes sense for households to delay their participation in (illiquid) pensions until later in life.

Savings statistics are reported in Figure 4.3, which displays a similar age profile to that reported for pension participation in Figure 4.2, decreasing early in life and increasing late in life. The extent to which households increase private savings to offset the reduced financial support that is provided by the state administered system is made clear by statistics reported for the 65 to 67 year age group, for which average total household wealth increases by approximately 12 per cent, with the largest proportional rise among households in the lowest income quintile (again, reflecting the regressive nature of the reform).

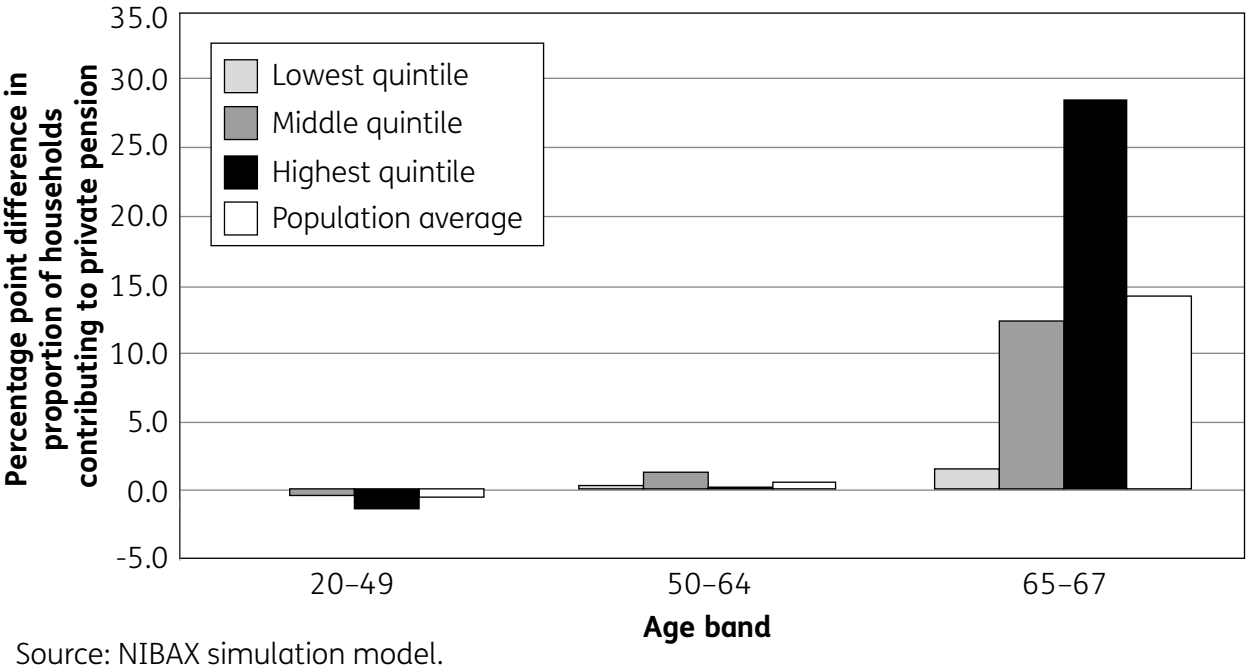
The distributional effects of the policy counterfactual on household consumption are reported in Figure 4.4. This figure indicates that long-run consumption generated by the model responds most strongly to an increase in the State Pension age in the period between the initial State Pension age and the new State Pension age, and falls most precipitously (in both absolute and relative terms) among households in the lowest income quintile. This is consistent with the fact that state pensions are most important for households with the lowest incomes. Otherwise, the policy counterfactual has the most consistent distributional impact on consumption late in the simulated lifetime, when it is observed to increase on average for all income quintiles.

Figure 4.1 Employment responses to an increase in State Pension age from 65 to 68 by age and lifetime income quintile



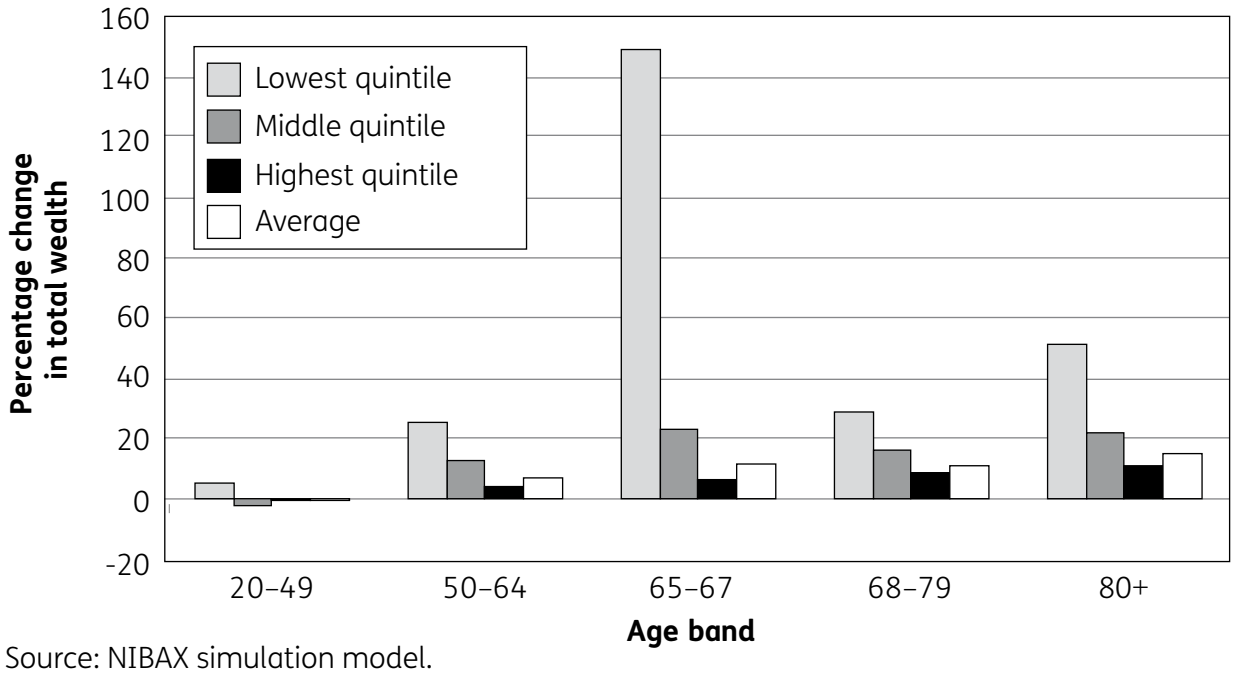
Source: NIBAX simulation model.

Figure 4.2 Private pension participation responses to an increase in State Pension age from 65 to 68 by age and lifetime income quintile



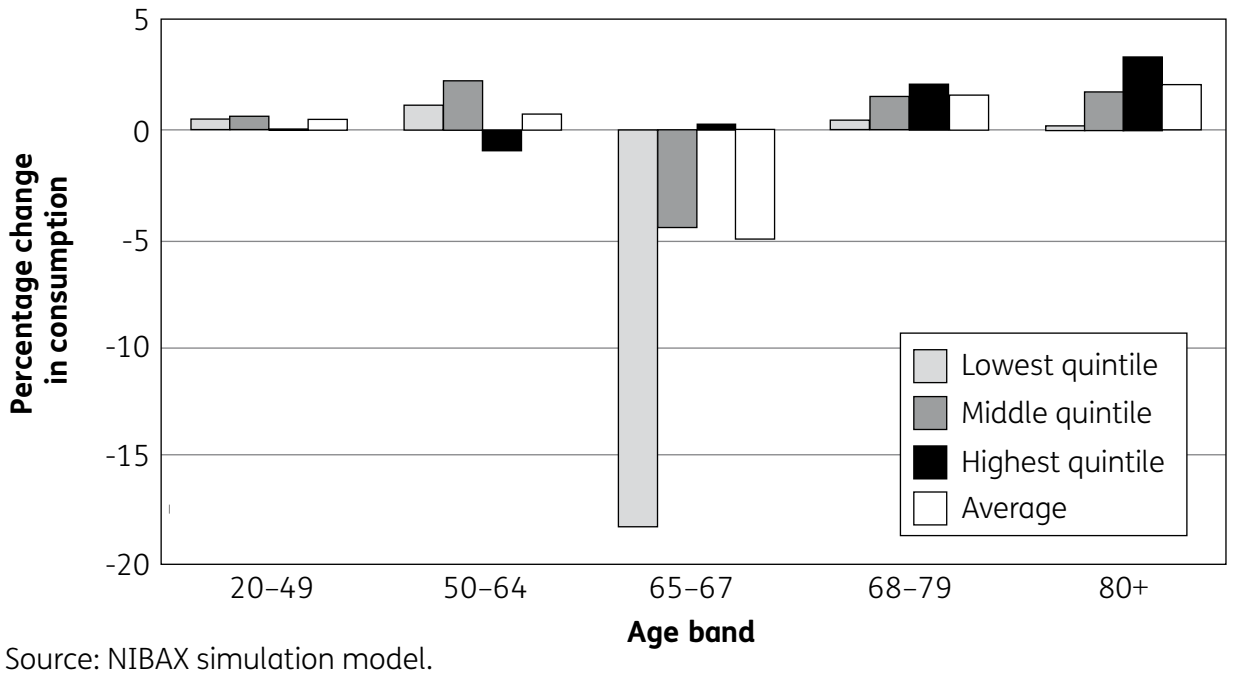
Source: NIBAX simulation model.

Figure 4.3 Savings responses to an increase in State Pension age from 65 to 68 by age and lifetime income quintile



Source: NIBAX simulation model.

Figure 4.4 Consumption responses to an increase in State Pension age from 65 to 68 by age and lifetime income quintile



Source: NIBAX simulation model.

4.2 Flat-rating of the State Second Pension – reform scenario 1

As described in Section 3.2, reform scenario 1 involves reducing the value of the maximum S2P by omitting associated earnings-related benefits, relative to the policy environment discussed in Section 4.1. This section explores the distributional effects of replacing the policy environment considered in Section 4.1 with reform scenario 1, subject to a fixed State Pension age of 68.

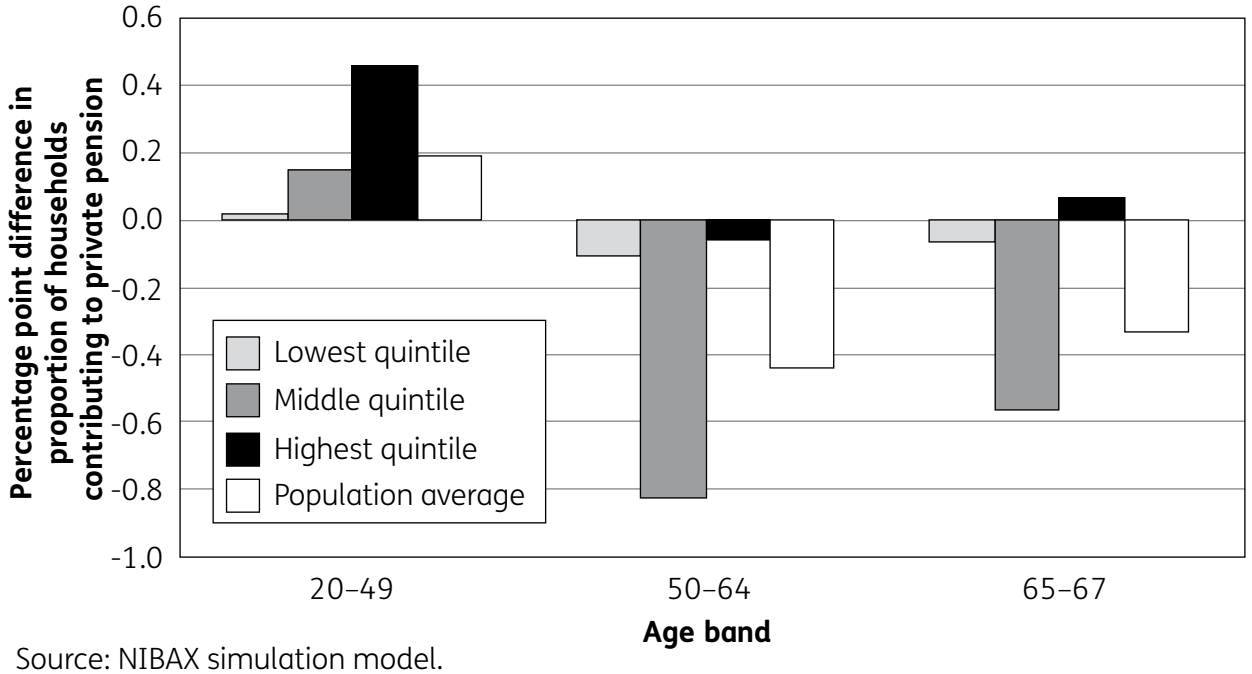
Omitting the earnings-related element of the S2P is projected to have a negligible impact on employment behaviour throughout the income distribution and the simulated lifetime and only slight impacts on saving and consumption behaviour. We consequently take up the discussion with responses in rates of pension scheme participation and total wealth, which are reported respectively in Figures 4.5 and 4.6.

As could be expected – given the nature of the policy counterfactual – reform scenario 1 has a muted impact on savings in general; total wealth tends to vary by less than two per cent following the reform for all but those in the lowest population quintile, for whom the associated variation is negligible in absolute terms. Two interesting incentive effects do, however, stand out as driving the associated behavioural responses. First, reducing the generosity of the state sponsored pensions system reduces the lifetime resources available to households, which reduces the demand for setting aside resources for the future. This is the dominant effect for households at the bottom of the lifetime income distribution in general, and for those at the middle of the distribution in respect of pension participation. Secondly, suppressing the earnings-related benefits delivered by the S2P puts greater emphasis on private savings for retirement. This effect dominates for households at the top of the distribution in general, and for households at the middle of the distribution in respect of total (private) wealth.

Figure 4.7 indicates the long-run effects on consumption of the withdrawal of earnings-related benefits payable under the S2P. The temporal discounting that is assumed for preferences implies that consumption is little affected early in the simulated lifetime for households throughout the income distribution. Consumption is projected to fall toward State Pension age for all households, as savings are accrued to offset the reduced generosity of the S2P. The simulations suggest that households will only offset part of the reduced generosity of the S2P with private saving, so that consumption is projected to continue to fall away into retirement.

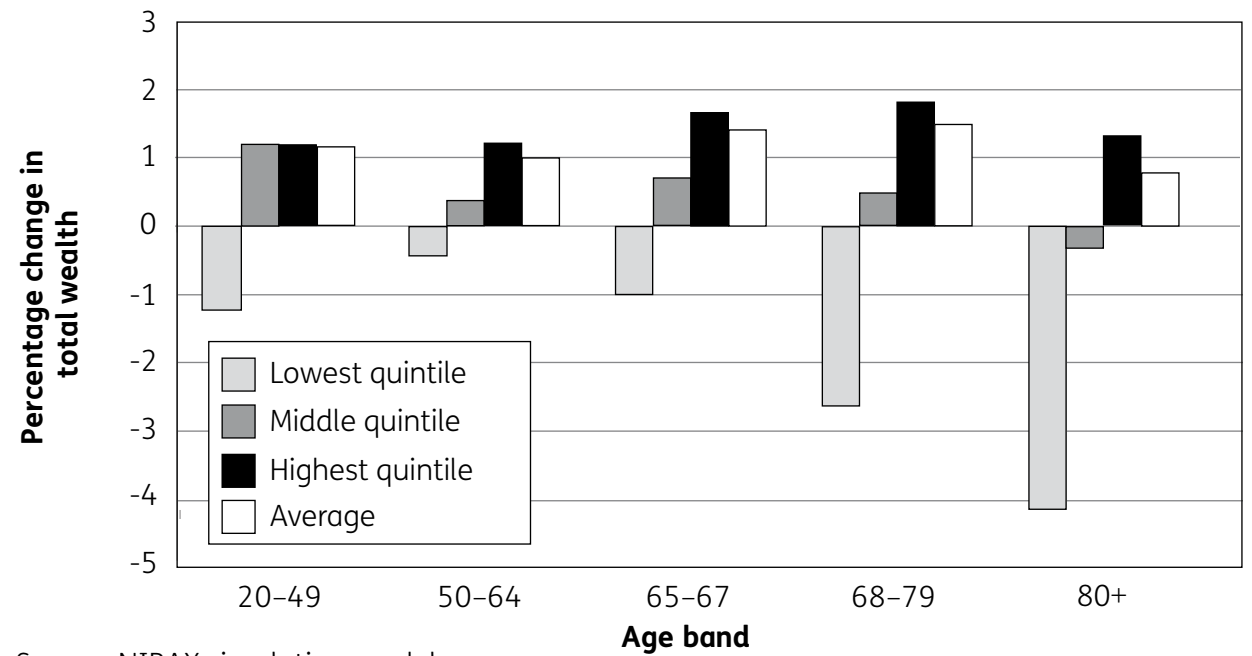
The substantive effort made by middle income households to shield themselves from the policy change through increased saving, relative to households at the population extremes is made most clear in Figure 4.7 by the consumption statistics reported from age 80. These statistics indicate that the middle income households must economise on their consumption by around one per cent per week between ages 68 and 79.

Figure 4.5 Private pension participation responses to flat-rating of the State Second Pension when the State Pension age is 68, by age and lifetime income quintile



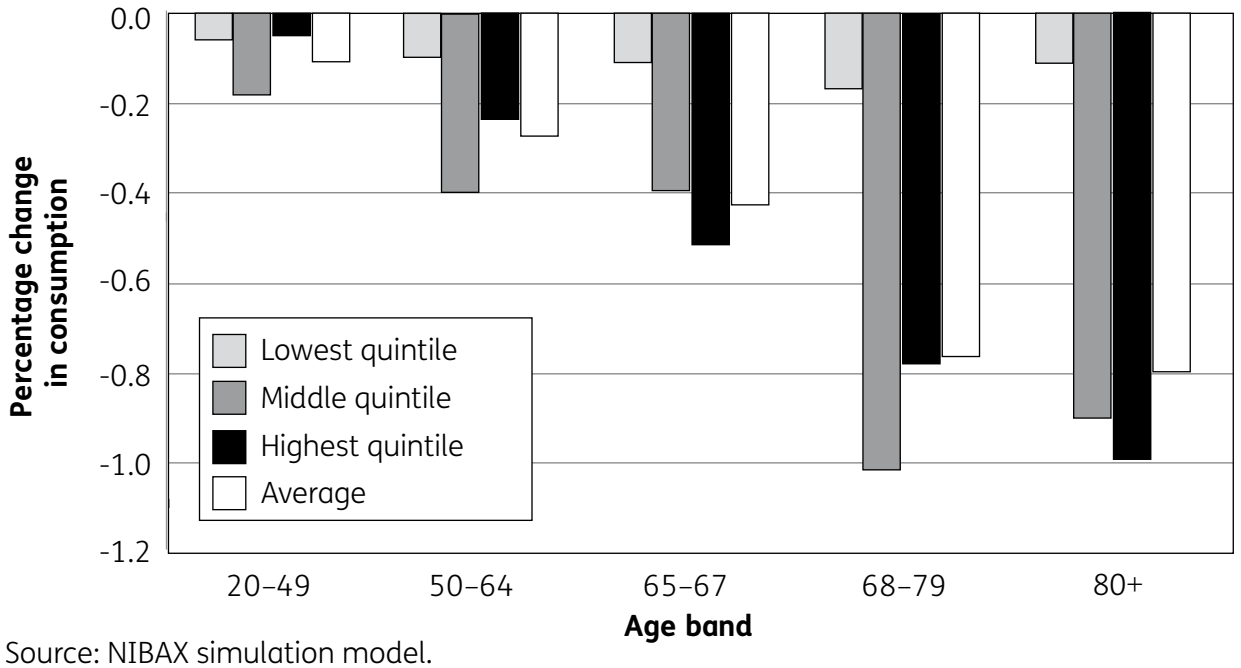
Source: NIBAX simulation model.

Figure 4.6 Savings responses to flat-rating of the State Second Pension when the State Pension age is 68, by age and lifetime income quintile



Source: NIBAX simulation model.

Figure 4.7 Consumption responses to flat-rating of the State Second Pension when the State Pension age is 68, by age and lifetime income quintile



Source: NIBAX simulation model.

4.3 Replacing the two-tier flat-rated state pension with a single-tier flat-rated State Pension – reform scenario 1 to reform scenario 2

This section reports the effects of replacing the two-tiered flat-rated pension subject to a State Pension age of 68 with the flat-rate single-tier State Pension defined by reform scenario 2.

Reform scenario 2 is not projected to have very substantial implications for behaviour, but does influence incentives in a more complex fashion than might be expected at first glance. It is consequently useful to distinguish between the three principal components of reform scenario 2, relative to scenario 1: omission of contracting-out of state pensions, fewer qualifying years required for a full State Pension, and variation over the time profile of eligible state pensions. The first of these components requires little explanation here, as it has been discussed at length in the contemporary policy debate. The second recognises the shift in terms of eligibility proposed for the single-tier pension, relative to the current two tier system. And the third consideration recognises that the single-tier State Pension scenario implies a smaller eligible benefit at State Pension age for individuals with a full work or crediting history, relative to the two-tier State Pension (including S2P), but applies higher benefits indexing from State Pension age.[17]

[17] This analysis assumes the single tier would be uprated by the 'triple lock' – the highest of the Consumer Price Index (CPI), earnings or 2.5 per cent. Under the two-tier flat-rated scenario although the basic State Pension (BSP) would be uprated by the triple lock and the S2P would be uprated by prices (CPI).

Discussion begins by describing the influence of omitting contracting out, before moving on to interpret responses to replacing reform scenario 1 with scenario 2. Simulation statistics that describe the impact of omitting contracting out from reform scenario 1 are, however, not reported separately here; the interested reader can find these in Appendix B.

When contracting out is considered in the current analysis, individuals who have sufficient labour income, and who are eligible to participate in a DB private pension (see Table 3.3), must choose between participating in the DB private pension, or participating in the S2P; they do not have the option to participate in both. When contracting out is omitted from the analysis, then these same individuals must choose between participating in the DB private pension and the S2P, or participating in the S2P only.[18] The obvious implication of omitting contracting out is that households accrue increased rights to state pensions (the S2P). It is also worth noting that omitting contracting out will bring returns to the exchequer, which could be used to reduce taxes. Such adjustments to taxation would have behaviour implications that are not explored here. We also do not consider the possibility of employers making changes to accrual rates to offset the increased costs they will face from making National Insurance contributions at a higher rate.

Three principal considerations work to ensure that households do not fully offset the increased rights to state pensions that is consequent on omitting contracting out against their private savings. First, the flat-rated S2P provides a higher internal rate of return in respect of associated contributions than is assumed to accrue to liquid wealth. Increased participation in the S2P, all else being equal, consequently makes households better off from a lifetime perspective. Secondly, the DB private pension that is assumed for analysis offers a high effective rate of return to participation, due to the matching employer contribution. This militates against the incentive to offset increased rights to the S2P by reducing participation in the DB pension scheme. And thirdly, rights held in both the S2P and personal pensions are illiquid, so that households must use liquid wealth to maintain precautionary balances. This militates against a reduction in liquid wealth to offset increased rights to the S2P.

Hence, although total (personal) wealth is simulated to fall when contracting out is omitted from the analysis (by between one and two percentage points on average), the offset against state pensions is less than complete for all but those with the lowest incomes; consumption is projected to rise (very slightly) into retirement as a result. Employment, by contrast, shows no discernible response to contracting out.

The behavioural responses to replacing reform scenario 1 with scenario 2 are clearly described by Figures 4.8 to 4.10: households increase their savings early in the working lifetime to finance earlier retirement, with consumption rising appreciably late in retirement. Total wealth during the working lifetime is projected to increase under reform scenario 2, relative to scenario 1, by over 2.5 percentage points on average between ages 20 and 49. This increase is supported by a rise in participation of private pensions, and reverses the two percentage point decline in total wealth that is projected following the withdrawal of contracting out (discussed above). The increased wealth accrued to age 49 allows households to bring forward their retirement under the single tier State Pension, with average rates of employment falling by over 1.5 percentage points between ages 65 and 67. Consumption is projected to rise by one percentage point on average from age 80, supported by both the omission of contracting out and the higher indexing applied to (aggregate) state pensions.

[18] This is to isolate the impact of contracting out. Under the single-tier there will be no S2P.

Two key factors are crucial in motivating the shift toward earlier retirement that is a central behavioural response simulated for the single-tier State Pension. First, the single-tier State Pension will reduce the number of qualifying years required to obtain the maximum benefit payable, relative to the two-tier State Pension in reform scenario 1. Importantly, this aspect of the policy counterfactual includes limiting to 30 years the contributions history that is required for the maximum single-tier pension, where individuals can contribute for more than 30 years. Limiting the accrual of rights to state pensions in this way reduces the effective rate of return to employment later in life for most households in the simulations. Secondly – as noted in Section 4.1 – we do not know what employment opportunities will exist for older people well into the future. The model will act to encourage early labour market participation, to the extent that it fails adequately to reflect the returns to employment that older people will face in the future. It is consequently important to recognise that this aspect of the model parameterisation remains a subject of conjecture.

There are, of course, a number of reasons why the results reported here may depart from the practical reality. In addition to the various qualifications that are set out in preceding sections of this report (see, especially, Section 2.2), six factors stand out. The first relates to the restrictions that limit the private pension contributions that households can make in the analysis. Households are assumed only to be able to contribute to private pensions when in employment, which has a clear bearing on employment incentives.

Secondly, all savings in private pensions are converted into an inflation-linked life-annuity at State Pension age in the analysis. A detailed analysis of the incentives associated with the indexing of pension annuities was undertaken, and the results indicate a degree of sensitivity over the assumptions made. Specifically, households in the model were identified as preferring a front-loaded annuity stream, in part because they are assumed to be impatient, and in part because of the increasing probability of mortality that is assumed with age. When an annuity structure tends to push consumption later into a household's lifetime, as with inflation protection, then the simulation model suggests the rational household response will be to offset this substituting out of pension wealth and into liquid wealth which might not be the case in reality. This assumption is important because the reality allows many households much greater flexibility over how they choose to draw down their pension wealth, which offers an alternative method of offsetting the higher indexing associated with the single-tier pension. The use of pension wealth to purchase a level cash annuity (unadjusted for inflation), which is popular in practice, is a case in point. In reality the 'triple locked' single-tier pension could act to offset falling real private pension income later in retirement that would result in the context of price inflation and fixed nominal annuities.

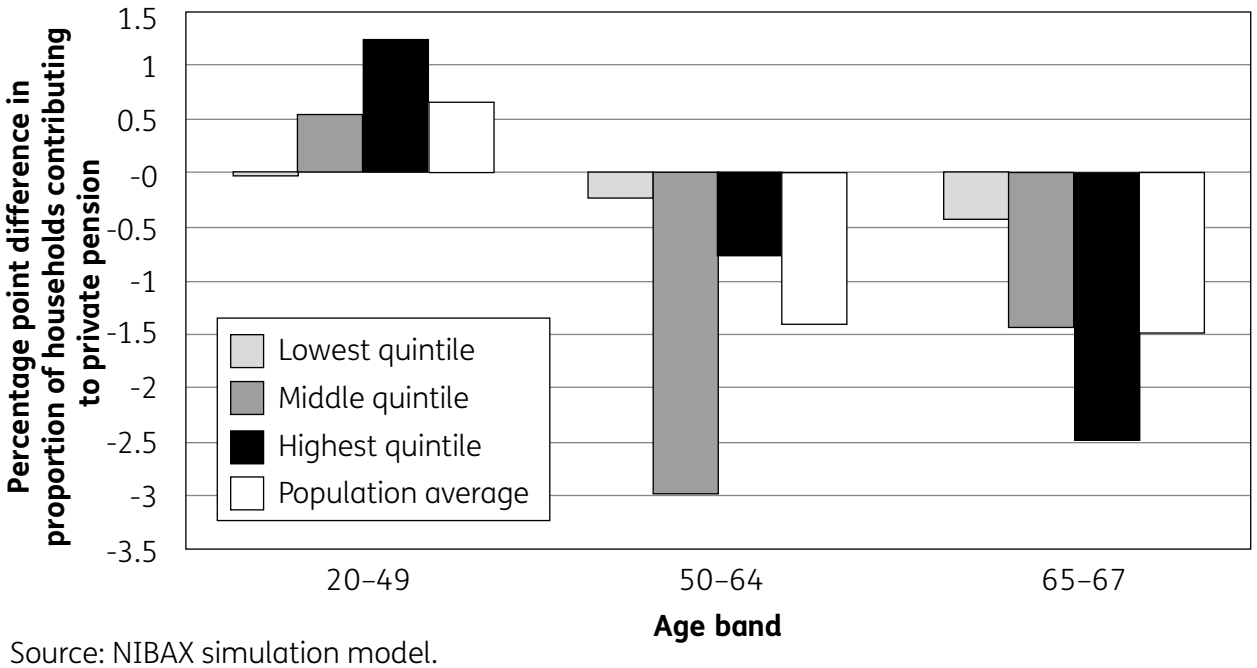
Thirdly, the simulations that are reported here suggest that all adults will be eligible to a full BSP in the long-run under reform scenario 1, as they will to the single-tier pension in reform scenario 2. In both simulation scenarios (1 and 2), no household is identified as receiving the Standard Minimum Guarantee in retirement. There are, however, good reasons why this is unlikely to be observed in practice. The simulation model does not reflect variation over health and disability that have an important influence on the benefits to which individuals may be entitled, it does not reflect imperfect rates of benefits take-up, nor is it suited to the consideration of extremely fragmented work-histories. Furthermore, the short-term implications of the respective policy reforms are influenced by the variable eligibility criteria that have applied to state pensions, which have notably limited the state pensions payable to elderly women in the UK. The single-tier State Pension is likely to substantively reduce reliance upon the Standard Minimum Guarantee in practice, particularly in the short-run, because its level is set above the Standard Minimum Guarantee. Taking people out of the Standard Minimum Guarantee is likely to improve associated savings incentives, which the current analysis fails to pick up.

Fourthly, the simulations assume that existing terms of uprating of state pensions would be maintained into the indefinite future. If the Government were, however, to alter the terms by which pensions were uprated, then this would have an important impact on income streams in retirement, which are crucial in determining associated savings incentives.

Fifth, abolishing contracting out would generate additional revenue to the exchequer via savings on the National Insurance rebate. This may give the Government some additional room for manoeuvre. The modelling that is reported here does not take such issues into account.

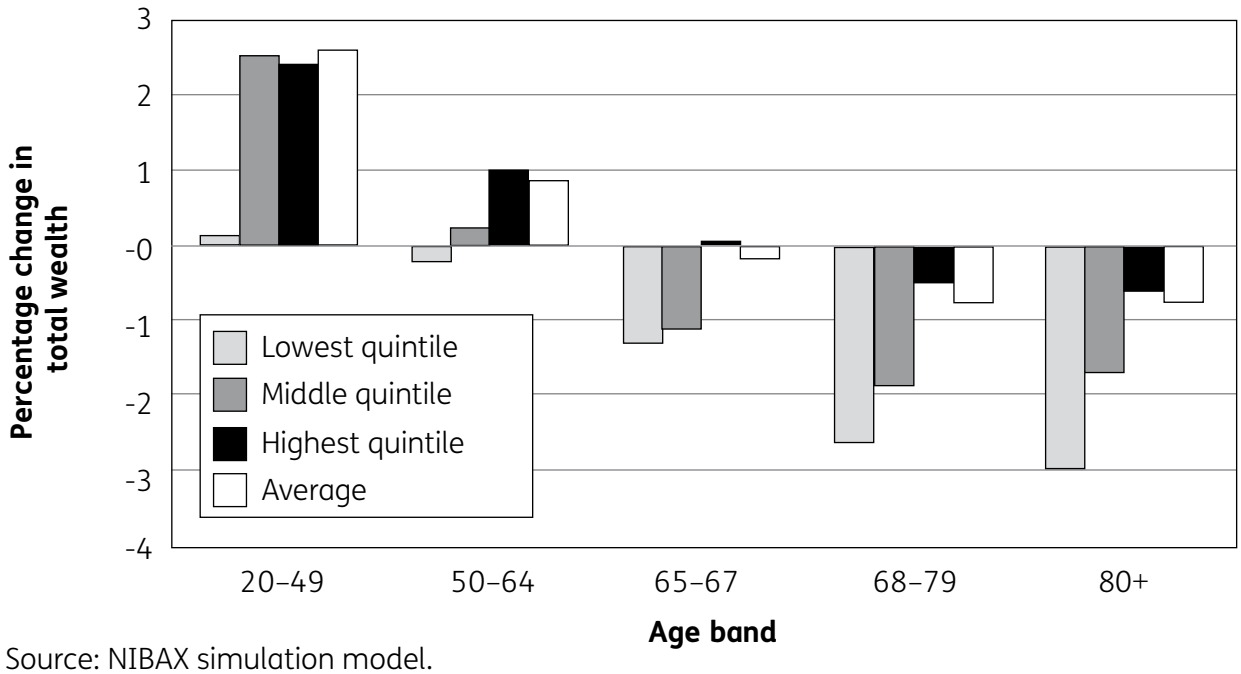
Lastly, individuals' employment decisions may not be driven by them knowing that they have worked enough years to claim the full State Pension when they reach State Pension age.

Figure 4.8 Pension participation reponses to replacing the two-tier flat-rated State Pension with a single-tier flat-rate State Pension when the State Pension age is 68, by age and lifetime income quintile



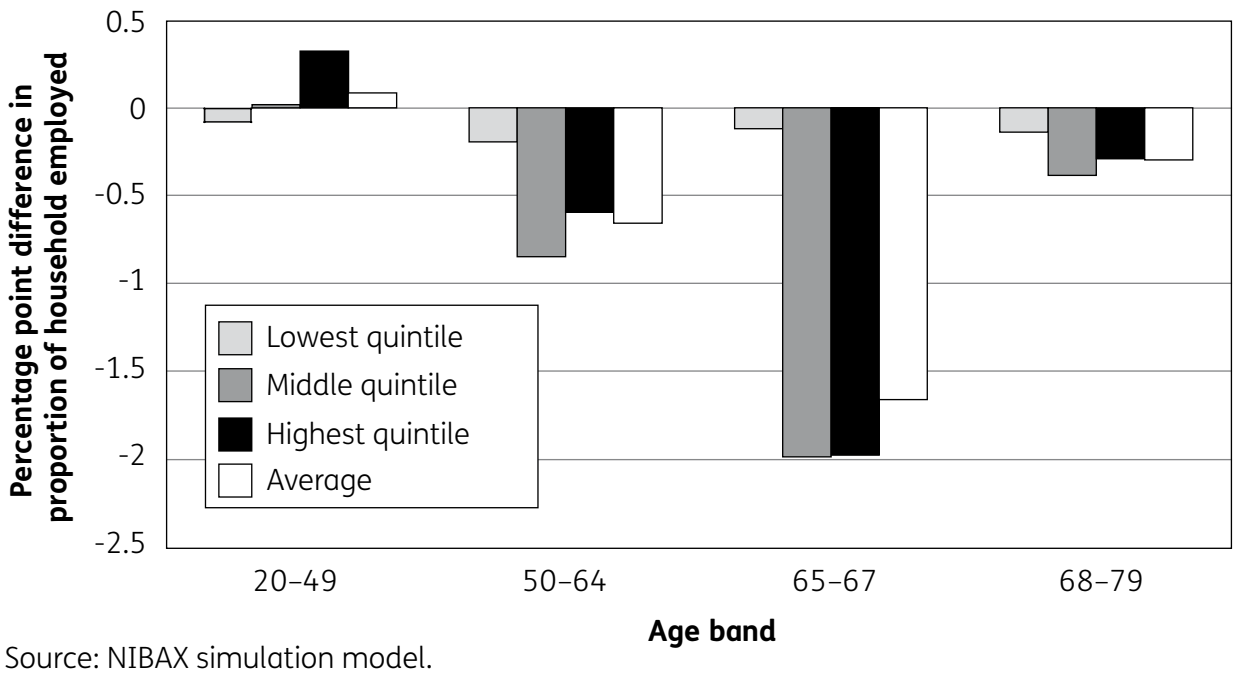
Source: NIBAX simulation model.
Notes: Long-run effects of replacing reform scenario 1 with reform scenario 2.

Figure 4.9 Savings reponses to replacing the two-tier flat-rated State Pension with a single-tier flat-rate State Pension when the State Pension age is 68, by age and lifetime income quintile



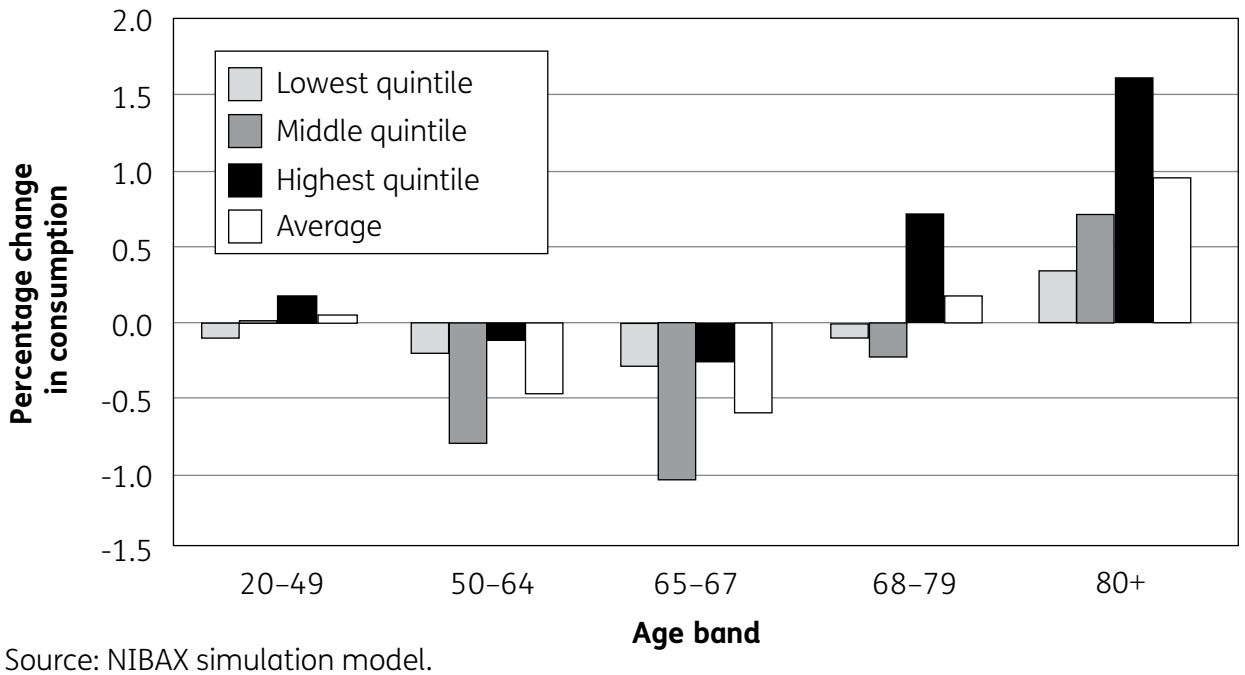
Source: NIBAX simulation model.
Notes: Long-run effects of replacing reform scenario 1 with reform scenario 2.

Figure 4.10 Employment reponses to replacing the two-tier flat-rated State Pension with a single-tier flat-rate State Pension when the State Pension age is 68, by age and lifetime income quintile



Source: NIBAX simulation model.
Notes: Long-run effects of replacing reform scenario 1 with reform scenario 2.

Figure 4.11 Consumption responses to replacing the two-tier flat-rated State Pension with a single-tier flat-rate State Pension when the State Pension age is 68, by age and lifetime income quintile



Source: NIBAX simulation model.
Notes: Long-run effects of replacing reform scenario 1 with reform scenario 2.

4.4 Sensitivity to present-biased preferences

The contemporary pension's debate has made significant reference to behavioural myopia as a motivation for state involvement in the retirement planning problem (e.g. Pensions Commission, 2005, pp. 68-69, Department for Work and Pensions, 2006, p. 31). One approach to reflect myopia that has been adopted in the economics literature is to redefine the preference function (see Section 2.1) so that a disproportionate weight is assigned to immediate consumption, relative to consumption in the future; otherwise referred to as a present-bias.

In the standard lifecycle model, upon which the analysis reported in Sections 4.1 to 4.3 is based, a constant rate of discounting is applied to consumption through time in evaluating lifetime welfare. Accommodating a present bias in the preference relation involves assuming that a higher rate of discounting applies to periods in the near-term. The NIBAX model is capable of exploring the implications of this alternative (non-standard) preference structure, as is discussed at length in van de Ven and Weale (2010).[19]

This section considers sensitivity of the analysis to present-biased preferences. This sensitivity analysis is conducted by increasing the rate of discounting associated with the first prospective period from four per cent per annum to 27 per cent per annum, and offsetting this increase by reducing the rate of discount for all other prospective periods from four per cent per annum to 1.7 per cent per annum. These adjustments are based upon previous empirical work that has matched the model to survey data (see van de Ven, 2011b).

19 To be specific, quasi-hyperbolic discounting is permitted within the NIBAX model.

Given the detailed analysis reported in Sections 4.2 to 4.3, this section reports the responses of the highest lifetime income quintile and the population average to reform scenario 1, relative to the current system (CS) scenario, under both time-consistent and present-biased preference parameters. Recall from Section 3 that this policy change involves both an increase in State Pension age from 65 to 68 and omission of the earnings-related component of the S2P.

The impact of a present-bias in preferences on responses in rates of pension participation to reform scenario 1 are reported in Figure 4.12. This figure indicates that the increase in pension participation rates associated with reform scenario 1 tend to increase throughout the income distribution when preferences are myopic. The largest effects are reported between ages 65 and 67, when pension participation rates increase by four percentage points on average under present-biased preferences, relative to time-consistent preferences, and by five percentage points among households in the top lifetime income quintile.

The observation that take-up rates increase more when preferences describe a present-bias may seem counter-intuitive. It is, however, a well-recognised behavioural phenomenon. The key to the result is that the population is assumed to be 'self-aware' in the sense that individuals take full account of the time-inconsistency of their preferences. This self-awareness generates demand for investment vehicles that enable myopic individuals to counter the effects of their present-bias; an individual who has a tendency to spend their savings prematurely may, for example, choose to lock their savings away in a term deposit, Christmas fund, or pension fund even if these do not offer high rates of effective returns, relative to more liquid investment alternatives.

The attendant impact that present-biased preferences have on total household wealth is reported in Figure 4.13. This figure indicates that the increase in savings simulated for reform scenario 1, relative to the CS scenario, is exaggerated under quasi-hyperbolic preferences throughout the simulated lifetime for households in the top lifetime income quintile. In contrast, the increase in wealth for households on average is lower under quasi-hyperbolic discounting prior to State Pension age (68), and is higher thereafter.

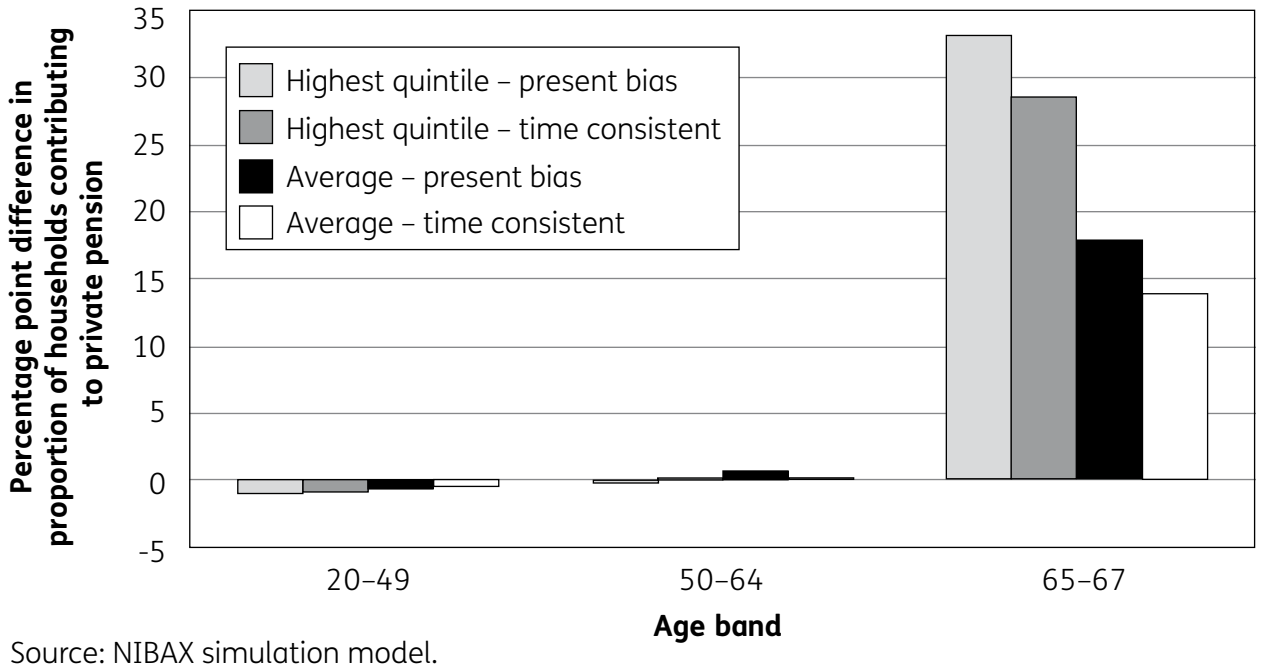
The variation observed in total household savings responses due to myopic preferences reflects the difficulty that myopic households have in maintaining balances of liquid wealth. The tendency of a myopic individual to spend their liquid savings prematurely can be offset by diverting savings into a pension fund, but this only provides partial relief in the analysis due to the desire to hold precautionary wealth balances and finance early retirement. The increased incentive to save through a pension fund tends to raise total household wealth (especially from State Pension age), and the bias toward the immediate consumption of liquid wealth tends to decrease total household wealth (especially prior to State Pension age). The second of these two considerations dominates for households on average prior to State Pension age, and the latter dominates for households in the top lifetime income quintile.

Figure 4.14 displays the impact of present-biased preferences on simulated rates of employment. This figure indicates that present biased preferences tend to have the most pronounced influence on behavioural responses generated for reform scenario 1, relative to the CS scenario, in the age band between the old and new State Pension ages (65-67). The assumption of myopic preferences tends to exaggerate the increase in employment that is generated between ages 65 and 67 under reform scenario 1, relative to the CS scenario, by nine percentage points for the simulated population on average, and by five percentage points amongst households in the top income quintile. The reasoning behind this result is highly intuitive: when preferences exhibit a present-bias, the temptation to spend savings prematurely makes it difficult for households to accumulate the balances of liquid wealth that are necessary to offset the reduction in state benefits that are

consequent on an increase in State Pension age. Hence, myopia tends to increase the extent to which a rise in State Pension age leads to a delay in the timing of retirement, a tendency that weakens with lifetime income.

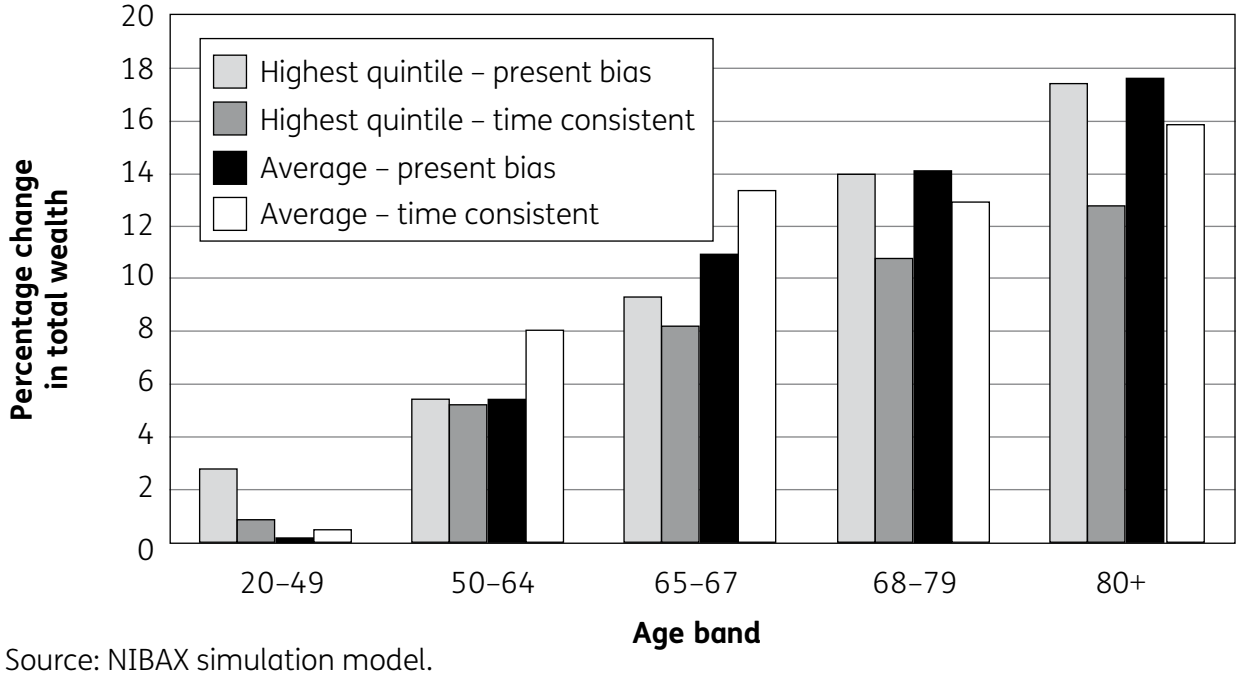
Figure 4.15 indicates that the present-biased preferences also tend to exaggerate simulated effects of reform scenario 1 on household consumption. As in the case of employment, the most significant responses are reported for the period between ages 65 and 67, the gap between the old and new State Pension ages.

Figure 4.12 Pension participation reponses to increasing the State Pension age from 65 to 68 and omitting the earnings-related component of the State Second Pension, by age, lifetime income quintile and preference relation



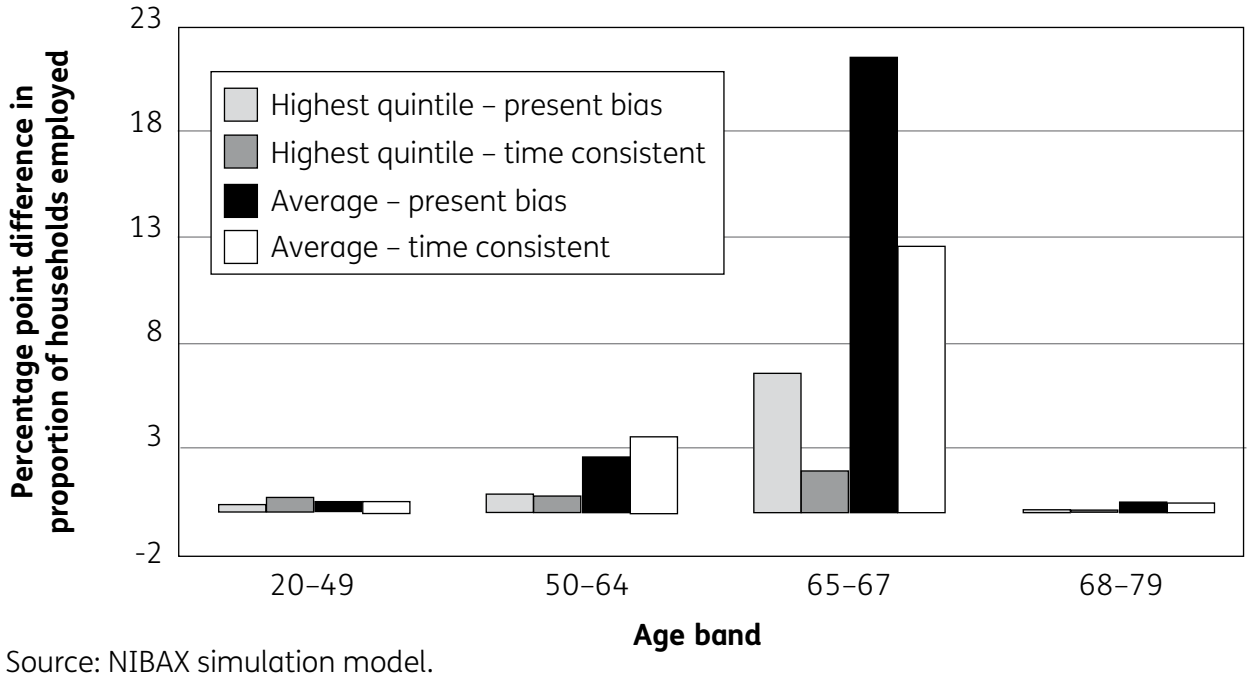
Source: NIBAX simulation model.
Notes: Long-run effects of reform scenario 1, relative to the CS policy scenario.

Figure 4.13 Savings responses to increasing the State Pension age from 65 to 68 and omitting the earnings-related component of the State Second Pension, by age, lifetime income quintile and preference relation



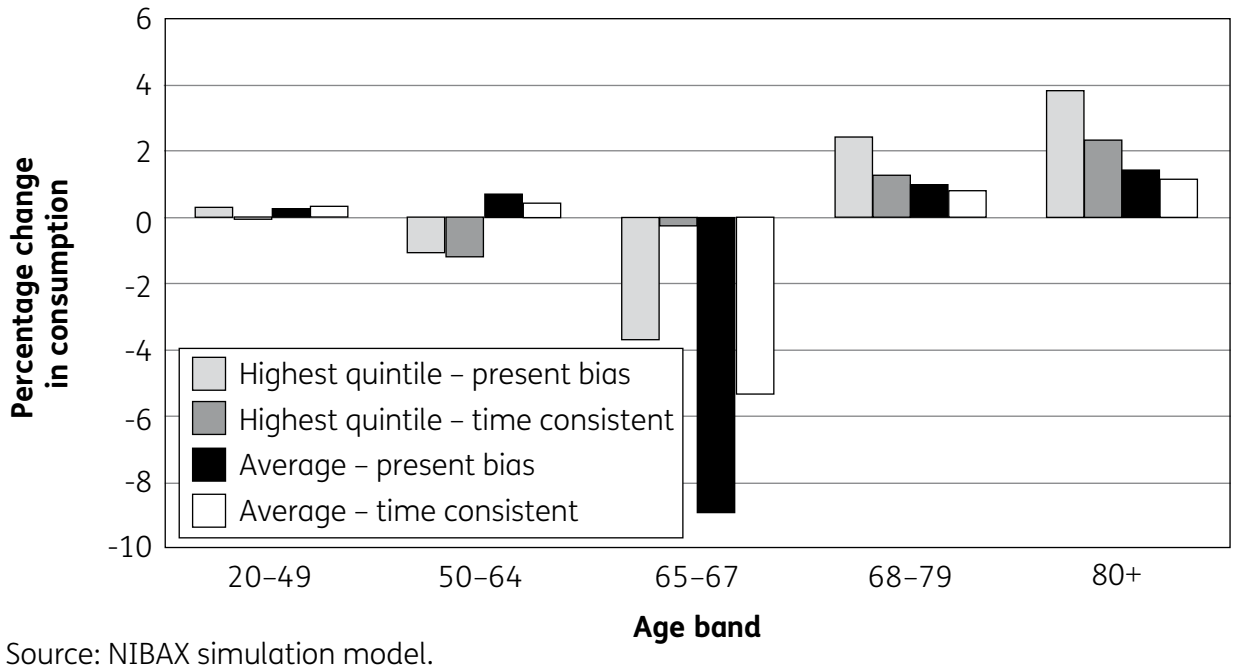
Source: NIBAX simulation model.
Notes: Long-run effects of reform scenario 1, relative to the CS policy scenario.

Figure 4.14 Employment responses to increasing the State Pension age from 65 to 68 and omitting the earnings-related component of the State Second Pension, by age, lifetime income quintile and preference relation



Source: NIBAX simulation model.
Notes: Long-run effects of reform scenario 1, relative to the CS policy scenario.

Figure 4.15 Consumption responses to increasing the State Pension age from 65 to 68 and omitting the earnings-related component of the State Second Pension, by age, lifetime income quintile and preference relation



Source: NIBAX simulation model.
Notes: Long-run effects of reform scenario 1, relative to the CS policy scenario.

5 Conclusions

The contemporary pensions debate in the UK has been much concerned with the perceived advantages associated with simplifying the existing system of state-sponsored retirement provisions. This study takes a somewhat different tack, focusing upon the implications for employment and savings incentives of recent proposals for pension's reform, on the assumption that the reforms and their counterfactuals are themselves well understood and people respond to them in a rational manner.

Two principal policy scenarios based on those set out in the consultation paper DWP (2011) are considered for analysis. These scenarios are interesting, not only because they are based on policy options that are currently under active consideration by the UK government, but also because the terms of the reforms incorporate many of the innovations that have featured prominently in contemporary policy debate. In this paper, I consider implications of the respective reforms using current best practice in the economic analysis of individual decision making.

The analysis that is presented highlights the extent to which incentives are context-specific, showing substantial variation both over the lifecourse and the income distribution. The results also stress the complexity and interconnectedness of the various factors that bear upon household saving and work incentives. Two broad observations are highlighted by the analysis.

First, labour supply incentives are likely to be jointly determined with savings, so that it is unwise to consider the one without the other. In the context of the planned rise in the State Pension age, for example, the analysis suggests that the impact of the policy change is likely to result in both higher household savings prior to the initial State Pension age and an increased duration of life spent in employment. Importantly, however, the increased savings that households are projected to engage in allows them to offset much of the rise in State Pension age against their duration in employment.

Secondly, employment incentives later in life are likely to play a crucial role in determining the long-term effects of pension policy alternatives. The current analysis emphasises the importance of both the wages that older people can earn, and the extent of present-bias in people's preferences for consumption. Regarding the latter of these characteristics, the analysis reveals that a present bias in consumption tends to limit individual's ability to use adjustments to liquid wealth to offset policy changes, placing greater emphasis on other aspects of decision making (such as the timing of retirement). Notably, both the wages that older people can earn and individual preferences are unobservable, which emphasises the uncertainties to which associated behavioural projections are necessarily subject.

Appendix A Technical details of the NIBAX model

A.1 Assumed preference structure

The model generates behaviour by identifying decisions that maximise expected lifetime utility, as described by the utility function:

$$V_t = \frac{1}{1-\gamma}\left\{u\left(\frac{c_t}{\theta_t}, l_t\right)^{1-\gamma} + E_t\left[\beta\sum_{i=t+1}^{T}\delta^{i-t}\left(\phi_{i,t}u\left(\frac{c_i}{\theta_i}, l_i\right)^{1-\gamma} + \left(1-\phi_{i,t}\right)\left(z_0 + z_1 w_i^{+}\right)^{1-\gamma}\right)\right]\right\} \quad \text{(1a)}$$

$$u\left(\frac{c_t}{\theta_t}, l_t\right) = \left[\left(\frac{c_t}{\theta_t}\right)^{1-1/\varepsilon} + \alpha^{1/\varepsilon} l_t^{\,1-1/\varepsilon}\right]^{\frac{1}{1-1/\varepsilon}} \quad \text{(1b)} \quad \text{(1b)}$$

where $\gamma > 0$ is the intertemporal iso-elastic parameter; E_t is the expectations operator (at time t); T is the maximum potential age; β and δ are discount factors (assumed to be the same for all households); $\varphi_{i,t}$ is the probability of living to age i, given survival to age t; $c_t \in R^+$ is discretionary composite consumption; $l_t \in [0,1]$ is the proportion of household time spent in leisure; $\vartheta_t \in R^+$ is adult equivalent size based on the 'revised' or 'modified' OECD scale; the parameters z_0 and z_1 reflect the 'warm-glow' model of bequests; and $w_t^+ \in R^+$ is net liquid wealth when this is positive and zero otherwise. $\alpha > 0$ is the (period specific) elasticity of substitution between equivalised consumption (c_t/ϑ_t) and leisure (l_t). The constant $\alpha > 0$ is referred to as the utility price of leisure.

If $\beta = 1$ then preferences are time consistent, subject to the constant exponential discount factor δ. If $\beta < 1$, then the preferences exhibiting a present-bias, which is sometimes referred to as myopia in the economic literature. To highlight the distinction between time consistent and time inconsistent preferences, note that with $\beta = 1$ we can re-write equation (1a) as:

$$V_t = \frac{1}{1-1/\gamma}u\left(\frac{c_t}{\theta_t}, l_t\right)^{1-1/\gamma} + \delta\phi_{t+1,t}E_t\left[V_{t+1}\right]$$

But if $\beta \neq 1$, then:

$$V_t = \frac{1}{1-1/\gamma}u\left(\frac{c_t}{\theta_t}, l_t\right)^{1-1/\gamma} + \beta\delta\phi_{t+1,t}E_t\left[W_{t+1}\right]$$

$$W_t = \frac{1}{1-1/\gamma}u\left(\frac{c_t}{\theta_t}, l_t\right)^{1-1/\gamma} + \delta\phi_{t+1,t}E_t\left[W_{t+1}\right]$$

and $W_t \neq V_t$. Recursive solution of the optimisation problem when $\beta \neq 1$ consequently requires W_t to be separately calculated and stored by the model: storing both V_t and W_t then permits evaluation of the full set of utility prices that are implied by quasi-hyperbolic preferences.

A.2 Model specification

The model specifics upon which the analysis is based accounts for household heterogeneity over the following dimensions:

Household characteristics:

- Age
- Relationship status (uncertain)
  - Number of children (a deterministic function of age and relationship status)
- Wage offer (uncertain)
- Wage rates (where a wage offer is received, uncertain)
- Liquid wealth (deterministic)
- Private pension wealth (deterministic)
- Eligibility to one of three private pensions, distinguished by employee and employer contribution rates, and whether contracted out of State Second Pension (uncertain)
- Contribution history in respect of the basic State Pension or single-tier flat-rate pension, depending on policy scenario (deterministic)
- Time of death

Household decisions:

- Consumption/saving in liquid wealth
- Labour supply
- Participation in private pensions

A detailed (technical) description of each of the terms listed above is provided in van de Ven (2011); see also van de Ven and Weale (2009) for a non-technical discussion. As discussed in Section 3.1, the analysis reported in this study involved amending the model described in van de Ven (2011) to make explicit allowance for the basic State Pension and the State Second Pension – see Section 3.1 for details regarding these.

A.3 Model calibration

The parameters of NIBAX were calibrated to match age-specific moments of a population generated by the model to the associated moments estimated from survey data. A detailed discussion of the various issues involved in calibrating the model is provided in van de Ven (2011). This section gives a brief account, focusing on the match obtained between the model and survey data.

WARNING: The time constraint to which this analysis was subject meant that it was impossible to undertake a through calibration of all model parameters. The values of two parameters were consequently assumed from earlier work: the intertemporal iso-elastic parameter, γ, and the intra-temporal elasticity, ε. These parameters tend to have an important influence on the distributional properties of population cohorts that are simulated by the model, as opposed to the population averages against which the remainder of the model parameters were calibrated (discussed below).

As such, some of the distributional implications of the model reported here should be treated with caution.

The specification of the model that was used to calibrate the parameters – as set out briefly in Section A.2 – imposes both hard and soft constraints on credit, includes uncertainty over relationship status, includes the possibility of a low wage offer (allowing for involuntary unemployment), allows households to choose their labour supply from up to five alternative options, and includes decisions to participate in private pensions. Importantly, risky assets were omitted from this model specification to reduce computation times.

The data used to calibrate the model are principally drawn from the 2009 wave of the Living Costs and Food Survey (LCFS), adjusting all monetary statistics to reflect real wage growth of 1.5 per cent per annum. The tax and benefits structure between ages 20 and 64 was specified to reflect Department for Work and Pensions' Tax Benefit Model Tables from June 2010. Similarly, the tax structure from age 65 was specified to reflect income taxes, the basic State Pension, the State Second Pension, the Pension Credit, Housing Benefit and Council Tax Benefit as they stood in 2010/11 (as discussed in Section 3.1).

The mortality rates that were imposed are calculated from the cohort expectations of life published by the Office for National Statistics (ONS). These data were used to calculate the age-specific probabilities of survival for a couple, where both members of the couple were aged 20 in 2007, and take into account official expectations regarding the prospective evolution of mortality rates.

With regard to credit, households under age 65 are considered to be able to borrow any sum, subject to the condition that debt is repaid in full by age 65. In context of income uncertainty and risk aversion, this imposes a hard liquidity constraint defined in terms of the minimum potential income stream. The (real) variable interest charged on unsecured loans was set to vary between 11.5 per cent and 19.8 per cent per annum, based upon historical data on the charges levied on personal loans and credit cards reported by the Bank of England. These compare with 2.7 per cent per annum that was assumed to accrue to positive balances of liquid wealth, and 4 per cent per annum on pension wealth.

The logit model that is assumed to govern relationship transitions was estimated on pooled data from waves 1 to 17 of the British Household Panel Survey, and the specification of private pensions was structured to broadly reflect commonly available private pension schemes, as described by Forth and Stokes (2008); see also van de Ven and George (2011).

The match obtained between the model and survey data is reported in Figures A.1 to A.4, which suggest that the model does a good job of reflecting the associated survey data. Starting with Figure A.1, the two panels of the figure indicate that the model does a good job of capturing employment rates throughout the working lifetime. Importantly for the current analysis, this includes the timing of departure from the workforce. The match obtained here is facilitated by the allowance that the model makes for experience effects of employment, which permit a match to be obtained early in the working lifetime when employment rates tend to be high and wages tend to be low, relative to later in life.

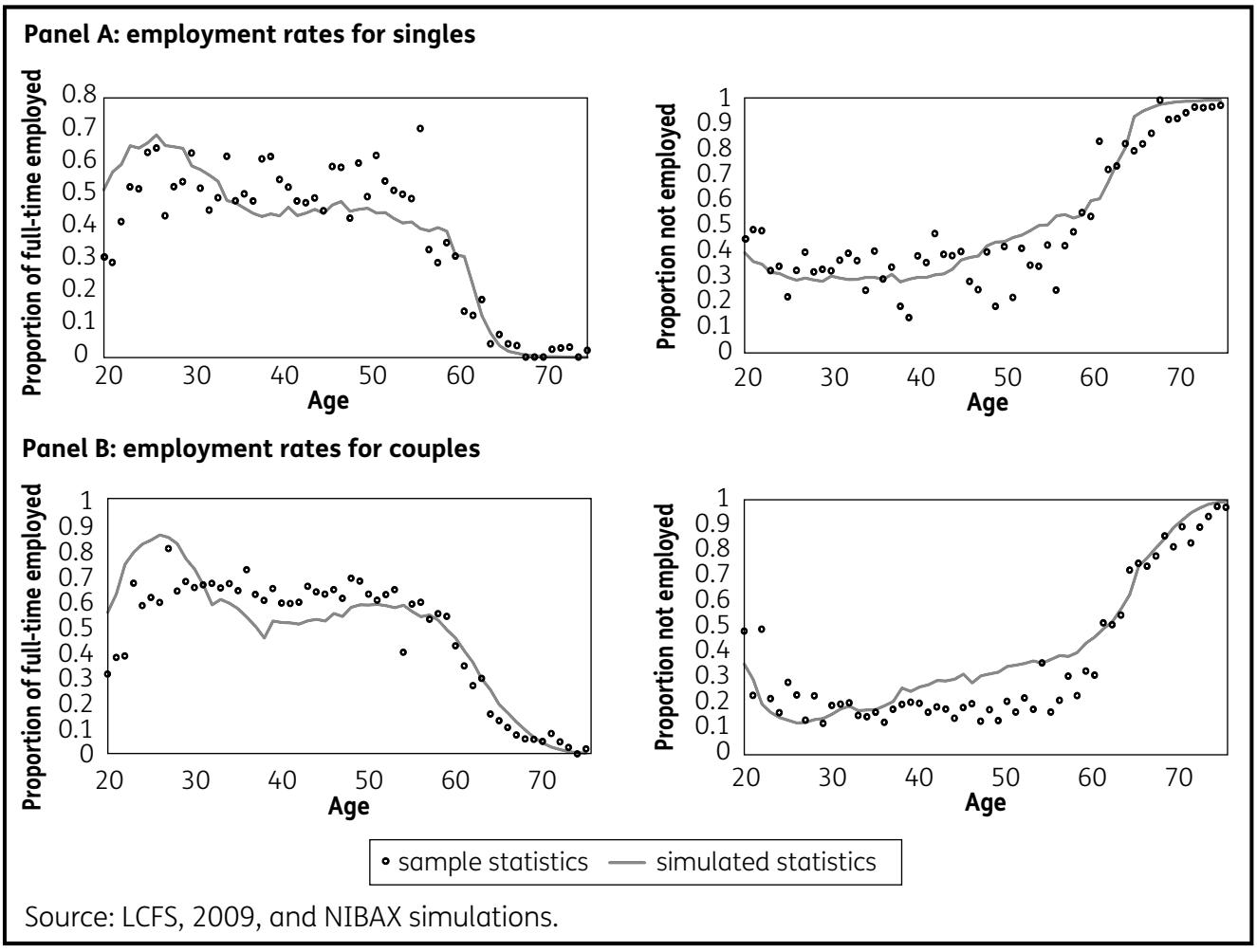
Figures A.2 and A.3 reveal that the model does a good job of capturing the humped shape profile that is evident for geometric means of income in survey data. This fact on its own is of little surprise, given that the model includes a full set of dummies that determine the age profile of employment income. What is more interesting is that a decent match is obtained to both private and disposable income, particularly for couples. As the difference (wedge) between these two is predominantly attributable to taxes and benefits, Figures A.2 and A.3 taken together suggest that NIBAX obtains

a reasonable approximation to the tax and benefits structure applied in the UK. Nevertheless, it is of note that it was not possible to match the respective variances of both measures of income simultaneously. The calibration consequently focused upon matching to the variance of disposable household income, as this can be expected to have a more immediate bearing on consumption decisions.

Similarly, the consumption moments that are reported in Figure A.4 reveal that the model obtains a close match to the geometric means observed for singles and couples, and to a slightly lesser extent the associated variances also.

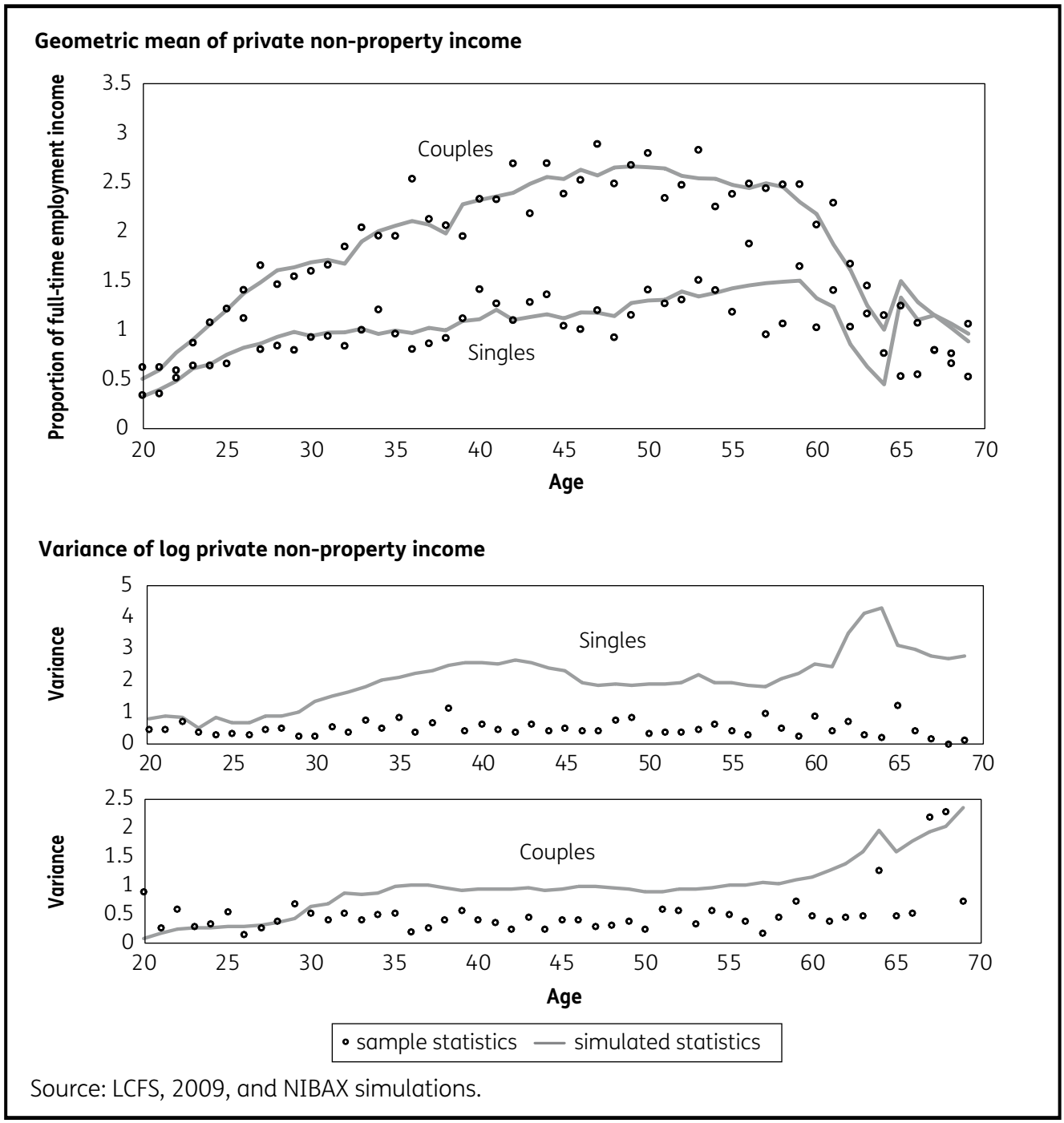
A further aspect of concern, given the current focus upon pension saving, was the proportion of pension participants identified for the three types of personal pensions considered for analysis. This aspect of the calibration was complicated by the fact that contemporary survey data fail to reflect the declining importance of DB pensions that is anticipated for the medium to longer term. Following detailed consultation, the parameters of the model were adjusted so that participation in the respective pension schemes matched the following proportions: 31 per cent in private pensions (pension scheme 1 in Table 3.3), 47 per cent in Defined Contribution occupational pensions (pension scheme 2 in Table 3.3), and 22 per cent in Defined Benefit occupational pensions (pension scheme 3 in Table 3.3).

Figure A.1 Employment rates by age and relationship status



Source: LCFS, 2009, and NIBAX simulations.

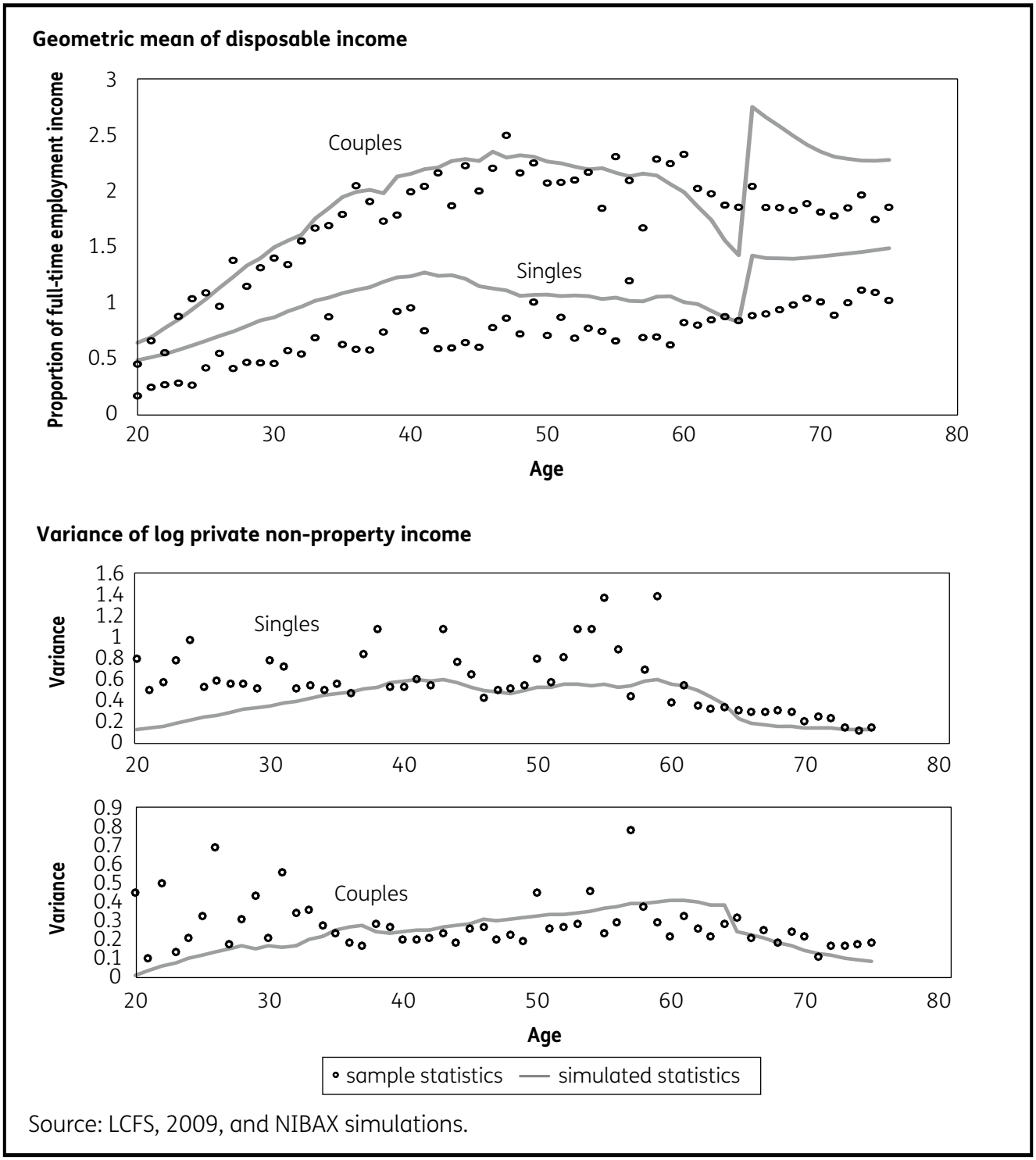
Figure A.2 Moments of private non-property income by age and relationship status[20]



Source: LCFS, 2009, and NIBAX simulations.

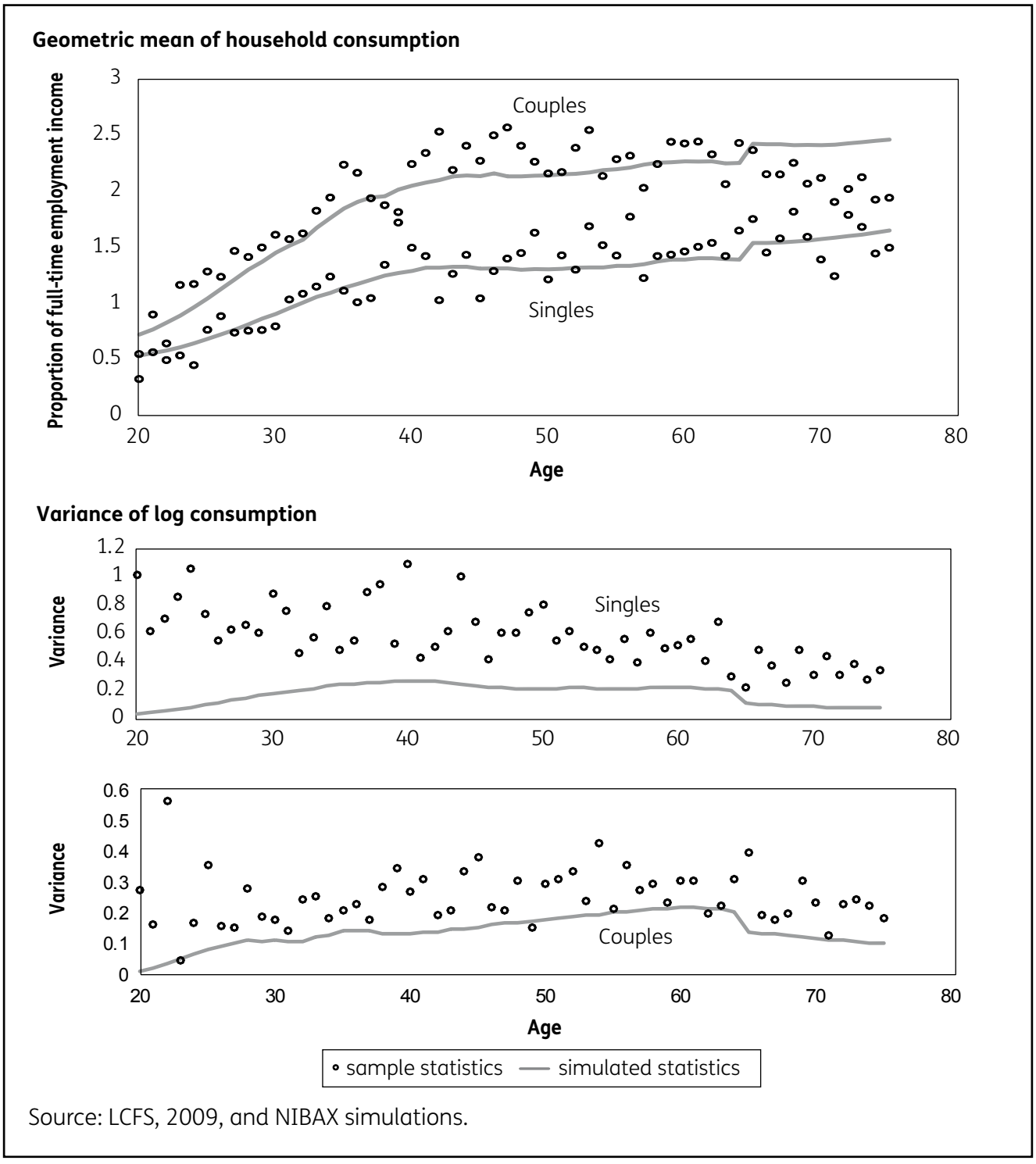
[20] The analysis assumes that households retire at State Pension age, but in reality there is a distribution around this.

Figure A.3 Moments of disposable income by age and relationship status



Source: LCFS, 2009, and NIBAX simulations.

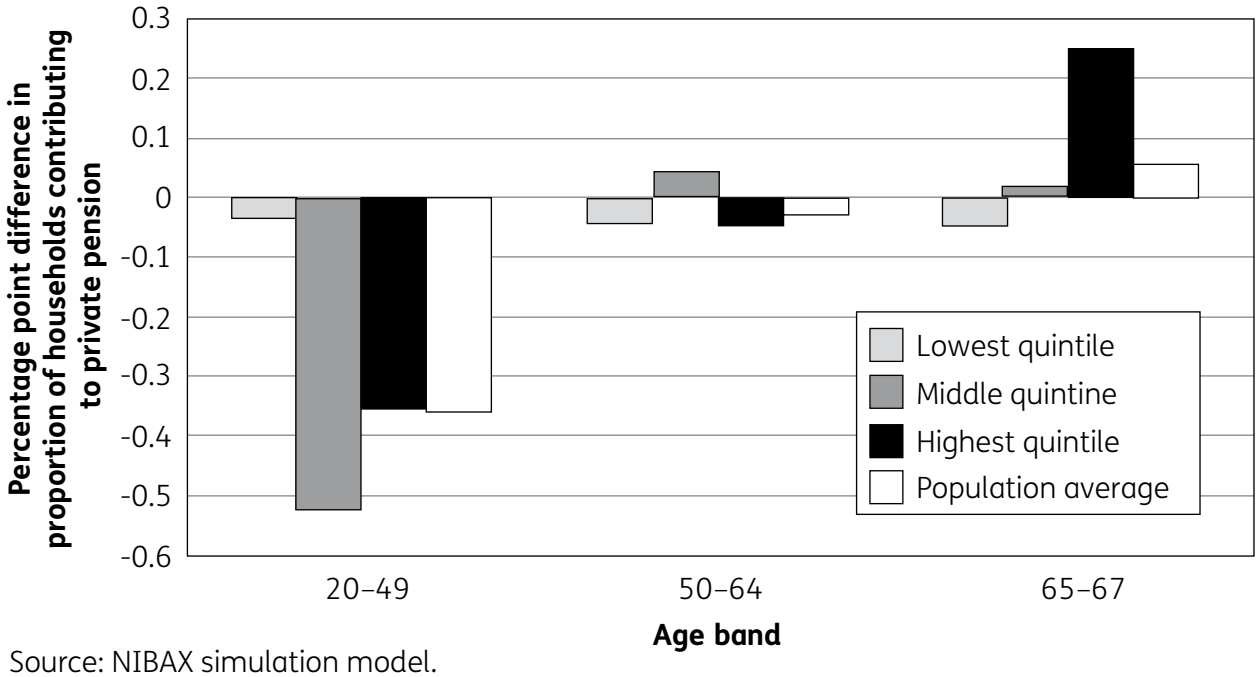
Figure A.4 Moments of consumption by age and relationship status



Source: LCFS, 2009, and NIBAX simulations.

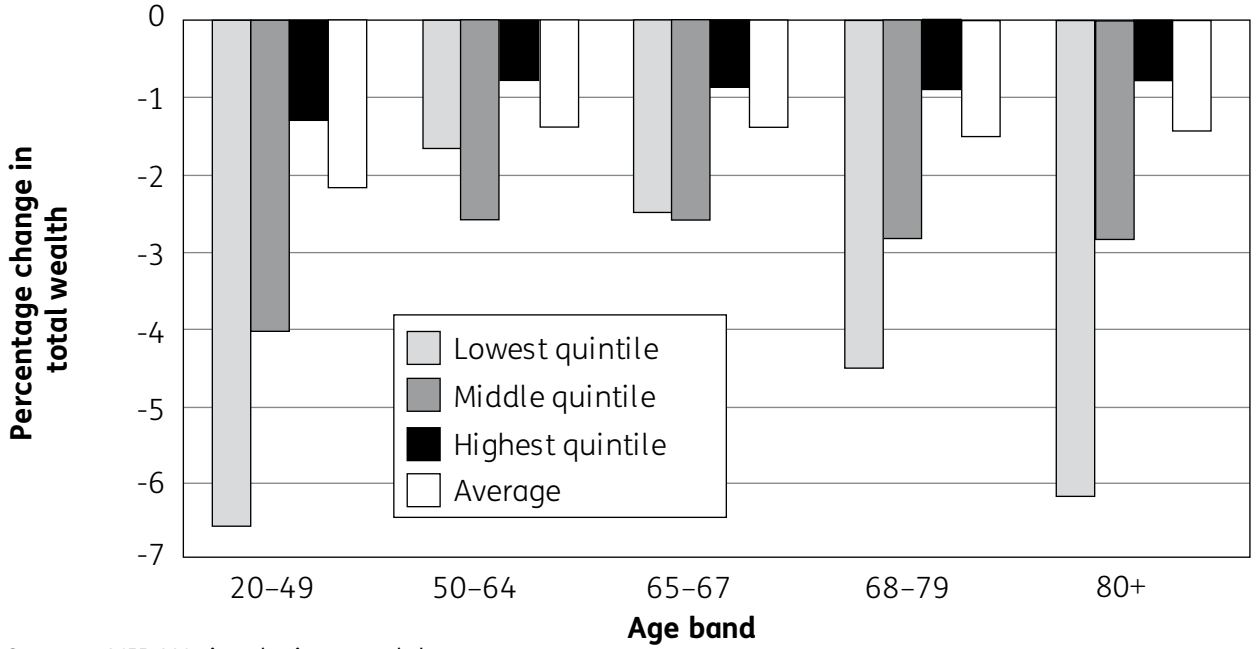
Appendix B Supplementary simulation statistics

Figure B.1 Pension participation responses to withdrawal of contracting out of Defined Benefit occupational pensions, by age and lifetime income quintile



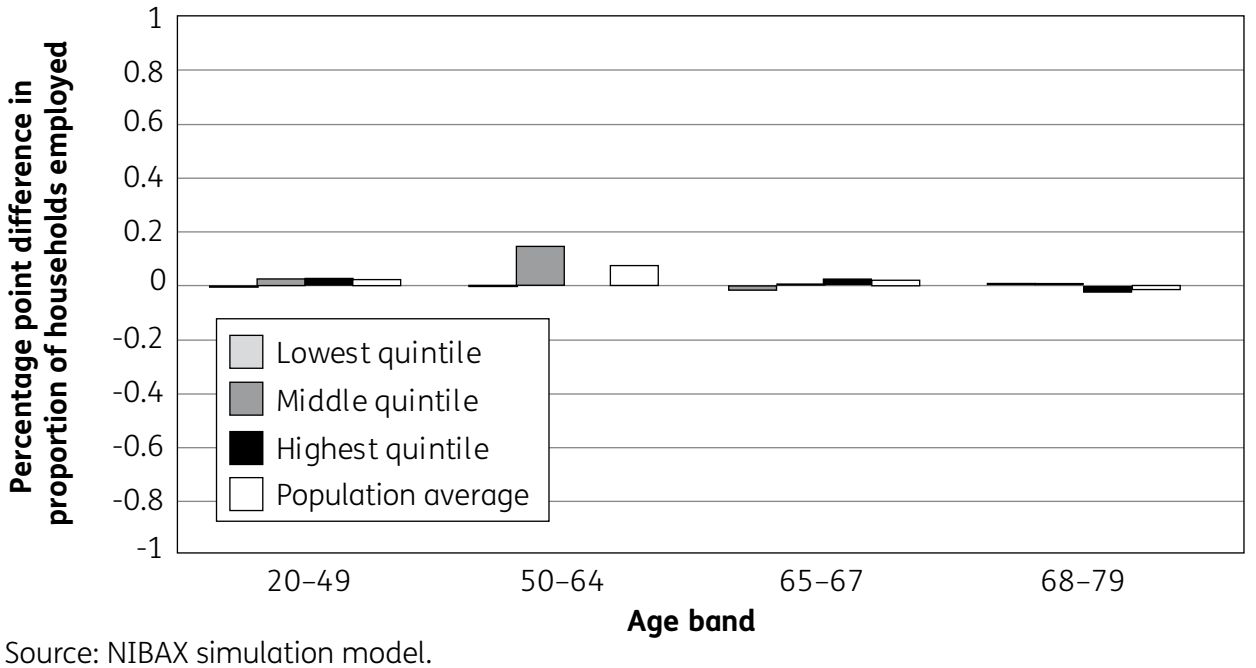
Source: NIBAX simulation model.
Notes: Long-run effects of altering reform scenario 1 to omit contracting out of the S2P.

Figure B.2 Savings responses to withdrawal of contracting out of Defined Benefit occupational pensions, by age and lifetime income quintile



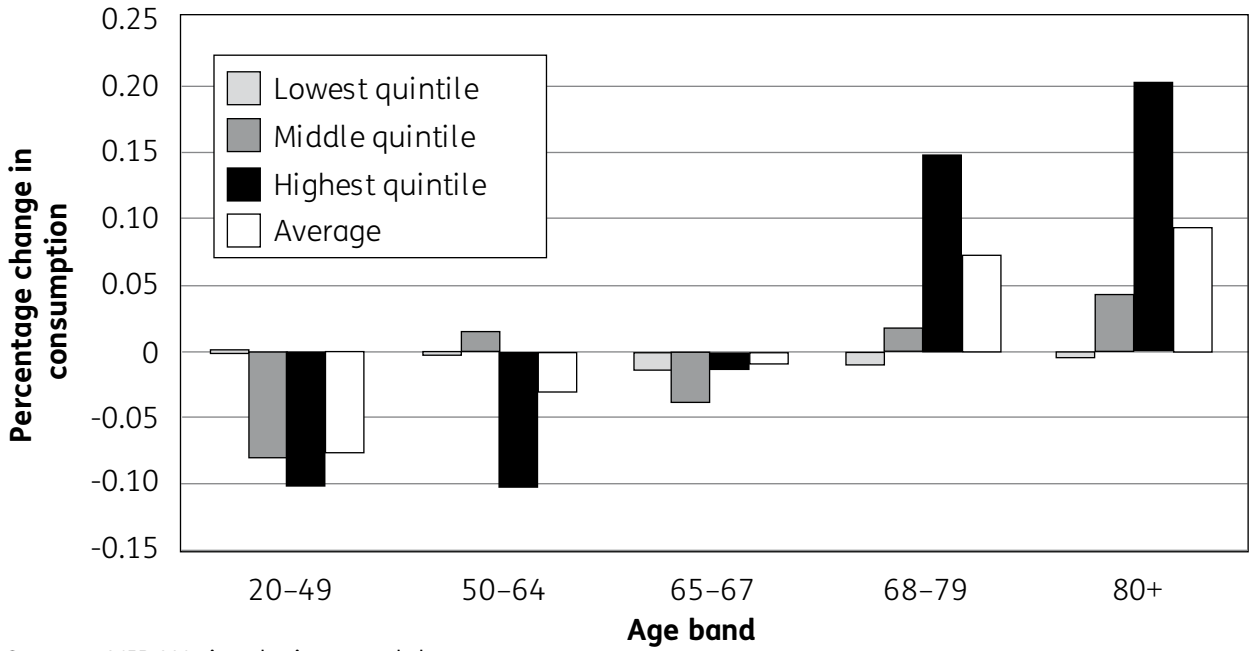
Source: NIBAX simulation model.
Notes: Long-run effects of altering reform scenario 1 to omit contracting out of the S2P.

Figure B.3 Employment responses to withdrawal of contracting out of Defined Benefit occupational pensions, by age and lifetime income quintile



Source: NIBAX simulation model.
Notes: Long-run effects of altering reform scenario 1 to omit contracting out of the S2P.

Figure B.4 Consumption responses to withdrawal of contracting out of Defined Benefit occupational pensions, by age and lifetime income quintile



Source: NIBAX simulation model.
Notes: Long-run effects of altering reform scenario 1 to omit contracting out of the S2P.

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In June 2011, the Department for Work and Pensions (DWP) commissioned the National Institute for Economic and Social Research to estimate the behavioural impact of:

- Raising the State Pension age (SP) from 65 to 68.
- A flat-rated State Second Pension scenario compared to the earnings-related system as it stood in 2011/12.
- A single-tier scenario (similar to that set out in the Green Paper consultation document, A State Pension for the 21st Century) compared to a flat-rated scenario.

Assumptions for the single-tier scenario were based on the policy proposal set out in the Green Paper consultation document, A State Pension for the 21st Century, which can be found at: http://www.dwp.gov.uk/docs/state-pension-21st-century.pdf. Since this, the Department has made changes to the proposed policy set out in the White Paper publication, The single-tier pension: a simple foundation for saving, which can be found at: http://www.dwp.gov.uk/docs/single-tier-pension.pdf

This report sets out some key results from the analysis, adding to the existing evidence base on behavioural change.

If you would like to know more about DWP research, please email: Socialresearch@dwp.gsi.gov.uk

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