National Institute of Economic and Social Research

IS AN ENGLISHMAN'S HOME HIS PENSION?

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FOREWORD

Purpose

In December 2016, Chancellor Philip Hammond highlighted the productivity challenge facing the UK, telling the Treasury Select Committee that, "We have some structural issues around saving in the UK, some of them specific to the UK - the structure of pension saving, the extraordinary role that housing wealth plays in the overall calculation of UK households. We do need to look at the interaction between the desire to save in the most effective way – and historically for many people that has been through housing – and the needs of the economy around accessing pools of savings. That is a productivity challenge for us."[1]

This is why the ABI commissioned the National Institute of Economic and Social Research to explore the economic relationships between housing and long-term savings. The research considers whether buying houses may reduce other forms of long-term savings, which may in part explain the UK's relatively low investment rate and weaker productivity performance in comparison with other OECD countries. The work also models the implications of a different composition of private investment across the economy.

Our aim in doing this work is to continue to encourage a more holistic debate on housing and long-term savings, to help ensure good retirement outcomes during increasingly uncertain economic circumstances.

Policy Context

The link between housing wealth and long-term savings is an under-explored area, but has important implications for retirement experiences, equality within and between generations, and the overall health of the UK economy. Economic and demographic changes over the last decade have increased the pressure on housing supply and on household finances in both the short and long-term. This is especially the case for younger savers, as the numbers and membership of defined benefit pension schemes, levels of home ownership and the savings ratio have all declined.

At the start of 2017, the value of the UK's housing stock soared to a record £6.8tn, worth 3.7 times GDP,[2] compared to 1.6 times of GDP in 2001.[3] This housing wealth is concentrated in the older generations, with the over 65s holding 43% of all equity held by owner occupiers, while the under

[1] The Telegraph (2016) "Put less money into housing and more into saving, says Phillip Hammond". http://www.telegraph.co.uk/business/2016/12/17/put-less-money-housing-saving-says-philip-hammond/.
[2] Savills (2017) "UK homes worth a record £6.8 trillion as private housing wealth exceeds £5 trillion". http://www.savills.co.uk/_news/article/72418/213407-0/1/2017/uk-homes-worth-a-record-%C2%A36.8-trillion-as-private-housing-wealth-exceeds-%C2%A35-trillion
[3] Financial Times (2017) "UK housing stock value soars to a record £6.8tn". https://www.ft.com/content/4906a246-dcb7-11e6-86ac-f253db7791c6

35s have just 5% of that equity pot.[4] This concentration of housing wealth has increased, with just over four in 10 households headed by someone aged 30 owning a home, compared to six in 10 households 25 years ago. Baby boomers at age 30 were 50% more likely to own their own home than millennials at the same age.[5,6]

In the last decade, a number of policy changes sought to address concerns about the unaffordability of purchasing a home, such as the Government's Help to Buy scheme and tax changes on Buy-to-let mortgages. The relationship between home ownership and retirement outcomes are also being explored in the FCA's work on the mortgage market and on ageing. Meanwhile, it is widely accepted that the New State Pension and minimum contributions from automatic enrolment alone will not be enough to meet most people's income expectations or needs in retirement.

Additionally, it is possible that the UK's high house prices, combined with a shrinking construction industry and greater restrictions on mortgage lending will continue to inflate costs in the private rental market. This in turn would leave young people with even less disposable income to put into long-term savings.

The ABI wants to avoid a false dichotomy that younger savers must choose between a home and a pension. But it is also important to recognise the trade-offs for individuals, policy-makers and the economy. This research explores and quantifies some of these trade-offs.

Implications

The economic relationships between housing and long-term savings deserve further exploration, even while the long-term impact of leaving the EU on the housing market and long-term savings is unknown. However, it has been speculated that the growth of housing stock value is likely to slow.[7]

Examples of outstanding policy challenges in this space include: re-examining the allocation of incentives to save for both a home and retirement; the impact of pension flexibilities on benefits eligibility in retirement; and income sources to fund later life care.

This research does not recommend any specific policy changes, as we have not assessed how a different balance of investments might be achieved, nor have we fully explored the potential consequences of such changes. This would require additional work with behavioural models. But it is clear that policy decisions about housing and long-term savings need to be holistic and not taken in isolation – just as an individual's decision about savings and retirement should take account of their overall financial circumstances.

[4] Savills (2017) "UK homes worth a record £6.8 trillion as private housing wealth exceeds £5 trillion".
[5] Laura Gardiner (2016) "Stagnation Generation: The case for renewing the intergenerational contract". *Resolution Foundation*. Section 4: Household Wealth. Figure 12, p. 33. http://www.resolutionfoundation.org/app/uploads/2016/06/Intergenerational-commission-launch-report.pdf
[6] Financial Times (2017) "UK housing stock value soars to a record £6.8tn".
[7] Financial Times (2017) "UK housing stock value soars to a record £6.8tn".

IS AN ENGLISHMAN'S HOME HIS PENSION? EXECUTIVE SUMMARY[8]

Angus Armstrong[9], Monique Ebell[10] and James Warren

This research project considers whether buying houses may reduce long-term savings in the UK economy. This may explain the UK's relatively low investment rate and weaker productivity performance over the long term. The study has two parts. First, we present new evidence on the saving behaviour of UK households showing that buying a house with a mortgage results in a lower saving rate, which is likely to mean less pension savings. Second, we examine the consequences for the UK of shifting the allocation of saving from housing and towards business investment.

For an individual, buying a house is a form of long-term saving. We forgo consumption today at the expense of acquiring a house, which provides us with shelter and comfort over the long term. A fairly fixed housing stock and relatively generous public policies have contributed to houses being one of the best performing large asset classes over the last twenty years, even before generous tax treatment is taken into account.[11] Home ownership is supported by public policies such as lack of capital gains tax on the primary residence, exemption from means testing assessments, more generous inheritance thresholds and even subsidies for acquiring houses. This may encourage some individuals to see their home as a form of pension asset, at the expense of lower long-term savings in real economy assets.

While an individual may feel wealthier as their home rises in value, for the country as a whole this may not constitute an increase in wealth. Buiter (2008) shows how house price inflation improves the position of an individual, but in aggregate this is redistribution across generations rather than an increase in national wealth. While house price inflation benefits households who already own a home, as their wealth increases, it harms non-homeowning households, who must pay higher rents to consume the same rental housing and/or pay a higher price to own the same house in the future. This suggests that allocating our savings towards houses only redistributes wealth rather than adding to the productive stock of the economy, which may lead to lower long term standards of living.

That the allocation of capital across asset classes is important to the growth of an economy has a long history. Feldstein (1982) and Tobin (1984) opened a distinction between productive and unproductive capital and the impact on long-term growth. We note that the Bank of England has also called for improved measurement of and further research into the distinction between productive and unproductive investment, including the possibility that mortgage lending may crowd out lending for productive investment.[12]

1. Evidence that taking out a mortgage may crowd out pension saving

If a household has enough resources to make an unconstrained allocation of savings, then they will invest in long-term or pension assets until the present value of future pension payments is equal to the present value of alternative investments, after taking account of risk. However, the vast majority of households are constrained in how much they can invest: the amount they can spend on a house

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[8] We are grateful to the Association of British Insurers and its members for financing this research project.

[9] All researchers were affiliated with the National Institute of Economic and Social Research at the time this study was completed

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[11] House prices have risen 7.3% per year (excluding any rental yield) versus 6.3% annual total returns (dividends reinvested) in the FTSE100 over the last twenty years.

[12] Bank of England, "Understanding and measuring finance for productive investment: A discussion paper," April 2016, available at: http://www.bankofengland.co.uk/financialstability/Pages/fpc/fsdiscussionpapers/080416.aspx

is usually limited by the amount they can borrow through a mortgage. In these conditions, a higher return on housing may 'crowd-out' or lead to less investment in pension assets.[13]

Our analysis is based on the British Household Panel Survey covering 10,000 individuals each year between 1991-2012. The dataset enables us to track people belonging to the same household, their housing status, employment status and saving behaviour over time. Using a panel dataset allows us to control for observable individual factors that change over time such as age, income, household type, and unobservable time-invariant characteristics. Technically, we do this by transforming the data so as to eliminate the influence of unobserved individual fixed effects.

We start by looking at whether buying a house leads to a decline in the saving rate in the years after the purchase compared to the years before. For those who buy homes without a mortgage we observe no significant difference in saving behaviour between before and after the acquisition. As these individuals have enough resources to make a cash payment for a house, they resemble an unconstrained investor and therefore we expect no change in behaviour (sample size is also small).

However, when we look at the saving behaviour of households who require a mortgage to finance the purchase of the house, we observe an economically and statistically significant decline in the savings rate. Figure 1 shows a decline in the average savings rate from 5% to 4% (marked by the period on the chart) which persists for at least 10 years from the purchase of the house. The confidence interval shows the range in which the true impact of mortgage on saving rate will be with 95% certainty. Note that we have controlled for personal and household income, individual age and employment status and household size in the regressions.

Figure 2 shows that, all else equal, individuals who bought a house with a mortgage are likely to receive lower private pension income. Although multiple factors may determine this outcome, this is consistent with a lower saving rate noted above. The estimated difference in private pension income is about 15% or £390 per year. The confidence intervals suggest that this difference is also statistically significant.

Taken together, these results suggest that taking out a mortgage does crowd out other kinds of long-term savings, including pension savings. While this result may seem intuitive, it is important because mortgagee households also had (usually rental) housing costs before buying a home.

The reductions in savings for mortgagees also seem to have an impact on their finances when retired. While retired individuals who own their own house are between 10% and 20% less likely to report financial difficulties, retired individuals who took up a mortgage at some point in life are slightly *more* likely (by about 5%) to report financial difficulties. This may be the effect of lower savings for retirement or lower pension income, as suggested by the analysis on the impact of mortgages on savings, or the result of residual mortgage payments into retirement.

Finally, comparing the 2008-12 and 1991-99 we note that the more recent survey shows that a higher proportion of the young (20 to 35) report that they save in order to buy a house and a lower proportion of the old (40 to 65) report that they save for retirement. This is consistent with higher house prices and a redistribution of wealth from the young, who may be under-invested in property, to the old, who may be over-invested in property.

13 The decision to buy a house may also depend on many other behavioural factors which are not analysed here.

2. Macroeconomic consequences of housing investment

The favourable public policy treatment of home ownership is likely to lead to a greater share of households' wealth in property compared to other long-term forms of savings. We note that residential property accounts for more than 60% of the net wealth in the UK economy.[14] Any increase in housing wealth will be due to higher house prices and some increase in new construction. However, the rate of new construction was less than 1% of the total stock in 2014, while the value of UK housing wealth grew by 8% between 2013 and 2014.[15]

The UK also has by far the lowest rate of business investment and one of the lowest labour productivity rates of the OECD advanced economies.[16] Table 3 shows the data. This may reflect that in order to buy houses, households might be cutting back on other forms of long-term saving and investment, or considering rising home values as a form of savings. Indeed, the UK's stock of private pension savings is only 97.4% of GDP, considerably lower than the average across OECD countries of 123.6% of GDP.[17] Moreover, there is evidence of a link between greater pension savings and greater access to external finance for business, which leads to higher economic growth.[18]

We use the National Institute's Global Econometric Model (NiGEM) to consider the macroeconomic consequences of alternative business investment scenarios.[19] We first assume that the composition of business investment becomes more similar to other OECD advanced countries. Total private investment is held constant, but the share of business investment is increased from 66% to 80% by 2028. This means an increase in business investment from 9.2% to 11.7% of GDP, in line with the Netherlands (11.7%) or Denmark (11.8%). Such a shift towards business investment would be expected to result from a more neutral tax treatment between housing and financial investments, or from other policies which moderate the returns to housing.

Our simulations show that by 2028, productivity is 2.3% higher and GDP is £55 billion higher than it would have been otherwise. GDP growth is predicted to be 1.9% rather than 1.7%. An additional 160,000 jobs are created which lowers the unemployment rate from 5.6% to 5.1%. Average annual earnings rise by £2,700, from £32,100 to £34,800. House price growth is 0.5 percentage points slower by 2028 and inflation is also somewhat lower at 1.3% rather than 1.9%.

In a second step, we also increase total private investment from 14.2% to 16.8% in 2028, again bringing the UK more into line with other advanced economies (Table 2). This raises business investment to 13.2% of GDP, similar to France (12.9%), but still short of Austria (14.3%), Sweden (14.7%) or Ireland (15.2%). Such an increase in business investment might occur if policy were successful at increasing the total level of savings in the economy. As a result by 2028, UK productivity is 3.8% higher than it would have been otherwise. Chart 3 shows that GDP is £90 billion higher and GDP growth is predicted to be 2.1% rather than 1.7%. An additional 220,000 jobs are generated and the unemployment rate falls to 4.9%. Average annual earnings rise by £4,600, from

[14] Office for National Statistics, National Balance Sheet for 2014, Table 2. Dwellings account for 61.5% of the value of UK fixed assets, and 62.7% of total net worth

[15] Office for National Statistics, Trends in the UK Housing Market 2014 and ONS, National Balance Sheet for 2014, Table B.

[16] Business investment consists of machinery, equipment, intellectual property (such as software, patents, designs) and commercial property, which are used to produce goods and services. Private investment is business investment plus housing investment.

[17] OECD, 2016, *Pension Markets in Focus*.

[18] Bijlsma, M., C. van Ewijk and F. Haaijen, 2014, "Economic growth and funded pension systems," Netspar Discussion Paper 07/2014-030.

[19] NiGEM is a global forecasting model used by central banks and international institutions (including the Bank of England and Treasury) on a subscription basis.

£32,100 to £36,700. House price growth is 0.7 percentage points slower by 2028 than otherwise and inflation is also somewhat lower at 1.0%.

To sum up, our results suggest that the UK economy would benefit from investment behaviour that was more in line with other advanced economies, in terms of total investment and the split between housing and business investment. When long-term savings increase, the pool of funds available for business investment also increases.

Of course, this work using a forecasting model can only illustrate the potential economic benefits of increasing long-term savings and business investment - but cannot illustrate how to achieve such an outcome. To understand which policies might be most effective at causing a shift towards more business investment in the UK requires further research. This research would require detailed behavioural models that allow for households and firms to react to policy changes.

Is An 'Englishman's Home' His Pension? An Introduction[20]

Angus Armstrong, Monique Ebell and James Warren[21]

This research project considers whether buying houses may reduce long term savings. This may explain some part of the UK's relatively low investment rate and weaker productivity performance over the long term. The study has two parts.[22] First, we present new evidence on the savings behaviour of UK households showing that buying a house with a mortgage may result in less pension savings. Second, we examine the consequences for the UK of shifting the allocation of savings from housing and towards business investment.

For an individual, buying a house is a form of long-term savings. We forgo consumption today at the expense of acquiring a house which provides us with shelter and comfort over the long term. A combination of a fairly fixed stock of housing and relatively generous public policies have contributed to housing being one of the best performing large asset classes over the last twenty years. Home ownership is supported by public policies such as favourable taxation (lack of capital gains on primary residence), exemption from means testing assessments, more generous inheritance thresholds and even subsidies for acquiring houses. This may encourage some individuals to see their home as a form of pension asset.

While an individual may feel wealthier as their home rises in value, for the country as a whole this may not constitute an increase in wealth. Buiter (2008) shows how house price inflation improves the position of an individual, but in aggregate this is a redistribution across generations rather than an increase in national wealth. While house price inflation benefits households who already own a home, as their wealth increases, but it harms non-homeowning households, who must pay higher rents to consume the same rental housing and/or pay a higher price to own the same house in the future. This suggests that allocating our savings towards houses may not add to the productive stock of the economy and be at the cost of lower long term standards of living.

That the allocation of capital across asset classes is important to the growth of an economy has a long history. Feldstein (1982) and Tobin (1984) opened a distinction between productive and unproductive capital and the impact on long term growth. We note that the Bank of England has also issued a call for evidence on the distinction between productive and unproductive investment.[23]

1. New evidence on pension savings and housing

We begin by investigating the impact of housing and pension decisions and savings rates, using data on UK households for 1991-2012. Our main finding is that households who take out mortgages to buy a home save less for at least the first ten years of paying off their mortgage than do households which either rent or own their homes outright. This suggests that households paying off a mortgage do divert savings to mortgage payments.

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[20] We are grateful to the Association of British Insurers and its members for financing this research project.

[21] All researchers were affiliated with the National Institute of Economic and Social Research at the time this study was completed.

[22] A full analysis requires a fully specified model which we hope to undertake in the third stage of this study.

[23] They consider most mortgage lending is not investment in this context, and ask for evidence on whether this may crowd-out productive investment.

We also investigate the impact on pension incomes in retirement of taking out a mortgage during one's working life. We find that pension incomes of those who took out a mortgage were 15% lower than those who rented or were able to buy outright, and mortgagee households were more likely to experience financial difficulties in retirement. While this does not necessarily imply that mortgagee households are worse off on average in retirement, this does suggest that there is an important trade-off between servicing mortgage debt and investing in long-term private pension schemes.

1. 1 Data and variables

The empirical analysis is conducted on a panel dataset obtained by combining the first 18 waves of the British Household Panel Survey (BHPS), and the waves two, three and four of the UK Household Longitudinal Study (UHLS). The resulting dataset covers the period 1991-2012 and a number of individuals ranging from 18,867 in 2001 to 9,249 in 1995. UK households are the sampling units of both datasets, and for each household individual member are re-interviewed in each survey wave. Variations in the number of households across waves are due to sample refreshment or to individuals setting up new households, while variations in the number of individuals at the household level are mostly due to: previously excluded household members reaching the minimum age for inclusion in the survey (i.e., 15 years old), deaths of household members or departure of members from the original household. Since its second wave, the UHLS incorporates the original sample of the BHPS. Unfortunately, the BHPS and the UHLS questionnaires are not exactly the same and some analysis are limited to the period 1991-2008 to avoid discrepancies in the key variables. Cross-sectional or longitudinal survey weights are provided and can be used to obtain statistics that are valid for the UK population.

The survey questionnaire conveniently includes a series of questions on income, saving behaviour and housing status. Data collected through the questionnaires include a mixture of continuous and categorical variables. Before conducting the analysis we correct for outliers in the distribution of the continuous variables. Outliers are often associated with errors in data entry and are corrected by trimming the top percentiles of the distributions of variables affected by this issue. This cleaning approach is also conducive to more robust regression estimates because extreme values tend to introduce a bias in regression coefficients.

Our analysis exploits a mixture of continuous and dummy variables. Dummy variables are variables that take only value one or zero, and they are used to identify subgroups of individuals with common features. For example, we often use a dummy variable to distinguish individuals who take out a mortgage (mortgage =1) from individuals who do not (mortgage=0) within our dataset. Dummies are included dependent variables of regression models when we model the probability that the individuals belongs to the subgroup identified by the dummy. When dummies appear as regressors they capture the average difference in the value of the dependent variables across groups of individuals.

The main **dependent variables** investigated in regression analyses are:

Individuals' savings rate (SR). This variable is obtained as the ratio between monthly savings (survey question: "*About how much on average do you manage to save a month?*") over total monthly income (this variable is imputed by summing all different sources of an individual's monthly income).

Total pension income (TPI). This variable is obtained as the sum of three sources of pension income: National Insurance Pension Income, Private Pension Income, and Employer Pension Income. The raw variables for pension incomes are obtained from BHPS income files. Monthly values for these variables are obtained by transforming weakly values.[24]

Enrolment into private pension (Enroll). This variable is a dummy variable taking value one for periods in which the individual is enrolled into a private pension scheme (i.e., equal or after the reported enrolment year) and value zero otherwise.

Financial difficulty indicator (Difficulty). This variable is based on the survey question "*How well would you say you yourself are managing financially these days? "*. We construct a dummy variable taking value one when individuals respond "*Finding it very difficult*", "*Finding it quite difficult*" or "*Just getting by*", because all these answers signal some degree of financial difficulty. The variable takes value zero when individuals respond "*Doing alright*" or "*Living comfortably*".

The **key independent variables** that we include on the right-hand side of our models are:

Mortgage (time invariant M). This variable takes value one if the individual has taken out a mortgage in the past and value zero otherwise. This variable varies across individuals but does not vary over time for the same individual. We use the time invariant mortgage indicator to capture differences in the dependent variable between individuals who made different financial decisions in the past.

Mortgage (time varyingM_s). The time-varying impact of mortgages on individuals' saving profile is captured by a series of dummy variables included on the right-hand side of regression models. Each dummy in the series takes value one in the year when the individual takes out a mortgage or in one of the ten years preceding and following the mortgage starting date. For example:

-M_0 is the dummy variable that takes value one in the year when the individual takes out a mortgage and value zero otherwise.

- M_{-1} is the dummy variable that takes value one in the year **preceding** the mortgage starting date and value zero otherwise.

-M_{+1} is the dummy variable that takes value one in the year **following** the mortgage starting date and value zero otherwise.

When we estimate regressions, the coefficients of these dummies measure differences in the expected value of the dependent variable vis-a-vis a reference period.

Enrolment into private pension (Enroll). This variable is a dummy variable taking value one for periods in which the individual is enrolled into a private pension scheme and value zero otherwise.

Regression models also include independent variables that act as **controls**. These controls are meant to capture the influence of factors that are both correlated with the independent variables of interest and with the dependent variables. For example, when trying to estimate the impact of taking out a mortgage on the savings rate is it necessary to control for household income, as this

[24] Monthly values are obtained by multiplying weakly values by 4.33.

variable is very likely to be affecting both individuals' savings rates (i.e., the dependent variable) and an individual's mortgage status (the independent variable of interest). Some of the main controls that we include in regression models are:

Age. An individuals' age is clearly an important predictor of major financial decisions. Individuals tend to take out mortgages, or to enrol in pension schemes, at earlier stages of their working life. Savings and consumption profiles also change over an individual's age. To account for the age dependency of many financial choices, we include the natural logarithm of an individual's age and its logarithm squared as controls in regressions. These two transformations of age capture non-linearity in the evolution of the dependent variable over an individual's age.

Household income. It is necessary to control for household income to account for resource pooling at the household levels.

Household type. BHPS identify different types of households: single elderly, single not elderly, couples without children, couple with dependent children, couple with not dependent children, single parents, unrelated adults and other households. To control for household type in regressions we include one dummy variable for each but one of the possible categories (i.e., single non elderly). The excluded category serves as the benchmark. For example, the regression coefficient of the dummy for "couples with children" captures the differential in the dependent variable between individuals that belong to this household type vis-a-vis "single non-elderly" individuals (i.e., the benchmark category).

1.2 Methodology

Impact of mortgage, house purchase or private pension enrolment on the savings rate

We investigate the impact of housing and pension decisions on individuals' savings rates by estimating the following Fixed-Effect model[25]:

$$y_{it} = \alpha + \sum_{s=-10}^{+10} \beta_s M_{si} + X'\gamma + D_i + D_t + \varepsilon_{it}$$

where α is a constant and y_{it} is the dependent variable (i.e., in this case the savings rate), the operator $\sum_{s=-10}^{+10} \beta_s M_{si}$ indicates that we include one dummy variable taking for the mortgage start year M_{0i} and a full set of dummy variables for each of the 10 periods preceding and following the mortgage start: M_{-10i} to M_{10i} . For individuals who do not take out a mortgage at any point in time all these dummies take value zero for all periods. We estimate a parameter β_s on each dummy. The vector X' includes the control variables that we described in the previous section, while γ is the vector of estimated parameters on different controls. The term D_i controls for all the unobservable individual-specific characteristics that do not change over time (i.e., risk attitude, thrift, past experiences, etc...) while the term D_t controls for year-specific macroeconomic factors affecting all individuals (i.e., financial shocks, policies etc...). The error term ε_{it} is the part of the dependent variable y_{it} that is not explained by the model.

[25] Fixed-Effect refers to the term D_i that controls for all the unobserved time invariant characteristics of individuals. This model eliminates the risk that the estimated coefficients may be biased due to the effect of unobserved time-invariant factors that are simultaneously correlated with the dependent and with the independent variable.

Impact of mortgage, house purchase on private pension enrolment

To estimate the effect of taking up a mortgage, or buying a property on the decision to enrol into a private pension scheme, we estimate a discrete-time duration model. This model is designed to gauge the impact of different factors on the length of time an individual spends in a particular status. We apply this model to estimate the impact of major financial decisions on the length of time an individual remains **not-enrolled** into a private pension scheme (i.e., the Survival Function). Traditionally, duration models are estimated on cross-sectional datasets (i.e., one observation for each individual) where the dependent variable contains information on the length of time the individual spends in a particular status (e.g., the survival time after diagnosis). With a panel dataset (i.e., same individual observed for several periods) we can implement this model by estimating a logistic regression on the dataset of individuals aged 16 or older that are not yet enrolled into a pension scheme. In this dataset, the time series for individuals who enrol into a private pension scheme terminate when they enrol into a pension scheme. The dependent variable y_{it} is a dummy variable that takes value zero in all period preceding enrolment into a private pension scheme and value one in the period of enrolment. The model takes the following specification:

$$y_{it} = \Lambda\left(\gamma_1 \ln(t) + \gamma_2 \ln(t)^2 + \beta M_{it} + X'\gamma\right)$$

Where $\Lambda(\cdot)$ is a logistic function that maps the linear argument within brackets to the enrolment dummy variable ($y_{it} = 1$ if individual *i* enrols into a pension scheme at time *t* and value zero otherwise). The first part of the equation in parenthesis (i.e., $\gamma_1 \ln(t) + \gamma_2 \ln(t)^2$) captures the way in which the probability of pension enrolment changes over time *t*. Time *t* is the number of years passed since 16th birthday of individual *i*. M_{it} is a dummy variable that takes value one if individual *i* has a mortgage at time *t* and value zero otherwise. We are interested in the coefficient β , that captures the difference in probability of enrolment between individuals with and without a mortgage. X' is a vector of individual-level controls including an individual's savings rate, income, sex, housing status (owned or rented), employment, household type. The model is estimated by maximum likelihood.

Impact of mortgage and house purchase on pension income

To test whether retired individuals who took up a mortgage in the past have a pension income that is significantly lower than individuals who did not take out a mortgage, we separately estimate cross-sectional regressions for each individual year of the BHPS. Caution is required when interpreting these results. In cross-sectional models we cannot control for the unobserved characteristics of individuals, and the estimated coefficients should not be used to infer causality. This model is estimate on a sample that includes only retired individuals aged 60 or older. We use the log of pension income as a dependent variable. This specification allows us to interpret the coefficient on the mortgage dummy as the percentage difference in pension income across retired individuals who have taken out a mortgage in the past. To account for the relationship between an individual's labour income and pension income, we control for an individual's average labour income before retirement.

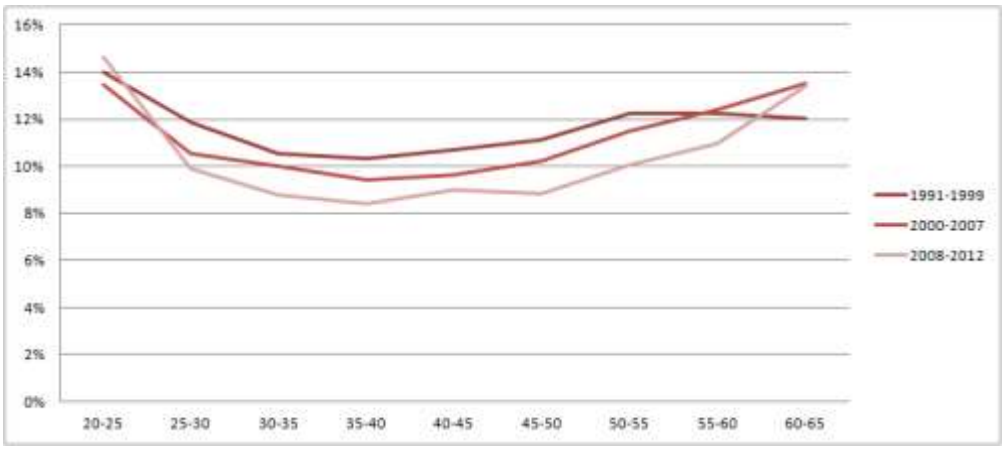
1.3 Results

Trends in saving behaviour and pension contribution

Before introducing regression results, we describe some patterns in savings rates across age groups and over time. Survey weights allow us to estimate statistics that apply to the broader UK population.

Figure 1 plots estimates of the average savings rate across different age groups of working age individuals.[26] We separately estimate the average savings rate for the periods 1991-1999, 2000-2007, and 2008-2012. We notice a general reduction in the savings rate over time that affects mostly individuals aged 25-60. A reduction in the savings rate is already present when comparing the 1991-1999 line with the 2000-2007 line. The gap widens when comparing the 1991-1999 line with the 2008-2012 line. The average gap in the savings rate between these two periods is about 2 percentage points, equivalent to a 16% savings rate decline.

Figure 1- Mean individuals' savings rate by age group across periods



Note. Mean savings rates are estimated for each individual cross-section by using cross-sectional survey weights.

Unfortunately, the BHPS questionnaire does not include questions that allow us to quantify the amount of money that individuals allocate for different uses. However, for the subgroup of individuals who manage to save part of their income, a follow-up question investigates the main reason for saving. Figure 2 and Figure 3 plot the percentage of savers in the different age groups reporting "house purchase" or "old age" as the main reason for saving. The shape of these lines is expected. The proportion of individuals reporting "house purchase" as the main reason declines as we move from younger to older age groups and the inverse pattern can be seen for the percentage of savers reporting "old age" as the main reason.

An interesting pattern emerges when comparing savers' motivations across different time periods. For the age band 20-40, the percentage of individuals reporting "buying a house" as the primary reason for saving is on average 5% higher for the period 2008-2012 than it is for period 1991-1999. Therefore, we conclude that over the last decade "buying a property" is considered by young individuals a relatively more compelling reason for saving than in previous periods. On the contrary, Figure 3 suggests that the percentage of individuals aged 45-65 who report saving for "old age" has

[26] Here we emphasize that we plot "estimates" of the mean savings rate because we use survey weights to infer from our sample the true mean for the UK population.

dropped significantly over time. Although this descriptive analysis is inadequate to establish substitution between pension and housing savings, it is nevertheless suggestive of a shift in savers' preferences that may be explained by common macroeconomic factors. For instance, increasing property prices may have induced savers to see houses as an investment generating good capital gains and income for retirement.

Figure 2- Percentage of savers reporting "house purchase" as the main reason for saving

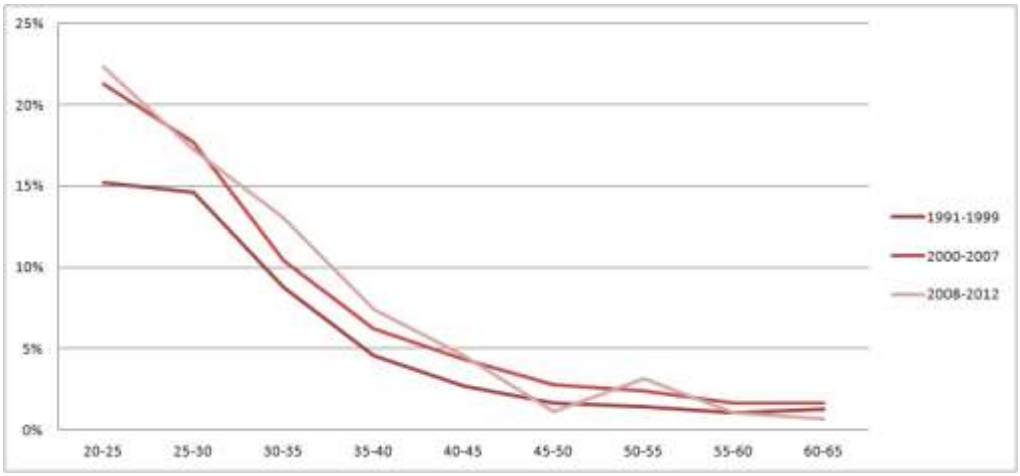


Figure 3- Percentage of savers reporting "old age" as the main reason for saving

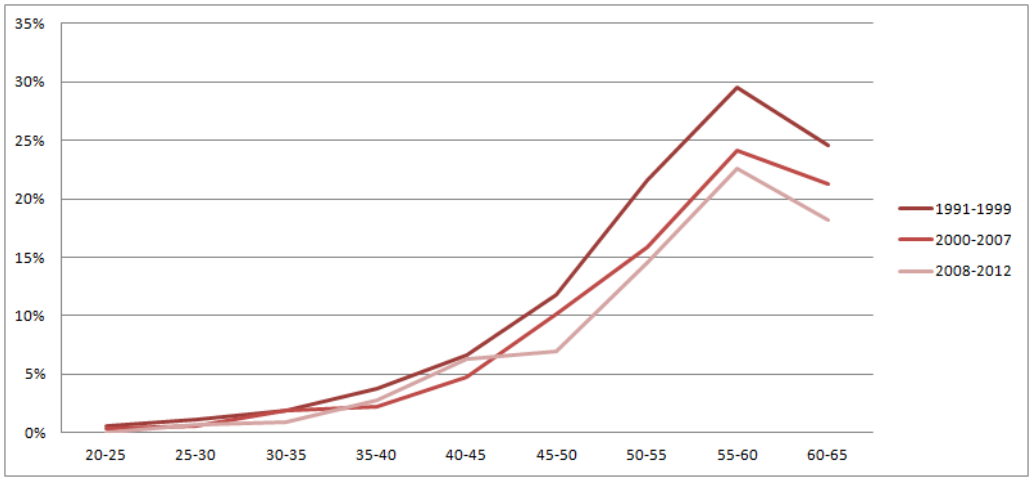


Figure 4 plots the percentage of individuals who contributed to a private pension scheme over the year. A comparison of the lines for the periods 2008-2012 and 1991-1999, shows a clear reduction in the percentage of individuals aged 20-55 who made a contribution to a private personal pension over the last year.[27] This pattern is inverted for older age groups for which we see a higher proportion of contributors in more recent periods of time. This inversion can be explained by a cohort-effect, as the high proportion of contributors aged 40-55 in 1991-1999 moves to older age group in the periods 2000-2007 and 2008-2012. The very strong reduction in the proportion of private pension contributors in 2008-2012 is likely to be related to the impact of the financial crisis on the income of younger cohorts of workers.

[27] Percentages are based on the number of individuals who responded positively to the following survey question: *"I'd like to ask you now about private personal pensions, that is a pension that you yourself have taken out on your own behalf. In the past year, that is since [...] have you paid any contributions or premiums for a private personal pension, or had such contributions paid on your behalf by the Department of Social Security?".*

Figure 4 - Percentage of individuals who made a contribution to a private pension in the last year

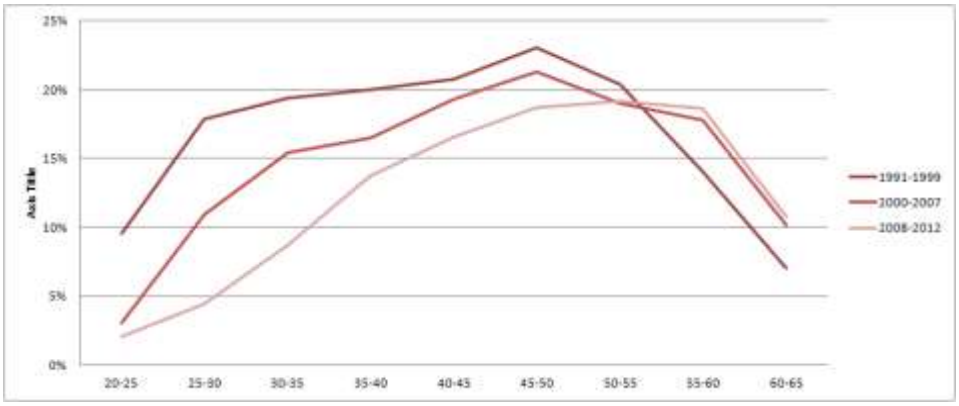


Figure 5 - Evolution of the ratio house purchase price / household annual income

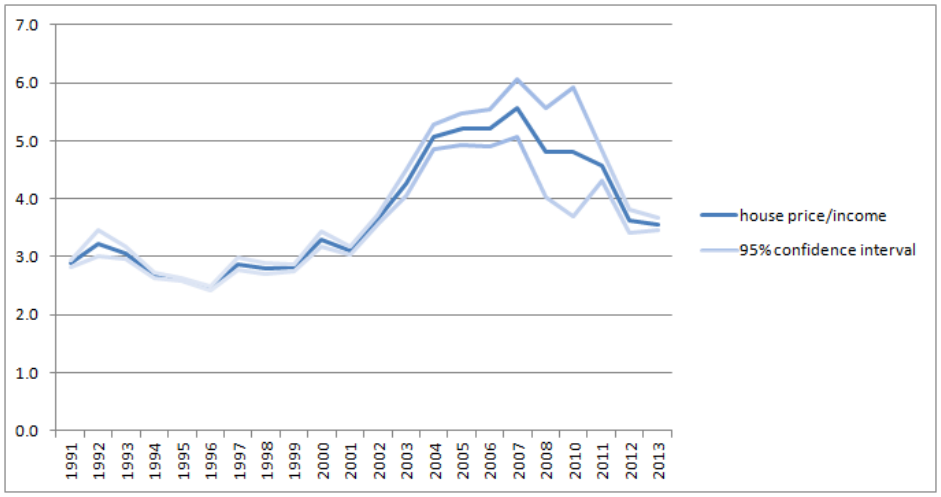
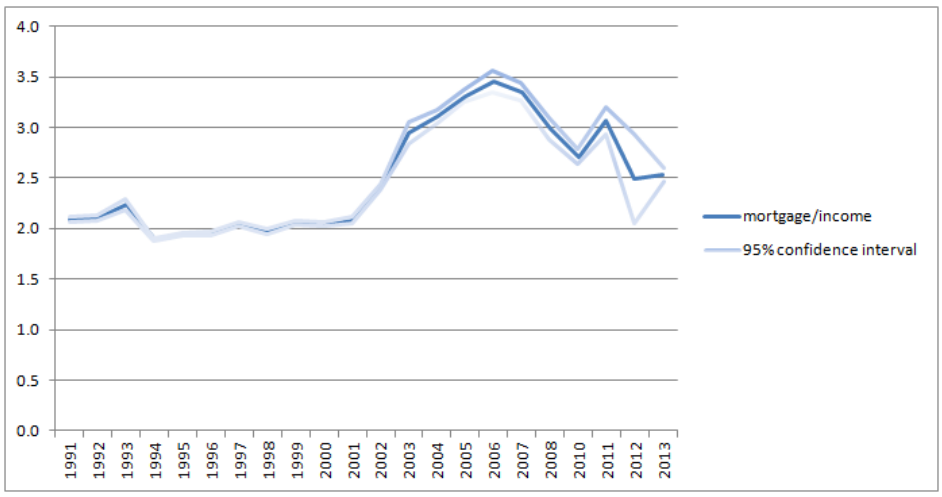


Figure 6 - Evolution of the ratio mortgage value at purchase / household annual income



The greater proportion of young individuals that reports house purchase as the main reason for savings in the 2000s suggests exploring the evolution of house prices relative to households annual

income. Indeed, an increase in the average ratio of house prices over the buyers' income may force individuals to divert a greater proportion of their savings to finance house purchase. Figure 5 is based on information provided by house buyers on the value of the property and on the total income of their household. The figure shows a sharp upward trend in house price relative to income over the period 1999-2007 and a decline in the aftermath of the financial crisis. The dynamics of house prices is reflected in a similar trend for the ratio of mortgage value at purchase over household income (figure 6).

Cross-sectional models are estimated on individual survey waves to identify which factors are positively or negatively correlated with the savings rate. Estimates from these models should not be used to infer causality as they do not control for unobserved individual-level characteristics. We retain in the estimation sample all working age individuals. For individuals that report no savings but a positive income, the dependent variable (i.e., the savings rate) takes value zero.[28]

The first set of explanatory variables on the right-hand side of the regression model includes individuals' characteristics: sex, age, employment status and whether they care for a sick, elderly or disabled relative. Age is introduced in the model in log and log squared. This functional form controls for non-linearity in the relationship between age and savings rate. The coefficients on these terms reflect the shape of the age-saving relationship traced in Figure 1: savings rate decreases with age for individuals aged 18-45 (i.e., hence the negative coefficient on log age) and then increases for older age groups (i.e., the positive coefficient on log age squared). As expected, employed individuals manage to save more (on average 20% more) than non-employed or retired individuals. For some cross-sections (i.e., 1998, 1999, 2000 and 2008), we find that the individuals caring for dependant relatives (i.e., sick, elderly or disabled) save on average 6% to 8% more.

The second set of explanatory variables captures two important household-level financial factors: total income and renting status. Individuals' savings rate increases in household income (10% increase in household income is associated on average with 5% savings rate increase). However, the positive relationship between household income and individual savings rate is non-linear (i.e., for high income households the relationship between household income and individual savings rate is weaker than it is for low income households). This result is expected, as low income individuals have greater marginal propensity to consume. An increase in income increases the savings rate relatively more for low-income individuals than it does for high income ones. We also find that the members of households that do not pay rent (i.e., because they own their property or they live in it rent-free) save on average 10%-14% more than individuals in rent-paying households. Again, this result should not be interpreted as an indication that non-rent housing arrangements have a positive impact on the savings rate.

The last set of regressors captures differences in the savings rate across individuals from different type of households (i.e., "single non-elderly" is the benchmark category). After controlling for household income), we find that only single elderly individuals have a savings rate greater than single non-elderly individuals.

Based on these results we can conclude that an individual's savings rate is higher at higher income levels, its evolution over an individual's working life follow a U-shaped relationship (i.e.,

[28] To account for the large number of individuals reporting 0 savings rate, we estimate Tobit models.

Table 1 - Results from cross-sectional models on the savings rate

Dependent: saving ratio (% income saved)	Year										
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Individual factors											
Female	0.314	-0.125	2.175	1.180	0.335	0.596	0.981	0.393	2.832	2.835*	-0.454
	(0.19)	(-0.07)	(1.20)	(0.90)	(0.17)	(0.36)	(0.54)	(0.30)	(1.55)	(1.79)	(-0.22)
ln(age)	-94.89**	-22.38	-52.70	-97.93***	-152.6***	-55.64	-119.9**	-75.08**	-49.66	-32.04	-80.49
	(-2.15)	(-0.51)	(-1.19)	(-2.84)	(-2.89)	(-1.35)	(-2.55)	(-2.26)	(-1.16)	(-0.88)	(-1.56)
ln(age)^2	12.77**	2.719	6.368	13.30***	20.41***	7.056	16.44**	10.31**	6.860	4.184	10.82
	(2.07)	(0.44)	(1.03)	(2.77)	(2.79)	(1.24)	(2.51)	(2.23)	(1.16)	(0.82)	(1.51)
Employed	27.84***	22.54***	23.15***	17.77***	26.32***	19.72***	24.54***	16.97***	26.67***	14.85***	21.40***
	(5.99)	(5.17)	(5.45)	(5.91)	(5.34)	(5.33)	(5.39)	(5.65)	(5.52)	(5.07)	(4.72)
Caring for dependent	8.601***	5.428**	6.716**	-0.365	1.389	2.258	4.039	0.551	-3.103	2.786	5.027*
	(3.18)	(2.08)	(2.55)	(-0.21)	(0.53)	(1.00)	(1.63)	(0.31)	(-1.26)	(1.37)	(1.70)
Household financial factors											
ln(Household income)	55.21**	109.6***	58.44**	56.35***	62.47***	34.88*	48.77**	41.05**	49.24**	52.90***	111.1***
	(2.05)	(3.62)	(2.40)	(3.31)	(2.59)	(1.81)	(2.25)	(2.10)	(2.08)	(2.70)	(3.24)
ln(Household income)^2	-2.242	-5.722***	-2.429	-2.648**	-2.724*	-1.051	-1.786	-1.586	-1.839	-2.136*	-5.194***
	(-1.30)	(-3.10)	(-1.58)	(-2.53)	(-1.83)	(-0.87)	(-1.34)	(-1.31)	(-1.27)	(-1.80)	(-2.59)
Not renting	10.82***	12.29***	12.16***	11.80***	14.78***	11.27***	14.27***	9.958***	9.077***	9.624***	14.11***
	(4.02)	(3.95)	(4.02)	(4.95)	(4.20)	(4.02)	(4.31)	(4.39)	(3.20)	(3.88)	(3.84)
Household type (benchmark: single no-elderly)											
Single elderly	8.612	11.32*	14.40**	3.710	1.414	7.991	9.489*	5.532	5.512	1.110	8.369
	(1.53)	(1.91)	(2.49)	(0.93)	(0.23)	(1.53)	(1.67)	(1.37)	(1.00)	(0.24)	(1.25)
Couple with no child	-12.57***	-11.33**	-5.092	-10.62***	-11.27**	-10.42***	-5.838	-10.93***	-6.757*	-12.27***	-18.39***
	(-3.01)	(-2.54)	(-1.26)	(-3.35)	(-2.48)	(-2.68)	(-1.45)	(-3.33)	(-1.65)	(-3.25)	(-3.25)
Couple with dependent child	-25.96***	-28.17***	-21.42***	-20.46***	-21.79***	-24.16***	-21.54***	-23.24***	-26.73***	-27.50***	-41.43***
	(-4.90)	(-4.67)	(-4.23)	(-5.14)	(-4.01)	(-4.76)	(-4.19)	(-5.31)	(-4.62)	(-5.38)	(-4.91)
Couple with no-dependent child	-20.58***	-25.58***	-18.46***	-17.44***	-24.32***	-20.05***	-17.03***	-20.21***	-18.84***	-20.48***	-32.64***
	(-3.98)	(-4.20)	(-3.55)	(-4.36)	(-3.96)	(-4.00)	(-3.28)	(-4.65)	(-3.50)	(-4.31)	(-4.31)
Single parent with dependent child	-18.42***	-20.39***	-12.51*	-18.13***	-23.06***	-11.32**	-12.69**	-20.74***	-21.53***	-19.28***	-28.09***
	(-2.95)	(-2.83)	(-1.90)	(-3.49)	(-3.09)	(-1.98)	(-2.07)	(-4.00)	(-3.11)	(-3.22)	(-3.27)
Single parent with no-dependent child	-13.86**	-19.61***	-17.97***	-15.38***	-13.84**	-15.23**	-22.88***	-20.17***	-15.51**	-23.65***	-28.33***
	(-2.36)	(-2.84)	(-2.70)	(-3.23)	(-2.01)	(-2.54)	(-3.31)	(-3.89)	(-2.46)	(-4.03)	(-3.46)
Unrelated adults	-26.15***	-22.54**	-18.43**	-11.35**	-26.16***	-14.60*	-27.93***	-24.12***	-11.30	-12.20	-24.30**
	(-3.10)	(-2.57)	(-2.44)	(-2.07)	(-2.95)	(-1.93)	(-3.14)	(-3.79)	(-1.51)	(-1.59)	(-2.10)
Other types of households	-23.97***	-7.919	-18.23*	-16.78**	-31.70***	-18.02**	-16.64*	-16.68***	-24.54***	-24.03***	-36.10***
	(-3.03)	(-0.93)	(-1.95)	(-2.46)	(-3.34)	(-2.30)	(-1.95)	(-2.60)	(-2.98)	(-3.51)	(-3.43)
Observations	**10,103**	**14,701**	**14,628**	**17,888**	**15,663**	**15,289**	**14,855**	**14,676**	**14,471**	**13,952**	**13,229**

Note. T-statistics in parentheses. Significance levels : * p<.1** p<.05, *** p<.01.

Figure 11 suggests that the lowest rate is for individuals aged 40-45). Single non-elderly individuals tend to have higher savings rates. A possible explanation for this result is that these individuals have lower costs (i.e., mortgage payments, child-related expenses) than couples and single parents. It is also possible that singles save more out of their income because they cannot pool resources with other household members, perhaps giving them a stronger precautionary savings motive

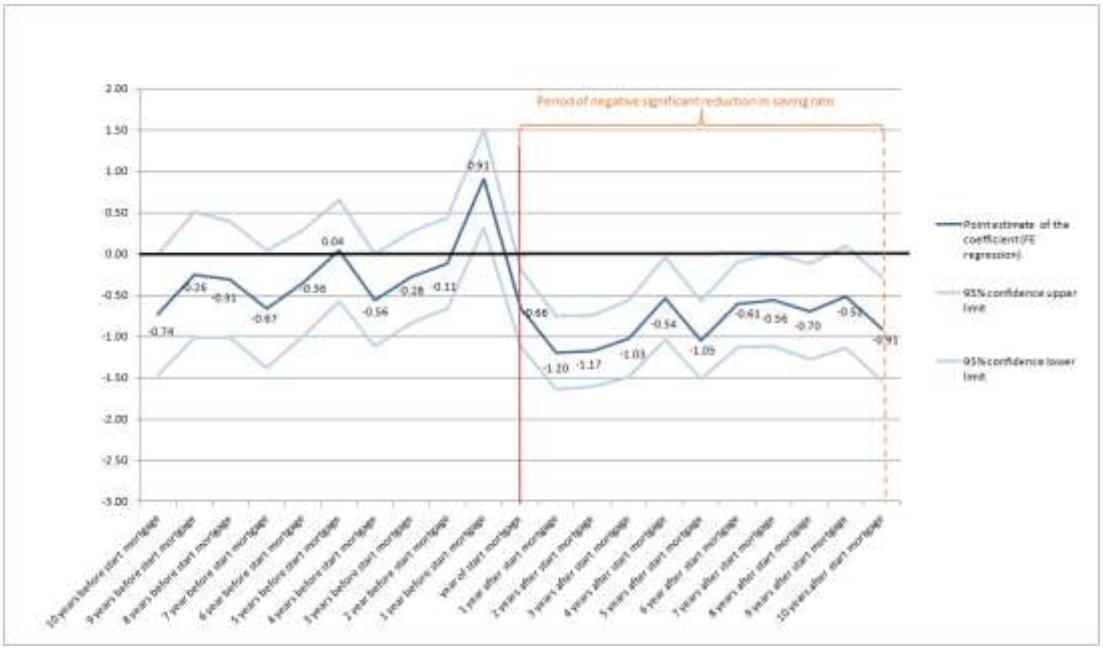
The impact of house purchase and mortgage on the saving ratio

In this section we present the result of the regression analysis on the impact of mortgages on individuals' savings rates. For this analysis we estimate fixed effects panel models. These models control for an individual's unobserved "fixed effect", namely time-invariant factors that determine differences in the levels of the dependent variable (i.e., in our case the savings rate) across individuals. By purging the effect of all these factors, these models are more appropriate to establish the causal impact of mortgages. Once individuals' fixed effects are "purged", regression coefficients are identified by comparing the savings rate of individuals who take out a mortgage before and after the mortgage starting date. Time-varying controls included in regressions are: employment status, log(age) and $\log(age)^2$, individual and household income. Dummies for individual years control for common macroeconomic factors and policies that affect all the individuals in the sample in a particular year.

Figure 7 plots the estimated coefficients on the set of dummy variables for each of the ten years preceding and following the mortgage starting date. The figure plots also the 95% confidence interval around the point estimates of the coefficient. Results are strikingly clear and very robust to variations in the size of the time window around the mortgage starting date. In the year preceding the mortgage starting date, individuals save on average 0.91 percentage points more out of their income. Because the average savings rate in the sample is 4.39% (i.e., it is rather low as we include individuals with a savings rate of zero), the relative increase in the savings rate is about +20%. This coefficient is statistically significant at the 95% level. This means that with the 95% level of confidence we can reject the hypothesis that this coefficient is equal to zero (i.e., indeed the confidence band around the point estimates does not cross the 0 line). It is plausible that an increase in the savings rate before taking out a mortgage is explained by the need to save enough money to pay for a deposit.

In the year individuals take out a mortgage, the savings rate is on average 0.6 percentage points lower, and it remains consistently lower over a 10-year periods (i.e., ranging from -1.20 in the following year to -0.54 four years after). This result clearly suggests that individuals who take out a mortgage divert part of their savings to mortgage payments. This is an intuitive, albeit not trivial result. Because individuals who buy their own property do not pay rent, the impact of mortgage on the savings rate may have been offset by the reduction in housing costs associated with rent payment. Alternatively, individuals might have chosen to reduce consumption instead of other forms of savings to meet mortgage payments.

Figure 7 - Impact of mortgages on the savings rate



The diversion of savings into mortgage payments is a likely explanation for the drop in the savings rates. Nevertheless, it may be possible that self-financed house purchase may lead to similar results. This would be especially the case if individuals perceive increases in housing value as an alternative to long-term savings to accrue the value of their assets. To test this alternative hypothesis we perform the same analysis, but in this case we use the date of house-purchase with own-funds as the discontinuity point in an individual's time-series.

Figure 8 - Impact of house ownership on the savings rate

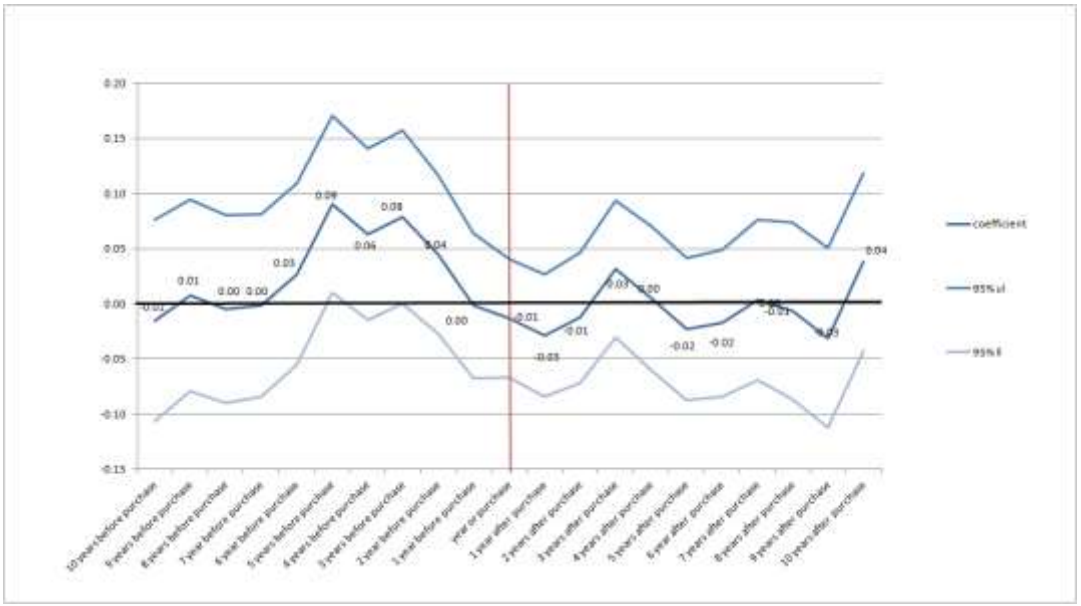


Figure 8 shows the results of the analysis on the impact of self-financed house ownership on the savings rate. Within the time-window around the purchase year, none of the coefficients are

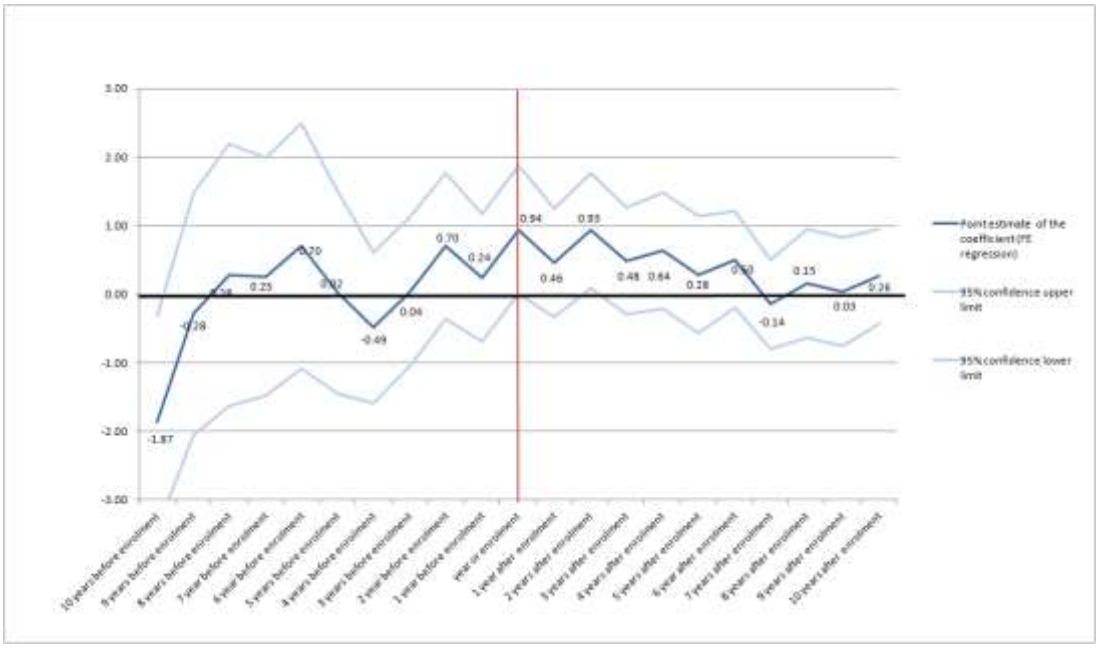
statistically significant. The figure clearly shows that all the point estimates are very close to zero and the confidence band always includes the zero line. Estimates are also less precise (i.e., larger confidence bands) as the sample of individuals who buy houses with their own funds is small.

The negative impact of mortgages on the savings rate and the insignificant effect of self-financed house purchase, suggest that individuals save less after purchasing their home only when they operate within binding financial constraints. Individuals who self-finance house purchases are more likely to have sufficient resources to keep saving the same proportion of income after buying a house. On the contrary, individuals who need a mortgage are more likely to reduce other forms of savings to service their debt obligations associated with housing.

Impact of private pension enrolment on savings rate

By adopting the same empirical strategy used to capture the impact of mortgage, we can investigate the impact of private pension enrolment on the savings rate. Figure 9 plots point estimates and confidence intervals from fixed effect regressions. In the period following an individuals' enrolment into a private pension scheme, coefficients are positive but barely significant at the 95% confidence level. We find a small significant effect of private pension scheme enrolment on savings only in the period immediately after enrolment.

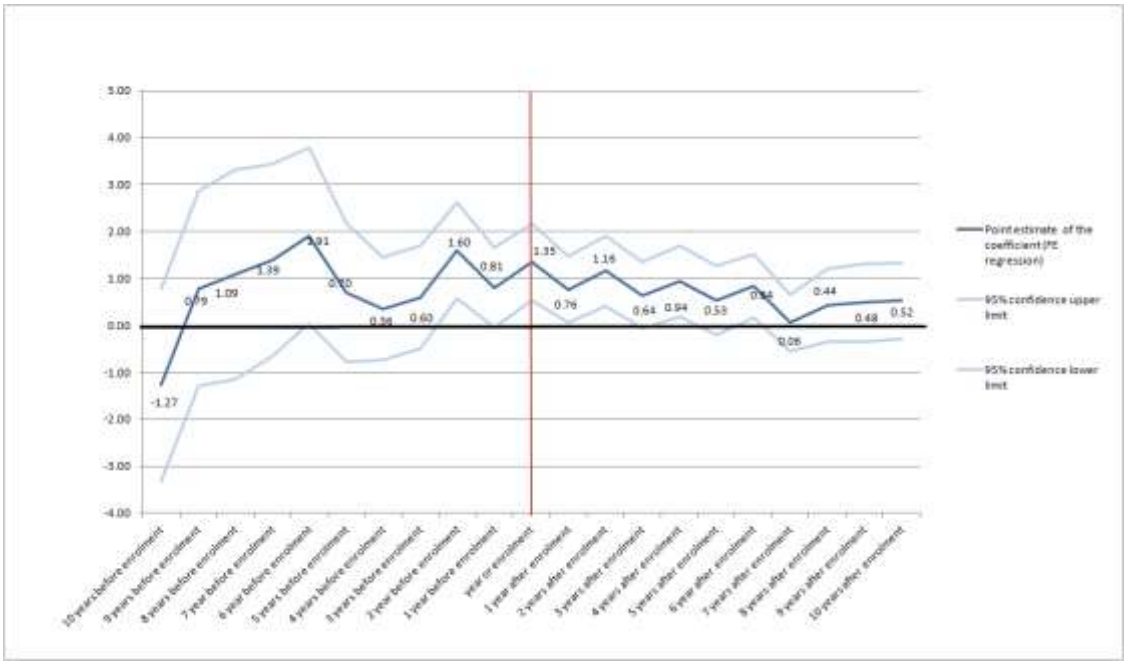
Figure 9 - Impact of private pension enrolment on savings rate (FE models)



Estimates are more frequently positive and significant in Figure 10 . While the estimates plotted in Figure 9 are obtained from fixed-effect Panel (FE) models, coefficients in Figure 10 are obtained from cross-sectional models. The main difference is that FE models, by controlling for all time-invariant individual factors, identify the impact of enrolment by comparing the savings rate of an individual in the periods before and after enrolment. On the contrary, cross-sectional models identify the coefficients by comparing the savings rate of individuals who enrol and the savings rate of individuals who do not enrol. The results from Fixed-Effect Panel models and cross-sectional models suggest that enrolment into private pension schemes has only a weak positive impact of the savings

rate, but that that individuals with higher savings rates tend to self-select into enrolment.[29] In other words, the most likely direction of causality runs from savings to enrolment and not the other way around.

Figure 10 - Private pension enrolment and savings rate (cross-sectional models)



Determinants of private pension enrolment

This section presents the results of the analysis on the determinants of pension enrolment, using data collected before the introduction of automatic enrolment. The dependent variable is a dummy variable taking the value zero in periods when the individual is not yet enrolled into a private pension scheme and the value one in the year of enrolment. Table 2 reports regression results. We present estimates obtained from four specifications of the model. Model 1 includes as independent variables only the log of an individual's age and its square, and a dummy variable "Have a mortgage" that takes value one if the individual has a mortgage in the current period and value zero otherwise. Model 2 augments the previous specification with the log of an individual's current income. Model 3 replaces the mortgage dummy used in previous specifications with the mortgage ratio (i.e., obtained as monthly mortgage payment over total monthly income). In this specification we also control for an individual's savings rate and the "rent ratio" (i.e., cost of rent over monthly income). Finally, Model 4 controls for household size and for enrolment into an employer's pension.

The probability of private pension enrolment increases with age but decreases with age squared. These estimates are perfectly consistent with the shape of the age-private pension contribution schedule in Figure 4. Across specifications, we cannot reject the hypothesis that the coefficients of the mortgage variables (i.e., either the mortgage dummy or the mortgage ratio) are equal to zero. On the contrary, income and the savings rate appear as important determinants of private pension enrolment. Predicted enrolment probabilities, based on the estimates from Model 2, are shown in Figure 11. The probability of pension enrolment increases very fast as an individual enters its 20s,

[29] We are using data before the introduction of automatic enrolment, when individuals needed to opt-in to enrol in private pension schemes.

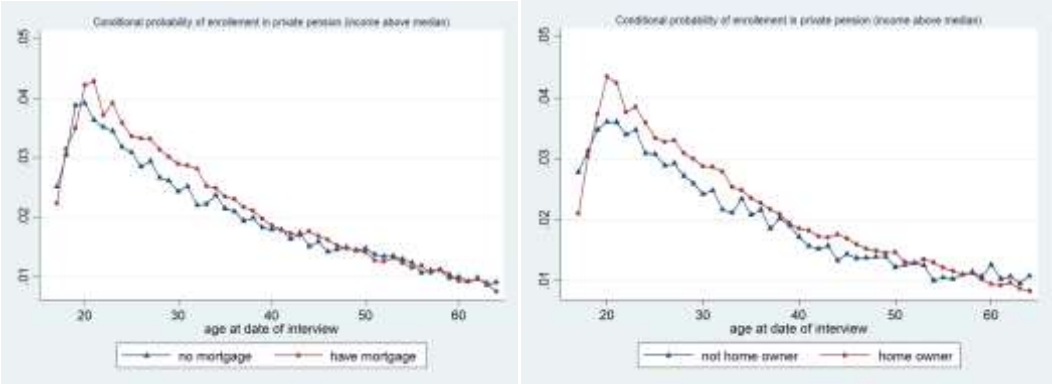
and it progressively declines as the individual grows older. Everything else equal, individuals with a mortgage appears to have a slightly higher enrolment probability than individuals without a mortgage, although this difference is not statistically significant (left-hand side panel of Figure 11). The right-hand side of the panel plots probabilities estimated by including in the model a dummy variable for individual who bought their house with their own money. Again, results suggest that house ownership is not significantly correlated with the probability of pension enrolment.

Table 2- Results from models on pension enrolment

	Model (1)	Model (2)	Model (3)	Model (4)
log(age)	1.232***	0.996***	0.878***	0.925***
	(7.09)	(5.66)	(4.82)	(4.98)
log(age)^2	-0.342***	-0.302***	-0.277***	-0.283***
	(-9.61)	(-8.45)	(-7.41)	(-7.47)
Have a mortgage	0.0718	0.0152		
	(1.39)	(0.29)		
Total Personal Income		0.283***	0.378***	0.283***
		(6.09)	(8.47)	(5.28)
Total Family Income				0.209***
				(3.35)
Saving Ratio (Saving/Income)			1.160***	1.006***
			(4.60)	(3.90)
Mortgage Ratio (cost/income)			-0.326	-0.209
			(-0.98)	(-0.60)
Rent Ratio (rent/income)			0.0180	0.254
			(0.04)	(0.50)
Enrolled in employer's pension				-0.0167
				(-0.25)
Family Size 2 components				-0.0849
				(-0.77)
Family Size >2 components				-0.153
				(-1.37)
Year FE	Yes	Yes	Yes	Yes
N	91993	89243	77543	77541

t statistics in parentheses
Significance levels : * p<.1** p<.05, *** p<.01

Figure 11 - Conditional probability of enrolment into private pensions



A limitation of this analysis is that it captures the relationship between mortgage (and house ownership) and pension enrolment only for individuals who take out a mortgage (or buy a house with their own money) before enrolling into a pension scheme. This is due to the design of the analysis, as we retain an individual in the estimation sample until enrolment. Because many individuals enrol into private pensions before taking out a mortgage, we are left with a limited number of cases to identify the impact of taking out a mortgage on the probability of pension enrolment.

Mortgages, home ownership and pension income

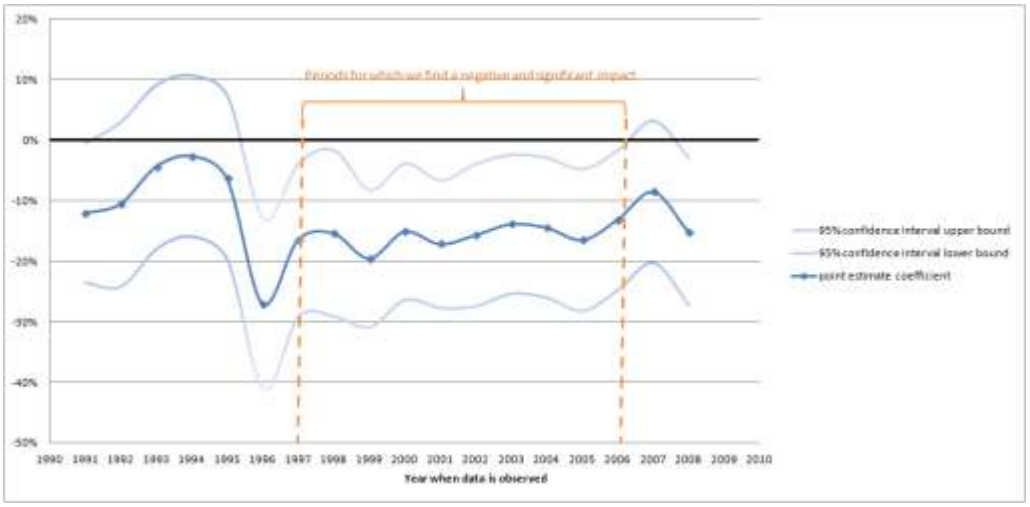
The previous analyses suggest that while taking out a mortgage does not affect pension enrolment, it has a clear negative impact on individuals' savings rates. The next step is to investigate whether individuals who took out mortgages during their working life have a different pension income during retirement. This analysis is an indirect test of whether there is some degree of substitution between savings for housing and long-term savings for retirement.

To answer this question we focus the analysis on the pension income of retired individuals. Retired individuals are defined as individuals aged 60 or older who declare they are retired. We generate a dummy variable for individuals who took up a mortgage while still working and a dummy variable for individuals who enrolled into a private pension while still working. In regressions we control for the average labour income of individuals before retirement and average household income. We also control for age and other demographic factors. We separately run regressions on total pension income, private pension income and NI pension income. For each retired individual in the sample, the main explanatory variable (i.e., either a dummy variable for having taken out a mortgage or a dummy variable for having enrolled into a private pension) do not change over time as they are based on the individual's past behaviour. Therefore, we cannot estimate a panel model where identification would rely on time variation in the regressors of interest. Instead, we run separate cross-sectional regressions for different survey waves and plot the estimated coefficient year by year.

Estimates of the coefficient of the "Took out a mortgage" dummy in regressions on total pension income are represented in Figure 12. Each point on the line represents the estimated coefficient on a single BHPS cross-section. The coefficient on the mortgage indicator is generally negative (i.e., it is found positive only the regression on the 1998 cross-section) but not significant at the usual confidence level (i.e., 95%). Unfortunately, estimates from earlier cross sections tend to be imprecise, generating very large confidence bands.

Figure 12 - Difference in total pension income for individuals who took out a mortgage

Figure 13 - Difference in private pension income for individuals who took out a mortgage



On the contrary, Figure 13 suggests that individuals who took out a mortgage during their working life obtain on average 15% less private pension income during retirement. Point estimates of the coefficient on the mortgage variable are consistently negative across the 1996-2006 cross-sections. We interpret this result as evidence that individuals who took out a mortgage had to sacrifice investment in long-term pension savings. This analysis does not necessarily suggest that individuals who took out a mortgage are worse off in retirement than individuals who did not take out a mortgage. However, we interpret the results as a strong indication that there is substitution between servicing mortgage debt and investing in long-term private pension schemes.

Mortgages, home ownership and financial difficulties in retirement

It remains to be determined whether home ownership or mortgage payments are related to more or less severe financial difficulties during retirement. We construct a dummy variable that takes value zero if retired individuals report that they "*live comfortably*" or if *"they are doing alright"* and value one if they report to "*have just enough to get by*" or if they report to "*find it quite difficult"* or *to "find it very difficult to get by"*. We use this variable as a dependent variable in regressions. Positive (negative) coefficients on the regressors of interest (i.e., "have private pension" or "had a mortgage" or "bought house with own funds") would suggest that these factors are associated with more serious (less serious) financial difficulties during retirement. As for previous models, we control for individuals' income, household type and age.

Figure 14 shows that retired individuals who own their own house are between 10% and 20% less likely to report financial difficulties (i.e., notice the negative coefficient). This difference is statistically significant and it persists across different periods of time. On the contrary, retired individuals who took up a mortgage at some point in life are slightly more likely (by on average 5%) to report financial difficulties as captured by our indicator (Figure 15). This can either be the effect of lower savings for retirement (i.e., as suggested by the analysis on the impact of mortgages on savings) or the effect of lower pension income or residual mortgage payments. Although all estimates are obtained after controlling for income and family factors, the cross-sectional nature of the analysis prevents us from inferring causal relationships from the estimated coefficients. For instance we cannot say that taking up a mortgage during the life-time increases the probability of

experiencing financial difficulties during retirement, but we can say that individuals who took up a mortgage have a higher probability of experiencing difficulties. While it might be the case that the burden of paying down a mortgage led to the higher probability of experiencing financial difficulties in retirement, it is also possible that some other unobserved factors caused households both to take on a mortgage and to end up in financial difficulties later in life. .

Figure 14 - Financial difficulties during retirement and house ownership

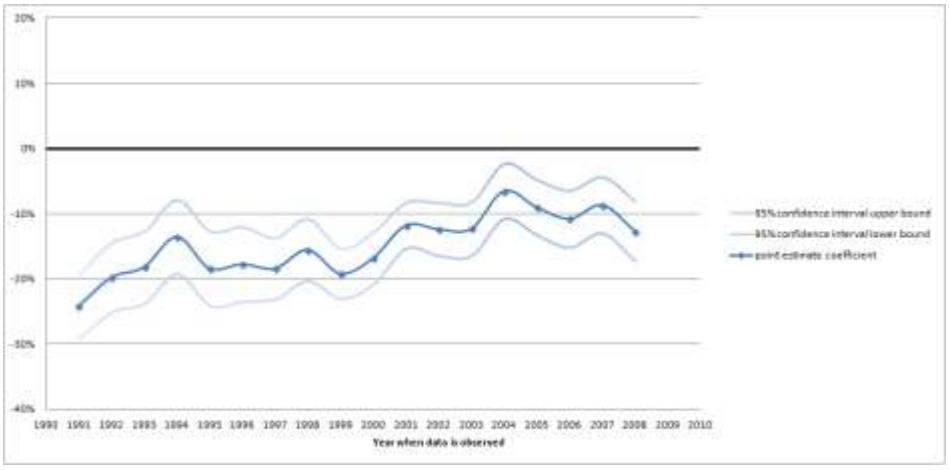
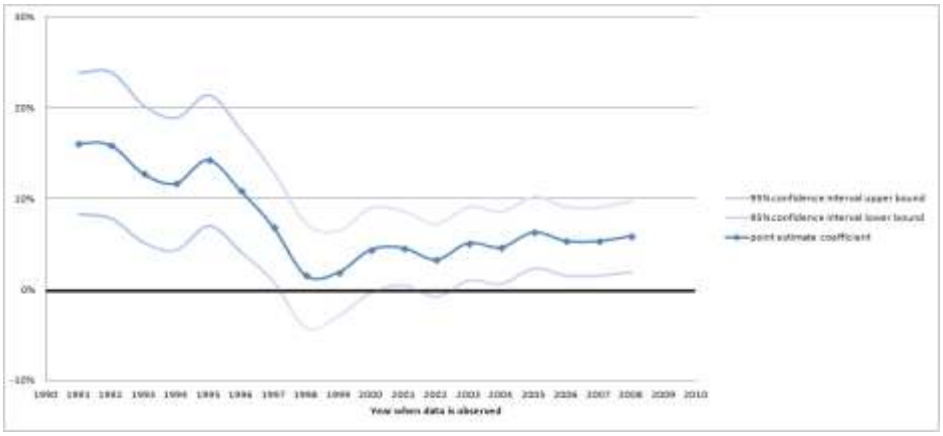


Figure 15 - Financial difficulties during retirement and mortgages



Summary

In this section, we investigated the impact of housing and pension decisions and savings rates, using data on UK households for 1991-2012. Our main finding is that households who take out mortgages to buy a home save less for at least the first ten years of paying off their mortgage than do households which either rent or own their homes outright. This suggests that households paying off a mortgage do divert savings to mortgage payments.

We also investigate the impact on pension incomes in retirement of taking out a mortgage during one's working life. We find that pension incomes of those who took out a mortgage were 15% lower than those who rented or were able to buy outright, and mortgagee households were more likely to experience financial difficulties in retirement. While this does not necessarily imply that mortgagee households are worse off on average in retirement, this does suggest that there is an important trade-off between servicing mortgage debt and investing in long-term private pension schemes.

2. The economic impact of higher business investment

The last section established a trade-off between servicing a mortgage and pension savings. As pension savings are an important source of business investment, it is natural to next investigate the implications for the macroeconomy of the UK's low levels of business investment. We first discuss existing evidence that the UK has both low levels of pension savings and low business investment rates compared to other advanced economies, as well as evidence that these two may be linked. Then we go on to investigate the implications for UK productivity, GDP and earnings of increasing the UK's business investment levels to be more in line with other advanced economies.

2.1 Introduction

The UK also has by far the lowest rate of business investment and one of the lowest labour productivity rates of the OECD advanced economies.[30] Table 3 shows the data. This may reflect that in order to buy houses, households might be cutting back on other forms of long-term saving and investment, or considering rising home values as a form of savings.

Table 3: Investment and Productivity

	Investment, % of GDP			%	
	Business	**Housing**	**Total Private**	**business share**	**output per hour**
UK	9.2	4.7	13.9	66.3	47.5
Spain	9.9	10.1	20.0	48.7	47.5
Canada	10.3	6.7	17.0	60.5	48.3
Italy	11.7	5.3	17.0	68.4	47.0
NL	11.7	5.0	16.7	70.4	60.6
Denmark	11.9	4.6	16.5	72.3	58.8
Germany	12.2	5.4	17.6	69.3	58.9
Finland	12.4	5.8	18.2	68.0	49.8
US	12.6	3.4	16.0	79.0	62.5
France	12.9	5.5	18.4	70.3	59.8
Japan	13.5	2.8	16.3	82.9	39.4
Sweden	14.7	4.0	18.7	78.5	54.4
Australia	14.8	6.8	21.6	68.5	53.4
Belgium	15.0	5.5	20.5	73.1	62.2
Ireland	15.2	3.4	18.6	82.8	62.0
Austria	15.3	4.3	19.6	77.9	52.5

Source: NIGEM database and other national statistical data

The evidence presented in the previous section indicates that there may be some crowding out of pension savings in favour of servicing mortgage debt in order to invest in residential property. Indeed, the UK's stock of private pension savings is only 97.4% of GDP, considerably lower than the average across OECD countries of 123.6% of GDP.[31] Moreover, there is evidence of a link between

[30] Business investment consists of machinery, equipment, intellectual property (such as software, patents, designs) and commercial property, which are used to produce goods and services. Private investment is business investment plus housing investment.

[31] OECD, 2016, *Pension Markets in Focus*.

greater pension savings and greater access to external finance for business, which leads to higher economic growth.[32]

Thus, low levels of pension savings might be a source of weakness in business investment. Business investment includes machinery and equipment, intangibles like intellectual property and patents, and non-residential commercial real estate. Indeed, the UK seems to have low levels of business investment compared to other advanced economies. The level of business investment is likely to have an important impact on productivity, measured as the amount of output produced by an hour's work, as workers who have access to more and more valuable capital are able to work more efficiently. Improving the UK's sluggish productivity performance since the crisis is a key issue for policymakers. In December 2016, Philip Hammond expressed concern to the Treasury Select Committee about the link between housing and pension savings: "We do have some structural issues around saving in the UK, some of them specific to the UK- the structure of pension saving, the extraordinary role that housing wealth plays in the overall calculation of UK households." Moreover, the Chancellor also indicated that this might be linked to productivity: "We do need to look at the interaction between the desire to save in the most effective way – and historically for many people that has been through housing – and the needs of the economy around accessing pools of savings. That is a productivity challenge for us."[33]

In this section, we first compare the UK's levels of business and housing investment to other advanced countries. We also present some evidence that low levels of business investment may be linked to weak productivity. Persistently low productivity growth in the UK has been a major source of concern for the UK economy since the crisis.

Next, we use NiGEM, the National Institute's large scale macroeconomic model, to examine the impact on the UK economy of increasing business investment to the levels of other advanced countries. We find that bringing the UK's business investment rates into line with other advanced economies leads not only to greater productivity and output, but also to higher wages and lower rates of inflation in the long term.

2.2 Stylized facts

2.2.1 Productivity

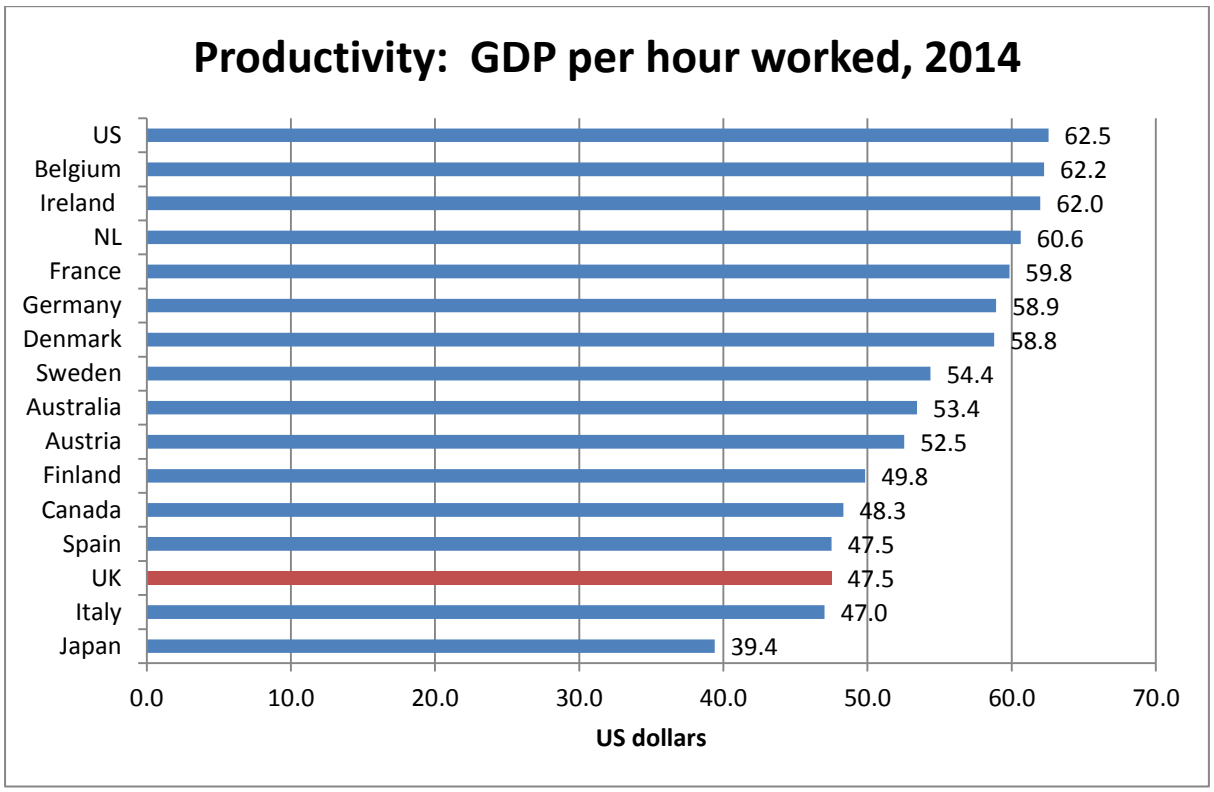
Productivity is the amount of GDP produced per hour worked. It is a measure of the overall efficiency of an economy. Generally, productivity is thought to be increasing in the amount of business capital in the economy. The idea is that the greater the amount of capital – be it machinery or intangibles like patents, software or brands – the greater the value of the output that workers can produce in each hour.

[32] Bijlsma, M., C. van Ewijk and F. Haaijen, 2014, "Economic growth and funded pension systems," Netspar Discussion Paper 07/2014-030.

[33] "Put less money into housing and more into saving, says Philip Hammond," The Telegraph of 17 December 2016, available online at: http://www.telegraph.co.uk/business/2016/12/17/put-less-money-housing-saving-says-philip-hammond/

The UK's weak productivity performance since the crisis has been well documented.[34] In 2014, the UK's productivity is among the lowest of the advanced countries in our sample (Figure 16).[35] While every person-hour worked increases UK GDP by $47.50 on average, an hour worked in the US increases GDP by $62.50 on average. That is, the average hour worked in the US is 32% more productive than the average UK hour worked. From Figure 16, we can see that the UK has the third-lowest productivity in our sample, roughly equal to Spain and Italy, while Denmark, Germany, France, the Netherlands, Ireland, Belgium and the US all have productivity that is at least 24% higher than the UK's.

Figure 16: Productivity, measured as GDP per hour worked in US dollars, 2014



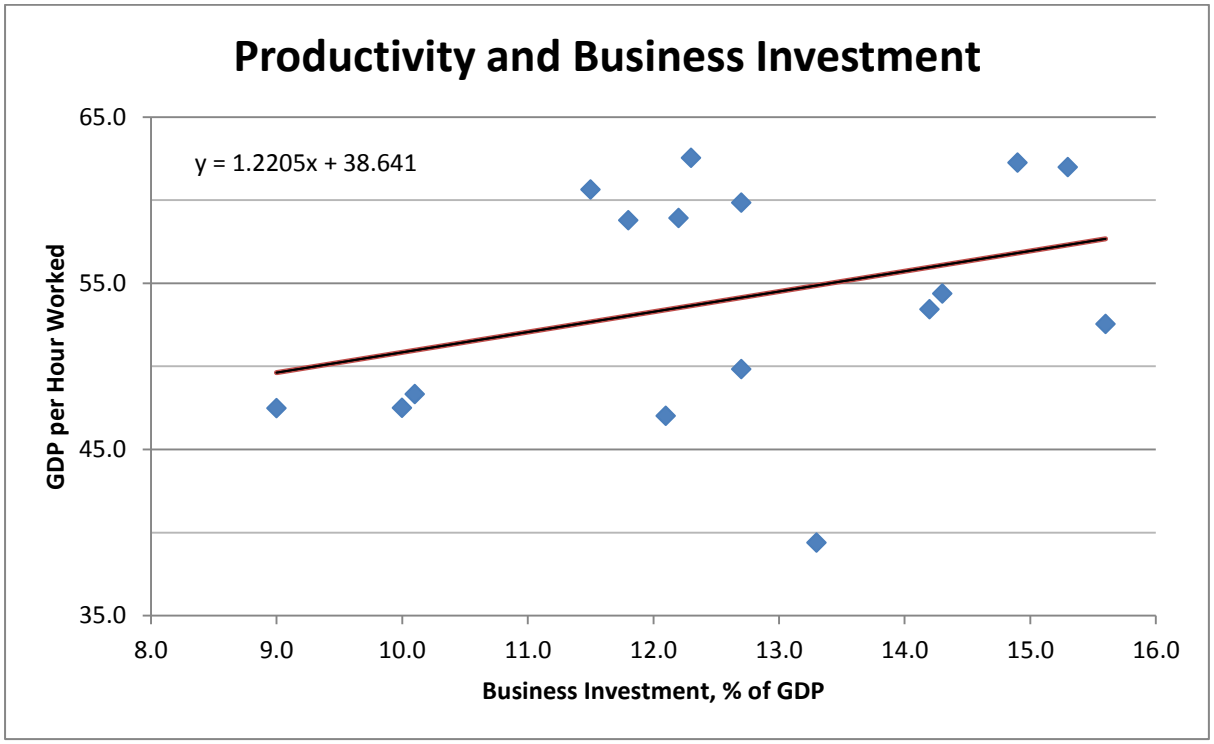
Source: NiGEM and other national statistical data

Next, we compare productivity to business investment rates, by plotting business investment as a share of GDP against productivity for our sample of advanced economies (Figure 17). On average, productivity rises by $1.22 per hour for each additional percentage point that the business investment share of GDP ratio is higher. This illustrates that low levels of business investment might be one source of the UK's weak productivity performance.

[34] Riley, R., C. Rosazza-Bondibene and G. Young, 2015, "The UK productivity puzzle 2008-13: evidence from British businesses," Bank England Staff Working Paper No. 531.
[35] Productivity data from the OECD for 2014.

Next, we compare the UK's business investment to that of other advanced countries.

Figure 17: Productivity and lagged business investment, 2014



Source: NiGEM and other national statistical data

2.2.2 Business Investment

As its name suggests, business investment is investment which is undertaken by private businesses, including machinery and equipment, intangibles like intellectual property and patents, and non-residential commercial real estate. UK business investment made up 9.2% of GDP in 2014, the lowest in our sample of 16 major developed economies (Table 3). As a share of GDP, the UK invested substantially less than Germany (12.2%), the USA (12.6%), France (12.9%), Ireland (15.2%) or Austria (15.3%).

The UK's low level of business investment as a share of GDP is partly due to a low level of total private sector investment, which is the sum of business investment and housing investment. It is also due to a relatively high share of private sector investment flowing into housing, rather than into business investment. It is important to emphasise that housing 'investment' can either take the form of physical expansion of the housing stock (which would be welcome, given the tight supply in many parts of the UK), or the form of rising valuations of the existing housing stock due to rising house prices. The latter does not create aggregate wealth, in the sense that the amount of housing that is available for consumption is unchanged.[36]

2.2.3 Total private sector investment

UK total private sector investment was 13.9% of GDP in 2014, the most recent year for which comparable data is available. This is by far the lowest among our sample of advanced economies.

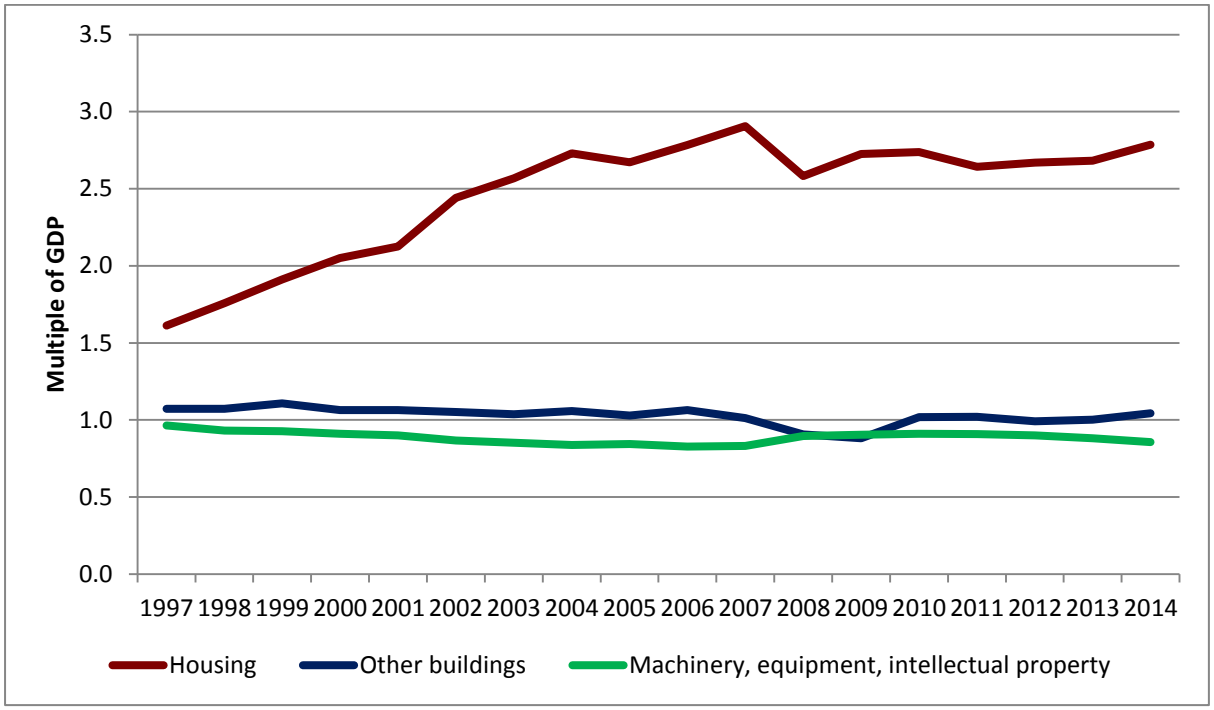
[36] See Buiter (2008), "Housing Wealth Isn't Wealth," NBER Working Paper 14204.

The next lowest private sector investment share was the US's 16%. Many of our European neighbours devoted substantially higher shares of GDP to private sector investment, including Germany (17.6%), France (18.4%), Sweden (18.7%), Austria (19.6%) and Belgium (20.5%).

2.2.4 Housing investment

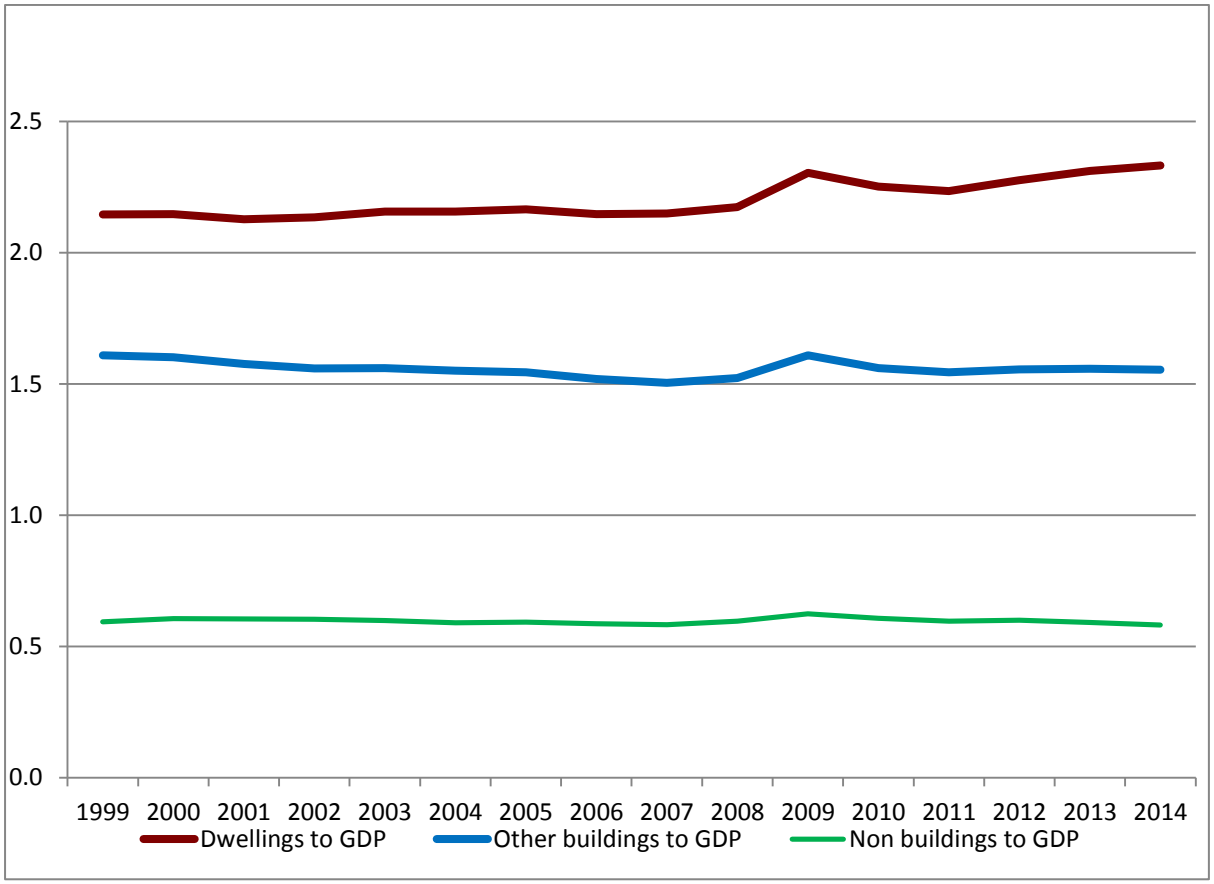
Private sector investment is composed of business investment and residential housing investment. Again, we emphasise that housing 'investment' can either take the form of physical expansion of the housing stock or the form of higher valuation of the existing housing stock. Figure 18 shows the evolution of the value of the UK's capital stock as a multiple of UK GDP. Clearly, the value of the housing stock has risen dramatically over the past 18 years, rising from 1.6 times GDP in 1997 to 2.8 times GDP in 2014. Given that rates of construction of new housing have been very low over this time period, this increase in value has been mainly driven by high and rising UK house prices. By comparison, Figure 19 shows the commensurate values for the German capital stock, where house price growth has been more moderate, rising from 2.1 times GDP in 1999 to 2.3 times GDP in 2014.

Figure 18: Value of UK capital stocks, as a multiple of UK GDP



Source: NiGEM and other national statistical data

Figure 19: Value of Germany's capital stocks, as a multiple of GDP



Source: NiGEM and other national statistical data

2.2.5 Accounting for the stylised facts

How might low levels of business investment be related to high and rising house prices. High and rising levels of house prices might crowd out business investment in several ways. Households might face such high mortgage payments or rents that they find it difficult to save in pensions or other vehicles likely to flow into business investment. Homeowners might view increases in home values as 'savings' and then save less in pensions. Tax-sheltering of capital gains and favourable inheritance tax treatment might also favour housing as a savings vehicle. Some households might hoard housing as a tax sheltered investment, preferring it as a store of value over pensions, stocks or bonds.

High property values can also be a cost to businesses, slowing down their investment. Also, when housing has higher after-tax returns, then investors will also demand higher after-tax returns on business investment, pushing up the cost of capital to business. Policies which moderate growth in property values might serve to free up resources for greater business investment.

2.3. NiGEM Experiments

Next, we use the National Institute's Global Econometric Model (NiGEM) to examine the macroeconomic consequences of weak business investment. In particular, we ask how much the UK economy might benefit from increasing business investment to levels which are more in line with other advanced economies. We examine the implications of increasing the level of UK business investment in two stages:

1. Increase the share of business investment, while holding total private sector investment constant.
2. Increase the share of business investment, both by increasing total private sector investment and by increasing the share of business investment.

We perform these two experiments to increase the level of UK business investment in the context of NiGEM, the National Institute Global Econometric Model. NiGEM is a large scale structural macroeconomic forecasting model, with a long track record of forecasting the UK economy. NiGEM is used by leading central banks, finance ministries and private sector financial institutions from around the world, including HM Treasury, the Bank of England, the OECD and the European Central Bank.

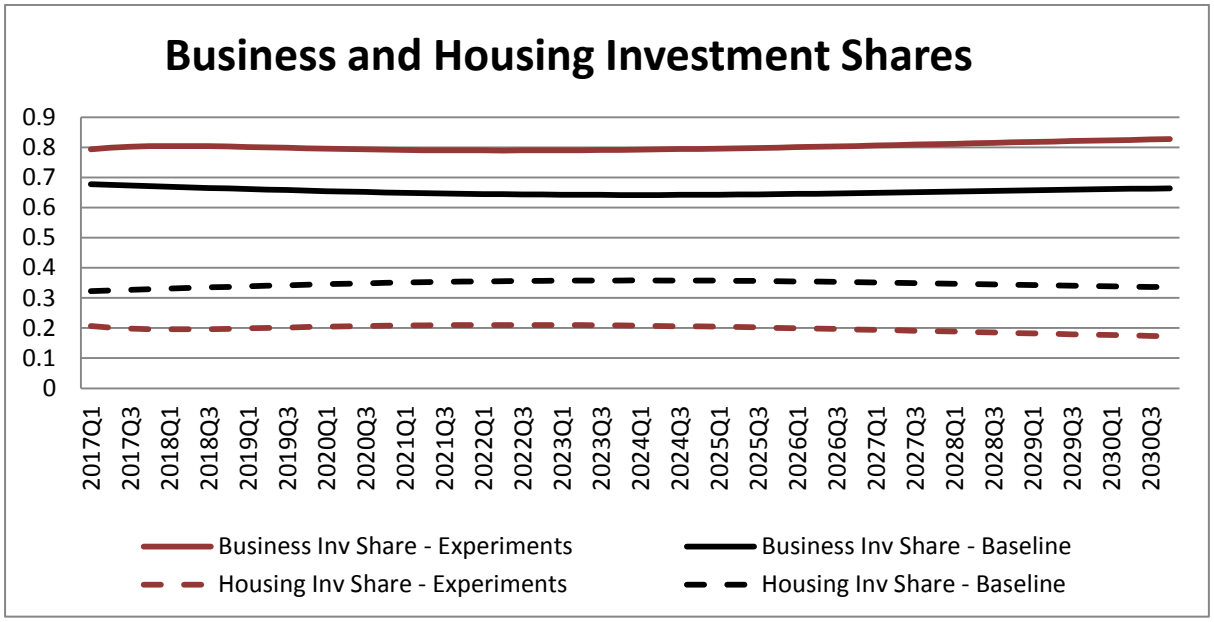
NiGEM is well-suited for our purposes because it separates out two components of private sector investment: business investment and housing investment. Business investment serves to increase the capital stock, and feeds into productivity and the potential output of the economy. Housing investment plays a role in the household sector, where it is treated both as a form of consumption and as a component of household savings, but it does not augment the supply side of the economy directly in the way that business investment does. As a result, NiGEM allows us to quantify the impact of shifting business and housing investment levels on the UK macroeconomy in a meaningful way. For each of our three experiments, we examine the impact on productivity, real wages, output and inflation, as well as the impact on monetary policy.

NiGEM is a useful framework for this analysis, as it can tell us how the UK economy would respond to these experiments, based on past performance of the economy. NiGEM does, however, have some limitations. Most importantly, the model is not fully behavioural, so there is no scope for households and firms to react to changes in policy. In our context, this means that NiGEM can help us to understand the impact of increasing UK business investment on the UK economy. NiGEM cannot, however, help us to estimate the impact of any specific policies which would favour pension savings over housing. For this we would need a fully specified model which allows households and firms to adjust their optimal behaviour to the changes in policy.

2.3.1 Experiment I: Increasing the share of business investment

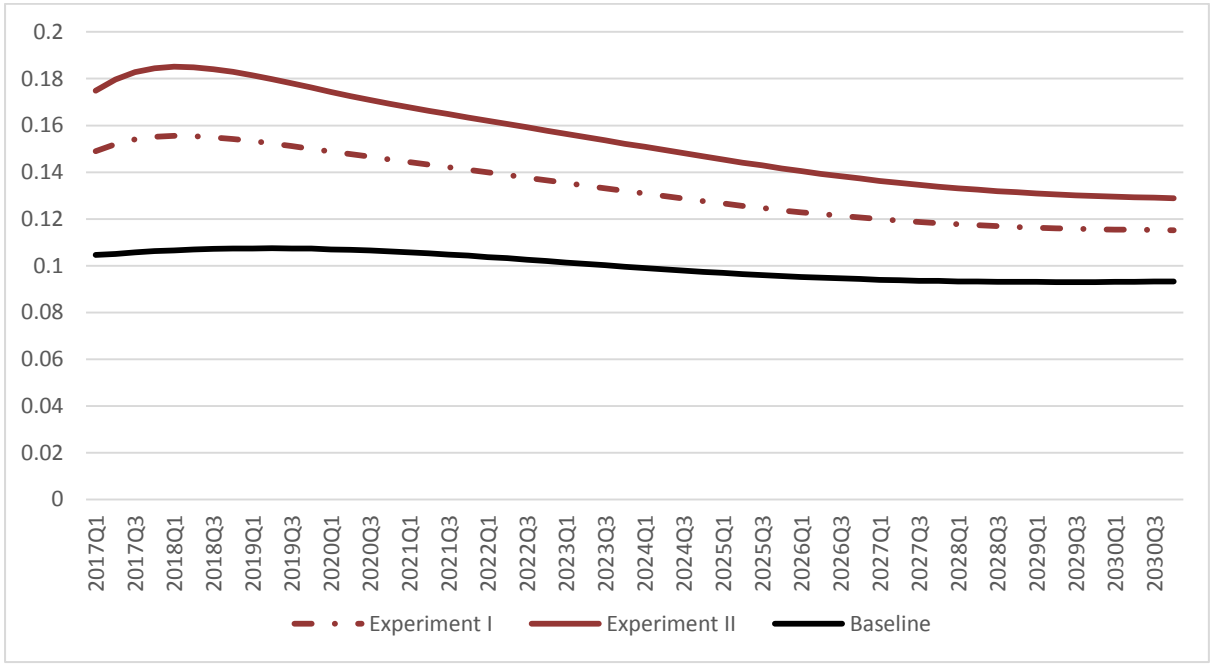
In our first experiment we increase the share of business investment to the level of other advanced economies in the long run, while holding the UK's current level of total private sector investment (PSI) constant. Specifically, we increase the share of the UK's total PSI which goes to business investment from its current level of 66% to 80% over the long-run (Figure 20a). This would increase UK business investment from its 2014 level of 9.2% of GDP to 11.7% of GDP by 2028 (Figure 20b), bringing it into line with the Netherlands (11.7%) and Denmark (11.8%), while still falling short of Germany (12.2%), the United States (12.6%), France (12.9%) or Sweden (14.7%).

Figure 20a: UK Business and Housing Investment Shares, Experiments and Baseline



Source: NiGEM and other national statistical data

Figure 20b: UK business investment as a share of GDP

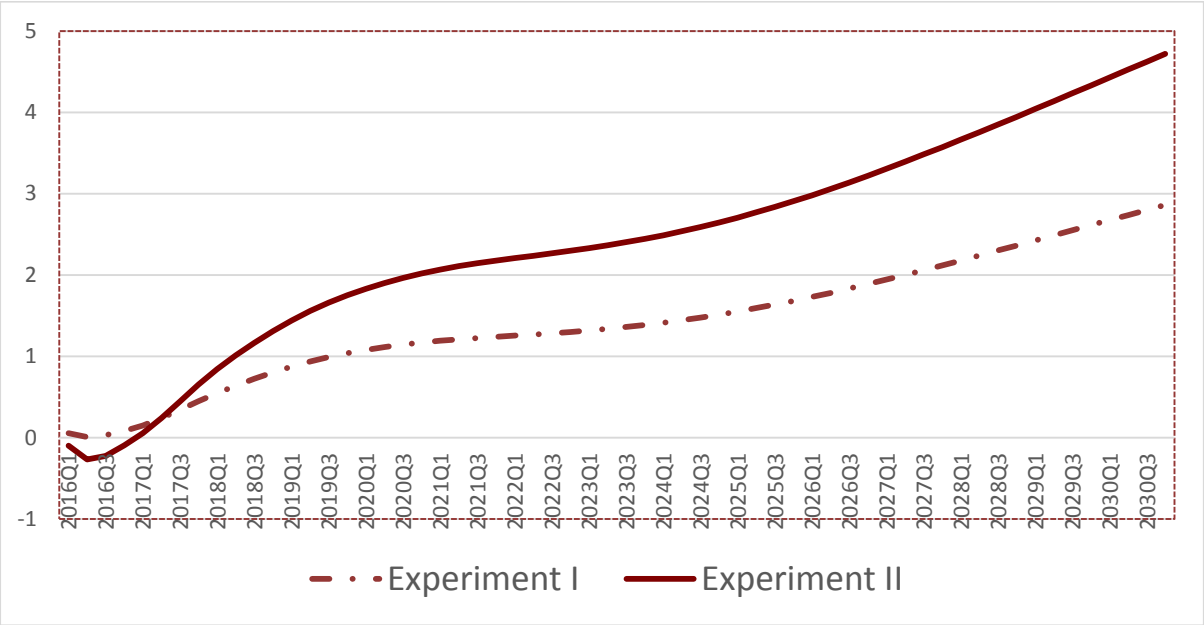


Source: NiGEM and other national statistical data

The main impact of higher business investment rates is higher long-run productivity, due to the greater stock of available business capital that has been built up. Figure 21a shows that UK output per hour worked, the preferred measure of productivity, increases by 2.3 % by 2028, and by 2.8% by

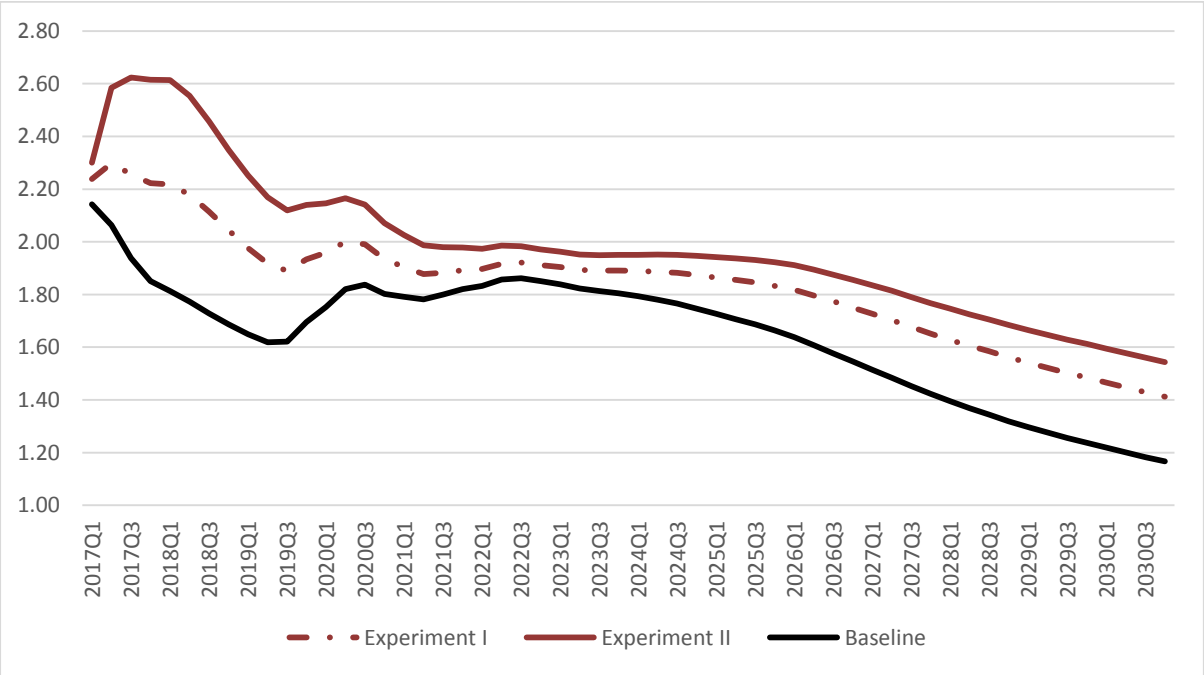
2030. Figure 21b also shows that the productivity gains from higher business investment keep growing over time. This is because the permanently higher rate of business investment also leads to a permanently higher rate of productivity growth (Figure 20b). In 2028, productivity growth is 1.59% annually, rather than 1.36%, an increase of nearly a quarter of a percentage point of productivity growth annually.

Figure 21a: UK Productivity, Percentage Increase from the Baseline



Source: National statistics from multiple countries, OECD

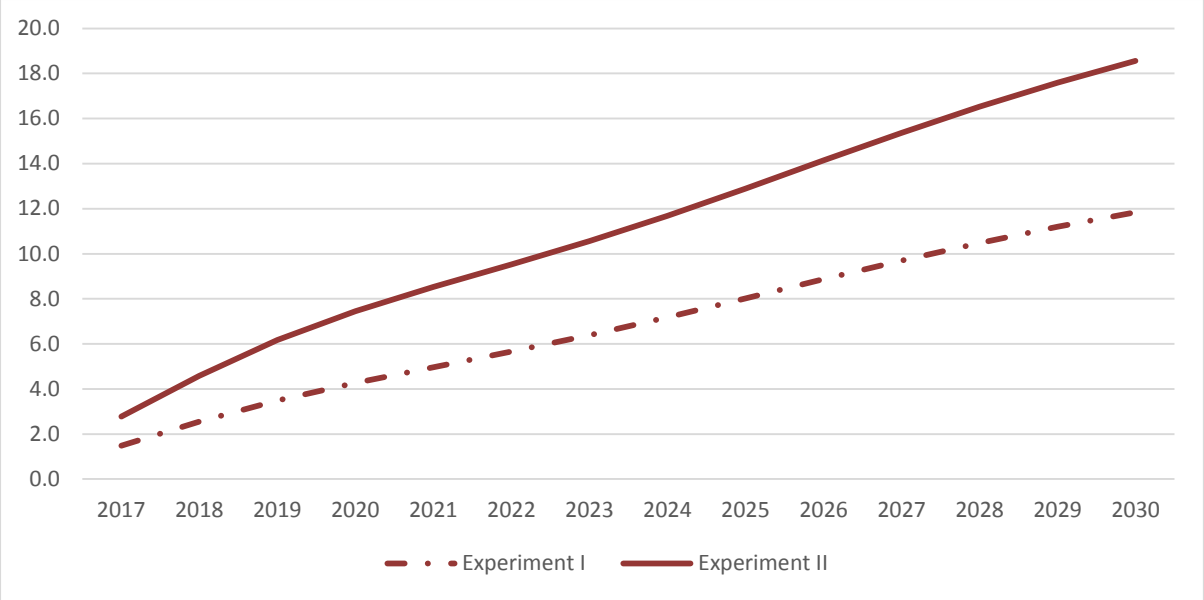
Figure 21b: UK productivity growth rates, annual



Source: National statistics from multiple countries, OECD

When workers are able to produce more in every hour worked, their wages should rise. Indeed, we see that by 2028, UK real consumer wages have increased by 10.5%, as shown in Figure 22.

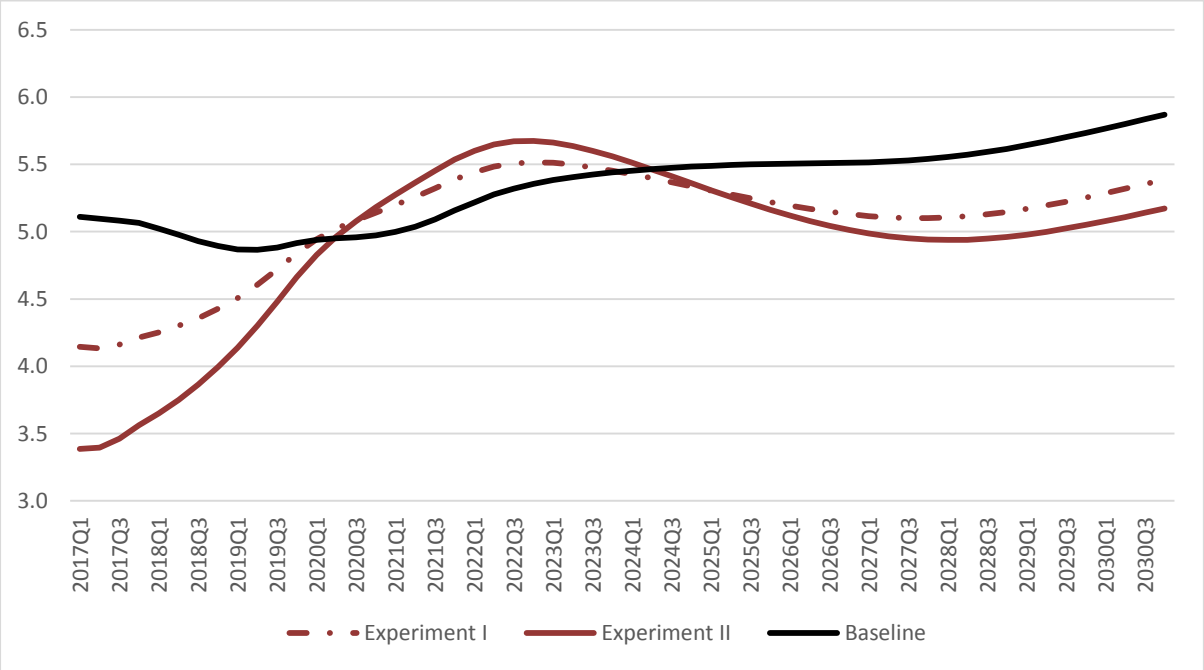
Figure 22: Real consumer wages, percentage increase from baseline



Source: NiGEM and other national statistical data

The increase in real wages is larger than the increase in productivity for three reasons. First, unemployment declines persistently in response to the stimulus of greater investment spending, as more workers are hired to use the larger capital stock (Figure 23).

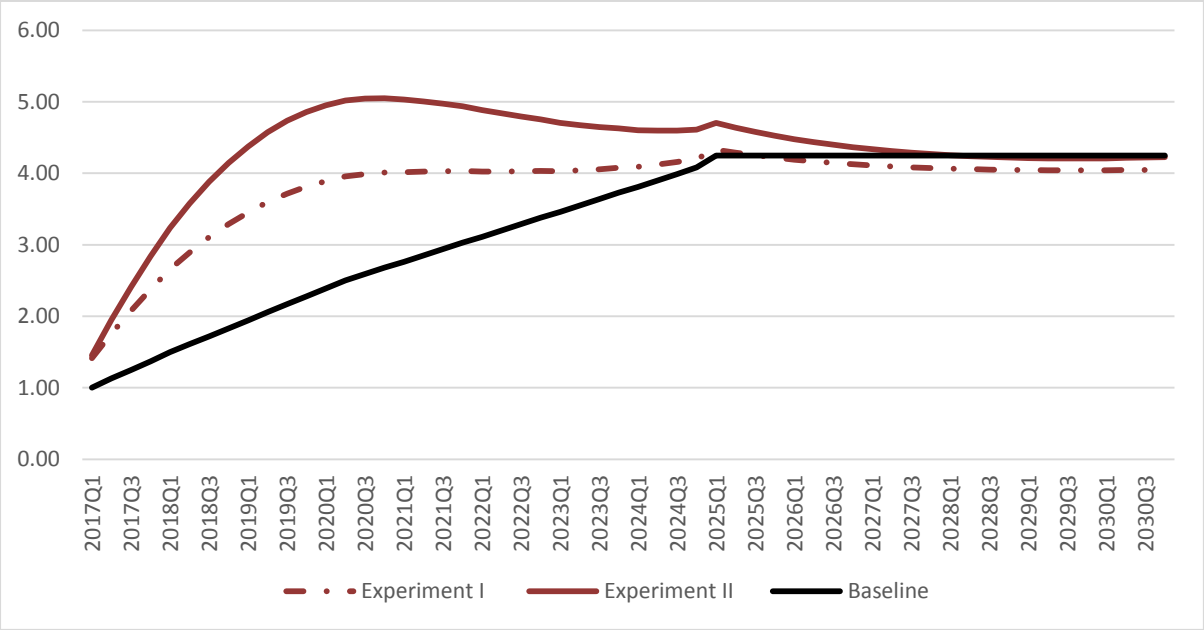
Figure 23: UK unemployment rates, levels



Source: NiGEM and other national statistical data

This grants workers greater bargaining power when negotiating over wages, allowing workers to obtain a greater share of any profits arising out of the employment relationship. The brief period of higher unemployment is caused by tighter monetary policy in response to the inflationary stimulus from increased business investment rates (Figure 24). Second, government spending plans are held constant, so that as productivity and GDP increase, tax rates on labour income can decrease, boosting after-tax wages. Finally, by 2028, cumulative inflation is slightly slower in Experiment I than in the baseline.

Figure 24: UK monetary policy interest rates, levels

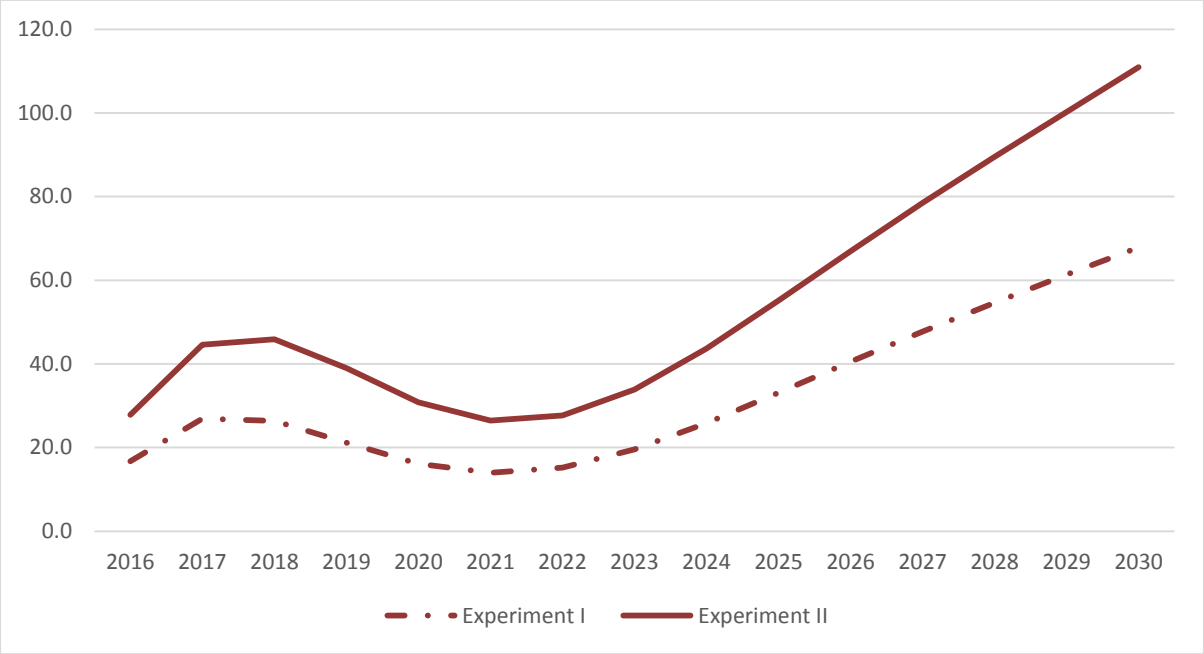


Source: NiGEM, Bank of England

Greater productivity also translates into higher GDP (Figure 25a). By 2028, annual GDP is £54.6 billion higher than in the baseline. This translates into annual GDP that is 2.3% higher than in the baseline by 2028. This is not only down to the larger business capital stock, but also due to the reduction in unemployment and commensurate increase in employment. Moreover, the increase in GDP is growing over time, due to the cumulative impact of GDP growth rates that are permanently higher by 0.25 percentage points annually (Figure 25b).[37] This long-term increase in GDP growth rates is due to permanently higher rates of business investment.

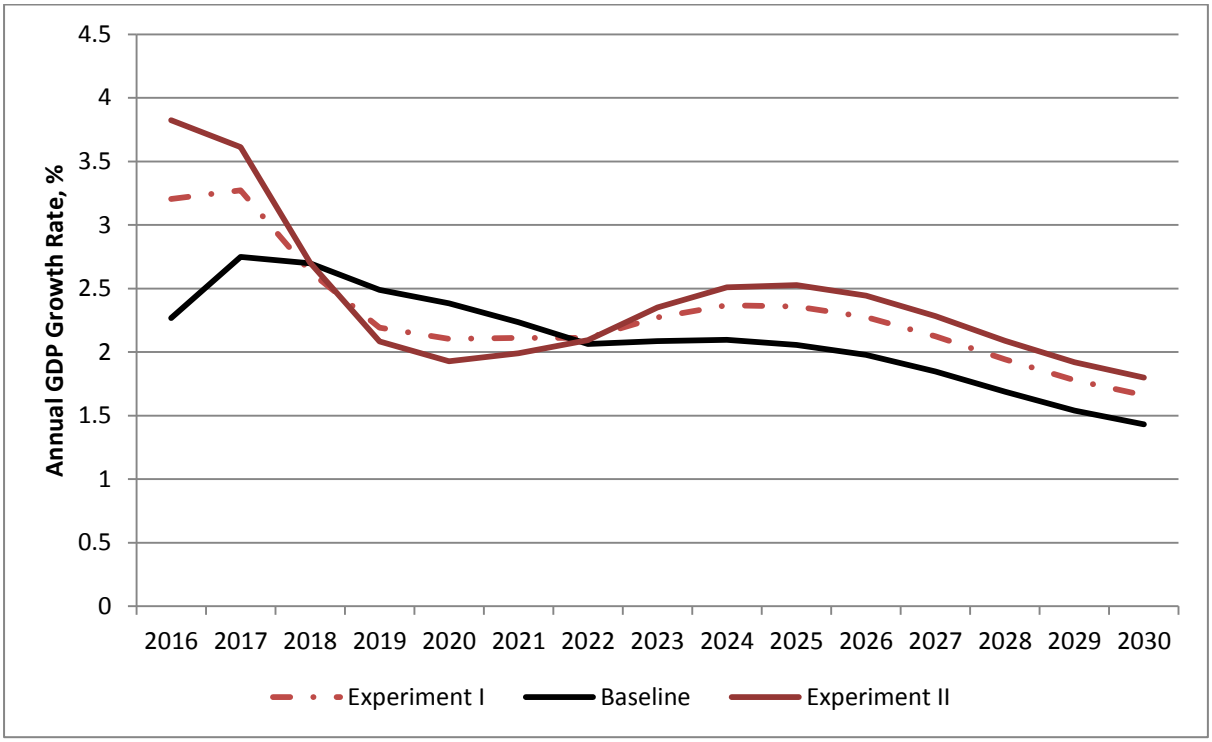
[37] Once again, there is a short-term dip in GDP growth rates compared to the baseline, as the monetary policy tightening peaks in 2019.

Figure 25a: GDP, increase from baseline in £ billions



Source: NiGEM and other national statistical data

Figure 25b: UK GDP growth rates, %



Source: NiGEM and other national statistical data

To put this long-run increase in GDP in perspective, we compare these gains to the long run losses in GDP from our assessment of the economic impact of Brexit (Ebell and Warren, 2016). The increase in GDP from increasing business investment to 11.7% of GDP by 2028 is similar to the loss in GDP from

the trade and FDI impacts of the Swiss scenario of 1.9% to 2.3% relative to the baseline. The Swiss scenario involves replacing the single market a free trade agreement with the EU covering goods, but not most services, including financial services.

Of course, as already mentioned above, this increase in business investment does not only stimulate the real economy. In our model, inflationary pressures rise too. As a result, the central bank tightens monetary policy in the short to medium term, in order to tame inflation. Initially, the monetary policy interest rate rises, peaking at 1.5 percentage points above the baseline in 2019, in order to bring inflation back to its target level of 2% (Figure 24). This monetary tightening dampens the impact of the increased business investment somewhat. However, in the longer term, higher productivity is projected to allow the Bank of England to keep interest rates about 0.2 percentage points lower than the baseline, whilst still meeting its inflation target.

2.3.2 Experiment II: Increasing both the share of business investment and total investment

Next, we examine the impact on the UK economy of increasing both the total level of private sector investment and the share devoted to business investment at the same time. This involves both increasing the UK's total private sector investment from 13.9% to 17.0% of GDP, and increasing the share of business investment in private sector investment to 78.4% from its 2014 level of 66%. The combined impact of these two measures on business investment would be to raise it from 9.2% of GDP to 13.3% of GDP (Figure 20b), similar to France (12.9%), but still short of Austria (14.3%), Sweden (14.7%) or Ireland (15.2%).

Once again, the chief impact of higher business investment is greater long-run productivity, due to the greater stock of available business capital. Now UK output per hour worked, the preferred measure of productivity, increases by 3.8 % by 2028, and by 4.6% by 2030. Again, the permanently higher rate of business investment also leads to a permanently higher rate of productivity growth (Figure 20b). Now productivity growth reaches 1.72% annually in 2028, an increase of 0.36 percentage points of productivity growth annually over the baseline productivity growth rate of 1.36%.

Again, the gains from higher output per hour worked are shared with workers in the form of higher wages. Indeed, we see that by 2028, UK real consumer wages have increased by 16.5%, as shown in Figure 22.[38]

Greater productivity also translates into higher levels of GDP (Figure 25a).Now, by 2028, annual GDP is £89.5 billion higher than in the baseline. This is equivalent to annual GDP that is 3.8% higher than in the baseline by 2028, and 4.5% higher than the baseline by 2030. Now, GDP growth rates are higher by 0.40 percentage points annually in the long run, reaching 2.1% annually in 2028 rather than 1.7% in the baseline (Figure 25b).[39] This long-term increase in GDP growth rates is due to permanently higher rates of business investment.

[38] See Experiment I for a discussion of why real wages increase more than productivity.
[39] Once again, there is a short-term dip in GDP growth rates compared to the baseline, as the monetary policy tightening peaks in 2019.

Again, we place the increases in GDP in perspective by comparing them to the projected losses in GDP from losses in trade and FDI from leaving the European Union. We note that Ebell and Warren (2016)'s assessment of the impact of leaving the single market for a WTO arrangement with the EU would involve a long-run decline in GDP relative to baseline of between 2.7% and 3.7%.

Once again, the stimulus of higher business investment causes inflationary pressures to rise. To bring inflation back to target, Bank of England is projected to respond by tightening monetary policy in the short to medium term, peaking in 2019 at 2.5 percentage points above the baseline (Figure 24). This monetary tightening dampens the impact of the increased business investment somewhat. However, in the longer term, monetary policy rates come back nearly to their baseline.

3. Conclusions

This study examines the relationship between home ownership and pension savings. We first use panel data on UK households covering the period 1991 to 2012 to examine whether investment in residential housing crowds out savings. We find that the savings rate does indeed decrease by 0.7% percentage points in the year that the mortgage is taken out, dropping from 4.4% to 3.7%, a decline of 16%. The savings rate remains lower by an average of 0.8 percentage points in the 10 years after the mortgage is taken out, for a decline of 18% in the savings rate. We interpret this as evidence that households paying off a mortgage do divert savings to mortgage payments. This indicates that paying down a mortgage does crowd out savings for mortgage borrowers, at least in the first decade after a house is bought.

We also find that pension incomes of those who had bought a house using mortgage borrowing were 15% lower than those who rented or were able to buy outright. This suggests that it is indeed pension savings which are crowded out by the burden of mortgage debt. Mortgage borrowers were also about 5% more likely to experience financial difficulties in retirement. While this does not necessarily imply that mortgagee households on average are worse off in retirement, this does suggest that there is an important trade-off between servicing mortgage debt and investing in long-term private pension schemes.

Having established that mortgage debt does seem to crowd out pension savings, we now examine the impact of lower pension savings on the UK economy. In particular, we examine the impact of lower business investment on the UK economy, as pension savings tend to flow into business investment.

We use NiGEM, the National Institute's macroeconomic forecasting model, to examine the impact of increasing business investment. We performed two experiments, raising the UK's business investment first from its baseline of 9.2% of GDP to 11.7% of GDP (the same as the Netherlands), and then to 13.3% of GDP by 2028 (slightly higher than France at 12.9% of GDP).

In the model, higher levels of business investment lead to greater long-run productivity, due a permanently higher stock of business capital. The model predicts that UK output per hour worked, our preferred measure of productivity, would rise by 2.8% by 2030 in the first experiment, and further to 4.6% by 2030 in the second experiment. Moreover, productivity growth is higher by about a quarter of a percentage point by 2030 in the first experiment, and by 0.36 percentage points in the second experiment. This higher productivity growth also translates into higher GDP growth. In the

second experiment, GDP growth is predicted to be permanently higher by 0.4% annually, reaching 2.1% annually in 2028 rather than 1.7% in the baseline. Thus, shifting the composition of UK savings towards business investment might have substantial benefits for UK economic performance in the long-run.