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Has monetary policy made you happier?

Philip Bunn, Andrew G Haldane and Alice Pugh

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Abstract

Concerns were raised about the distributional impact of the loosening in UK monetary policy following the financial crisis. We assess the impact of this loosening on well-being using household-level data and estimated utility functions. The welfare benefits are found to have been positive, in aggregate and across most of the household distribution, relative to what otherwise would have happened. They are significantly larger than when looking at financial factors alone due to the non-financial benefits of lower unemployment and financial distress. Most people were made better-off in welfare terms from the monetary loosening, rich and poor, although the young have benefited more than the old.

Key words: Monetary policy, households, inequality, well-being.

JEL classification: D12, D31, E52, E58.

(1) Bank of England. Email: philip.bunn@bankofengland.co.uk
(2) Bank of England. Email: andy.haldane@bankofengland.co.uk
(3) Bank of England. Email: alice.pugh@bankofengland.co.uk

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Bank of England, Threadneedle Street, London, EC2R 8AH
Email enquiries@bankofengland.co.uk

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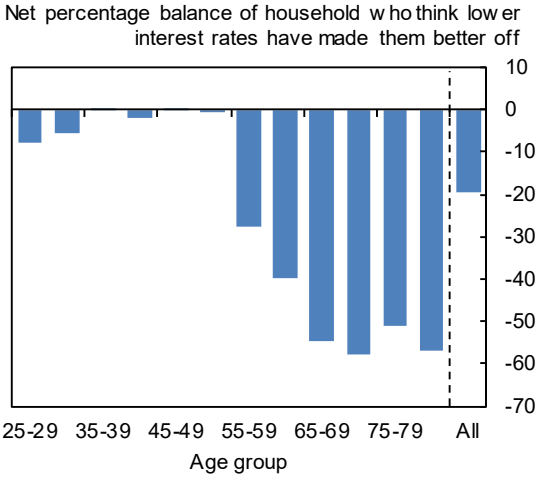
1. Introduction

The financial crisis led to an unprecedented loosening in monetary policy in many countries. Interest rates in advanced economies fell to historical lows, including in the United States, United Kingdom and euro area. And central banks in each of these countries provided additional stimulus by expanding their balance sheets, most commonly via Quantitative Easing (QE). For over a decade, interest rates stayed close to their zero lower bound in a number of advanced economies, while over $10 trillion of purchased assets remained on the balance sheets of major central banks in 2019.[1]

Chart 1: Households think that low interest rates have made them worse off since 2008[(a)]



(a) Data are taken from the April 2017 NMG Survey of households, commissioned by the Bank of England. Households were asked 'Taking into account all of the ways in which you think you have been affected, do you think that lower interest rates (Bank Rate) have made you better or worse off than would have been the case if interest rates had remained at 4.5% in every year since 2008?'. For more detail see Bunn et al (2018).

Over the same period, concerns about widening inequality rose to the forefront of public debate (Joyce and Xu (2019)). Monetary policy easing by central banks is often perceived to have worsened these problems (Bernanke (2015)). For example, it has been argued that, by boosting asset prices, QE has increased inequalities between the rich and poor (Colciago et al (2019)). Some of these concerns have shaped public perceptions regarding monetary policy. For example, in surveys of UK households, a majority believe lower interest rates have made them worse off financially, particularly older households (Chart 1).

Partly in response to these criticisms, several recent studies have analysed the quantitative impact of looser monetary policy on the income and wealth of households, using macro time-series and micro-based approaches. Using either approach, these studies typically find that the effects of monetary policy loosening on inequality and the distribution of income and wealth have been modest and monetary policy may even have reduced inequality slightly (Coibion et al (2017), Mumtaz and Theophilopoulou (2017), Bunn et al (2018), Casiraghi et al (2018), Furceri et al (2018), Guerello (2018) and Lenza and Slacalek (2018)).

This paper looks beyond the effects of looser monetary policy on income and wealth to its effects on household well-being. We focus on the United Kingdom although many of our results are likely to be relevant to the experience of other countries too. We link quantitative estimates of the macroeconomic impact of looser monetary policy over the financial crisis to survey data on individual household balance sheets and well-being. To our knowledge, this is the first paper to attempt to quantify these effects.

[1] This refers to the UK, euro area, US and Japan.

We find that looser monetary policy between end-2007 and 2014 had a positive and significant impact on household well-being in the UK, in aggregate and across most of the distribution, relative to a counterfactual of no change in policy. Because overall well-being fell after the financial crisis, the effect of monetary policy was to mitigate this fall rather than boost well-being in absolute terms. Strikingly, much of this relative welfare gain came through *non-financial*, rather than the conventional financial (income and wealth) channels. The lower incidence of household unemployment and financial distress than would otherwise have been the case is estimated to account for 80% of the overall welfare gain. Rises in household income account for most of the remainder, with wealth only accounting for a small fraction despite these effects often being large in financial terms.

Monetary policy loosening is found to have had a positive impact on the well-being of the majority of the public, with only a minority made worse-off. Younger households with less secure jobs and higher debts experienced the largest welfare gains, as looser monetary policy helped them avoid unemployment and financial distress. Older households dependent on savings income are most likely to have been made worse-off, although these households are found to have been relatively few in number and the scale of loss is typically small.

It seems probable that households do not attribute lower unemployment and financial distress to monetary policy, when thinking about whether or not looser monetary policy over the financial crisis made them better off. Households are likely to observe the direct and immediate effects of looser policy, such as higher asset prices and lower deposit rates. But it is harder for them to recognise, or attribute to monetary policy, the indirect benefits such as the boost to job prospects or the reduction in the chances of financial distress. These take longer to emerge but their welfare effects are larger. It may also be hard for households to understand what might have happened without the monetary easing, particularly as the financial crisis had an adverse impact on well-being even after the effects of easier monetary policy. For these reasons, surveys of public perceptions (such as the one shown in Chart 1) may systematically under-estimate the welfare benefits of monetary policy easing.

While our focus is on the global financial crisis, the channels that we consider will also be relevant for assessing the welfare implications of the monetary policy response to other shocks such as the spread of Covid-19 during 2020. The precise implications of the response to other events will depend on factors such as the policy instruments used, the size and timing of policy changes and households' prior financial positions. But we contribute a framework for analysing the impact on well-being of the policy response to such events. In particular, we demonstrate the importance of accounting for the large welfare benefits that may be associated with policy mitigating the extent of any rise in unemployment or financial distress.

Our study complements and extends the literature on the quantitative effects of monetary policy by placing these effects in an explicitly welfare setting. It is also closely related to the literature on the economic determinants of well-being. Economic evidence – including from regressions of happiness on income using cross-sectional data – suggests that higher income is associated with greater happiness (see for example Clark et al (2008)). That relationship is less clear when looked at over a longer period of time (Easterlin (1974), Easterlin (2013)), although one explanation for this discrepancy is that relative levels of income may matter more for well-being than absolute levels (Clark and Oswald (1996), McBride (2001), Blanchflower and Oswald (2004), Clark et al (2008)).

The extent to which income and wealth are associated with greater well-being is important for our study, since we want to quantify the relationship between monetary policy-induced changes in

income and wealth and household well-being. We estimate utility functions based on household survey data in which income and wealth are associated with greater well-being. The marginal utility of additional income and wealth is diminishing, however, which means that even though wealthier households tended to gain more than poorer households in cash terms from looser monetary policy, they may not have benefitted more in utility terms.

The happiness literature also investigates the importance of macroeconomic outcomes, including unemployment and recessions, for well-being (Di Tella et al (2001), Frey and Stutzer (2002), Di Tella et al (2003)). It has been well established that unemployment has a large negative impact on the happiness of those who lose their jobs (Clark and Oswald (1994), Winkelmann and Winkelmann (1998), Blanchflower and Oswald (2004)). Our findings are consistent with these studies. Both joblessness and debt arrears have been found to have significantly negative psychological effects on household well-being, over and above their negative effects on household income (Marmot et al (1997), Weich and Lewis (1998) and Brown et al (2005), Taylor et al (2011)). There is also evidence that unemployment can lower the overall level of well-being beyond the impacts on the affected individuals, for example by creating a fear of unemployment (Di Tella et al (2001), Clark (2003)).

There are several important caveats to our work. First, our study is an event-study exercise focused on the monetary policy response to a single event – the global financial crisis. The exercise considers the impact of monetary policy relative to a counterfactual world in which there was no change in Bank Rate and no quantitative easing. It is therefore not an assessment of policy decisions relative to some counterfactual monetary policy rule or a measure of equilibrium interest rates.

By focussing on a single, unprecedented event, our research does not speak to how monetary policy interventions over the course of the conventional business cycle might affect household welfare. Loosening monetary policy will not always benefit welfare and nor necessarily will tighter policy worsen it. For example, if monetary policy tightens because demand is strong and inflationary pressures are rising, that could generate a gain over the business cycle if the chances of a larger and sharper subsequent economic correction are avoided. An assessment of the welfare effects of monetary policy over the business cycle is left for future research.

Finally, our study does not attempt to quantify the welfare gains that have come from the current inflation targeting framework. A large literature has shown that this framework has been successful at delivering low and stable inflation (see for example Clarida et al (1999), Walsh (2009), Hammond (2012)).[2]

The remainder of the paper is structured as follows. Section 2 describes our methodology, covering our estimates of household utility functions and how these are used to assess the welfare implications of UK monetary policy changes after the end of 2007. Section 3 presents the results from this exercise for household welfare, in aggregate and across the distribution. Section 4 concludes with some implications for policy and future research.

[2] There is also evidence that poorer households experience higher and more volatile inflation, and so benefit more from the improvements brought about by the current inflation targeting framework. See for example 'CPIH-consistent inflation rates for income groups by category of spend, UK: 2005 to 2018', Office for National Statistics, and Carney (2016).

2. Methodology

2.1 Estimating utility functions

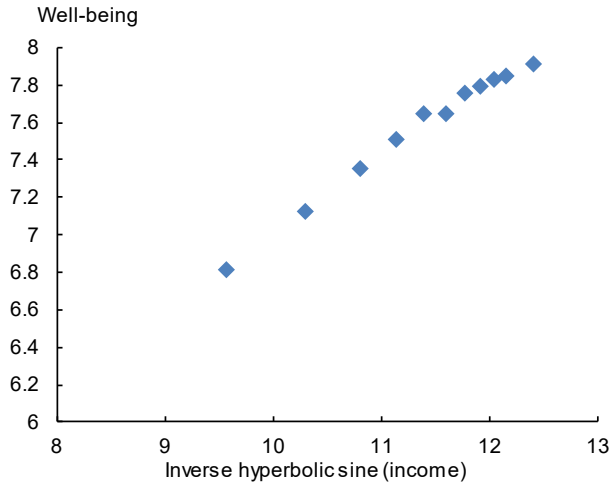
Monetary policy influences household well-being in a number of ways. Most obviously, it affects households' income and wealth through various channels. But it may also have effects beyond financial channels - for example, by reducing the incidence of unemployment or financial distress. To analyse the welfare effects of monetary policy on households, we need a way of capturing these financial and non-financial effects on households' welfare. To do so, we estimate household-level utility functions of the general form:

$$U = \emptyset(\alpha(y), \beta(w), \gamma(X)) \quad (1)$$

where U is utility, y is income, w is wealth and X includes variables other than income and wealth. This empirical specification can be used to assess, among other things, the relative utility weight households place on current versus permanent income (wealth), α and β; which variables other than income and wealth, X, affect household well-being and with what weight, γ; and the curvature of the utility function (degree of diminishing marginal utility), $\emptyset$.

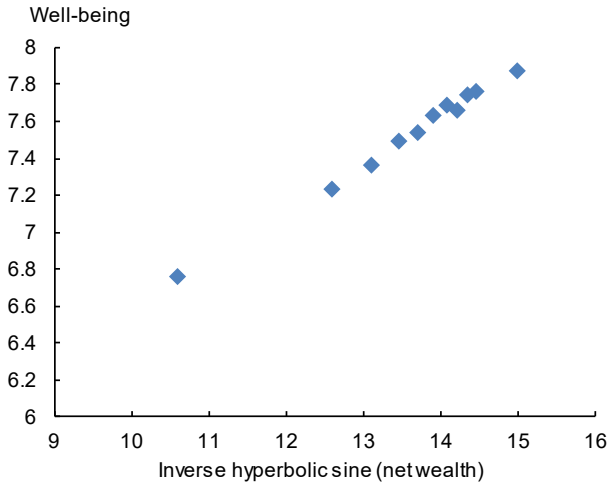
A number of approaches are possible for estimating household utility functions. We draw on the survey-based approach of Layard et al (2008), using direct measures of subjective well-being from the UK's Wealth and Assets Survey (WAS).[3] Specifically, this survey asks UK households to rate their well-being on a scale of 0-10 based on four questions.[4] Our primary measure of well-being is the average of the survey questions on satisfaction and happiness for all adults in the household, though robustness checks based on other measures are included in the Annex.

Chart 2: Well-being and income[(a)]



(a) Well-being is defined as the average of happiness and life satisfaction. Data are for 2011-2016. Income is annual and in real terms at 2013 prices. Diamonds are for households grouped into £10,000 income bands. The top group is income over £100,000.

Chart 3: Well-being and net wealth[(a)]



(a) Well-being is defined as in Chart 2. Data are for 2011-2016. Wealth is in real terms at 2013 prices. Diamonds are for households grouped into £100,000 wealth bands. The top group is wealth over £1,000,000.

[3] The Wealth and Assets Survey is a household survey with a large panel element run by the UK statistical agency, the Office for National Statistics (ONS). It is the primary source of disaggregated data on households' balance sheet positions in the UK, with households interviewed once every 2 years beginning in 2006-08. The latest available wave when the analysis in this paper was carried out was for 2014-16. Around 20,000 households are interviewed during each wave. Questions on well-being were introduced in 2011 during the 2010-12 wave, and so we restrict our regression analysis to the surveys carried out in mid-2010 to mid-2012, mid-2012 to mid-2014 and mid-2014 to mid-2016: around 48,000 observations in total.

[4] These are: 'Overall, how satisfied are you with your life nowadays?'; 'Overall, to what extent do you feel that the things you do in your life are worthwhile?'; 'Overall, how happy did you feel yesterday?'; and 'Overall, how anxious did you feel yesterday?'

Charts 2 and 3 show that there is a clear positive relationship between income and wealth and household well-being in our sample data.[5] This relationship is log-linear which implies diminishing marginal utility of income and wealth, as previous empirical studies have found (for example, Layard et al (2008)). Put differently, it suggests changes in well-being arising from changes in income and wealth are appropriately captured in percentage terms.

Our approach to estimation assumes that subjective well-being, *u*, is linked to true household utility, U, in the following form:

$$u_{it} = \alpha_i + \delta_t \frac{y_{it}^{1-\theta}-1}{1-\theta} + \gamma_t \frac{w_{it}^{1-\theta}-1}{1-\theta} + \sum_j \beta_j x_{jit} + \gamma_t + \varepsilon_{it} \quad (2)$$

where u_{it} is the average well-being score for all members of household *i* at time *t*; y_{it} and w_{it} are the income and wealth of household *i* at time *t* (both measured in real terms); and $\theta = 0$ corresponds to a linear relationship between utility and income, while $\theta = 1$ indicates log-linearity.

$\sum_j \beta_j x_{jit}$ is a vector of other controls. This includes dummies for being unemployed, in arrears for more than two months on a mortgage or unsecured debt, and falling behind with other bills, to capture the additional non-financial costs of unemployment and financial distress. We also include household-specific controls for age, marital status, economic activity of head of household, the number of adults and children in the household, region and housing tenure. γ_t is a time dummy (corresponding to the month of interview in the WAS) and ε_{it} is the error term. As the WAS is a longitudinal survey, we include household-level fixed effects,α_i, to help eliminate bias from correlation between unmeasured household-level characteristics and the other determinants. Controlling for fixed effects is particularly important for our purpose of estimating how different well-being would have been if a household's financial circumstances had been different, i.e. we want the utility function to be estimated from past changes in circumstances for individual households in the panel and not from cross-sectional variation.

Our estimated utility functions, based on data from 2011-2016, are shown in Table 1.[6] The results match well with economic theory. Changes in income and wealth have a statistically significant positive effect on household well-being. Whilst the role of income in determining well-being has been widely studied, much less attention has been paid to the contribution of wealth, primarily because of constraints on data availability.[7] The impact of a 1% change in wealth has a substantially smaller effect on well-being, however, than a similar change in income (column 1).[8,9] This is consistent either with households exhibiting a significant degree of myopia or following a "hand-to-mouth" heuristic when setting their spending (Kaplan et al (2014)). The latter could reflect the costs of transforming illiquid wealth – such as housing or pension wealth – into cash.

[5] We use the inverse hyperbolic sine transformation rather than the log transformation because it allows zero and negative values to be included. The interpretation is similar to the log transformation: a 0.01 unit change in ihs(income) is approximately equivalent to a 1% change in income.
[6] Table A1 in the Annex reports alternative estimates of utility functions using different well-being measures as the dependent variable. The main findings we show in Table 1 are robust to this. The equations in Table 1 are estimated by OLS. Since the well-being data that we use as the dependent variable are discrete, the equations could be also be estimated using an ordered probit or logit model. But this would not allow household fixed effects to be easily included in the equation and so we prefer the OLS estimation where this is straightforward to implement. Estimating without fixed effects our results are broadly similar using OLS or an ordered probit.
[7] ONS (2015) presented some initial analysis of the relationship between wealth and well-being using the WAS, but only based on cross-sectional analysis of one wave.
[8] The equations in Table 1 use a measure of income after debt servicing costs. That is because when we come to estimate the welfare implications of monetary policy using this utility function we measure lower interest payments on debt as contributing to higher income. Columns 1 to 3 of Table A2 in the Annex show that there is not a large difference in the coefficient if income before debt servicing costs is used and that debt servicing costs have a significant negative coefficient in the utility function if included directly.
[9] Columns 6 and 7 of Table A2 in the Annex show the impact on the coefficients of excluding wealth and household-level fixed effects from the estimation. Excluding fixed effects causes the size of the income coefficient to double.

Table 1: Estimated household utility functions

Dependent variable	Average of happiness and life statisfaction			
	[1]	[2]	[3]	[4]
ihs(Income)	0.075***	0.065***	0.063***	
	(0.023)	(0.024)	(0.024)	
ihs(Net wealth)	0.020**			
	(0.010)			
ihs(Net financial wealth)		0.012***		
		(0.002)		
ihs(Pension wealth)		0.001	-0.000	
		(0.004)	(0.004)	
ihs(Net housing wealth)		-0.004	-0.004	
		(0.010)	(0.010)	
ihs(Physical wealth)		0.089***	0.083***	
		(0.030)	(0.030)	
ihs(Deposits)			0.033***	
			(0.008)	
ihs(Other gross financial wealth)			0.009***	
			(0.003)	
ihs(Unsecured debt)			-0.006	
			(0.003)	
Household head unemployed	-0.335***	-0.331***	-0.327***	-0.372***
	(0.108)	(0.108)	(0.108)	(0.107)
Other unemployed person in household	-0.058	-0.056	-0.056	-0.080
	(0.074)	(0.074)	(0.074)	(0.074)
Mortgage arrears of 2 months plus	-1.401***	-1.343***	-1.332***	-1.408***
	(0.345)	(0.337)	(0.339)	(0.342)
Unsecured debt arrears of 2 months plus	-0.258**	-0.243*	-0.253**	-0.280**
	(0.128)	(0.127)	(0.127)	(0.128)
Falling behind with bills & credit commitments	-0.327***	-0.301***	-0.304***	-0.337***
	(0.103)	(0.102)	(0.102)	(0.103)
Additional controls	Yes	Yes	Yes	Yes
Household Fixed effects	Yes	Yes	Yes	Yes
Observations	29,594	29,594	29,594	29,594

Robust standard errors in parentheses (clustered at household level), *** p<0.01, ** p<0.05, * p<0.1.
All equations are estimated by OLS using data collected betw een 2011 and 2016. All equations include additional controls for month of interview , age, marital status, economic activity of head of household, number of adults and children in household, region and housing tenure. Effect of being unemployed is relative to being employed. Income and w ealth variables are all in real terms and are at 2013 prices. Income is measured net of debt servicing costs. ihs is the inverse hyperbolic sine transformation.

Splitting net wealth into its various components corroborates the hypothesis that illiquid wealth matters less for well-being than more liquid forms. The only components of wealth to have a statistically significant effect on well-being are physical wealth (for example, cars or jewellery), financial wealth (for example, equities) and bank deposits (columns 2 and 3 of Table 1). In other words, assets that can easily be used to finance spending have a significant impact on well-being.

By contrast, housing and pension wealth, which are more difficult to monetise, do not affect welfare significantly.

Both becoming unemployed and suffering financial distress have a large and highly significant negative impact on household well-being, over and above their effects on income and wealth. Column 4 of Table 1 shows that the head of household becoming unemployed leads to a 0.37 point fall in well-being (on the 0-10 scale). After controlling for the negative effects on income and wealth, that effect is only a little smaller at 0.33 points (column 3 of Table 1). By way of comparison, a 10% fall in income is equivalent to only a 0.006 point fall in well-being.

The effects on well-being of being in arrears on unsecured debts, or behind on bills, are of a similar order of magnitude to becoming unemployed. The effects of being in mortgage arrears and at risk of losing your home are larger still, at around 1.3 points on the 0-10 scale. These results are consistent with micro-level evidence suggesting that the non-pecuniary or psychological impact of losing your job or facing financial distress can far outweigh the financial impact.

A number of studies have argued that relative income (and wealth) may also affect well-being. See Clark et al (2008) for a discussion. Table A2 in the Annex (columns 4 and 5) presents estimates including income and wealth measured relative to the average of the age group of the household head. While the coefficients on these relative terms are similar to the absolute coefficients, when included together the absolute terms dominate, perhaps because the sample periods are short and there was relatively little change in these average measures. We omit relative terms from our analysis, although the results are not sensitive to including them.

Finally, we investigated the possibility that 'fear of unemployment' also affects households' well-being, as was found by Di Tella et al (2001) and Clark (2003). In Table A3 of the Annex we report versions of our estimated utility function that include terms for the expected unemployment rate of the head of household. This is based on their age, their education and the region that they live in and therefore represents the unemployment rate of 'people like them'.[10] We also allow the coefficient on this variable to vary in our well-being equation depending on whether the head of household is employed or not to capture the fact that this effect should be most relevant to those in work. The coefficients on this fear of unemployment term are not statistically significant once income and wealth are fully controlled for. We therefore do not consider this channel in our later analysis. But we note that this 'fear of unemployment' is a more difficult channel to identify than the impact of unemployment on the well-being of those who lose their jobs, particularly with our relatively short time series and it could still be an important way in which monetary policy affects welfare. If there were an effect it is likely it would only further increase the importance of non-financial factors.

2.2 Assessing the welfare implications of monetary policy

To assess the impact of monetary policy on welfare, we need estimates of how it has affected each of the variables in the estimated utility function. For this we draw on the results of Bunn et al (2018). They combine estimates of the macroeconomic impact of monetary policy changes between the end of 2007 and 2014 (on output, employment, inflation and asset prices) with micro-data from the UK Wealth and Asset Survey on households' balance sheets, to estimate the impact of policy changes on households' measured income and wealth – a "macro-to-micro" approach. Table A4 of the Annex provides more information on the methodology used.

[10] The expected unemployment rate is estimated as the fitted values from a linear probability model for whether a person is unemployed with age, education, region and time as explanatory variables. All coefficients are allowed to vary by year. Data are from the Labour Force Survey between 2010 and 2016.

Over the sample period we consider, UK interest rates were lowered from 5.5% to 0.5% and £375 billion of QE was undertaken. This large policy intervention is estimated to have had a material aggregate impact on the UK economy (see Charts A1 to A6 in the Annex). The level of output is estimated to have been boosted by up to 8%, and the unemployment rate to have been lowered by 4 percentage points, relative to their counter-factual levels without any change in monetary policy.[11] Real asset prices are estimated to have been boosted by over 20%.

Bunn et al (2018) capture various channels through which monetary policy affects household balance sheets, income and employment. These channels include: the effects of lower interest rates in reducing the interest payments of borrowers and the savings income of savers; the effects of monetary policy on employment and wages and hence on household labour income; and the effects of monetary easing on asset prices and hence on measured financial, housing and pension wealth.

Charts 4, 5 and 6 summarise estimates from Bunn et al (2018) on the impact of the monetary policy changes after the end of 2007 on UK households' finances. The cumulative effects on income and wealth are estimated to have been large, at almost £100,000 per household on average. The effects are different for different age cohorts, with younger households estimated to have experienced the largest boost to disposable incomes as they are more likely to have been net borrowers and in work (Chart 4). By contrast, older households are estimated to have lost out on savings income, but to have gained most from the boost to financial, housing and pension wealth from higher asset prices.

Chart 4: Effects of monetary policy changes after end-2007 on income and wealth, by age

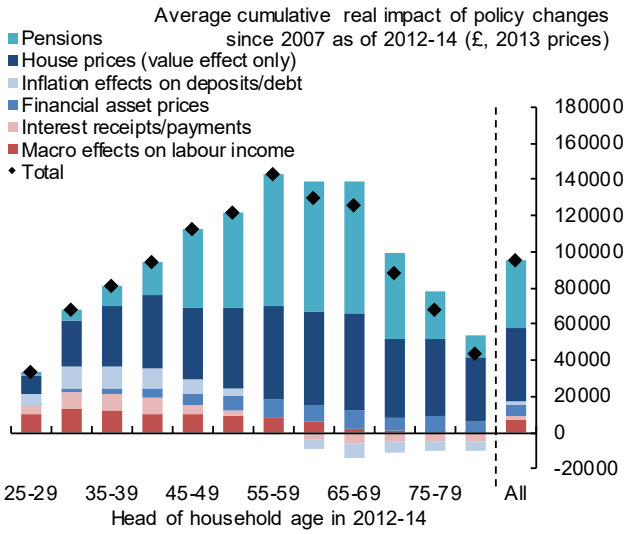
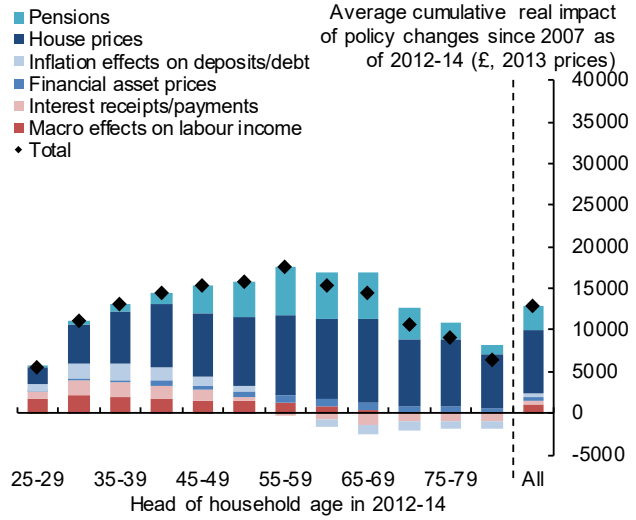
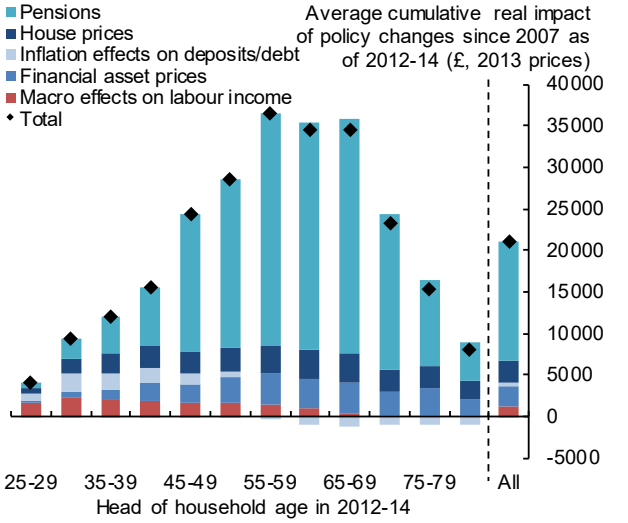


Chart 5: Distributional effects of a reduction in Bank Rate, by age[(a)]



(a) Results are scaled to show the effects of a policy loosing that would have boosted the level of GDP by an average of 1% a year during our sample period.

Chart 6: Distributional effects of QE, by age[(a)]



(a) Results are scaled to show the effects of a policy loosing that would have boosted the level of GDP by an average of 1% a year during our sample period.

[11] This simulation used the Bank of England's forecasting model and is the same as the one discussed in Carney (2016).

The effects of interest rates and QE are estimated to have been different (Charts 5 and 6 are scaled to allow a comparison for a similar amount of policy stimulus). In particular, QE is estimated to have provided a large boost to the value of pensions and financial assets, whereas the wealth effects of lower interest rates worked mainly through house prices.[12] Overall, monetary loosening is estimated to have had little effect on income and wealth inequality, with the boost to income and wealth not proportionally larger for rich than poor households.[13]

We also require estimates of the non-financial effects in our utility function, specifically the threat of unemployment or financial distress. In aggregate, it is estimated that the unemployment rate would have been 4 percentage points higher without monetary loosening in our scenario. To identify some individuals within the WAS survey who would have lost their jobs, Bunn et al (2018) draw some of those who were in work as people would have otherwise been unemployed, where the probability of been drawn as unemployed is based on experience during the financial crisis. Here younger and less educated people were more likely to lose their jobs (Charts A11 and A12 of the Annex). We use the same estimates and apply the estimated impact of being unemployed on well-being from our utility function to these people. In the event of unemployment, labour income is assumed to fall to the level of unemployment benefits. This is already captured by the labour income channel so the unemployment impacts represent the effects on well-being over and above the effects that unemployment has on income.

Bunn et al (2018) did not analyse financial distress but did model the impact of monetary loosening on income, unemployment and debt servicing costs. Using these determinants, we estimate linear models of the probability of being in mortgage arrears, arrears on unsecured debts and falling behind with bills and credit commitments. That allows us to estimate the change in the probability of entering these states for each household in the scenario where monetary policy was not eased after 2007. We use these probabilities to draw some households who would have otherwise faced financial distress without monetary loosening and assign them the associated boost to well-being from avoiding this implied by our utility function. Around 0.7% of households are estimated to have avoided facing some form of financial distress.[14] The modelling of financial distress is described in more detail in the Annex.

3. The welfare effects of monetary policy changes

Having combined the results from our estimated utility functions with our estimates of how monetary policy changes between the end of 2007 and 2014 affected each of the variables in that utility function, we can now consider what impact this extraordinary monetary policy intervention had on well-being, in aggregate and across the distribution of households.

Several results stand out. First, monetary policy loosening is estimated to have had a positive overall impact on household well-being, relative to a counterfactual of no change in policy. Average well-being is estimated to have increased by around 0.25%, or around 0.02 units on the 0 to 10 scale (Table 2). This may sound like a small effect. But the historical context is important. Chart 7 shows that households' average life satisfaction scores have remained broadly stable since the mid-

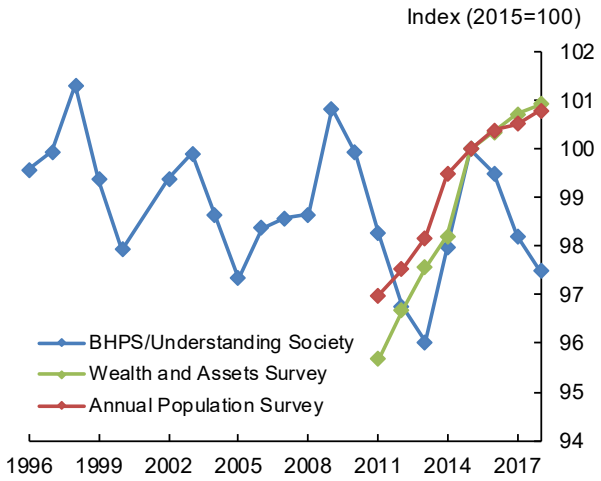
[12] Charts 5 and 6 are scaled so that they represent the effects of a similar amount of policy stimulus. Bunn et al (2018) only reported estimates of the combined effect of lower Bank Rate and QE on pension wealth. Charts 5 and 6 split this into contributions from Bank Rate and QE based on the estimated contribution of each policy measure to the reduction in gilt yields between end-2007 and 2014.
[13] The distribution of financial gains in cash terms was highly uneven, but this was due to the highly uneven prior distribution of income and wealth. See Annex Charts A7 to A10 for more details.
[14] 0.3% of households are estimated to have avoided mortgage arrears, 0.25% avoided unsecured debt arrears and 0.25% would have otherwise fallen behind on bills and credit commitments. There is allowed to be some overlap between these different forms of distress. See the Annex for further details.

1990s, only moving in a range of about 5%. And it is important to remember that this is a boost to well-being relative to what would have otherwise have happened. Unemployment and financial distress rose overall during this period, but by less than they would have done without the loosening in monetary policy.

Table 2: Effects of monetary policy changes after end-2007 on well-being (as of 2012-2014)

	Impact on well-being from monetary policy	Contribution to total increase in well-being from monetary policy
Channel:		
Income	0.04%	16%
Wealth	0.01%	4%
Unemployment	0.13%	50%
Mortgage arrears	0.05%	21%
Unsecured arrears	0.01%	4%
Behind on bills	0.01%	5%
Total	0.25%	100%

Chart 7: Life satisfaction over time



The non-financial benefits of looser monetary policy on welfare are estimated to have been large, and larger than the financial effects. Only 20% of the overall boost to welfare comes from financial factors (Table 2). Within that, income rather than wealth accounts for most of the increase, despite wealth effects dominating in monetary terms. That is because pension and housing wealth are estimated to have little impact on well-being, despite being boosted significantly, while financial wealth has only a small effect.

By contrast, non-financial channels account for 80% of the boost to aggregate household welfare. Lower unemployment explains 50% of the household welfare gain, with reduced financial distress accounting for the remaining 30%.[15] It is clear that failure to take account of these non-financial channels, which has tended to be the case in earlier studies on the effects of the monetary easing following the financial crisis, would seriously under-estimate the welfare benefits of these policy changes.[16]

While our analysis suggests that looser monetary policy has had important welfare benefits for households, this contrasts sharply with the negative public perceptions. This discrepancy can be explained by the general public failing to attribute to monetary policy its indirect benefits, in particular the increased chances of getting a job or avoiding debt arrears. This could lead households to under-estimate systematically the single-largest source of welfare benefit from monetary loosening. The idea that monetary policy prevented things from being worse than they would otherwise have been is also a harder concept for the public to understand than if absolute well-being had increased.

[15] Financial distress here refers to the combined effect of lower mortgage arrears, lower unsecured debt arrears and fewer people being behind on bills and credit commitments. Mortgage arrears account for around 70% of the total financial distress effect given the larger coefficient that mortgage arrears has in the utility function reported in Table 1.
[16] Remember from the previous section that the loss of income associated with unemployment is measured as part of the income effect here, so the unemployment effect refers to the effects on well-being over and above the loss of current income. This is likely to reflect the psychological effects of unemployment although it could also reflect expectations of lower future income.

Looking across the household distribution, easier monetary policy is estimated to have left the majority of households better-off in welfare terms. In Chart 8, we define better/worse off as an increase/decrease of at least 0.01% in household welfare. That is income-equivalent to just over 1% of annual income, or £375 for the average household. Using this definition, around 60% of households experienced an improvement in welfare, with a further 20% largely unaffected and around 20% worse-off. The worse-off households tend to be retired savers, whose savings income fell but who did not benefit from higher wages and a reduced risk of job loss.

Chart 8: Distribution of changes in well-being from monetary policy changes after end-2007

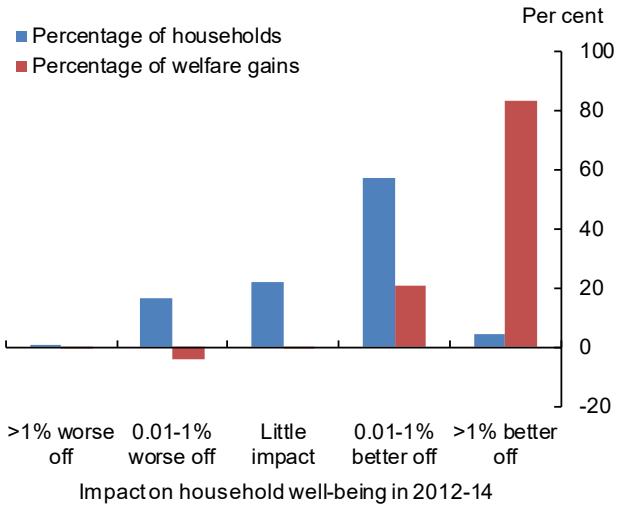


Chart 8 suggests that a small but significant number of households were made *a lot* better off, whereas almost no households were made a lot worse off. Around 4% of households saw an increase in welfare of over 1%, the equivalent of around two years' worth of income for the average household in our utility function. These are households who avoided becoming unemployed or entering financial distress. This group accounts for 80% of the aggregate welfare gains from looser monetary policy (the red bars on Chart 8).

Looked at by age, the benefits from looser monetary policy, and particularly the non-financial benefits, were heavily concentrated among younger households (Chart 9). They tend to have less-secure jobs and larger debts, which means they have a higher probability of unemployment and arrears. They also tend to benefit more in income terms from easier monetary policy as they are more likely to be in work and to be net debtors. Around 85% of households where the head is under 40 are estimated to have been made better-off, with only 1% worse off (Chart 10).[17]

The average well-being of older households was broadly unchanged (Chart 9). However, a slightly higher proportion of older households are estimated to have been made worse off than better off. Around 40% of households where the head is 65 or above were made worse-off, compared to around 20% who have been made better-off (Chart 10). Older cohorts tended to benefit less from non-financial channels and are more likely to have lost out from lower savings receipts. For some, this was offset by increases in the value of financial assets which were large in financial terms but have a modest impact on well-being.

[17] Charts A16 and A17 in the Annex show the distribution of households made better and worse off by income and net wealth decile. Note that our calculations do not capture the effects of looser monetary policy on future housing costs. Looser monetary policy tends to raise the cost of future housing, which affects younger households more than older households since the former are more likely to want to buy their first house or to trade up in future. See Bunn et al (2018) for more details.

Chart 9: Effects of monetary policy changes after end-2007 on well-being, by age

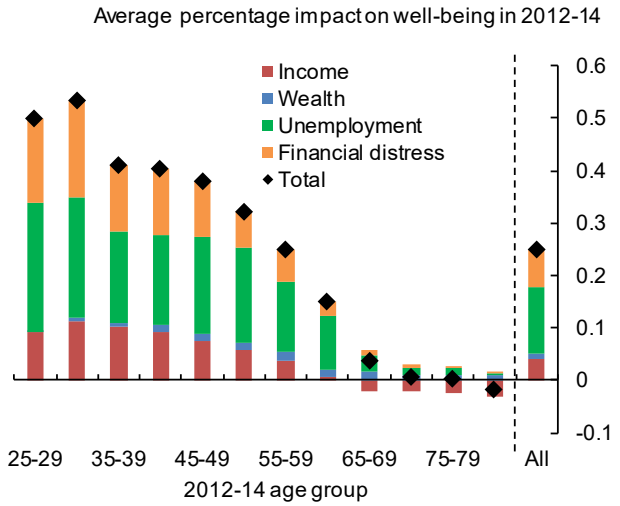
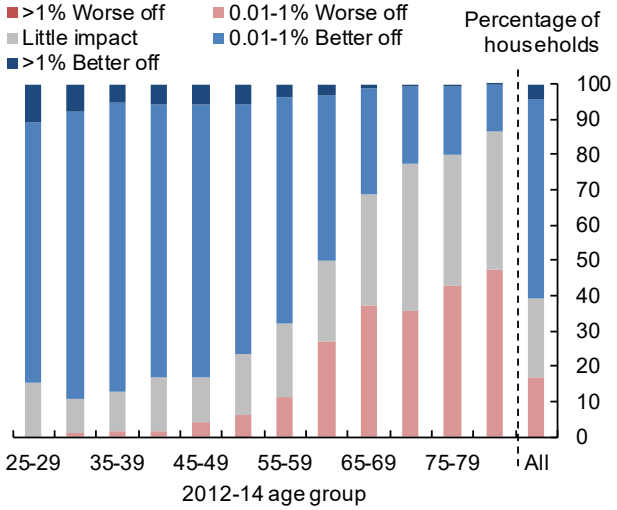


Chart 10: Proportion of households made better/worse off in well-being terms, by age



The impact of monetary policy on well-being also varied by income and wealth (Charts 11 and 12). Households in the bottom half of the wealth distribution are estimated to have gained more in well-being terms than those in the top half, particularly from the non-financial channels. By income, the welfare gains were been slightly larger further up the income distribution where people are more likely to be employed and to be net debtors. Households at the very bottom of the income distribution are estimated have seen the smallest benefits, as they tend to be renters (and so hold less debt) and are less likely to be in employment. Often, these are older retired households.

Chart 11: Effects of monetary policy changes after end-2007 on well-being, by wealth decile

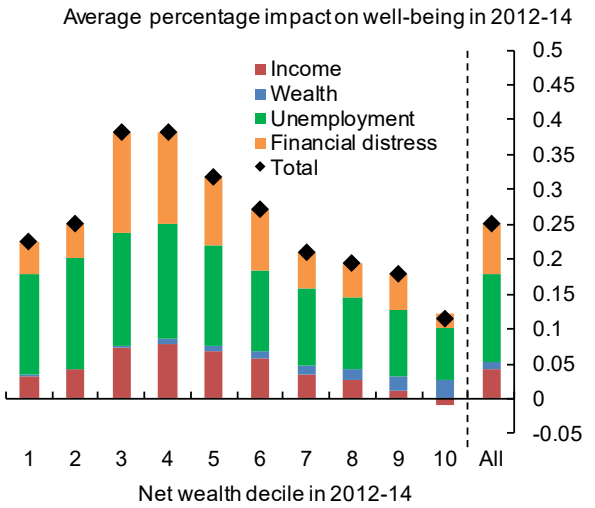
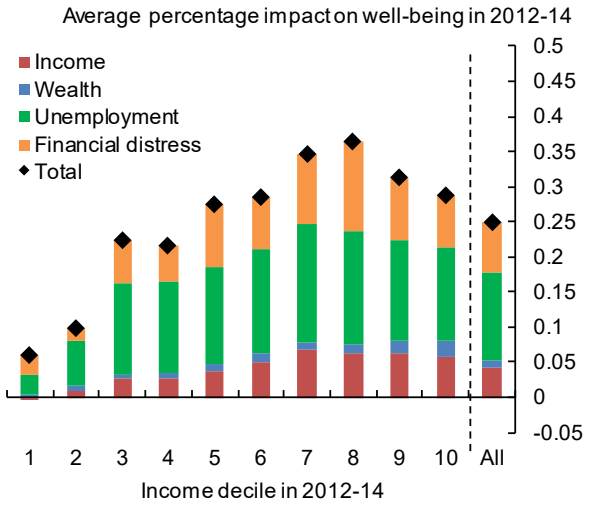


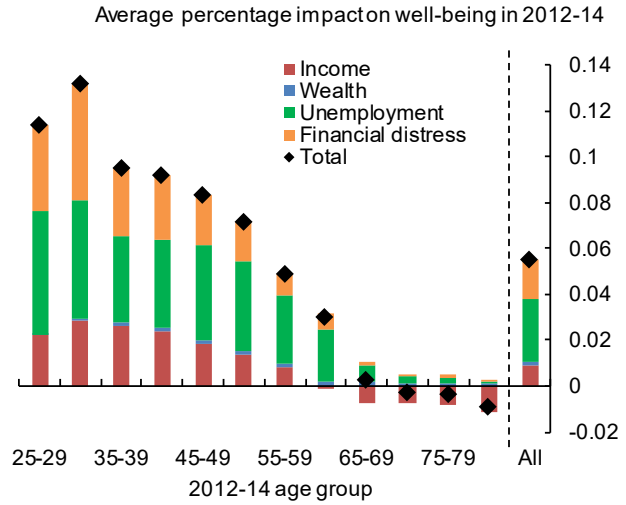
Chart 12: Effects of monetary policy changes after end-2007 on well-being, by income decile



Finally, the effects of lower interest rates and QE on well-being are estimated to have been relatively similar when scaled to the amount of stimulus that they provided (Charts 13 and 14 are scaled to allow a comparison for a similar amount of policy stimulus); more so than when compared in purely financial terms. The financial distress channel is estimated to have been larger for interest rates than QE, whereas the effects of QE on well-being is positive for all age groups as older households did not suffer from lower interest payments but did see their wealth boosted. Contrary to

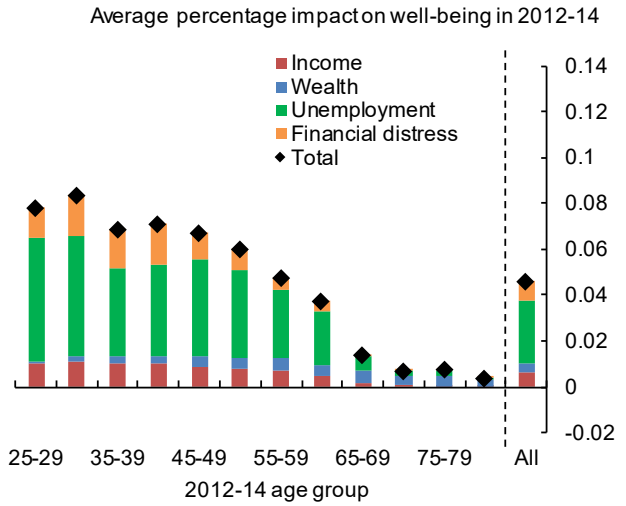
popular perception, QE had *fewer* adverse distributional side-effects than interest rates in well-being space. Indeed, QE appears to have made no household cohort worse off in an absolute sense.[18]

Chart 13: Impact on well-being of a reduction in Bank Rate, by age[(a)]



(a) Results are scaled to show the effects of a policy loosing that would have lowered the unemployment rate by 1pp in 2012-14.

Chart 14: Impact on well-being of QE, by age[(a)]



(a) Results are scaled to show the effects of a policy loosing that would have lowered the unemployment rate by 1pp in 2012-14.

4. Conclusion

This paper has used a novel macro-to-micro empirical methodology to assess the welfare benefits of the UK's significant loosening in monetary policy between 2008 and 2014. It is an event-study focussed on one episode (the financial crisis) and the monetary policy response to it. We find that the welfare benefits of monetary policy loosening were significant. They were also substantially larger than the monetary impacts alone, due to the effects of lower unemployment and financial distress. Monetary policy helped to lessen the negative effects of the financial crisis on well-being for the majority of households. A number of households were made significantly better-off than would have been the case, with almost no households made significantly worse-off. The young benefitted more than the old from easier monetary policy in welfare terms. The distributional effects of interest rates and QE were similar from a welfare perspective, though QE appears to have made almost no household worse-off.

Our results contrast with negative public perceptions of the impact of looser monetary policy. This may be because the general public do not attribute to monetary policy some of the indirect and lagged effects of policy actions – for example, the increased probability of finding/remaining in employment or the reduced probability of financial distress. Indeed, existing quantitative studies of the impact of QE and lower interest rates have also tended to overlook these non-pecuniary benefit and as a consequence have under-estimated their welfare impact.

Given these perception problems, our research highlights the importance of clear communications when explaining to the general public how monetary policy has benefitted them. One solution to this problem is for monetary policymakers to routinely publish distributional analysis.[19] This has already

[18] We scale Charts 14 and 15 by their impact on unemployment rather than GDP to make them as comparable as possible given the importance of unemployment to our estimates of the welfare impact of monetary policy. Charts A18 to A21 in the Annex show results for Bank Rate and QE split by income and wealth decile. Again these illustrate how the effects of interest rates and QE are broadly similar.
[19] The Behavioural Insights Team are specialists in the area of 'framing' the effects of policy in ways which increase public interest, understanding and trust. See Halpern (2015).

been done in other public policy settings, such as tax policy, and has been found to improve policy transparency and accountability (Sheffield Political Economy Research Institute (2015), Hallsworth et al (2017), Barnes et al (2018)). This paper is a contribution to that objective.

A second, more ambitious, approach to tackling the perception problem would be to link policy actions more explicitly to individual characteristics – so-called 'personalised framing'. Experimental trials suggest people are more likely to pay taxes or donate to charity if they know the personal impact of doing so (Behavioural Insights Team (2014), Agerstom et al (2016)). An equivalent for monetary policy could be a 'scorecard' allowing households to assess how policy affects their balance sheet, income, employment prospects and well-being (Haldane (2018)).

More generally, our research suggests that measures of well-being are a useful complement to traditional indicators of economic progress when designing and assessing the impact of public policy (Layard (2011)). A growing body of literature is making the case for looking "beyond GDP" when tracking the performance of the economy. Our research provides an example of how a well-being framework can be used to analyse the implications of macro-economic policies which do not have distributional objectives, but which can have distributional consequences.

Turning to future research, this paper has studied a large and specific monetary policy intervention. It focuses on the effects on well-being at a single point in time when the impact of the stimulus provided by monetary loosening was close to its peak. An interesting complementary study would consider the implications of monetary policy for well-being over the normal business cycle. This would be a fruitful topic for future research. So too would research using well-being measures to assess the optimal monetary policy response to different types of shocks to the economy.

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Annex

i) Alternative specifications of the household utility function

Table A1: Alternative household utility function estimates using different dependent variables

Dependent variable:	Average of happiness and life statisfaction	Average of all 4 well-being measures	Happiness	Life satisfaction	Life worthwhile	How anxious (inverted)
	[1]	[2]	[3]	[4]	[5]	[6]
ihs(Income)	0.063***	0.061***	0.077**	0.048**	0.040	0.071
	(0.024)	(0.022)	(0.033)	(0.024)	(0.025)	(0.044)
ihs(Pension wealth)	-0.000	0.000	-0.001	0.000	0.003	-0.002
	(0.004)	(0.004)	(0.006)	(0.005)	(0.005)	(0.008)
ihs(Net housing wealth)	-0.004	0.002	-0.010	0.002	-0.001	0.018
	(0.010)	(0.009)	(0.014)	(0.009)	(0.010)	(0.020)
ihs(Physical wealth)	0.083***	0.073***	0.110***	0.055*	0.084**	0.053
	(0.030)	(0.028)	(0.039)	(0.031)	(0.033)	(0.055)
ihs(Deposits)	0.033***	0.025***	0.025**	0.041***	0.024***	0.013
	(0.008)	(0.007)	(0.010)	(0.008)	(0.008)	(0.014)
ihs(Other gross financial wealth)	0.009***	0.005*	0.010**	0.009***	0.003	-0.002
	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.005)
ihs(Unsecured debt)	-0.006	-0.010***	-0.006	-0.005	-0.003	-0.027***
	(0.003)	(0.003)	(0.005)	(0.003)	(0.003)	(0.006)
Household head unemployed	-0.327***	-0.294***	-0.070	-0.584***	-0.393***	-0.141
	(0.108)	(0.099)	(0.145)	(0.108)	(0.114)	(0.189)
Other unemployed person in household	-0.056	-0.030	0.031	-0.143*	-0.070	0.067
	(0.074)	(0.067)	(0.097)	(0.075)	(0.078)	(0.128)
Mortgage arrears of 2 months plus	-1.332***	-1.103***	-1.475***	-1.187***	-0.692**	-1.043*
	(0.339)	(0.279)	(0.430)	(0.341)	(0.316)	(0.550)
Unsecured debt arrears of 2 months plus	-0.253**	-0.283**	-0.158	-0.356***	-0.200	-0.526**
	(0.127)	(0.116)	(0.167)	(0.131)	(0.137)	(0.214)
Falling behind with bills & credit commitments	-0.304***	-0.319***	-0.357***	-0.249**	-0.229**	-0.429***
	(0.102)	(0.091)	(0.130)	(0.110)	(0.108)	(0.163)
Additional controls	Yes	Yes	Yes	Yes	Yes	Yes
Household Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	29,594	29,499	29,613	29,608	29,547	29,600

Robust standard errors in parentheses (clustered at household level), *** p<0.01, ** p<0.05, * p<0.1.
All equations are estimated by OLS using data collected betw een 2011 and 2016. All equations include additional controls for month of interview , age, marital status, economic activity of head of household, number of adults and children in household, region and housing tenure. Effect of being unemployed is relative to being employed. Income and w ealth variables are all in real terms and are at 2013 prices. Income is measured net of debt servicing costs. ihs is the inverse hyperbolic sine transformation.

Table A2: Alternative household utility function estimates including alternative income variables

Dependent variable:	Average of happiness and life statisfaction						
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
ihs(Income after debt servicing costs)	0.075***				0.074**	0.080***	0.159***
	(0.023)				(0.036)	(0.023)	(0.014)
ihs(Net wealth)	0.020**	0.020**	0.020**		0.018*		0.044***
	(0.010)	(0.010)	(0.010)		(0.010)		(0.005)
ihs(Income before debt servicing costs)		0.081***	0.084***				
		(0.030)	(0.031)				
ihs(Debt repayments)			-0.011**				
			(0.004)				
Income after debt servicing costs % deviation				0.062***	-0.004		
from age group mean				(0.024)	(0.037)		
Net wealth % deviation from age group mean				0.038*	0.027		
				(0.022)	(0.023)		
Household head unemployed	-0.335***	-0.338***	-0.339***	-0.355***	-0.337***	-0.331***	-0.373***
	(0.108)	(0.108)	(0.108)	(0.107)	(0.108)	(0.108)	(0.060)
Other unemployed person in household	-0.058	-0.062	-0.058	-0.067	-0.059	-0.060	-0.192***
	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)	(0.052)
Mortgage arrears of 2 months plus	-1.401***	-1.397***	-1.402***	-1.412***	-1.398***	-1.415***	-0.869***
	(0.345)	(0.344)	(0.343)	(0.342)	(0.345)	(0.343)	(0.160)
Unsecured debt arrears of 2 months plus	-0.258**	-0.261**	-0.240*	-0.274**	-0.258**	-0.276**	-0.462***
	(0.128)	(0.128)	(0.128)	(0.128)	(0.128)	(0.127)	(0.073)
Falling behind with bills & credit commitments	-0.327***	-0.329***	-0.326***	-0.334***	-0.327***	-0.332***	-0.894***
	(0.103)	(0.103)	(0.103)	(0.103)	(0.103)	(0.103)	(0.051)
Additional controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	No
Observations	29,594	29,594	29,594	29,594	29,594	29,594	41,423

Robust standard errors in parentheses (clustered at household level), *** p<0.01, ** p<0.05, * p<0.1.

All equations are estimated by OLS using data collected betw een 2011 and 2016. All equations include additional controls for month of interview , age, marital status, economic activity of head of household, number of adults and children in household, region and housing tenure. Effect of being unemployed is relative to being employed. Income and w ealth variables are all in real terms and are at 2013 prices. Income and w ealth deviations from age group mean are based on 5 year age groups in the same survey w ave. ihs is the inverse hyperbolic sine transformation.

Table A3: Alternative household utility function estimates including 'fear of unemployment' variables

Dependent variable:	Average of happiness and life statisfaction			
	[1]	[2]	[3]	[4]
ihs(Income)			0.063***	0.063***
			(0.024)	(0.024)
ihs(Pension wealth)			-0.000	-0.000
			(0.004)	(0.004)
ihs(Net housing wealth)			-0.004	-0.004
			(0.010)	(0.010)
ihs(Physical wealth)			0.082***	0.082***
			(0.030)	(0.030)
ihs(Deposits)			0.032***	0.032***
			(0.008)	(0.008)
ihs(Other gross financial wealth)			0.009***	0.009***
			(0.003)	(0.003)
ihs(Unsecured debt)			-0.006	-0.006
			(0.003)	(0.003)
Household head (hh) unemployed	-0.338***	-0.395***	-0.327***	-0.366***
	(0.098)	(0.111)	(0.108)	(0.122)
Other unemployed person in household	-0.111*	-0.112*	-0.055	-0.055
	(0.065)	(0.065)	(0.074)	(0.074)
Expected unemployment rate for hh	-2.131		-0.407	
	(1.472)		(1.612)	
Expected unemployment rate for hh*hh not employed		-1.418		0.046
		(1.617)		(1.748)
Expected unemployment rate for hh*hh employed		-2.542*		-0.732
		(1.521)		(1.676)
Mortgage arrears of 2 months plus			-1.332***	-1.333***
			(0.339)	(0.338)
Unsecured debt arrears of 2 months plus			-0.253**	-0.253**
			(0.127)	(0.127)
Falling behind with bills & credit commitments			-0.304***	-0.305***
			(0.102)	(0.102)
Additional controls	Yes	Yes	Yes	Yes
Household Fixed effects	Yes	Yes	Yes	Yes
Observations	35,240	35,240	29,594	29,594

Robust standard errors in parentheses (clustered at household level), *** p<0.01, ** p<0.05, * p<0.1.

All equations are estimated by OLS using data collected between 2011 and 2016. All equations include additional controls for month of interview, age, marital status, economic activity of head of household, number of adults and children in household, region and housing tenure. Effect of being unemployed is relative to being employed. Income and wealth variables are all in real terms and are at 2013 prices. Income is measured net of debt servicing costs. Expected unemployment rate for head of household is estimated as the fitted values from a linear probability model for whether a person is unemployed with age, education, region and time as explanatory variables using data from the Labour Force Survey between 2010 and 2017, all coefficients are allowed to vary by year. ihs is the inverse hyperbolic sine transformation.

ii) The estimated impact of monetary policy changes after end-2007 on the macroeconomy

Chart A1: Interest rates

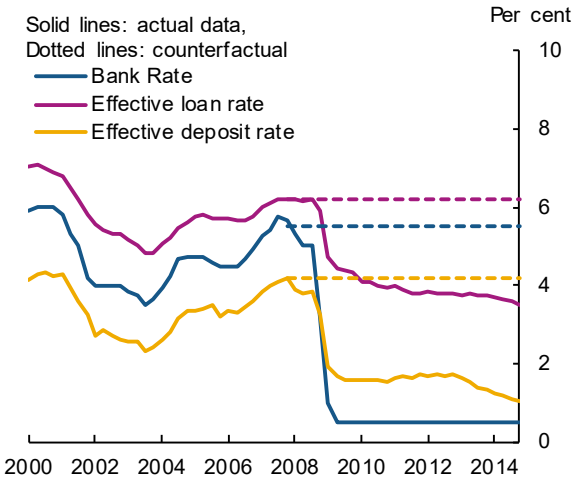


Chart A2: Stock of asset purchases

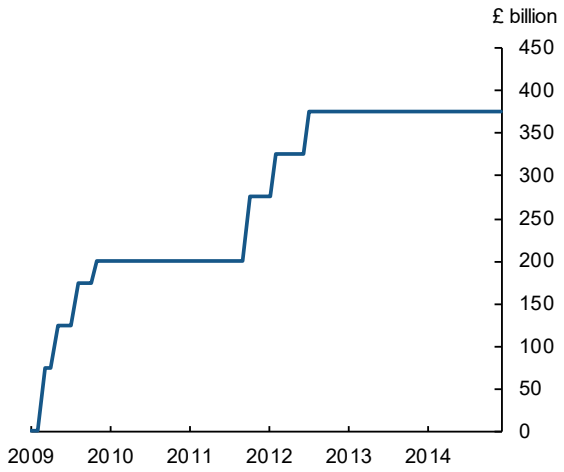


Chart A3: Effects of monetary policy changes after end-2007 on GDP

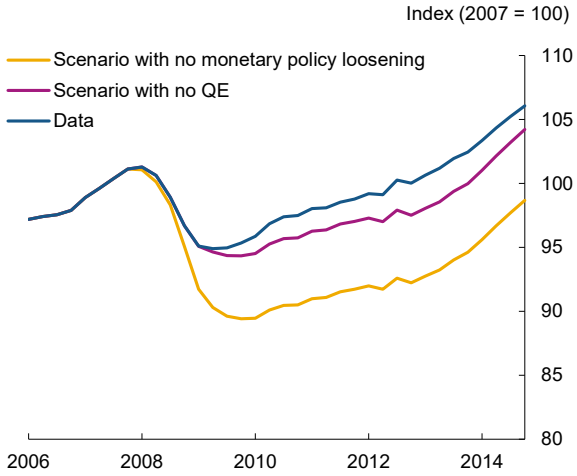


Chart A4: Effects of monetary policy changes after end-2007 on the unemployment rate

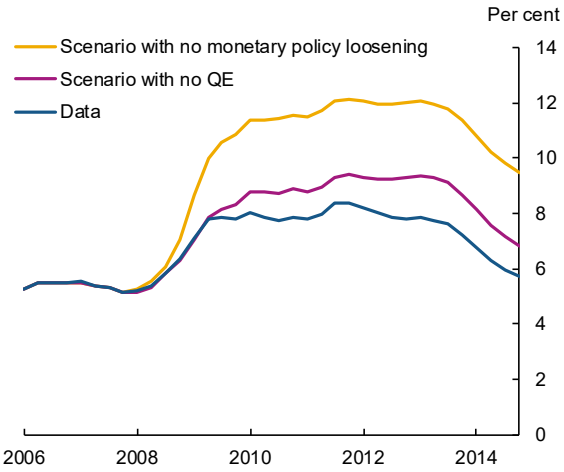


Chart A5: Effects of monetary policy changes after end-2007 on real equity prices

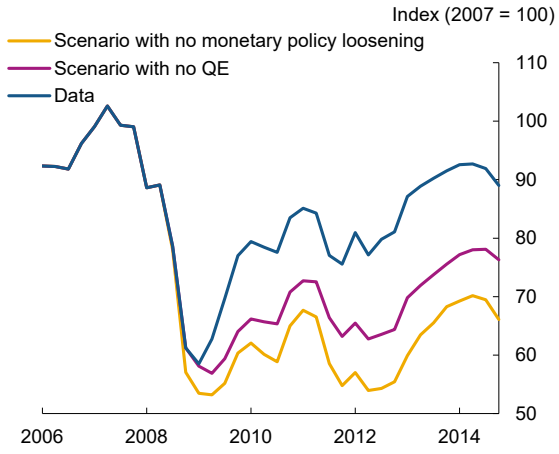
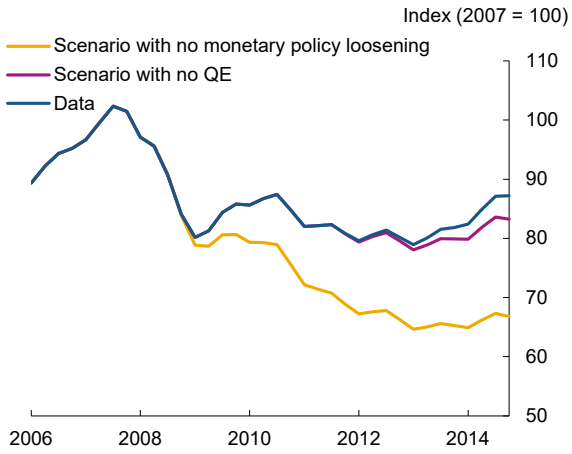


Chart A6: Effects of monetary policy changes after end-2007 on real house prices



iii) Estimating the impact of monetary policy in household survey data

Table A4: Summary of methodology used by Bunn et al (2018) to map macroeconomic scenarios into the impacts on individual households in the Wealth and Assets survey

Channel	Macroeconomic scenario variables	Wealth and Assets Survey variables	Method
Income channels:			
Interest payments/receipts	Interest rates	Total debt, bank deposits	Use survey data on stocks of debt and deposits to estimate how different each household's interest payments and receipts would have been with different paths for interest rates.
Macroeconomic effects on labour income	Employment, average wages	Labour market status, labour income, age, education	Draw some individuals who would have otherwise been unemployed and set their labour income to unemployment benefit – chance of unemployment depends on age and education level, based on recession experience. Adjust wages for those who remained in work in proportion with the change in with average wages, but again allow for differences by age and education.
Wealth channels:			
Financial asset prices	Equity prices, gilt yields	Value of equities and gilts held	Use survey data on value of equities and gilts held directly and estimates of boost to prices from monetary policy to calculate the increase in financial wealth for each household that can be attributed to policy.
House prices	House prices	Housing wealth	Use survey data on housing wealth and estimates of boost to prices from monetary policy to calculate the increase in housing wealth for each household that can be attributed to policy.
Effects of inflation on the real value of debt and deposits	Inflation	Total debt, bank deposits	Revalue the stocks of debt and deposits that each household has in line with the differences in the aggregate price level in the counterfactual macroeconomic scenario.
Private pension wealth	Equity prices, gilt yields	Value of defined benefit (DB) pensions, defined contribution (DC) pensions and pensions in payment. Age specific annuity rates.	DB & pensions in payment: revalue using annuity rates from 2006-2008 and assume that all changes in annuity rates since then reflect monetary policy. DC: similar approach to directly held assets (assume 50-50 split between equities and gilts).

iv) The effects of monetary policy changes after 2007 on household income and wealth

Chart A7: Effects of monetary policy changes after end-2007 by income decile as a percentage of income

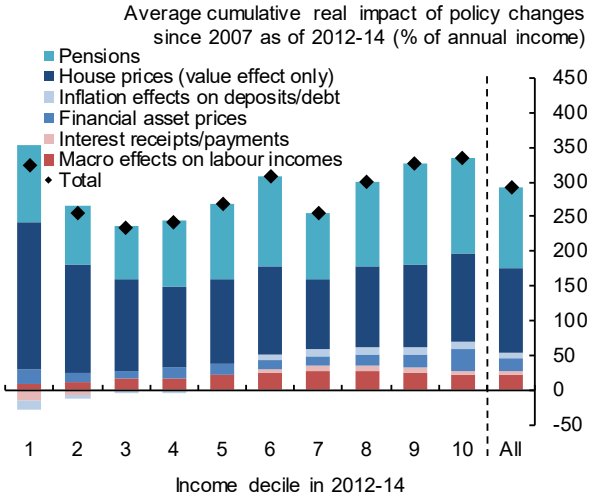


Chart A8: Effects of monetary policy changes after end-2007 by net wealth decile as a percentage of wealth

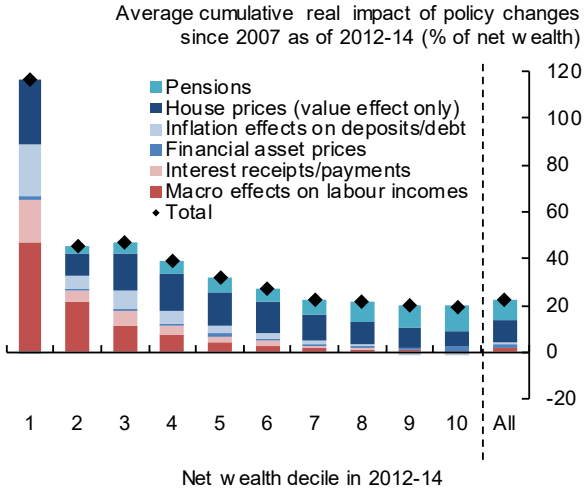


Chart A9: Effects of monetary policy changes after end-2007 by income decile in cash terms

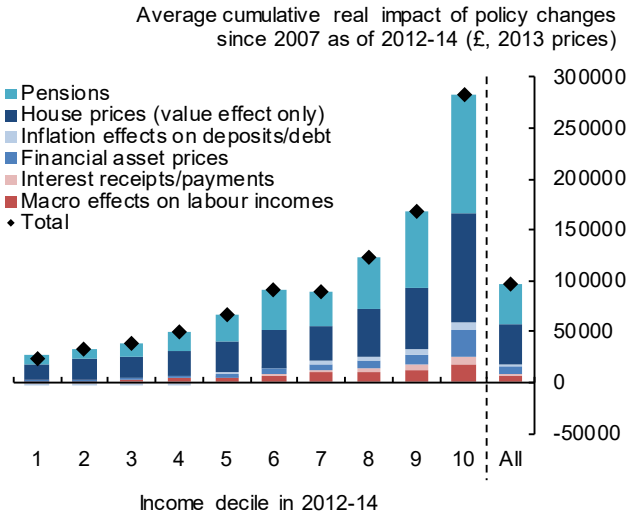
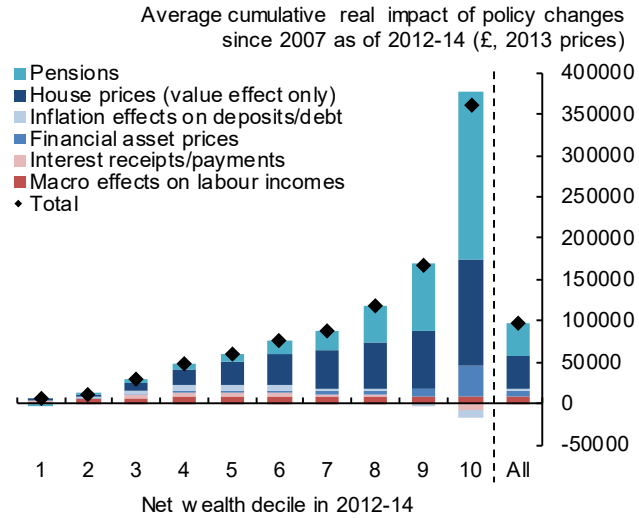
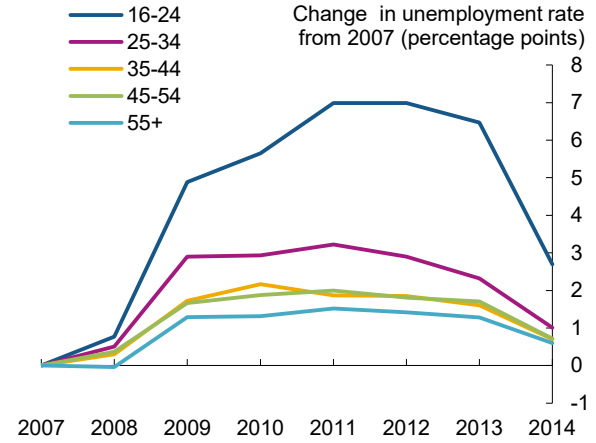


Chart A10: Effects of monetary policy changes after end-2007 by net wealth decile in cash terms



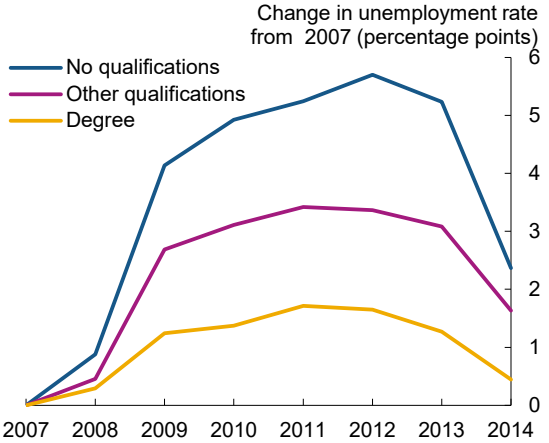
v) Risk of unemployment by household characteristics

Chart A11: Change in unemployment after 2007 by age



Source: Labour Force Survey (LFS) and authors' calculations.

Chart A12: Change in unemployment after 2007 by education



Source: LFS and authors' calculations.

vi) Estimating the determinants of financial distress

We consider three types of financial distress: mortgage arrears, being in arrears on unsecured debt and reporting being behind on bills and credit commitments. As was shown in Table 1 in the main text, each of these variables is found to have a statistically significantly impact on household well-being. We use household survey data to estimate linear probability models for each type of distress.

Mortgage arrears

Table A5 reports equations for being in mortgage arrears for at least two months, conditional on having a mortgage. Columns 1 and 2 are estimated using data from the British Household Panel Survey (BHPS) between 1992 and 2008. Column 1 includes the mortgage debt servicing ratio (DSR) and loan-to-value as continuous variables. In column 2 we allow these relationships to be non-linear. There is evidence of non-linearity: there is a significant increase in the probability of arrears once mortgage debt servicing costs exceed 50% of income and when a household enters negative equity (house worth less than the mortgage secured on it). Column 3 estimates a similar equation to that in column 2 using data from the Wealth and Assets Survey (WAS), which has a shorter time series (2010 to 2016) but a wider cross-section. The coefficients in column 3 are quite similar to those in column 2 but are less statistically significant, mostly likely reflecting the shorter available time series and relatively low rates of arrears during this period. We use estimates based on column 2 in the analysis in this paper, but the results would be broadly similar using the other equations.

We combine these regression models with estimates of how changes in monetary policy after the end of 2007 affected each of the determinants of distress to estimate how different the probability of being in mortgage arrears for each household in the WAS would have been had monetary policy not been loosened after the end of 2007. As summarised in Section 2.2, these inputs are taken from the microsimulation exercise reported in Bunn at al (2018). For each household, that work provides estimates of whether they would have otherwise been unemployed, the effect on their incomes, the effect on the value of their house (and hence whether they would have been in negative equity) and

how their mortgage DRS would have changed given the effects on both their mortgage repayments and income.

Table A5: Linear probability models for being in mortgage arrears

Data source	BHPS (1993-2008)		WAS (2010-2016)
	[1]	[2]	[3]
ihs(Income)	-0.007	-0.008	-0.006
	(0.007)	(0.006)	(0.007)
Mortgage debt servicing ratio	0.051***		
	(0.019)		
Mortgage debt servicing ratio 10-20%		-0.003	0.004
		(0.002)	(0.004)
Mortgage debt servicing ratio 20-30%		0.001	0.002
		(0.003)	(0.005)
Mortgage debt servicing ratio 35-50%		0.009	-0.001
		(0.007)	(0.009)
Mortgage debt servicing ratio 50%+		0.026**	0.015
		(0.011)	(0.019)
Loan-to-value ratio	0.004		
	(0.006)		
Negative equity dummy		0.010*	0.014
		(0.006)	(0.011)
Household head unemployed	0.065***	0.065***	0.043
	(0.016)	(0.016)	(0.028)
Other unemployed person in household			
Additional controls	Yes	Yes	Yes
Household Fixed effects	Yes	Yes	Yes
Observations	22,977	22,977	9,985

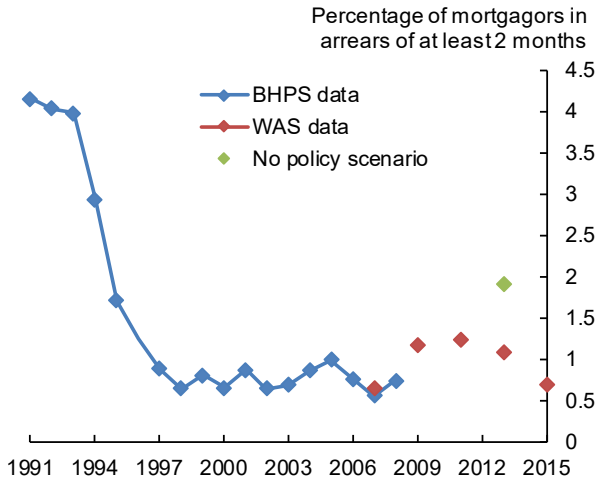
Robust standard errors in parentheses (clustered at household level), *** p<0.01, ** p<0.05, * p<0.1.
All equations are estimated by OLS. Mortgage arrears are defined as being at least two months in arrears. Equations are only estimated for households with a mortgage. Dependent variable is a dummy variable. Mortgage debt servicing ratio is defined as last mortgage repayment as a share of monthly post-tax household income. Loan to value ratio is defined as outstanding mortgage debt on main residence as a share of the estimated value of that residence. Being in negative equity is defined as have a loan-to-value ratio above 1. The sample for all equations is limited to households where the head is younger than 60. All equations include additional controls for month of interview, age, marital status, economic activity of head of household, number of adults and children in household, region and housing tenure. Effect of being unemployed is relative to being employed. Income is measured before debt servicing costs and is in real terms at 2013 prices. ihs is the inverse hyperbolic sine transformation.

Without looser monetary policy after the end of 2007, our results imply that an extra 0.8% of households with a mortgage would have been in arrears as of 2012-14. For our welfare analysis, we randomly draw 0.8% of mortgagors to be the additional households who would have been in arrears without monetary loosening after 2007 based on their estimated additional probability of being in arrears. Chart A13 puts this increase into historical context. It is larger than the increase in mortgage arrears seen after the financial crisis (within the survey data), but is still a long way below

the rates of mortgage arrears seen in the early 1990s. 0.8% of mortgagors equates to 0.25% of all households.

Our equations may underestimate the extent to which arrears would have been higher without looser monetary policy. That is because household surveys tend to under-record mortgage arrears relative to official data, perhaps because households suffering arrears are more reluctant to respond to surveys and/or disclose this sensitive information. However, it is hard to assess the potential magnitude of this bias and we therefore make no adjustment for it. And despite this, the estimates that we do construct still find an important role for arrears in understanding the welfare implications of monetary policy.

Chart A13: Effects of monetary policy changes after 2007 on mortgage arrears



Arrears on unsecured debts

We take a similar approach to modelling arrears on unsecured debts. Unsecured debt arrears are defined as being at least two months in arrears on repayments on personal loans, credit cards, store cards, mail order catalogue repayments or hire purchase agreements. These equations are estimated using data from the WAS between 2010 and 2016 for households who are making repayment on unsecured debts only.[20] They are reported in Table A6.

In column 1 of Table A6, unemployment and the unsecured debt servicing ratio are the only statistically significant determinants of unsecured debt arrears. In column 2 we allow the coefficients on these variable to vary by housing tenure. Neither coefficient is significant for outright owners, but both are significant for mortgagors and renters. The effects of unemployment are estimated to be similar for mortgagors and renters, but the coefficient on unsecured DSRs is much larger for renters than for mortgagors. Allowing the coefficient to vary by tenure does not make much difference to the estimated number of households who were saved from going into arrears as a result of easier monetary policy after the end of 2007 but it does affect which households were affected. In particular, renters, who tend to be in the lower part of the wealth distribution are more likely to have benefitted. The larger effect for renters is consistent with the higher rates of unsecured debt arrears among renters in the data (Chart A14).

[20] The BHPS did not collect regular information on unsecured debts and arrears. Student loans are excluded from this analysis since the WAS does not measure student loan repayments.

Using column 2 of Table A6, we estimate that an extra 0.7% of households with unsecured debts would have been in arrears on those debts around 2013 without monetary loosening after 2007. That is around 0.25% of all households. Chart A15 shows this increase relative to the actual data.

Table A6: Linear probability models for other forms of financial distress

Dependent variable:	Unsecured debt arrears		Falling behind with bills & credit commitments		
	[1]	[2]	[3]	[4]	[5]
ihs(Income)	0.008		-0.005	-0.006*	
	(0.011)		(0.003)	(0.003)	
ihs(Income) x outright owner		*-0.001*			*-0.001*
		(0.010)			*(0.002)*
ihs(Income) x mortgagor		*-0.004*			*0.005*
		(0.013)			*(0.006)*
ihs(Income) x renter		*0.019*			*-0.020***
		(0.020)			*(0.008)*
Mortgage debt servicing ratio	-0.007	-0.024	0.024	0.020	0.039
	(0.033)	(0.036)	(0.023)	(0.023)	(0.025)
Unsecured debt servicing ratio (UDSR)	0.099***		0.086***	0.056***	
	(0.025)		(0.019)	(0.018)	
UDSR x outright owner		*-0.024*			*0.014*
		(0.040)			*(0.017)*
UDSR x mortgagor		*0.080****			*0.049***
		(0.026)			*(0.022)*
UDSR x renter		*0.214****			*0.108***
		(0.065)			*(0.047)*
Household head unemployed	0.098***		0.062***	0.053***	
	(0.033)		(0.019)	(0.018)	
HH unemployed x outright owner		*-0.018*			*0.007*
		(0.025)			*(0.023)*
HH unemployed x mortgagor		*0.111**			*0.014*
		(0.066)			*(0.042)*
HH unemployed x renter		*0.120****			*0.071****
		(0.045)			*(0.024)*
Other unemployed person in household	-0.015	-0.016	-0.008	-0.008	-0.008
	(0.018)	(0.018)	(0.011)	(0.011)	(0.011)
Mortgage arrears of 2 months plus				0.236***	0.239***
				(0.063)	(0.063)
Unsecured debt arrears of 2 months plus				0.214***	0.211***
				(0.026)	(0.026)
Additional controls	Yes	Yes	Yes	Yes	Yes
Household Fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	11,650	11,650	38,340	38,340	38,340

Robust standard errors in parentheses (clustered at household level), *** p<0.01, ** p<0.05, * p<0.1.
All equations use data from the Wealth and Assets Survey (2010-2016) and are estimated by OLS. Dependent variable is always a dummy variable. Unsecured debt arrears are defined as being at least two months in arrears on repayments on personal loans, credit cards, store cards, mail order catalogue repayments or hire purchase agreements. Unsecured arrears equations are only estimated for households making unsecured debt repayments. Being behind with bills and credit commitments is defined as the head of household responding either 'Falling behind with some' or 'Having real financial problems and have fallen behind with many of them' in response to the question 'Which one of the following statements best describes how well you arekeeping up with your bills and credit commitments at the moment?'. Mortgage debt servicing ratio is defined as last mortgage repayment as a share of monthly post-tax household income. Unsecured debt servicing ratio is defined as last repayment on all unsecured debts as a share of monthly post-tax household income. All equations include additional controls for month of interview, age, marital status, economic activity of head of household, number of adults and children in household, region and housing tenure. Effect of being unemployed is relative to being employed. Income is measured before debt servicing costs and is in real terms at 2013 prices. ihs is the inverse hyperbolic sine transformation.

Chart A14: Financial distress by housing tenure (2012-14 data)

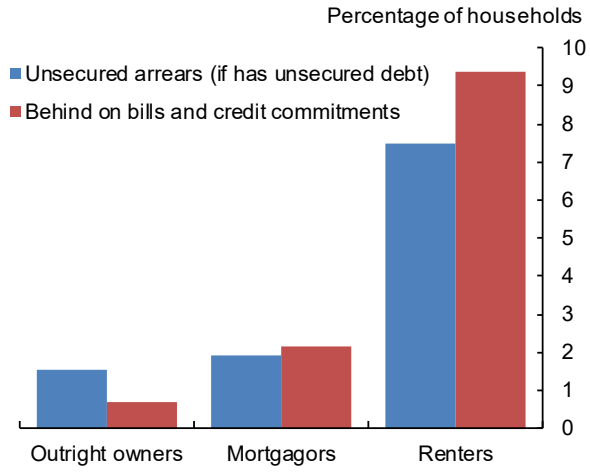
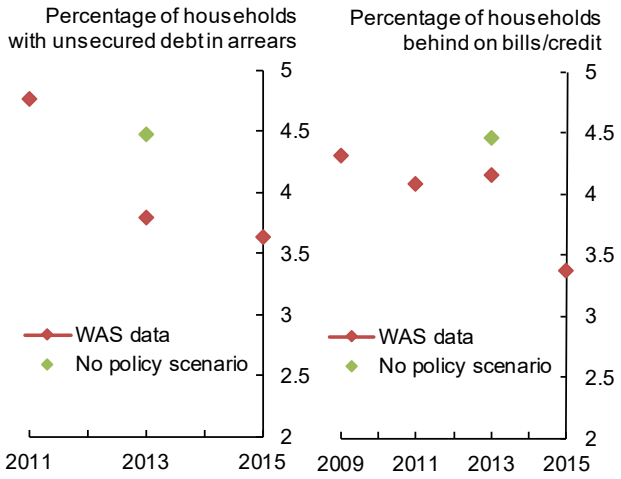


Chart A15: Effects of monetary policy changes after 2007 on financial distress



Behind on bills and credit commitments

In columns 3, 4 and 5, Table A6 also reports linear probability models for the probability of a household reporting that they are behind on their bills and credit commitments, again based on data from the WAS. The difference between columns 3 and 4 is that column 4 also adds dummy variables for whether a household is also in arrears on their mortgage or unsecured debts. Both have a significant and quantitatively large effect. In column 5 we allow the main determinants to vary by housing tenure. As with unsecured arrears, the proportion of households who have fallen behind on bills has been highest among renters (Chart A14) and the coefficients on the income, unemployment and the unsecured DSR are all largest amongst this tenure group.

We estimate that if monetary policy had not been loosened after 2007 an extra 0.3% of households would have fallen behind on their bills and credit commitments by 2013 (Chart A15). We calculate this using a similar approach to other forms of arrears: by taking estimates from Bunn et al (2018) on how the main determinants of distress would have changed to estimate increases in the probability of distress and then drawing households based on these probabilities. We do this using the coefficients from column 5 of Table A6. The one difference here is that if households have also been drawn into mortgage or unsecured debt arrears that is also allowed to influence their probability of falling behind on bills and credit commitments. Around 40% of households who we estimate would have fallen behind with their bills would have also fallen into some other form of arrears, such that, overall, 0.7% of households are estimated to have been saved from some form of financial distress by the loosening in monetary policy after the end of 2007.

Being behind on bills and being in arrears on a mortgage or unsecured debt cover a number of forms of financial distress that are captured by the Wealth and Assets Survey. But these may not necessarily be the only forms of financial distress that may affect households' well-being. And the extent of financial distress in the event of an even more severe crisis than actually occurred could have been more non-linear than these simple models suggest. For these reasons, our estimates may be more likely to underestimate rather than overestimate the effects of monetary policy changes after 2007 in reducing financial distress and consequently they may understate the impact on well-being.

vii) Quantifying the effect of monetary policy changes on well-being: additional charts

Chart A16: Proportion of households made better/worse off, by income decile

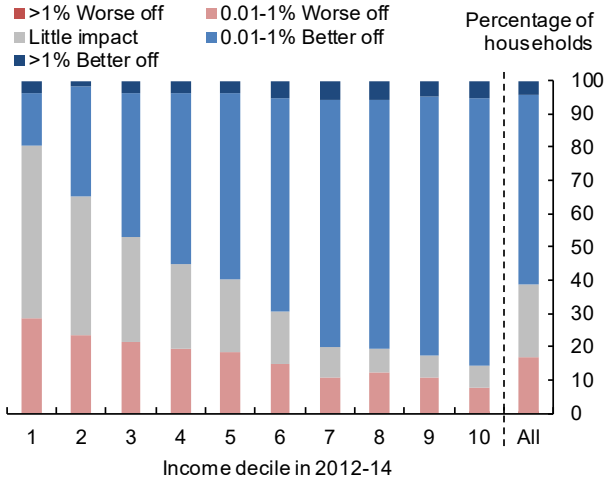


Chart A17: Proportion of households made better/worse off, by net wealth decile

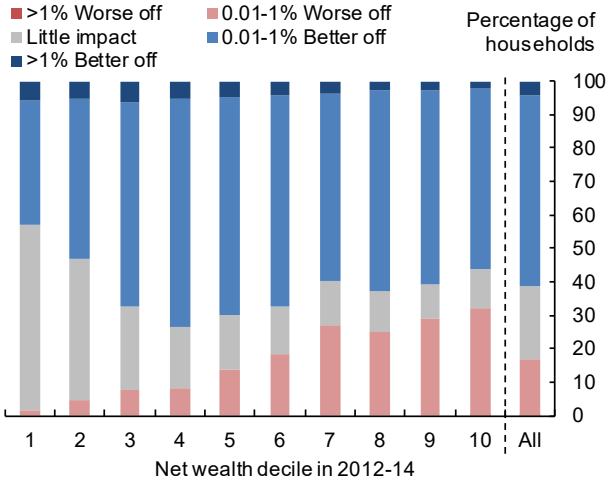
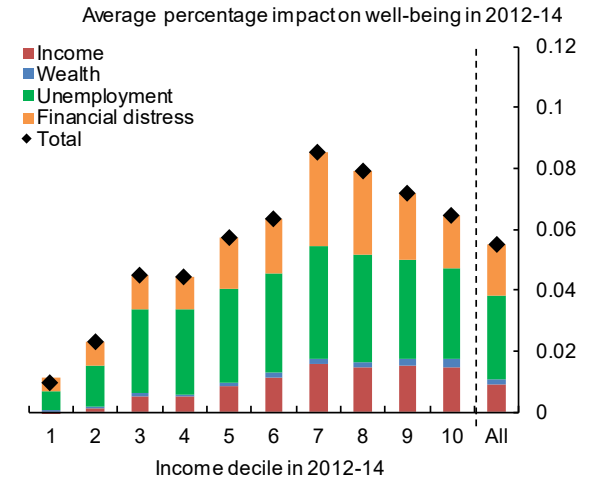
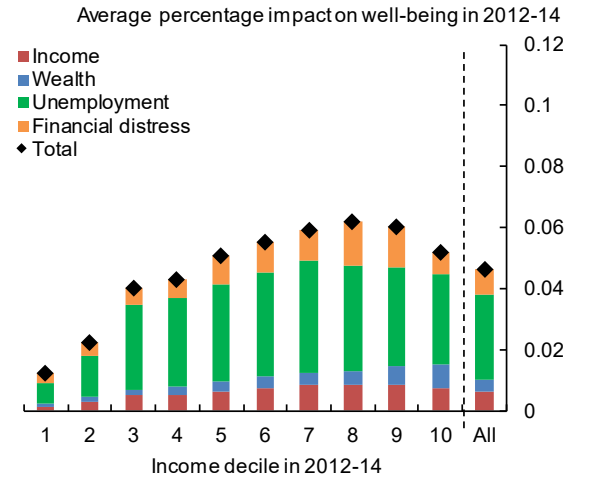


Chart A18: Impact on well-being of a reduction in Bank Rate, by income decile[(a)]



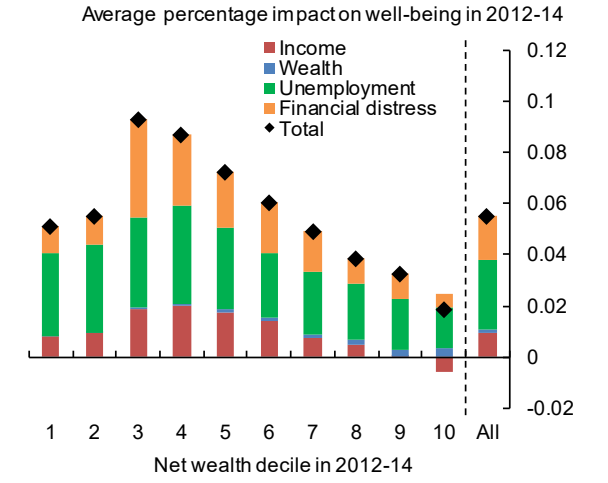
(a) Results are scaled to show the effects of a policy loosing that would have lowered the unemployment rate by 1pp in 2012-14.

Chart A19: Impact on well-being of QE, by income decile[(a)]



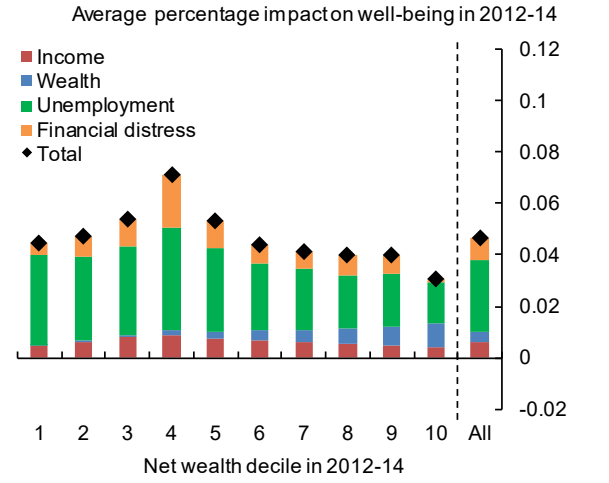
(a) See footnote to Chart A18.

Chart A20: Impact on well-being of a reduction in Bank Rate, by wealth decile[(a)]



(a) See footnote to Chart A18.

Chart A21: Impact on well-being of QE, by wealth decile[(a)]



(a) See footnote to Chart A18.