

# THE CONSUMPTION RESPONSE TO POSITIVE AND NEGATIVE INCOME CHANGES

Philip Bunn, Jeanne Le Roux, Kate Reinold & Paolo Surico<sup>1</sup>

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**Abstract.** We exploit a set of newly designed questions in the Bank of England/NMG consulting survey of British households to uncover the marginal propensity to consume (MPC) out of positive and negative temporary income changes. An unanticipated increase in a household's income leads to an average rise in spending of 14 pence for each extra pound, whereas spending falls by 64 pence for every pound that household income unexpectedly decreases. The responses to positive and negative income changes are significantly more pronounced among households who report to: lack a buffer of savings for emergencies, be concerned about access to credit markets and face the risk of a likely fall in future income. We discuss several explanations for the observed asymmetry, some of which we are able to provide empirical evidence in favour of. We also demonstrate that the asymmetric consumption responses to positive and negative income changes can be replicated using a simple partial equilibrium model with an occasionally binding borrowing constraint. The MPC asymmetry has important implications for households' responses to large changes in monetary and fiscal policy.

**Keywords:** Marginal propensity to consume, consumption asymmetry.

**JEL codes:** E21, E52, D12, D14.

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## 1. Introduction

A large empirical literature has reported significant and heterogeneous consumption responses to positive income changes, as generated for instance by tax rebates, minimum wage hikes or hypothetical/anticipated increases in household resources. Far less, however, is known on the consumption responses to negative, unanticipated income changes. Understanding how households respond to income shocks of both signs is crucial for understanding how changes in the macro economy will affect consumption and what the effects of policy measures will be. In this paper, we contribute to filling in this important gap in the literature by relying on a set of questions added to the Bank of England/NMG survey of British households between 2011 and 2014. These questions ask about the size and sign of any unanticipated income change during the previous year, as well as the share of that change spent.

Our results reveal that a one pound unexpected rise in income leads, on average, to a 14 pence increase in household expenditure whereas an unanticipated fall in income of one pound is associated with a reduction in consumption of 64 pence. This asymmetry is present across the four years of our sample. The average effects, however, mask significant heterogeneity, with households facing credit constraints, liquidity shortages and a higher risk of lower income in the future typically having significantly higher marginal propensities to consume (MPCs). A large literature has considered whether household spending responses in the face of income shocks accord with the predictions of standard economic models, for example Campbell & Mankiw (1989), Attanasio & Weber (1993, 1994), Jappelli & Pistaferri (2010), Krueger & Perri (2011). This literature has tended to focus on the *magnitude* of consumption responses, and the expectation that in the face of temporary shocks, households should respond little. There has also been particular interest in understanding how households with different characteristics respond to income shocks, and whether this can be rationalised by deviations from standard consumption theory.

But few papers have considered or empirically identified an asymmetry between the response to positive and negative income shocks, with the exceptions of Shea, 1995; Bracha and Cooper, 2013. In contrast, standard economic models would imply symmetric consumption responses to positive and negative changes in income. There are, however, deviations from this theory which could generate the sort of asymmetry in consumption responses that we observe, such as credit constraints, income uncertainty and loss aversion. The theoretical mechanisms which could generate these effects, as well as the empirical literature on estimating MPCs, are discussed further in Section 2.

An overview of the survey data, including the distributions of positive and negative income shocks is discussed in section 3. While, in Section 4, we present descriptive statistics on the MPCs out of positive and negative shocks across a number of household characteristics, including demographics, income risks, balance sheet and debt positions.

Section 5 is devoted to a more formal econometric analysis into the drivers of the reported MPCs. We conduct an extensive regression analysis along a large number of observable dimensions, which suggests that several household characteristics play a statistically significant role in explaining the difference in MPCs across households. The most important appear to be balance sheet characteristics.

We propose several hypotheses for the observed asymmetry, in section 6, some of which we are able to provide tentative evidence in favour of. One of these adopts a propensity score matching approach to show that differences in the strength of the household balance sheet and the extent of income risks facing different earners can account for up to one quarter of the asymmetry in consumption responses between positive and negative income shocks.

This empirical evidence is further supplemented, in section 7, by showing that a simple partial equilibrium model with an occasionally bind borrowing constraint can replicate the asymmetric consumption responses observed in the survey responses.

## **. 2. Theoretical predictions and related empirical work**

Friedman's permanent income hypothesis predicts that consumption should move only in response to a change in life time resources and therefore the marginal propensity to consume out of temporary shock should be very small. Furthermore, in the absence of constraints of any sort, the household response should be symmetric to positive and negative income shocks. But there are some relaxations of the assumptions behind the permanent income hypothesis predictions which can generate the type of asymmetry, we observe in survey responses, in MPCs following a positive or negative income shock.

A prominent example is one where households have imperfect access to credit markets, impeding their ability to substitute consumption across time (e.g. Deaton, 1991). In the face of a negative income shock, the household is unable to bring future consumption forward, resulting in a larger MPC. In contrast, in the face of a positive income shock, they would be able to save (if the shock was sufficiently large to bring them off the constraint). This would imply a potentially smaller consumption response to a positive income shock than to a negative one. This effect is not limited to households with low total assets, but also potentially a feature of the wealthy hand to mouth who have low liquid assets and face transaction costs to adjusting their (more sizeable) illiquid assets (Kaplan, Violante & Weidner, 2014).

A second factor which could also generate a consumption asymmetry between how a household responds to positive and negative income shock is precautionary saving (Caballero, 1990; Carroll, 1992, 1994 and 2001). Whenever a household is uncertain about their future income, they might be tempted to hold a buffer of savings to help smooth through income shocks: a household concerned

about their precautionary buffer being too small might cut spending sizably were it to experience a negative income shock, but might only raise expenditure modestly (and rather increase savings) in the face of a positive income shock.<sup>2</sup>

Third, if some households weigh the prospect of losses more heavily than the prospect of gains (Kahnemann and Tversky, 1979), their consumption response might be asymmetric. The intuition is that in the face of a windfall, loss-averse households save their extra resources to hedge against any possible negative income changes in the future but in the face of a negative income shock they are left with nothing other than reducing their spending. This may be particularly acute if these households also lack of the opportunities to smooth their consumption intertemporally.

On the empirical side, a vast literature has investigated the consumption responses to unanticipated income changes. These contributions can be broadly divided into three groups, reflecting the different sources of exogenous variation that are exploited. The first group employs abrupt (policy) changes as quasi-natural experiments, including income tax rebates (Johnson, Parker and Souleles, 2006; Parker, Souleles, Johnson and McClelland, 2013; Agarwal and Quin, 2014; Misra and Surico, 2014, among many others), minimum wage hikes (Aaronson, Agarwal and French, 2013) and credit card limit increases (Gross and Souleles, 2002; Aydin, 2016). The second strand is based on a statistical decomposition of the income process into predictable and unpredictable movements, which are then correlated to consumption (Hall and Mishkin, 1982; Attanasio and Davis, 1996; Blundell, Pistaferri and Preston, 2008, among many others). Finally, another branch of research focuses on survey based responses to *intended* (as opposed to *actual*) changes in income, (Shea, 1995<sup>3</sup>; Bracha and Cooper<sup>4</sup>, 2013)) or hypothetical increases in household resources (Jappelli and Pistaferri, 2014).

With these earlier contributions we share an emphasis on the household characteristics driving the MPCs' heterogeneity. Unlike previous literature, however, we are able to provide evidence on the consumption responses to *actual* positive shocks as well as *actual* negative shocks within the same household survey dataset, which contains self-reported, unanticipated income changes of either signs.

### **3. The Bank of England/NMG survey design**

In this section, we describe the source of data and present the main characteristics of the positive and negative income shocks reported by the survey respondents.

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<sup>2</sup> The dynamics of this are made more complicated by the fact that these models would also predict that the desired buffer stock, typically defined as a ratio of wealth to income, also changes with the income shock.

<sup>3</sup> The authors consider changes in income implied by anticipated changes in payroll taxes.

<sup>4</sup> The authors use changes in the consumption responses to positive and negative predicted tax changes.

### 3.1. The identification of unanticipated income changes

The Bank of England and the NMG conduct an on-line survey of British households every year.<sup>5</sup> This takes place in the second week of September and consists of a repeated cross section, designed to be representative of the UK population in terms of age, gender, region, housing tenure and employment status. Over the years in which the questions on unanticipated positive and negative income changes were asked, the sample size has increased from around 1,000 in 2011 to 6,000 in 2014 (Table 1). The survey contains a variety of questions on household characteristics, such as income, influences on spending and balance sheet and debt positions. This information allows us to examine differences between the traits of households that received different types of income shocks, as well as compare the MPCs of different types of households.

The exact questions used to generate household MPCs are reported in Appendix 1. We first try to identify households who have received income shocks, by asking about whether their income differed from what they expected a year ago, and if so, by how much. If they did receive an income shock, they were then asked whether the change was likely to be transitory or one that they would expect to persist. And finally they were asked how they had adjusted their spending in response to the unexpected change in income. Where households reported the sign and size of their spending response and the sign and size of the income shock, we are able to compute their MPC as the ratio of the two (such that a value of one implies that the household changed their spending one-for-one with the shock). While several studies identify changes in non-durable spending, note that the NMG survey questions refer to changes in ‘spending’ and so are likely to incorporate a wider range of spending.

The survey questions have multiple layers to them, and as such there is potential for households to answer some of the questions but not all. Indeed, Table 1 shows that there is quite a high degree of attrition as the questions progress, e.g. while 33% of households in the sample reported having experienced an income shock, only 15% of them gave sufficient information for us to compute an MPC. In the formal econometric analysis below, however, we will show that our findings are robust to using probit regressions in which we only rely on the binary information on whether the household has spent out of its windfall, thereby revealing that this attrition is unlikely to be a source of major concern. Furthermore, we can base our analysis on information gathered about *actual* spending responses following positive and negative income windfalls. This compares favourably to previous studies which were exposed to the critique of possible large difference between intended and actual consumption responses to an income change (Graziani, Van Der Klaauw & Zafar, 2013).

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<sup>5</sup> The survey runs since 2004 but prior to 2010 it was conducted face-to-face. In 2011, a second parallel online trial was launched (in which our questions on positive and negative unanticipated income changes were first included) and, from 2012 onwards, the survey has been fully conducted online. This has allowed the increase in the sample size over the years in which our questions were included.

As with any survey responses, we may be concerned about misreporting or outliers, and as such we have trimmed our dataset to exclude responses which seemed improbable. We excluded the largest 2.5% of positive shocks relative to household income, and the largest 2.5% of negative shocks relative to household income. We also exclude reported MPCs which were smaller than zero (i.e. cut (increased) spending in response to a positive (negative) shock) or larger than 1.5. Overall, we discard a little fewer than 9% of observations but we have verified that none of our results hinge upon this cut of the data, which however improved accuracy relative to the unrestricted sample.

### **3.2. The distribution of positive and negative income shocks**

Around a third of households in our sample reported experiencing an income shock (Table 1). This share has fallen across the years of the survey, dropping from 38% in 2011 to 28% in 2014. More households report experiencing a negative rather than positive income shock. The share of negative income shocks has, however, fallen in each year of the survey (from 70% in 2011 to 54% in 2014), possibly consistent with the improvement in the macro economy over that period.

Reported income shocks tend to be fairly small relative to overall income. Across the four years of the survey the median is around £2,000 for both positive and negative shocks. There are, however, long tails of some very large income shocks (Figure 1). The largest reported negative shock (in our trimmed sample) was £130,000 and the largest reported positive shock was £100,000. These long tails lead to mean positive and negative shocks of £4,900 and £4,200 respectively, which are somewhat larger than the median shock. It is also notable that despite the share of households reporting a negative income shock having fallen as the economy has improved, the distribution of the size of the shocks has stayed fairly constant, i.e. negative shocks have not become smaller, nor positive shocks larger. Finally, the majority of income shocks are reported to be persistent (73%), with a slightly larger share of negative shocks thought to be persistent than positive shocks (81% versus 64%).

In Tables 2 and 3, we report descriptive statistics on household traits across positive and negative income shocks. Households experiencing a windfall appear to be similar to those experiencing negative shocks along several dimensions: annual income<sup>6</sup>, secured and mortgage debt, mortgage debt service ratios, loan to value (LTV) and loan to income<sup>7</sup> (LTI) ratios.

On the other hand, households experiencing positive income shocks tend, on average, to be slightly younger than those experiencing a negative income shock. The net liquid asset (liquid assets less unsecured debt) holdings of households that reported a positive income shock are substantially higher

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<sup>6</sup> The annual income shock is reported in post-tax disposable income space, while annual income is reported on a pre-tax basis. We use a simple approach to adjust the self-reported post-shock annual income to reflect pre-shock annual income, simply adding (subtracting) the income shock to (from) reported post-shock annual income. To the extent that positive and negative shocks are randomly distributed across tax rate bands, the fact that this approach ignores the impact of tax paid on the income shock should not influence the results.

<sup>7</sup> Income measure is annual pre-tax, pre-shock income

than for those that reported a negative income shock (£45,000 compared to £29,000). This continues to be true when households' net liquid asset positions are reported relative to annual income.

The discrete characteristics reported in Table 3 show that a significantly greater proportion of households experiencing a negative income shock reported being credit constrained, thought a fall in their income was likely, were somewhat or very concerned about debt, or felt that they were worse off now than they might have expected had they been asked before the occurrence of the financial crisis. In contrast, households reporting a positive income shock were more likely to have a buffer of savings to draw on in the event of an emergency, and to perceive the income shock to be temporary.

#### **4. The Marginal Propensity to Consume out of positive and negative income shocks**

A striking result across all years of the survey is that the MPC out of a negative income shock is considerably larger than that out of a positive income shock (Figure 2), with very little variation in the value of MPCs between years. The mean MPC across the four waves of the survey is 0.64 for a negative shock, and 0.14 for a positive shock.

Figure 3 shows that the distribution of MPCs by direction of income shock also remains broadly similar across the four waves of the survey. A striking feature is the large share of MPCs with the value of zero for positive shocks (77% for the aggregate sample). The distribution across MPC values is more even for negative income shocks, although there does remain some bunching of responses at zero and one. Jappelli & Pistaferri (2014) find a similar 'heaping' of responses at round values (in their case at MPCs of zero, a half and one), when asking about the spending response to a hypothetical windfall. It is also interesting that in each year of the survey, between 5 and 10 per cent of households report an MPC greater than one (but smaller than 1.5) out of a negative income shock, i.e. they cut their spending by a greater amount than the income shock they experienced.

Figure 4 shows that there seems to be little difference between the mean MPC out of a persistent income shock versus a transitory shock. Although reported MPCs are a little higher for persistent negative shocks than transitory negative shocks, the difference is much smaller than theory would suggest. And for positive income shocks there is no statistically significant difference in MPCs according to the persistence of the shock. This is true for all years of the survey (see Chart A1 in Appendix A) and may reflect ambiguity in the interpretation of the temporal horizon over which to expect the shock to be permanent or transitory for households.

We supplement the evidence in Figures 3 and 4, with Table 4 where we document variation in MPC values by direction of shock, conditional on a variety of discrete household characteristics. A striking feature of the results of our survey is the consistently low value of MPCs out of positive income shocks and high MPCs out of negative income shocks, irrespective of household or shock

characteristics. In general, the variation of MPCs across household characteristics is greater for negative income shocks than for positive income shocks.

Outright owners appear to respond less to both positive and negative income shocks relative to social tenants, perhaps reflecting the fact that they are less likely to face liquidity constraints. There appears to be little difference between the MPCs of those working for somebody else and those self-employed. In contrast, households headed by someone unemployed display a markedly higher MPC out of negative shocks but a smaller MPC out of positive shocks. This latter finding however is based on the very small sample of those who were unemployed and received a positive income shock.

MPCs are consistently higher for households reporting being credit constrained; having concerns about their debt; thinking a future fall in income is likely; or reporting that they have an insufficient buffer of savings in the event of an emergency. This is true for both positive and negative shocks, although the difference in the value of the MPC between households reporting the above mentioned characteristics and those not is materially larger for negative shocks.

One important factor potentially influencing our results is that the surveys were conducted in the wake of the 2007-8 financial crisis. This is likely to have affected the balance sheet position of most households, but some are likely to have been affected more adversely than others. Households that report being better off now, relative to what they might have expected prior to the crisis, have considerably lower MPCs out of negative income shocks. Although, interestingly, households reporting both positive income shocks over the previous 12 months, and being worse off than expected in 2006, have very similar MPCs to those who report a positive income shock and being better off than expected in 2006. .

In Figures 5 to 7, we summarize the variation in MPC values by direction of shock, conditional on a variety of continuous household characteristics. Figure 5 shows that the MPC out of both positive and negative income shocks for those over the age of 65 is lower than (or equal to) the MPC of other age groups. Figures 6 and 7 show the mean MPCs associated with gross household income and net liquid asset to income ratios, where we have grouped the sample into 5% bins.<sup>8</sup> For positive shocks, the mean MPC is very similar across households in all income groups. In contrast, households with a higher gross income reported materially lower MPCs out of negative income shocks. Similarly, for a negative income shock, households with a high net liquid wealth to income ratio reported lower MPCs than those with a smaller ratio.

The MPCs associated with households' LTI and LTV ratios, and debt (both secured and unsecured) repayments as a share of monthly income are presented in Figures 8 to 10. Across these three

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<sup>8</sup> The thresholds for the 5% groups were computed for the whole sample such that the levels of income and net liquid asset to income in each group are comparable for those with positive and negative shocks.



characteristics, the mean MPC out of positive income shocks is fairly similar for all groups, although there is a small tick up in the value of the MPC for those households with the highest LTIs (greater than 4 times income) and LTVs (greater than 90%)<sup>9</sup>. For negative shocks, there appears to be a gradual upward trajectory in the magnitude of MPCs, as LTIs; LTVs and debt servicing ratios grow larger. Lastly, in Figure 11, we plot the mean MPC for positive and negative income shocks by size of shock. For households with a positive income shock, MPCs increase as the size of the shock increases. While the opposite is true for households experiencing a negative income shock, with the MPC falling as the shock size rises. This is perhaps a reflection of these households facing a limit to which they are able to reduce spending in the face of a large negative shock.

## **5. Explaining the response to positive and negative shocks**

To explore more formally what drives the heterogeneity in the reported MPCs across households, and to help understand how household traits affect the response to a positive versus negative income shock, we have conducted regression analysis using three alternative specifications. The first part of this section explores the results based on OLS regressions. The second part considers the robustness of these results by discussing alternative regression specifications (Probit and Tobit) meant to tackle different features of the data. The final part discusses the overarching themes from our regression analysis. For each of the specifications, we conduct separate regressions for positive and negative income shocks. This allows the regressors to have different effects on the MPC depending on the sign of the income shock (e.g. a household that is concerned about their future income might cut spending sharply in the face of a negative income shock, but only raise it a little if they experienced a positive income shock).<sup>10</sup>

### **5.1. Baseline results**

Our OLS regressions treat the MPC as the dependent variable and the characteristics of the shock as well as the household traits as regressors. We run six separate specifications for positive and negative income shocks (Table 5), all with robust standard errors. In the first five columns, we regress the MPC against a specific set of household characteristics reflecting (i) demographics, (ii) the nature of the shock, (iii) household balance sheets, (iv) net liquid wealth positions and (v) debt to assess the contribution of each set of variables in isolation. The final column combines all of the characteristics in our richest specification, which allows for a comparison of the relative merits of each set of covariates.

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<sup>9</sup> Sample sizes are relatively small in these groups. There are only 18 and 23 households with an LTV greater than 90% that experienced positive and negative income shocks, respectively.

<sup>10</sup> An alternative would be to run a single regression but with interactions between the regressors and a dummy for whether the shock was positive. This would produce equivalent (but more accurate) point estimates, but only in the case of slope homogeneity across all non-interacted covariates.

Table 5 shows that several characteristics play a significant role in explaining the MPCs, but that the constant explains the majority of the level of the MPC for all regressions. Demographics appear to play a fairly small role: for example, MPCs are fairly similar for most working age groups.<sup>11</sup> MPCs for households aged 65+ are lower than the benchmark household (aged between 25 and 44) for both positive and negative income shocks (consistent with the findings of Jappelli & Pistaferri, 2014). The youngest households also have significantly lower MPCs when the shock is negative. Employment status also matters for negative shocks; unemployed households cut their spending by less than employed households.

The next column considers the role of shocks of different sizes and persistence. MPCs are significantly higher out of large (top two quartiles by size) positive income shocks, whereas for negative shocks, the MPC out of income shocks in the top quartile is significantly lower. This might reflect limits on the ability of a household to smooth through very large income shocks. More transitory income shocks tend to have an MPC which is only 0.1 lower than persistent shocks when the sign of the shock is negative whereas there is no significant difference for positive income shocks.

An important determinant of the response to an income shock is likely to be the balance sheet position of a household, indicators of which are introduced in the third column. As theory predicts, credit constrained households seem to have higher MPCs out of both positive and negative shocks, +0.1 and +0.07 respectively. Households who report some likelihood of a fall in income over the next year (an indicator of income risk) have higher MPCs out of a negative shock, but no significant difference for positive shocks. Finally, respondents who have a buffer of savings for emergencies have significantly lower MPCs for both positive and negative income shocks (-0.09 and -0.18).

These are qualitative indicators of overall balance sheet health, so as a crosscheck we include more quantitative measures of financial assets (in the fourth column) and debt (in the fifth column). We consider the ratio of net liquid assets to household income<sup>12</sup>, which might be thought of as an indicator of whether the household is hand-to-mouth (in the traditional sense, or as the wealthy hand-to-mouth described by Kaplan, Violante and Weidner, 2014). Again, consistent with what one might expect, households who have a high ratio of liquid assets to income have lower MPCs for income shocks of both signs. The difference is particularly large for negative shocks: households with a liquid asset to income ratio in the top tertile have an MPC which is 0.2 lower than a household in the bottom tertile. On the debt side, households who are concerned about their level of debt have a significantly higher MPC for income shocks of both signs. For positive shocks, households with a loan to value

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<sup>11</sup> Ideally, we would consider a wider range of demographic controls, but information about education, marital status etc, are only available for certain waves of the survey.

<sup>12</sup> Net liquid assets is defined as less unsecured debt (excluding credit card balances which the household intends to pay in full over the month)

ratio above 90% have MPCs which are 0.19 higher than those with a LTV below 75% but the results are not monotonic across LTV bands.

The final column includes all of the regressors in our richest specification. Unsurprisingly, since many of the regressors are likely to be correlated with each other, the size and significance of several of our individual coefficients are reduced, e.g. on age, unemployment, liquid asset to income ratios, being concerned about debt, and in the case of negative income shocks, credit constraints. For positive income shocks, households facing larger shocks or who are credit constrained have a higher MPC whereas households who report to face significant income risks, have a buffer of saving or an LTV between 75% and 90% have a lower MPC. Across negative income shocks, only facing a transitory shock, future income risks and having a buffer of savings remain significant.

## 5.2. Sensitivity analysis

In this section, we discuss the robustness of our regression results to two alternative specifications: Tobit and Probit. The Tobit specification maintains the MPC as the dependent variable, but imposes bounds on the values that the MPC might take. This is motivated by the fact that the MPC is a ratio which theory would suggest lies in the vicinity of zero to one.<sup>13</sup> Our Probit specification instead uses as the dependent variable a dummy which has a value of one if the MPC is greater than zero. This allows us to exploit a much larger sample (5,397 versus a trimmed sample of 2,263 for actual MPCs), since there are a larger number of households for which we can ascertain whether the MPC is equal to or greater than zero but not the precise MPC (i.e. only the direction of the consumption change but not its size is reported). In principle, it might also better capture the distribution of our results, given the large share of households that report an MPC of zero (particularly for positive income shocks).

The results of the Tobit and Probit specifications are reported in Appendices 3 and 4 respectively. Note that while we can compare the direction and significance of the coefficients across specifications it is hard to compare the magnitude. While the linearity of the OLS specification means that the estimated coefficients indicate the marginal effect of changing the regressor from any starting level, this is not true for these alternative specifications. Both Tobit and Probit specifications imply a non-linear relationship between the regressors and the dependent variable, such that when reporting coefficients, it is necessary to select a starting value for the regressors. For both the Tobit and Probit specifications we use an ‘at means’ approach, e.g. it reports the marginal effect of being credit constrained rather than unconstrained conditional on being average in every other regard. Furthermore, for the Probit results, the coefficients report the effect on the probability of having an MPC greater than zero rather than on the MPC itself.

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<sup>13</sup> In practice, we bound our results on 0 and 1.5.

Overall, the characteristics which are statistically significant in these additional specifications are very similar to those which have a significant effect in the OLS regressions reported in Table 5. The factors which are consistently important in determining the response to a positive income shock are the balance sheet characteristics (having a buffer of savings, credit constraints and income risk), larger income shocks and having a high LTV ratio. For negative income shocks, income risk and having a buffer of savings are consistently important across specifications. There is, however, more variation for other regressors (e.g. transitory shocks, being unemployed and the net liquid asset to income ratio). It is also notable that the sign of coefficients is generally robust across specifications.

### **5.3. Discussion**

Our regressions can in principle shed light on two questions. First, how do different types of households respond to a similar shock? Second, how do household characteristics influence MPCs differently depending on whether the shock they receive is positive or negative?

Beginning with the first question, several household characteristics do play a statistically significant role in explaining the differences in MPCs across households. The most important characteristics appear to be balance sheet characteristics, as well as the size of the shock in the case of positive shocks. These results (for positive shocks) are qualitatively similar to those of Jappelli & Pistaferri (2014), who find an important role for balance sheet characteristics such as cash-on-hand. However it is also notable that there remains a large portion of the reported MPC which cannot be explained by observable differences across households.

The equations also do not reveal much about the difference between the average response to a positive shock versus a negative shock. The greatest difference between the estimated coefficients is the constants, which suggests that it either reflects some difference in household characteristics that we have not captured in our regressors, or something innate about the reported responses to income shocks of different signs (we explore these hypotheses more in Section 7). Similar household characteristics are important in determining the response to positive versus negative shocks, and where coefficients are significant, the sign is generally the same (although the magnitude tends to be smaller for positive income shocks). The main exception is income risk where this tends to be associated with lower MPCs when the shock is positive, but higher MPCs when the shock is negative, perhaps related to a desire to hold (or not deplete) a precautionary savings buffer. The next section considers different hypotheses for how we might rationalise the difference between the MPCs out of positive and negative shocks.

## 6. What drives the MPC asymmetry? Empirical Evidence

A striking feature of our results is the large asymmetry between the MPC out of positive and negative income shocks. This difference is consistent across all years of the survey (2011 to 2014) and is related in large part to the four fifths of households reporting they did not increase spending at all out of a positive shock. This section discusses a few different hypotheses which might explain the asymmetry we observe, and the empirical evidence that we can glean on them. The next section will consider a theoretical model which can generate the type of asymmetric consumption response that we observe.

First, it is possible that the types of households that received positive shocks are, *ex ante*, different to those who received negative shocks (and in Table 4 we show that different types of households have different MPCs). In Section 4, we showed that there are a lot of similarities between the households who received the positive and negative shocks, but there are also some differences, particularly across their balance sheet positions. This means that simply comparing the sample average of MPCs from a positive shock to the average from a negative shock does not reveal the true effect of receiving a positive shock rather than a negative one.

To try to unpick how important this channel might be, we use a propensity score matching (PSM) framework. In the first stage, a Probit or Logit regression computes the likelihood that a household would have received a positive shock rather than a negative one based on certain characteristics (this is their propensity score). It then matches households from the positive and negative income shock groups based on their propensity scores, to find households who *ex ante* would have face a similar likelihood of receiving a positive shock rather than a negative one. This allows us to compute a ‘counterfactual’ MPC for households with a positive income shock, had they instead received a negative one. The difference between their actual MPC and their matched MPC can then be treated as a more genuine read on the effect of receiving a positive shock rather than a negative one.

Table 6 reports the results of this exercise. The top row gives the unmatched difference between MPCs when a household receives a positive shock rather than a negative one and therefore represents the *unconditional* average difference between the two groups. The remaining rows report the average difference between the MPC of a household who received a positive shock and the MPC of a household who received a negative shock *conditional* on the characteristics in the column heading being held similar (or matched in the PSM jargon) across the groups of positive and negative shocks. The columns of the table give the results where different regressors are included in the production of the propensity score in the first stage.<sup>14</sup> This implies that, for each column, the difference between the entry in the first row and each of the remaining rows could be interpreted as suggestive of the

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<sup>14</sup> Small differences across the columns for the unmatched MPCs reflect the fact that some households did not respond to all of the survey questions.

marginal contribution of the added set of variables (in that column) to explain the unmatched average difference between the MPCs of positive and negative shock groups in the first row. The remaining rows of Table 6 differ according to the specification of the regression to produce the propensity score (Probit or Logit) and the method by which households are matched.

The Average Treatment effect on the Treated (ATT), which is the actual MPC for a household with a positive shock minus the average matched MPC, declines monotonically across the columns as additional variables are included in the propensity score regression. The greatest effect comes when the balance sheet dummy variables are included in the first stage regression. This suggests that these factors (being credit constrained, having an uncertain income or a buffer of savings) seem partly responsible for the observed MPC asymmetry, with a contribution around one fourth of the overall unmatched MPC difference of 0.50 (i.e.  $100 * [-0.50 + 0.37] / [-0.50] = 26\%$ ). A challenge with this type of analysis is that it relies on these qualitative household characteristics being a good indication of the household's 'pre-shock' position. As a robustness check, we also considered a specification excluding the uncertain income dummy variable (which is likely to be the most transitory), and found that these balance sheet differences contribute around 20% of the unmatched asymmetry.

A second possibility is that the asymmetry between MPCs from positive and negative shocks does not reflect the household's characteristics at the time but changes in the household's balance sheet position brought about the shock itself. In the next section, we will consider a model where an unexpected shock can either alleviate or induce a borrowing constraint. Here, we look for evidence that negative income shocks might generate a precautionary savings motives, either via income uncertainty or loss aversion. In particular, a negative income shock might worsen a household's perception about its future income stream, and so cause them to cut spending significantly now in order to preserve their assets to smooth through any future falls. Tentative evidence that this mechanism might play a role is that the MPC for households that received a negative income shock and were concerned about future falls in income (at 0.72) were significantly higher than those that received negative income shocks but were not concerned about further falls (at 0.59). Meanwhile, for positive income shocks, there was no significant difference.

Finally, we consider two explanations for the difference in consumption response to positive and negative income shocks about which it is difficult to gather evidence from the survey, but which we cannot rule out as being important. First, the asymmetry could reflect the point in the economic cycle at which the survey waves were conducted. Second, it could simply reflect survey bias.

Turning to the first, the surveys were conducted between 2011 and 2014, at a point at which the UK economy was recovering from the financial crisis. As well as the heterogeneous effects that the financial crisis might have had on different households (discussed in Section 4), the weaker macroeconomic environment could have affected the behaviour of *all* households. For example, there

could have been heightened risk aversion, making households reluctant to spend out of windfalls, and quick to cut spending heavily in the face of income losses. Alternatively, households might have revised their view of the productive potential of the UK economy, and so expectations of their own permanent income. Over this period, they may have been in a period of adjustment to a lower level of consumption. However, were the state of the economy to play a large role, we might have expected the asymmetry to narrow in the later years as the economy improved. Table 7 shows that several indicators of household financial conditions did improve over the survey waves, and in Section 3 we showed that there was a decline in the share of negative income shocks. Nonetheless, the asymmetry in reported MPCs is remarkably steady across all years of the survey (Figure 1).

Finally, the asymmetry may reflect survey bias. As with all surveys, there is the potential for misreporting. If this simply reflects human error, we might expect it to affect the response to positive and negative income shocks equally. But if it is instead a reflection of some desire to appear financially responsible, households may report very little extra spending when they face a positive windfall but a large cut in spending where the shock is negative, such that it contributed to the asymmetry in MPCs.

Overall, it seems likely that some of the asymmetry reflects differences in the households that receive positive and negative income shocks, especially with respect to their household balance sheet position. Unfortunately, it is not possible to uncover the role of other factors with our current information set. In order to understand the role of the macroeconomic environment it would be revealing to repeat the questions at a different point in the economic cycle. Understanding the role of survey bias and the importance of the response horizon, however, would likely be more difficult.

## **7. What drives the MPC asymmetry? Model Evidence**

In the previous section we explored the available empirical evidence on possible explanations for the asymmetry in MPCs. One of those explanations, for which we are able to find only tentative empirical evidence in the survey responses, is that the income shock itself alleviates or induces constraints on household balance sheets, leading to the observed asymmetry.

This section further explores that possibility using a simple, partial equilibrium model with an occasionally binding borrowing constraint. The model includes two regimes. In the first, the household is unconstrained by the borrowing constraint and they are able to borrow sufficient funds to smooth consumption optimally. But in the second, households are constrained in the amount that they can borrow and so behave in a more hand-to-mouth fashion. But the constraint is endogenous to income, which means that where a shock is sufficiently large, a household that began the period constrained by the borrowing constraint can find themselves in the unconstrained regime, and vice versa. We demonstrate that, considering a calibration based on UK data, the model generates

asymmetric consumption responses to positive and negative income shocks that are consistent with the estimates of MPCs from the survey.

We consider a very simple partial equilibrium model which sets out the decision faced by the household. The representative household in the model maximises their lifetime utility subject to a budget constraint,

$$\max E_0 \sum_{t=0}^{\infty} \beta^t \log(c_t) \quad (1)$$

$$c_t + h_t + Rb_{t-1} = y_t + b_t \quad (2)$$

Households spend their income,  $y_t$ , on consumption goods,  $c_t$ , and housing,  $h_t$ . Expenditure on housing is assumed to be a constant fraction of household income<sup>15</sup>,

$$h_t = Hy_t \quad (3)$$

They use bonds,  $b_t$ , to smooth their consumption intertemporally, which they repay at interest rate,  $R$ , in the next period. But they face a borrowing constraint which ensures that the debt that they acquire each period does not exceed a proportion,  $M$ , of their income.

$$b_t \leq My_t \quad (4)$$

The model incorporates two regimes according to whether the borrowing constraint restricts household behaviour or not. In the case where the borrowing constraint is slack, the Lagrange multiplier on the Euler condition,  $\lambda_t$ , is set to zero and the household optimally smoothes their consumption across time.

$$\lambda_t = \frac{1}{c_t} - \frac{\beta R}{c_{t+1}} \quad (5)$$

Where the borrowing constraint is binding, households are unable to optimally allocate consumption and the Lagrange multiplier,  $\lambda_t > 0$ . In that state of the world, households borrow as much as they can (such that (4) becomes an equality) and the current period's consumption is determined by the borrowing constraint.

Finally, household income in the model is determined by an autoregressive income process, where  $\varepsilon_t$  is a normally distributed shock with mean zero and standard deviation one, and  $\sigma$  represents the standard deviation of income shocks.

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<sup>15</sup> We include housing in the model to reflect the fact that households are asked about unexpected changes to their income before housing expenditure is deducted.



$$\log(y_t) = \rho \log(y_{t-1}) + \sigma \varepsilon_t \quad (6)$$

Since sufficiently large income shocks cause the household to switch between the constrained and the unconstrained regimes, we use the occasionally binding constraints toolkit of Guerrieri & Iacoviello (2015a) to solve for the transitional dynamics. This toolkit delivers a piecewise linear approximation to the non-linear solution which is shown to approximate the full solution very well.<sup>16</sup>

The model is calibrated to match the annual statistics of UK data (Table 9), based on a combination of survey and aggregate data.

Figure 11 shows the impulse responses to an unexpected positive (in blue) and negative (in red) income shock. The shocks are assumed to be symmetric and are scaled to 6% of income (the mean shock to income in our sample). The top subplot shows that the income shocks themselves are symmetric. But the second subplot shows that consumption responds asymmetrically according to the sign of the shock. Where the shock is negative, households cut their spending back sharply, as they find that the borrowing constraint limits the amount that they are able to borrow. But when the shock is positive, it is sufficiently large to ease the borrowing constraint for the household, such that consumption rises only a little, but is persistently higher, as the income shock is smoothed across time. Taking the ratio of the consumption response to the income response over the first year (the first period given the annual calibration) delivers a marginal propensity to consume of 0.08 to a positive income shock, and 0.59 to a negative income shock.<sup>17</sup>

While this model is very simplistic, it demonstrates that the interaction of the shock itself and occasionally binding constraints on household balance sheets can generate the type of asymmetric consumption responses that we observe in the survey estimates. Extending the mechanism to a general equilibrium model (such as that considered in Guerrieri & Iacoviello (2015b)) would likely generate richer dynamics but not overturn the intuition.

Note that the size of the income shock is likely to be important for this type of mechanism. Large positive income shocks are more likely to ease a borrowing constraint than smaller ones, and equivalently, large negative shocks are more likely to introduce one. The time horizon is also important. A marginal propensity to consume taken over the first year generates the peak asymmetry in the consumption response. Over a longer horizon, the cumulative change in consumption relative to income looks much more similar, as the borrowing constraint essentially constrains the speed with which the household responds to the income shock. As such, were this mechanism to be playing an

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<sup>16</sup> One mechanism which the piecewise linear solution is unable to account for is precautionary savings motives associated with the possibility that the constraint might bind in the future.

<sup>17</sup> Alternative calibrations would be able to deliver the MPC we observe in the survey exactly, but here we take a data driven approach.

important role, the large asymmetry that we observe in the MPC estimates is likely to reflect the relatively short horizon over which we ask about the household's consumption response (one year).<sup>18</sup>

## 8. Conclusions

A large empirical literature has reported significant and heterogeneous consumption responses to positive income changes, as generated for instance by tax rebates, minimum wage hikes or hypothetical/anticipated increases in household resources. Far less, however, was known on the consumption responses to negative, unanticipated income changes. In this paper, we have contributed to filling in this important gap in the literature by relying on a set of newly added questions to the Bank of England/NMG survey of British households. These questions ask about the size and sign of any unanticipated income change during the previous year as well as the share of that change spent.

A one pound unexpected rise in income leads, on average, to a 14 pence increase in household expenditure whereas an unpredicted fall in income of one pound is associated with a reduction in consumption of 64 pence. The average effects, however, mask significant heterogeneity, with households more likely to be facing credit constraints, liquidity shortages and a higher risk of lower income in the future typically having significantly higher MPCs. An extensive regression analysis along a large number of observable dimensions suggests that differences in the strength of the household balance sheet and in the extent of income risks facing different earners can account for up to one quarter of the observed MPC asymmetry between positive and negative income shocks.

Using household balance sheet and debt position information in the NMG survey, we compute the MPCs out of positive and negative income shocks for borrowers and savers. These estimates can be used to simulate the possibly asymmetric effects of contractionary and expansionary economic policies on aggregate consumption. Furthermore, our analysis suggests that the asymmetry in the responses of aggregate consumption to monetary policy would tend to be more pronounced during periods of higher income risks and more stringent credit conditions.

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<sup>18</sup> Ideally, we might like to ask households about the response over a longer horizon but in practice this is likely to be an unreasonable horizon to expect households to recall accurately.

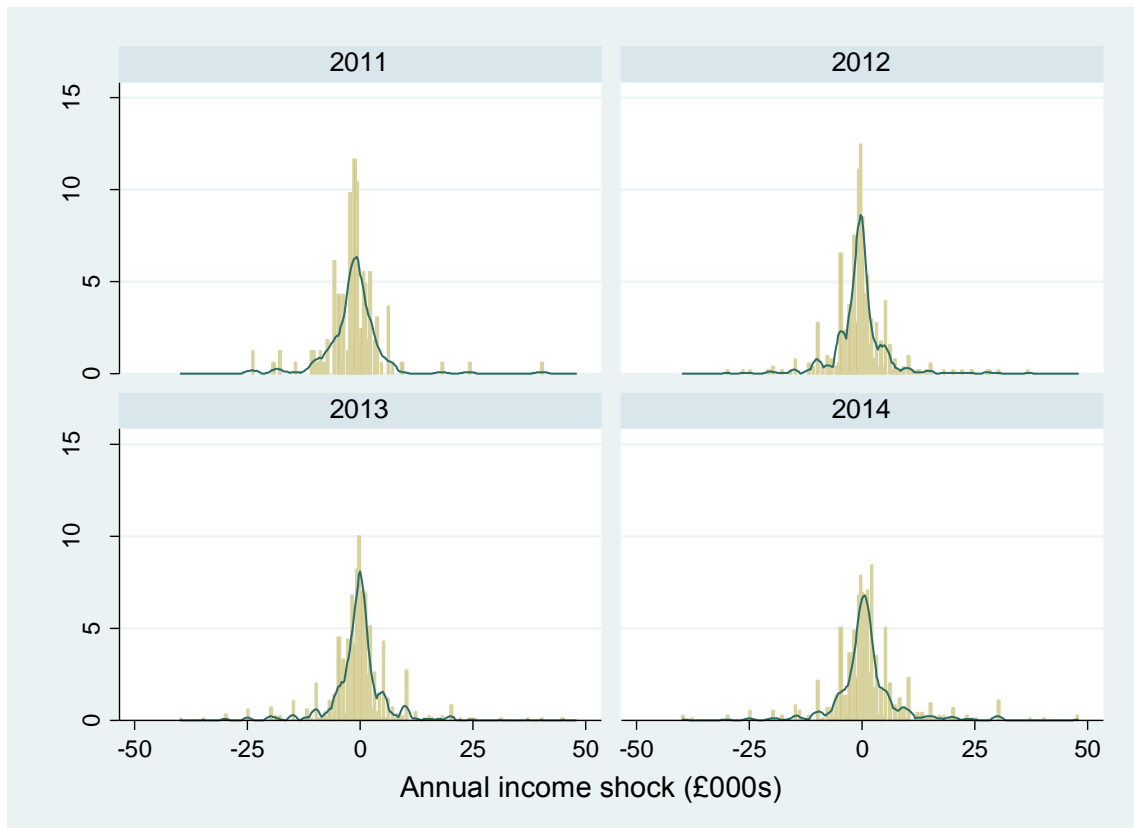
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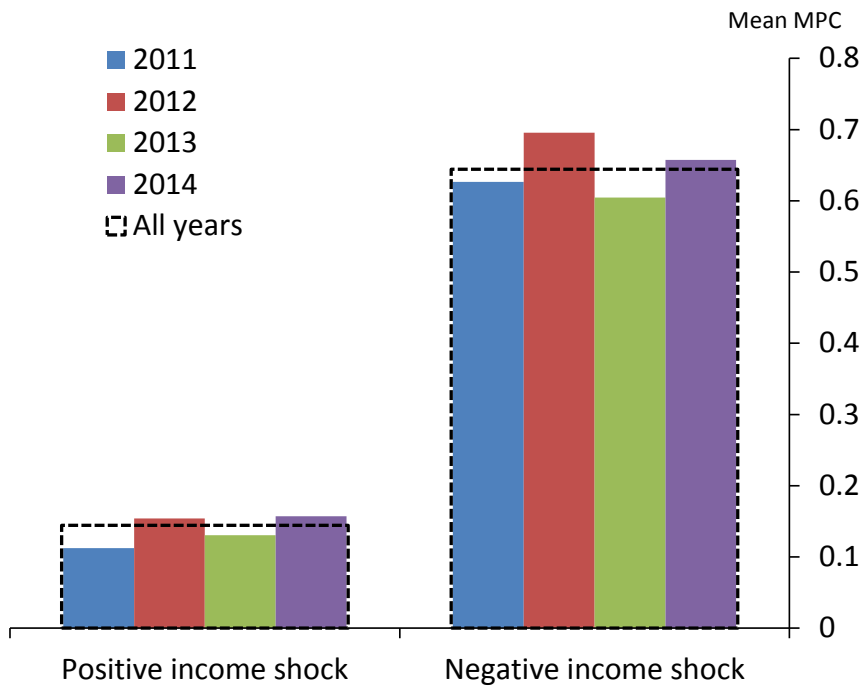
## FIGURES

**Figure 1: Size of shocks to annual income by year<sup>a</sup>**

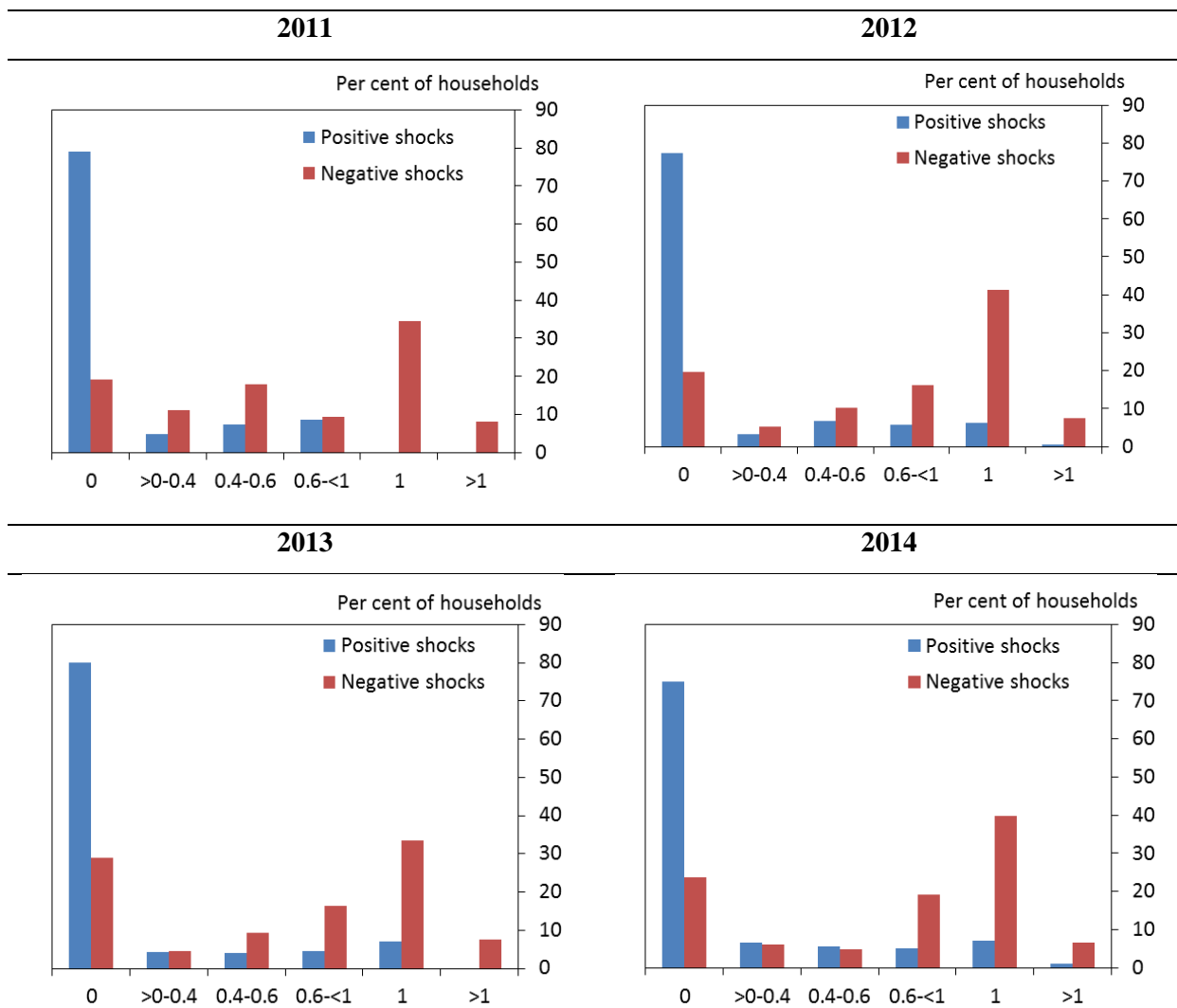


a) Distribution cut at -£50,000 and +£50,000 for presentational purposes (actual range after trimming is -£130,000 to +£100,000)

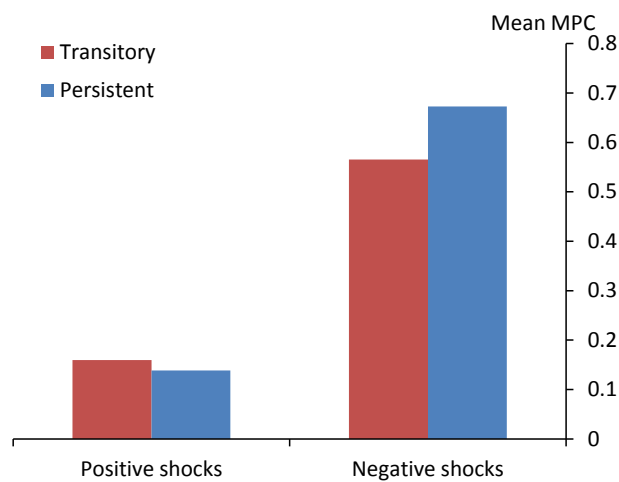
**Figure 2: Mean MPC by year**



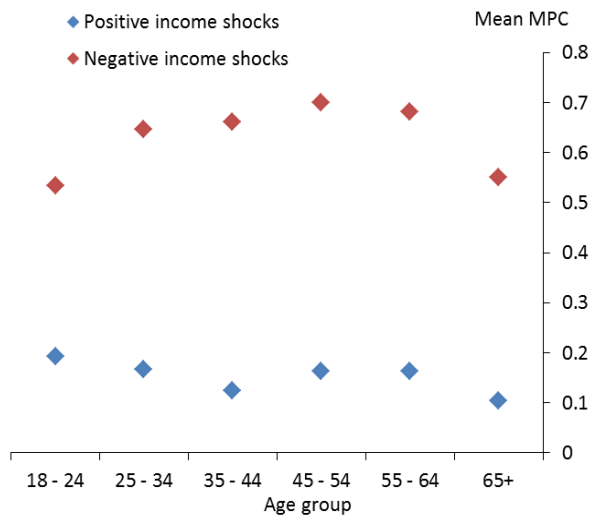
**Figure 3: Distribution of reported MPCs by year**



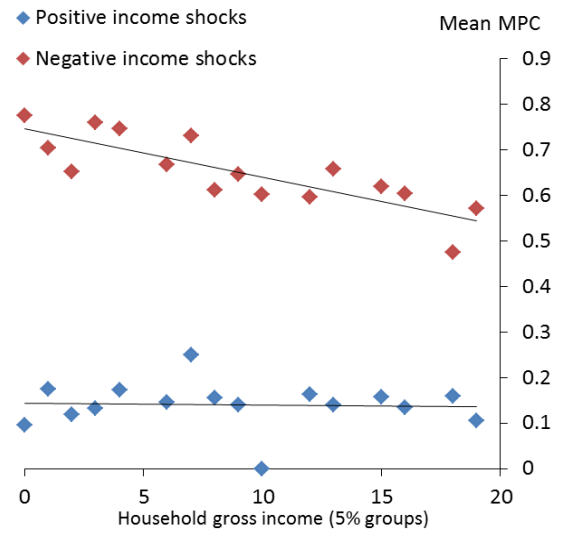
**Figure 4: Mean MPC by persistence of shock**



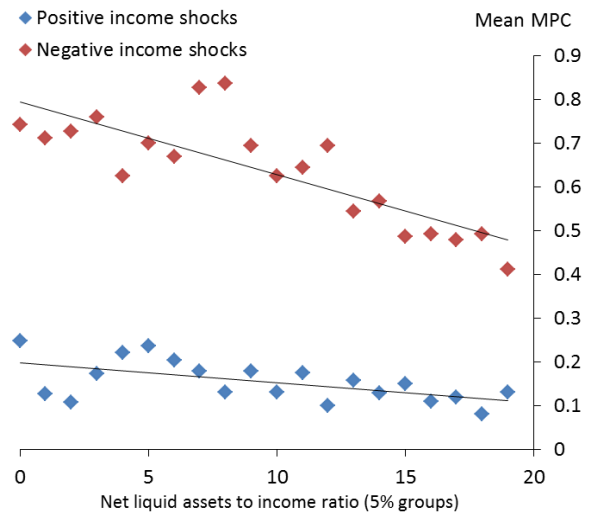
**Figure 5: Mean MPC by age group**



**Figure 6: Mean MPC by gross income<sup>19</sup>**



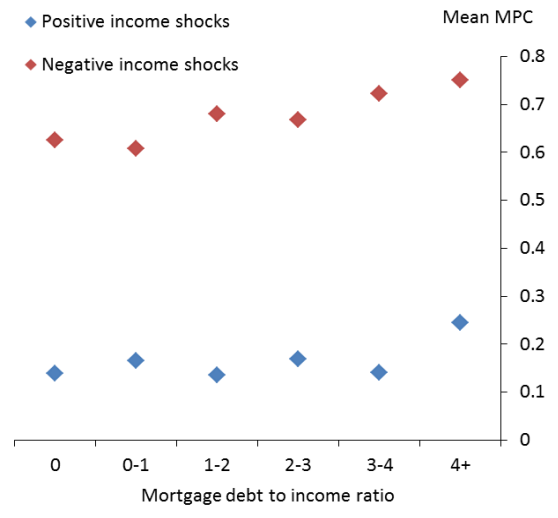
**Figure 7: Mean MPC by net liquid assets to income ratio**



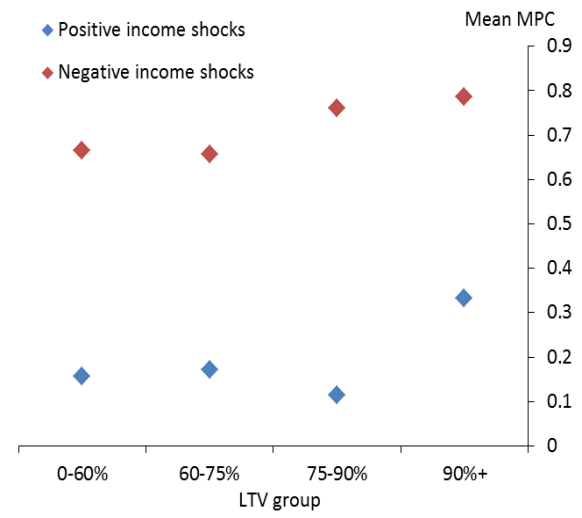
<sup>19</sup> Only 5 households are in the 10th income group for positive shocks (with a mean MPC of zero).



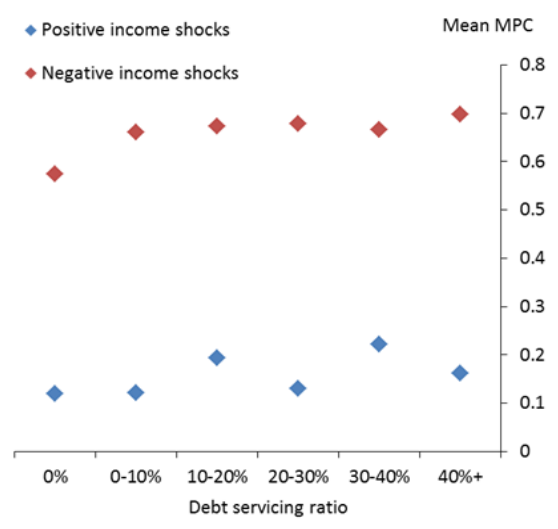
**Figure 8: Mean MPC by mortgage debt to income ratio**



**Figure 9: Mean MPC by LTV group**



**Figure 10: Mean MPC by debt servicing ratio**



**Figure 11: Mean MPC by size of shock**

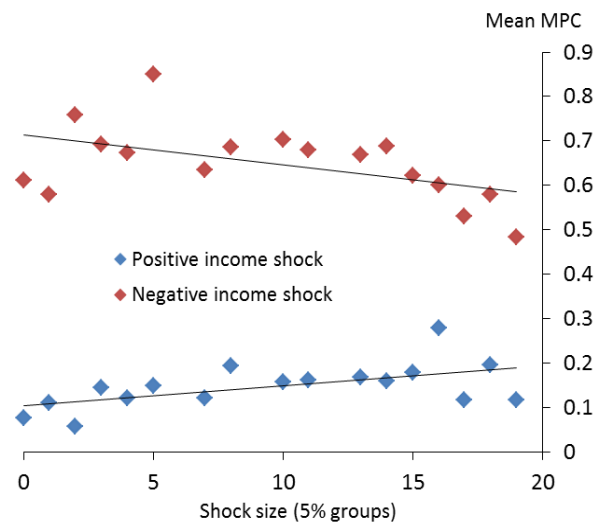
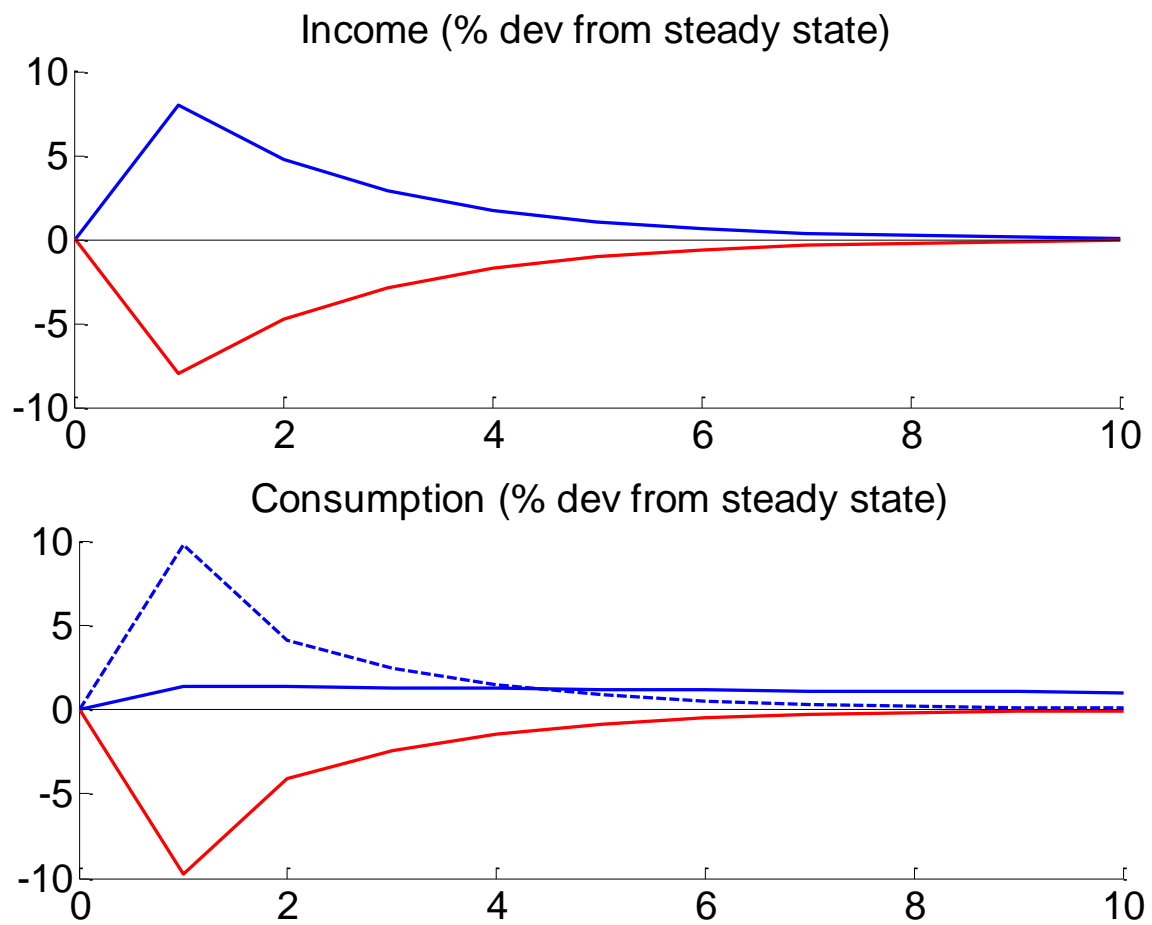


Figure 11: Impulse responses to unexpected income shock



Solid lines correspond to the model where the borrowing constraint is occasionally binding, and the dashed line to the model where the borrowing constraint is always binding.

## TABLES

**Table 1: Sample sizes across years**

Year	Total sample	Experienced an income shock		Reported sufficient information to:					
		Positive	Negative	Determine whether MPC=0 or MPC>0		Compute MPC value		Compute MPC value (after trimming)	
				Positive	Negative	Positive	Negative	Positive	Negative
2011	1,004	117	268	92	260	66	126	55	110
2012	4,003	467	1,022	424	997	228	346	206	305
2013	6,006	777	1,295	727	1,279	439	486	396	450
2014	6,001	778	918	720	898	448	340	427	314
All years	17,014	2,139	3,503	1,963	3,434	1,181	1,298	1,084	1,179
<i>Per cent of total sample</i>		<i>12.6</i>	<i>20.6</i>	<i>11.5</i>	<i>20.2</i>	<i>6.9</i>	<i>7.6</i>	<i>6.4</i>	<i>6.9</i>

**Table 2: Characteristics of households by sign of income shock – continuous variables <sup>a</sup>**

	Positive shocks				Negative shocks				Significantly different
	Mean	Median	Interquartile range	Sample	Mean	Median	Interquartile range	Sample	
MPC	0.15	0	[0,0]	1,084	0.65	0.8	[0.13,1]	1,179	Yes***
Age	45.81	44	[30,61.5]	1,084	49.1	50	[38,61]	1,179	Yes***
Annual pre-tax income (£'000)	37.27	33.00	[20.85,47.9]	1,084	37.0	31.0	[21,46]	1,179	No
Unsecured debt (£'000)	8.13	4.25	[0.9,12.5]	729	8.7	4.3	[0.75,12.5]	765	No
Mortgage debt (£'000)	87.80	75	[35,110]	478	90.6	75	[43,120]	447	No
Mortgage debt service ratio	19.40	15	[9.40,21.43]	476	21	18	[12,26.5]	443	No
Loan to value ratio	0.44	0.41	[0.18,0.67]	478	0.5	0.5	[0.2,0.7]	447	No
Loan to income ratio	2.80	1.92	[0.93,3.05]	474	2.4	1.9	[1.1,2.9]	447	No
Net liquid assets (£'000)	45.49	6.0	[-1.5,47.5]	1,041	28.9	1	[-4,24.5]	1,127	Yes***
Annual income shock (£'000)	4.91	2.00	[0.74,5]	1,084	-4.2	-2	[-5,-1]	1,179	Yes***
Net liquid assets / Annual income	2.69	0.66	[0.15,2.4]	717	1.7	0.43	[0.1,2.2]	681	Yes***

a) Variation in sample sizes across rows reflects different subsamples (e.g. mortgagors only) and response rates to different survey questions

**Table 3: Characteristics of households by sign of income shock – discrete variables <sup>a</sup>**

	Positive shocks			Negative shocks			Significantly different
	Per cent of households	Standard deviation	Sample	Per cent of households	Standard deviation	Sample	
Credit constrained	19.07	0.39	1,054	37.35	0.48	1,146	Yes***
Fall in income likely	9.62	0.3	956	39.1	0.49	959	Yes***
Concerned about debt	31.65	0.47	1,027	52.08	0.5	1,058	Yes***
Buffer stock of savings	68.45	0.46	989	38.86	0.49	996	Yes***
Worse off since 2006	26.35	0.44	816	82.11	0.38	760	Yes***
Temporary shock	35.98	0.48	970	18.27	0.39	996	Yes***

a) Variation in sample sizes across rows reflects different subsamples (e.g. mortgagors only) and response rates to different survey questions

**Table 4: MPC by discrete household characteristics**

		Mean MPC			
		Positive shock	Sample	Negative shock	Sample
Housing tenure	Owner occupier	0.10	325	0.56	377
	Mortgagor	0.16	490	0.68	456
	Private tenant	0.15	196	0.65	180
	Social tenant	0.22	65	0.77	158
Employment status	Employed	0.16	656	0.64	606
	Self-employed	0.12	67	0.65	111
	Unemployed	0.07	12	0.79	37
	Retired	0.10	264	0.58	241
Credit constrained	No	0.13	853	0.58	718
	Yes	0.24	201	0.75	428
Fall in income is likely	No	0.15	864	0.59	584
	Yes	0.17	92	0.72	375
Concerned about debt	No	0.13	702	0.57	507
	Yes	0.19	325	0.72	551
Have a buffer of savings	No	0.21	312	0.74	609
	Yes	0.12	677	0.50	387
Worse off than expected in 2006	No	0.14	601	0.44	136
	Yes	0.16	215	0.67	624

**Table 5: OLS regression results, dependent variable MPC**

VARIABLES	POSITIVE INCOME SHOCKS					NEGATIVE INCOME SHOCKS				
	Demographics <sup>(a)</sup>	Shock characteristics <sup>(b)</sup>	Balance sheet dummies <sup>(c)</sup>	Net liquid wealth <sup>(d)</sup>	All <sup>(f)</sup>	Demographics <sup>(a)</sup>	Shock characteristics <sup>(b)</sup>	Balance sheet dummies <sup>(c)</sup>	Net liquid wealth <sup>(d)</sup>	All <sup>(f)</sup>
Age 18-24 dummy	0.05 (0.03)				0.05 (0.04)	-0.13** (0.07)				-0.10 (0.07)
Age 45-64 dummy	0.02 (0.03)				0.02 (0.03)	0.02 (0.03)				0.06 (0.04)
Age 65+ dummy	-0.04* (0.02)				-0.01 (0.03)	-0.10** (0.04)				-0.02 (0.05)
Unemployed dummy	-0.10 (0.07)				-0.10 (0.08)	0.14** (0.06)				0.09 (0.07)
Shock size in 2nd quartile dummy		0.02 (0.03)			0.02 (0.03)	-0.01 (0.05)				0.05 (0.05)
Shock size in 3rd quartile dummy		0.05* (0.03)			0.08** (0.03)	0.02 (0.04)				0.05 (0.04)
Shock size in top quartile dummy		0.07** (0.03)			0.08*** (0.03)	-0.08** (0.04)				-0.04 (0.04)
Transitory shock dummy		0.02 (0.02)			0.02 (0.02)	-0.10*** (0.03)				-0.07* (0.04)
Credit constrained dummy			0.10*** (0.03)		0.09*** (0.03)		0.07** (0.03)			0.06 (0.04)
Income uncertainty dummy			-0.03 (0.02)		-0.04* (0.02)		0.13*** (0.04)			0.09** (0.04)
Has buffer of savings dummy			-0.09*** (0.03)		-0.11*** (0.03)		-0.18*** (0.03)			-0.12*** (0.04)
2nd tertile of liquid assets to income dummy				-0.03 (0.03)	0.00 (0.03)			0.03 (0.03)		0.06 (0.04)
Top tertile of liquid assets to income dummy				-0.06** (0.02)	0.01 (0.03)			-0.20*** (0.03)		-0.08 (0.05)
Mortgagor dummy									-0.01 (0.03)	-0.02 (0.04)
LTV > 90% dummy					0.17 (0.10)				0.07 (0.05)	0.09 (0.05)
LTV 75%-90% dummy					-0.07* (0.04)				0.04 (0.06)	0.06 (0.07)
Concerned about debt dummy					0.06*** (0.02)				0.14*** (0.03)	0.02 (0.04)
2013 dummy	-0.03 (0.03)	-0.04 (0.03)	-0.04 (0.03)	-0.02 (0.02)	-0.06** (0.03)	-0.09*** (0.03)	-0.08** (0.03)	-0.07** (0.03)	-0.09*** (0.03)	-0.08** (0.04)
2014 dummy	0.01 (0.03)	0.00 (0.03)	0.01 (0.03)	0.02 (0.02)	-0.01 (0.03)	-0.03 (0.03)	-0.04 (0.04)	-0.01 (0.03)	-0.03 (0.03)	-0.03 (0.04)
Constant	0.16*** (0.03)	0.12*** (0.03)	0.23*** (0.04)	0.18*** (0.02)	0.18*** (0.05)	0.71*** (0.03)	0.74*** (0.05)	0.72*** (0.03)	0.62*** (0.03)	0.62*** (0.07)
Observations	1,029	970	903	1,084	854	1,069	996	1,179	1,058	817
R-squared	0.012	0.014	0.043	0.008	0.019	0.026	0.026	0.051	0.037	0.123

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

(a) Benchmark household is aged 25-44 and employed, responding to the 2012 survey

(b) Benchmark household is one with a shock size in the lowest quartile, faces a persistent shock, responding to the 2012 survey

(c) Benchmark household is one with access to credit, not uncertain about income and without a buffer of savings, responding to the 2012 survey

(d) Benchmark household is in the bottom liquid assets to income tertile, responding to the 2012 survey

(e) Benchmark household is probably a renter or owner-occupied who is unconcerned about debt, responding to the 2012 survey

(f) Benchmark household has all the characteristics of benchmark households in earlier regressions

**Table 6: Average treatment effect, alternative matching approaches**

PSM VARIABLES	(1)	(2)	(3)	(4)	(5)
	Demographics	As (1), plus: Shock characteristics	As (2), plus: Balance sheet dummies	As (3), plus: Liquid assets	As (4), plus: Debt
<b>Unmatched</b>	-0.50*** (0.02)	-0.50*** (0.02)	-0.50*** (0.02)	-0.50*** (0.02)	-0.49*** (0.02)
<b>Kernel matching (epanechnikov), Probit</b>					
ATT	-0.48*** (0.02)	-0.47*** (0.02)	-0.37*** (0.03)	-0.37*** (0.03)	-0.36*** (0.03)
<b>Nearest five neighbour matching, Probit</b>					
ATT	-0.53*** (0.06)	-0.49*** (0.03)	-0.36*** (0.03)	-0.36*** (0.03)	-0.36*** (0.03)
<b>Kernel matching (normal), Probit</b>					
ATT	-0.53*** (0.06)	-0.49*** (0.03)	-0.36*** (0.03)	-0.36*** (0.03)	-0.36*** (0.03)
<b>Kernel matching (epanechnikov), Logit</b>					
ATT	-0.48*** (0.02)	-0.47*** (0.02)	-0.37*** (0.03)	-0.37*** (0.03)	-0.36*** (0.03)
Observations	2,263	1,966	1,678	1,678	1,671

Standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 7: Indicators of improvement in sentiment in survey**

	2012	2013	2014
<b>Per cent of households who report that:</b>			
They are worse off than 2006	n.a.	50.2	43.5
They see a large fall in income as possible	63.1	63.8	58.5
They are credit constrained	26.4	24.3	20.4
They are concerned about debt	41.3	35.9	34.2
They have a savings buffer for emergencies	52.5	53.7	55.7

**Table 8: MPCs for borrowers and savers**

	MPC based on buffer of savings		MPC based on net wealth		Average MPC based on buffer of savings
	Positive income shock	Negative income shock	Positive income shock	Negative income shock	
Borrower	0.21	0.74	0.16	0.70	0.48
Saver	0.12	0.50	0.13	0.58	0.31

**Table 9: Calibration of occasionally binding constraint model**

		<b>Source</b>	<b>Calibrated value</b>
R	Long run real interest rate	Consistent with UK real interest rates since early 1990s	1.02
$\beta$	Discount factor	Consistent with interest rate and consumption Euler equation	0.98
H	Share of income spent on housing	Family Expenditure Survey	0.3
M	Borrowing constraint (share of income)	Mean unsecured debt to income ratio, NMG survey	0.15
$\rho$	Persistence of autoregressive income process		0.6
$\sigma$	Standard deviation of income shocks	Standard deviation of annual income, NMG survey	0.601

## Appendix 1: Survey Questions

### MPC QUESTIONS

1) Has your household received more or less money, from both work and non-work sources, **over the last 12 months**<sup>20</sup> than you would have expected this time last year?

Please consider your income after income tax and National Insurance but before any housing costs or bills are paid. Please include any unexpected pay increases or decreases, bonuses, lottery winnings, unexpected tax bills or repayments, PPI claims and inheritance, lifestyle changes etc.

- a) More
- b) About the same
- c) Less

2) Compared to what you expected this time last year, how much **more [less]** money did your household receive **over the last 12 months**?

Please consider your income after income tax and National Insurance but before any housing costs or bills are paid. Please include any unexpected pay increases or decreases, bonuses, lottery winnings, unexpected tax bills or repayments, PPI claims and inheritance, lifestyle changes etc.

Please specify an approximate annual amount in pounds.

Don't know/Prefer not to state

3) Are you treating this unexpected increase [decrease] in money received by your household as:

- a) A temporary increase
- b) An increase that is likely to persist
- c) Don't know/Prefer not to state

4) How did you change your **annual spending** in response to this unexpected change in money received by your household?

- a) Spent more
- b) Spent the same

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<sup>20</sup> In 2011, households were asked about changes to their monthly income over the previous year. For the purposes of our analysis we have annualised the 2011 responses.



c) Spent less

5) You indicated earlier in the survey that your household received £[reported amount ] more/less over the last 12 months than you had expected a year ago. By how much did you **increase/decrease your annual spending** in response to this?

Please specify an approximate annual amount in pounds.

Don't know/Prefer not to state

## **OTHER HOUSEHOLD CHARACTERISTICS**

### *Credit constraints:*

Have you been put off spending because you are concerned that you will not be able to get further credit when you need it, say because you are close to your credit limit or you think your loan application would be turned down? Yes; No

### *Liquid assets*

How much do you (or any member of your household) currently have in total, saved up in savings and investments? Include bank /building society savings accounts or bonds, stock and shares, ISAs, Child Trust Funds, NS&I account/bonds and premium bonds. Please exclude any pensions you may have.

### *Income risk*

To the best of your knowledge, how likely is it that your household income will fall sharply over the next year or so (for example, because you or someone in your family are made redundant)?

- a) Not very likely – my household income is very secure;
- b) Not likely, but there is a small chance of a sharp fall in my household income;
- c) Quite likely – my household income could fall sharply

### *Debt concern*

How concerned are you about your current level of debt? Please consider all debt, including any balances on credit/store cards, loans or secured debt such as your mortgage.

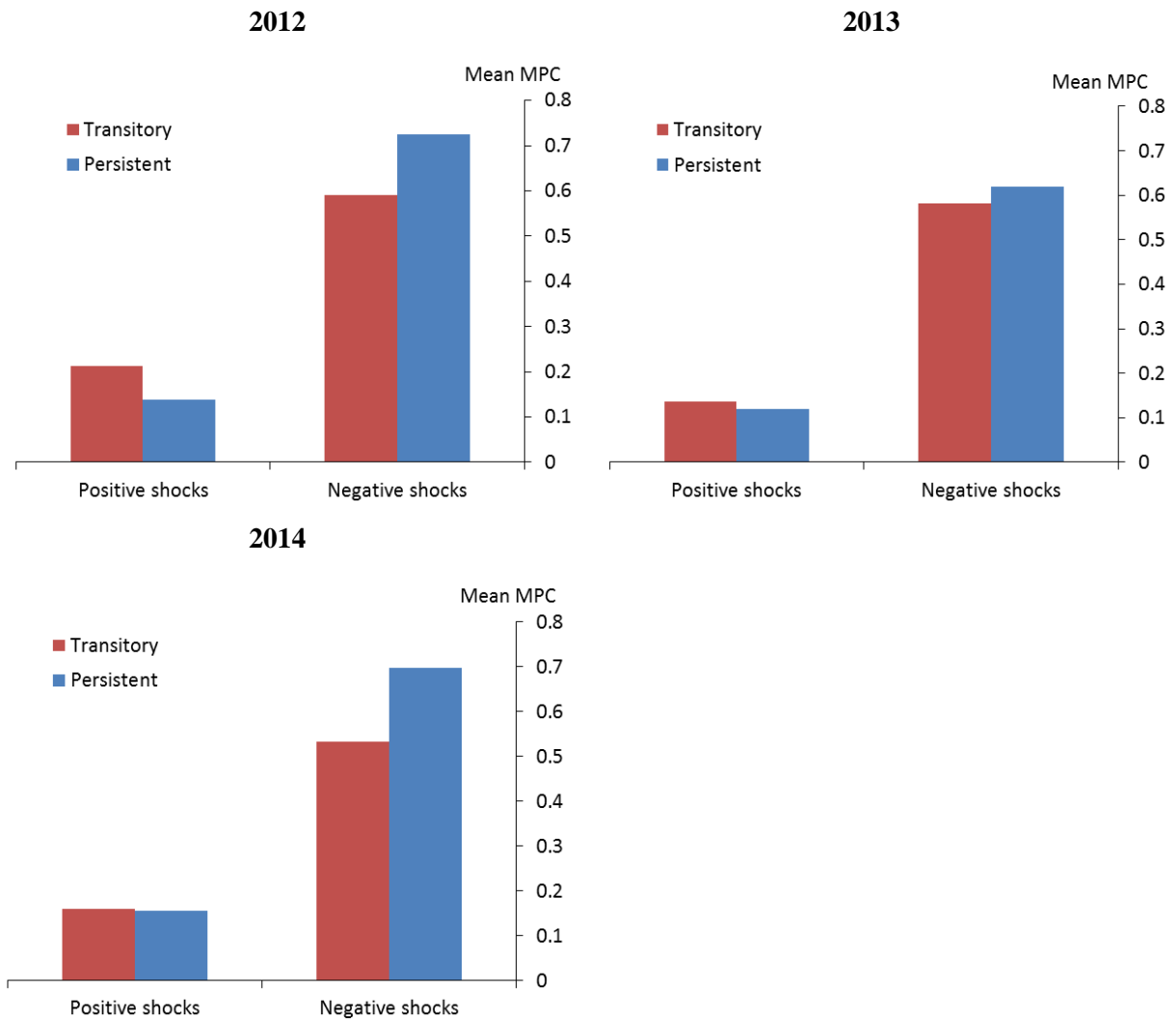
- a) Very concerned;
- b) Somewhat concerned;
- c) Not at all concerned

### *Buffer stock of savings*

Do you feel that you have enough money set aside for emergencies? Yes; No

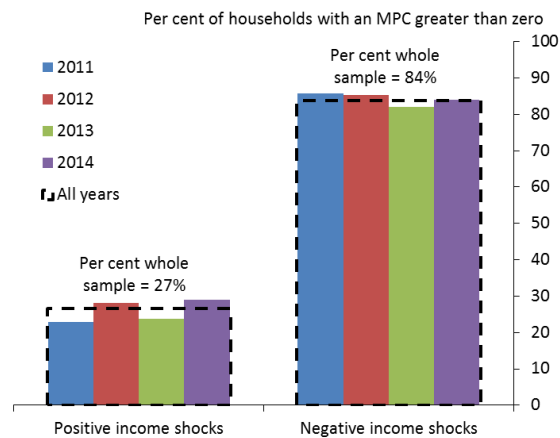
## Appendix 2: Additional Descriptive Statistics

Figure A1: Mean MPC by shock persistence, by year<sup>1</sup>



1. Households were not asked about the persistence of the shock in the 2011 survey

Figure A2: Share of households with MPC greater than zero



## Appendix 3 – Tobit regression results (dependent variable MPC)

VARIABLES	POSITIVE INCOME SHOCKS					NEGATIVE INCOME SHOCKS						
	Demographics <sup>(a)</sup>	Shock characteristics <sup>(b)</sup>	Balance sheet dummies <sup>(c)</sup>	Net liquid wealth <sup>(d)</sup>	Debt <sup>(e)</sup>	All <sup>(f)</sup>	Demographics <sup>(a)</sup>	Shock characteristics <sup>(b)</sup>	Balance sheet dummies <sup>(c)</sup>	Net liquid wealth <sup>(d)</sup>	Debt <sup>(e)</sup>	All <sup>(f)</sup>
Age 18-24 dummy	0.21* (0.12)					0.20 (0.13)	-0.17* (0.09)					-0.11 (0.09)
Age 45-64 dummy	0.03 (0.10)					0.01 (0.11)	0.02 (0.04)					0.07 (0.05)
Age 65+ dummy	-0.31** (0.12)					-0.14 (0.14)	-0.15*** (0.06)					-0.03 (0.07)
Unemployed dummy	-0.37 (0.42)					-0.23 (0.40)	0.20*** (0.07)					0.15* (0.08)
Shock size in 2nd quartile dummy		0.19 (0.14)				0.22 (0.14)	0.00 (0.06)					0.08 (0.07)
Shock size in 3rd quartile dummy		0.29** (0.13)				0.36*** (0.14)	0.05 (0.05)					0.09 (0.06)
Shock size in top quartile dummy		0.47*** (0.11)				0.49*** (0.12)	-0.07 (0.05)					-0.01 (0.06)
Transitory shock dummy		0.13 (0.09)				0.10 (0.09)	-0.13*** (0.05)					-0.08 (0.05)
Credit constrained dummy			0.36*** (0.10)			0.32*** (0.11)		0.10** (0.04)				0.08* (0.05)
Income uncertainty dummy			-0.05 (0.09)			-0.16* (0.09)		0.20*** (0.06)				0.15** (0.06)
Has buffer of savings dummy			-0.33*** (0.09)			-0.35*** (0.11)		-0.24*** (0.05)				-0.17*** (0.06)
2nd tertile of liquid assets to income dummy				-0.10 (0.10)		-0.00 (0.11)			0.03 (0.04)			0.09* (0.05)
Top tertile of liquid assets to income dummy				-0.25*** (0.10)		0.04 (0.12)			-0.26*** (0.04)			-0.08 (0.07)
Mortgagor dummy					0.08 (0.09)					-0.01 (0.04)		-0.03 (0.05)
LTV >90% dummy					0.46* (0.26)					0.11** (0.05)		0.13** (0.07)
LTV 75%-90% dummy					-0.30 (0.19)					0.05 (0.08)		0.08 (0.09)
Concerned about debt dummy					0.25*** (0.09)					0.21*** (0.04)		0.04 (0.05)
2013 dummy	-0.14 (0.11)	-0.16 (0.12)	-0.19 (0.12)	-0.11 (0.11)	-0.11 (0.11)	-0.25** (0.12)	-0.13*** (0.04)	-0.11** (0.05)	-0.10*** (0.04)	-0.12*** (0.04)	-0.12*** (0.04)	-0.11** (0.05)
2014 dummy	0.06 (0.11)	0.04 (0.11)	0.06 (0.11)	0.10 (0.10)	0.08 (0.11)	0.00 (0.11)	-0.04 (0.04)	-0.05 (0.05)	-0.02 (0.04)	-0.04 (0.05)	-0.04 (0.05)	-0.04 (0.05)
Constant	-0.66*** (0.12)	-0.97*** (0.13)	-0.45*** (0.13)	-0.59*** (0.11)	-0.81*** (0.11)	-0.69*** (0.19)	0.66*** (0.04)	0.52*** (0.07)	0.69*** (0.03)	0.53*** (0.04)	0.53*** (0.04)	0.48*** (0.10)
Observations	1,029	970	903	1,084	1,027	854	1,069	996	875	1,179	1,058	817

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

(a) Benchmark household is aged 25-44 and employed, responding to the 2012 survey

(b) Benchmark household is one with a shock size in the lowest quartile, faces a persistent shock, responding to the 2012 survey

(c) Benchmark household is one with access to credit, not uncertain about income and without a buffer of savings, responding to the 2012 survey

(d) Benchmark household is in the bottom liquid assets to income tertile, responding to the 2012 survey

(e) Benchmark household is probably a renter or owner occupier who is unconcerned about debt, responding to the 2012 survey

(f) Benchmark household has all the characteristics of benchmark households in earlier regressions

## Appendix 4: Probit regression results (dependent variable dummy for MPC greater than zero)

VARIABLES	POSITIVE INCOME SHOCKS					NEGATIVE INCOME SHOCKS				
	Demographics <sup>(a)</sup>	Shock characteristics <sup>(b)</sup>	Balance sheet dummies <sup>(c)</sup>	Net liquid wealth <sup>(d)</sup>	All <sup>(f)</sup>	Demographics <sup>(a)</sup>	Shock characteristics <sup>(b)</sup>	Balance sheet dummies <sup>(c)</sup>	Net liquid wealth <sup>(d)</sup>	All <sup>(f)</sup>
Age 18-24 dummy	0.08*** (0.03)				0.09*** (0.03)	-0.05** (0.02)				-0.04 (0.03)
Age 45-64 dummy	-0.03 (0.03)				-0.04 (0.03)	0.01 (0.02)				0.04* (0.02)
Age 65+ dummy	-0.15*** (0.03)				-0.14*** (0.04)	-0.06*** (0.02)				-0.01 (0.02)
Unemployed dummy	0.01 (0.09)				0.01 (0.10)	0.06* (0.03)				0.04 (0.04)
Shock size in 2nd quartile dummy		0.05 (0.04)				0.01 (0.04)				
Shock size in 3rd quartile dummy		0.07* (0.04)				0.06* (0.03)				
Shock size in top quartile dummy		0.15*** (0.03)				0.05 (0.03)				
Transitory shock dummy		0.06** (0.03)				-0.05 (0.03)				
Credit constrained dummy			0.13*** (0.03)		0.11*** (0.03)		0.03 (0.02)			0.02 (0.02)
Income uncertainty dummy			0.00 (0.02)		-0.02 (0.02)		0.11*** (0.02)			0.10*** (0.02)
Has buffer of savings dummy			-0.09*** (0.03)		-0.08*** (0.03)		-0.12*** (0.02)			-0.10*** (0.02)
2nd tertile of liquid assets to income dummy				-0.02 (0.02)				0.02 (0.02)		0.06*** (0.02)
Top tertile of liquid assets to income dummy				-0.08*** (0.02)				-0.10*** (0.01)		-0.02 (0.02)
Mortgagor dummy									-0.01 (0.02)	-0.02 (0.02)
LTV >90% dummy									0.06 (0.06)	0.07 (0.07)
LTV 75%-90% dummy									0.00 (0.04)	0.00 (0.04)
Concerned about debt dummy									0.11*** (0.01)	0.04* (0.02)
2013 dummy	-0.05** (0.03)	-0.04 (0.04)	-0.05 (0.03)	-0.04 (0.03)	-0.05* (0.03)	-0.03** (0.02)	-0.09*** (0.03)	-0.04** (0.02)	-0.03** (0.01)	-0.04** (0.02)
2014 dummy	0.01 (0.03)	0.02 (0.04)	0.03 (0.03)	0.02 (0.03)	0.02 (0.03)	-0.01 (0.02)	-0.03 (0.03)	-0.03 (0.02)	-0.02 (0.02)	-0.03 (0.02)
Probability for benchmark household	0.31	0.16	0.31	0.30	0.35	0.86	0.79	0.81	0.87	0.76
Observations	1,871	1,007	1,520	1,963	1,508	3,174	1,071	2,190	3,434	2,159

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

(a) Benchmark household is aged 25-44 and employed, responding to the 2012 survey

(b) Benchmark household is aged 25-44 and employed, responding to the 2012 survey

(c) Benchmark household is one with access to credit, not uncertain about income and without a buffer of savings, responding to the 2012 survey

(d) Benchmark household is in the bottom liquid assets to income tertile, responding to the 2012 survey

(e) Benchmark household is probably a renter or owner occupier who is unconcerned about debt, responding to the 2012 survey

(f) Benchmark household has all the characteristics of benchmark households in columns a), c), d) and e)