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The consumption response to positive and negative income changes

Philip Bunn,⁽¹⁾ Jeanne Le Roux,⁽²⁾ Kate Reinold⁽³⁾ and Paolo Surico⁽⁴⁾

Abstract

A set of newly added questions in the 2011 to 2014 Bank of England/NMG Consulting Survey reveals that British households are estimated to change their consumption by significantly more in reaction to temporary and unanticipated *falls* in income than to *rises* of the same size. Household balance sheet characteristics (including the presence of a savings buffer), concerns about credit market access and higher subjective risk of lower future income account for a sizable share of this spending asymmetry and explain significant variation in the marginal propensity to consume across households. Our findings have important implications for predicting the response of aggregate consumption to expansionary and contractionary macroeconomic policies.

Key words: MPC asymmetry, household balance sheet, heterogeneity, transmission mechanism.

JEL classification: E21, E52, D12.

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1. Introduction

The marginal propensity to consume (MPC) out of temporary income changes plays an important role in the transmission of economic shocks to the real economy. According to the permanent income hypothesis (PIH), households only respond to shocks that alter their lifetime resources and therefore a non-permanent change in disposable income should only trigger a small change in current consumption. Yet, there is abundant evidence of significant and large estimates for the MPC, with liquidity constraints, income risk and precautionary motives being prominent explanations put forward for the violation of the PIH.

Despite a large empirical literature (surveyed in Section 2) on the spending response to temporary income windfalls, there are far fewer works on what happens to household expenditure following a temporary fall in income. In the light of the more scant evidence on the latter, it is then unsurprising that there are an even lower number of contributions (if any) which are able to look – within the same dataset – at the actual consumption response to positive and negative income changes. This limitation is potentially serious because it poses the external validity concern that the estimates obtained for income changes of a certain sign may not provide reliable inference for the consumption response to income changes of the opposite sign.

In this paper, we make use of a set of newly designed questions in the Bank of England/NMG Consulting survey of British households to provide an unprecedented evaluation of the spending response to positive and negative income changes on actual data. Households were asked to report not only the sign *and* the size of any unanticipated change in income over the previous year but also the sign *and* the size of any associated change in spending. The answers to these questions allow us to compute household-specific MPCs for positive and negative income shocks. In addition, information on demographics and balance sheet position allows us to relate these characteristics with the individual MPCs at the household-level, both within and across income changes of opposite sign. As with virtually all survey approaches to estimating MPCs, the reliability of the inference one can draw depends on the ability of households to respond accurately to questions about their actual income and consumption changes. Accordingly, we subject our findings to an extensive range of sensitivity analysis to alternative strategies to shock identification, to different treatments of non-responses and to using a more qualitative indicator of the spending response, which we also observe for the non-respondents to the questions on the size of the unexpected income change and on the size of the associated spending change.

Our main results can be summarised as follows. First, the average MPC out of a negative income shock is estimated to be between 0.46 and 0.68 across alternative cuts of the data but the range is only 0.07 to 0.17 following a positive income shock. Second, the MPCs of borrowers were systematically larger than those for savers, with the asymmetry between the responses to positive and negative



income changes being less pronounced among the latter. Third, households with no or little saving buffer, facing some form of liquidity constraints and more pessimistic about their income prospects tended to exhibit a significantly larger MPCs, especially after a fall in income. Fourth, household balance sheet characteristics, and in particular low liquid wealth relative to income and high leverage, were strong predictors of a larger consumption response to a negative shock of a certain size than to a positive shock of the same magnitude. Fifth, among households who received a negative income shock, the MPC was significantly larger for those reporting to be more concerned about their future income, consistent with a precautionary motive linked to income risk. Finally, our inference is robust to using a propensity score method to control for differences in the ex-ante probability of receiving a shock of opposite sign based on observables. It is also robust to a number of estimation strategies handling some forms of nonlinearity and measurement errors as well as to using the responses to a newly added set of questions which asked households about their consumption behaviour following a *hypothetical* change in their income that is temporary and unexpected.

Most of the household balance sheet measures in the Bank of England/NMG survey refer to either past or present conditions. But household behaviour may also reflect expectations about future access to credit markets. To evaluate this hypothesis, in the last part of the paper, we consider the consumption responses to a 6% shock of disposable income (the average size in the data) in a partial equilibrium model with occasionally binding borrowing constraints. Our analysis reveals that, despite its simplicity, the model is able to replicate well the consumption asymmetry observed across positive and negative changes, thereby providing further evidence for a significant role played by household balance sheet positions in the transmission mechanism.

As for policy implications, the MPC asymmetry documented in this paper implies that monetary and fiscal policies aimed at stimulating the economy may exert a smaller impact on consumption than contractionary interventions of the same magnitude. While this is reminiscent of the “pushing on a string” conjecture often attributed to John Maynard Keynes, it also suggests that expansionary policy measures need to be bolder than contractionary measures in order to generate a change of the same magnitude in consumer spending.

The paper is structured in nine parts. Section 2 discusses the predictions of several theoretical mechanisms which may generate a consumption asymmetry to income changes of opposite signs and briefly surveys the empirical evidence on MPCs. Section 3 describes the survey questions and presents some summary statistics on British households. Section 4 reports the main finding of the paper on asymmetric MPCs out of actual changes in income. Section 5 presents results from hypothetical questions which more directly ask households about their MPCs. Section 6 offers a regression analysis of the determinants of variation in the MPCs, both across households and income changes. Section 7 records complementary evidence based on a propensity score method. Section 8

analyses the consumption responses to positive and negative income shocks based on a model with occasionally binding constraints. Section 9 offers concluding remarks and draws some policy implications.

2. Theoretical predictions and related empirical work

Friedman's permanent income hypothesis predicts that consumption moves only in response to a change in lifetime 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 that can generate the type of asymmetry in MPCs that we observe in survey responses 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 is also potentially a feature of wealthy 'hand to mouth' households who have low liquid assets despite holding sizeable illiquid assets (Kaplan, Moll and Violante, 2016, Hedlund, Karahan, Mitman and Ozkan, 2016 and Cloyne, Ferreira and Surico, 2015).

A second factor which could also generate a consumption asymmetry between how a household responds to a 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 make a sizeable cut to spending 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.¹

Third, if some households weight 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

¹ 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.

possible negative income changes in the future, but in the face of a negative income shock they are left with no alternative other than reducing their spending. This may be particularly acute if these households also lack the opportunity to smooth their consumption intertemporally.

On the empirical side, a vast literature has investigated the consumption responses to unanticipated income changes.² 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 Qian, 2014; Misra and Surico, 2014, among many others), minimum wage hikes (Aaronson, Agarwal and French, 2012) 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, 1995³; Bracha and Cooper⁴, 2013) or hypothetical increases in household resources (Jappelli and Pistaferri, 2014).

With these earlier contributions we share an emphasis on the characteristics that drive the heterogeneity in the distribution of the MPCs across households. Unlike previous literature using a survey based approach, however, we are able to provide evidence on the consumption responses to reported *actual* positive shocks as well as *actual* negative shocks within the same household survey dataset. This novelty comes from the fact the survey we consider contains self-reported, unanticipated income changes of either sign, which is unprecedented for this type of household-level data.

3. Identifying unanticipated income changes using the Bank of England/NMG survey

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.

3.1. Survey questions

Every year since 2003, the Bank of England has commissioned NMG Consulting to conduct a survey of British households.⁵ This usually takes place in September and, designed to be representative of

² For a recent survey see Jappelli & Pistaferri (2010).

³ The authors consider changes in income implied by anticipated changes in payroll taxes.

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

⁵ The survey has been running since 2003. It has been run online since 2012, following pilots in 2010 and 2011. Before that, the survey was conducted face-to-face. Moving the survey online allowed an increase in the sample size over the years in which our questions were included. Since 2014, an additional survey has been carried out during April. See Anderson et al (2016) for more details on the NMG survey.

the UK population in terms of age, gender, region, housing tenure and employment status. It is primarily a repeated cross section but also contains a small panel element. Over the years in which the questions on unanticipated positive and negative income changes were asked, the sample size increased from around 1,000 in 2011 to 6,000 in 2014 (Table 1). The survey contains a variety of questions on households' 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 to compare the MPCs of different types of households.

The exact questions used to generate household MPCs are reported in Appendix A. We first 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. But no question was asked about permanent shocks. Finally, they were asked how they had adjusted their spending in response over the previous year to the unexpected change in income.⁶ 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). Given the novelty of the question design upon which the MPCs are estimated, we verify the robustness of our findings to both an alternative income shock identification strategy based on hypothetical shocks (similar to Jappelli and Pistaferri (2014)) and a more qualitative indicator of the spending response (closer to that used by Sahm, Shapiro and Slemrod (2010)).

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 a high degree of non-response as the questions progress. For instance, while 33% of all households in the sample reported having experienced an income shock, only 15% gave information on both the size of the income change and the size of the spending change for us to compute an MPC. If this non-response is associated with differences in household characteristics, then it could distort inference. We discuss the characteristics of the non-respondents in the next subsection and present evidence there and in Section 6 suggesting that the attrition rate is unlikely to influence our main finding of asymmetric MPCs. Furthermore, our analysis refers to information about *actual* spending responses following positive and negative income changes. This compares favourably with previous studies that focused on hypothetical changes, as the latter are exposed to possible large difference between intended and actual consumption responses (Graziani, Van Der Klaauw and Zafar, 2013).

⁶ The NMG survey questions refer to changes in 'spending' and so are likely to incorporate a wider range of categories over and above non-durable goods and services.

To minimize the effects of outliers, we exclude 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 either negative or implausibly large (above 1.5). Overall, we discard fewer than 9% of observations but we have verified that none of our results hinge upon these restrictions, though the standard errors of the specifications estimated below tend to be larger in the unrestricted sample. Finally, the survey questions only ask about the spending response in the year that the shock took place, and so do not capture the response over a longer period.

3.2. The distribution of positive and negative income shocks

Around a third of households in our sample reported experiencing an income shock in any given year (Table 1). This share fell in the later years of the survey, dropping from 38% in 2011 to 28% in 2014. More households reported experiencing a negative rather than positive income shock, which may reflect the state of the UK economy during our sample period. The share of negative income shocks did, however, fall in each year of the survey (from 70% in 2011 to 54% in 2014), possibly consistent with the improvement in the macro economy.⁷

Reported income shocks tend to be fairly small relative to overall income. Across the four years of the survey the median size is around £2,000 (6% of average household income) for both positive and negative shocks. There are, however, long tails of some very large income shocks (Figure 1), which lead to mean positive and negative shocks of £5,000 and £4,200 respectively. A greater share of positive income shocks were reported to be transitory (rather than persistent) than was the case for negative income shocks (36% of positive income shocks were reported to be transitory and 18% of negative shocks) and transitory income shocks were larger (with a mean of around +/-£6,000 compared to +/-£4,000 for persistent shocks). It is also notable that despite the fact that the share of households reporting a negative income shock fell as the economy improved in the latter part of the sample, the distribution of the size of the shocks has stayed fairly constant across the years of the survey, i.e. negative shocks did not become smaller, nor positive shocks larger.

In the 2012 survey, households were asked to use seven categories of explanations for shocks of each sign (e.g. higher/lower than expected pay rise, higher/lower than expected bonus, lifestyle changes, higher/lower taxes) or the option to give another answer. While responses were spread across all these options (see Table B1 in Appendix B), important explanations for positive income shocks were new jobs, higher pay rises than expected and higher pension income. Common negative income shocks were loss of jobs or benefits, higher taxes, lower wages than expected and lower interest income.

⁷ For a small number of households in the survey's panel, we can observe reported income shocks for the same household in multiple years. Around 50% of households that reported a negative income shock had also reported a negative income shock in the previous year, while 30% of households that received a positive income shocks had also had a positive income shock a year ago. We discuss their MPCs in Section 4.3.

In Tables 2a and 3a, we report descriptive statistics on household characteristics across positive and negative income shocks. Households experiencing a windfall appear to be similar to those experiencing negative shocks along several dimensions: annual income⁸, unsecured and mortgage debt, mortgage debt service ratios, loan-to-value (LTV) and loan-to-income⁹ (LTI) ratios.

On the other hand, households experiencing positive income shocks are, on average, somewhat younger than those experiencing a negative shock. The net liquid asset (liquid assets less unsecured debt) holdings of households that reported a positive income shock appear substantially higher than for those that reported a negative income shock (£44,000 compared to £30,000). This continues to be the case when households' net liquid asset positions are reported relative to annual income.

The discrete characteristics reported in Table 3a show that a significantly greater proportion of households experiencing a negative income shock reported (i) to be credit constrained, (ii) thought a fall in their income was likely, (iii) to be somewhat or very concerned about debt, or (iv) 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 hit by a positive shock were more likely (a) to have a buffer of savings to draw on in an emergency and (b) to perceive the income shock to be less persistent.

Non-respondents sample: As shown in Table 1, there was a high degree of non-response to the income shock and spending response size questions. Tables 2b and 3b report the characteristics of the non-responders and comparisons to Tables 2a and 3a reveals that there are differences between the characteristics of the two groups (some of which are significant), suggesting that the non-response may not have been entirely random. The group that did not respond had lower educational attainment, lower net liquid assets, less unsecured debt and some slightly weaker self-reported balance sheet characteristics (e.g. greater concerns about debt and less likely to have a buffer of savings for emergencies). However, based on a Heckman-type selection model, the analysis in Section 6.2 reveals that inference on the MPC asymmetry or our analysis of its determinants is unlikely to be distorted by non-response.

Furthermore, and more importantly for our focus on the consumption responses to positive and negative income changes, the stylised facts by shock sign for the responder sample that we described above – such as higher liquid assets and stronger self-reported balance sheets for those that reported positive income shocks than negative – all still hold for the non-respondents sample (see the final column of Tables 2b and 3b). As well as the sign, the magnitude of the differences between the

⁸ The annual income shock is reported on a post-tax disposable income basis, 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.

⁹ Income measure is annual pre-tax, pre-shock income.

characteristics of the positive and negative shock samples is mostly similar, e.g. the share of credit constrained households in the negative income shock sample is 15pp (vs 18pp) larger than in the positive sample among non-respondents (respondents).

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

In this section, we present descriptive statistics about the distribution of the MPCs across a number of household and shock characteristics.

4.1 MPC distribution

A striking result across all years of the survey is that the MPC out of a negative income shock was 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 was 0.64 for a negative shock, and 0.14 for a positive shock.

Figure 3 shows the distribution of MPCs by direction of income shock. A notable feature of this distribution is the large share of MPCs with the value of zero for positive shocks (77% for the aggregate sample). The distribution across MPC values was more even for negative income shocks, although there does remain some bunching of responses at zero and one. Jappelli & Pistaferri (2014) find a similar ‘bunching’ 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 between 5 and 10 per cent of households reported an MPC greater than one out of a negative income shock, i.e. they cut their spending by a greater amount than the income shock they experienced.

Shock duration: a further question was asked about the nature of the shocks, allowing households to describe their unexpected income change as either transitory or persistent. This question did not allow households to distinguish between persistent (but temporary) and permanent shocks. While standard theory would suggest very different responses between transitory and permanent shocks, the differences between transitory and persistent (but temporary) shocks might be much smaller. Restricting the sample to only transitory shocks is also interesting on its own as it can be seen as a robustness check about this wording ambiguity and the possibility that some households might have reported as ‘persistent’ some shocks that might have been permanent.

Figure 4 shows that the mean MPCs out of transitory income shocks also exhibit a strong asymmetry in response (0.17 for positive income shocks versus 0.57 for negative income shocks). Reported MPCs were a little higher for persistent negative shocks than transitory negative shocks and there was no significant difference between positive temporary and positive persistent income shocks, consistent

with the persistent income shocks largely being temporary. This holds across all years of the survey (see Chart B1 in Appendix B) and chimes with the evidence from Sahm, Shapiro & Slemrod (2010) that household spending responses to the 2009 U.S. income tax rebate did not differ according to whether they perceived the change in policy to be temporary or persistent. Finally, for 2012 only, households were asked about the reasons for their income shocks and whether they perceived that reason to be more transitory or more persistent (Table B1 in Appendix B). While the samples are small, the differences in MPCs across perceived duration (within positive shocks and within negative shocks) do not appear large, consistent with shocks in the ‘persistent’ category not necessarily being perceived to be very different from the transitory ones and limiting the extent to which we should expect differences in responses.

4.2 MPC by household characteristics

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 standout feature of the results 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 responded 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 was little difference between the MPCs of those working for somebody else and those self-employed. In contrast, households headed by someone unemployed reported 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 sizably larger for negative shocks.

One factor potentially influencing our results is that the surveys were conducted in the wake of the financial crisis. This may have affected the balance sheet position of most households, with some likely to have been more adversely affected than others. Households who reported being better off at the time of interview, relative to what they might have expected prior to the crisis, had 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 had very similar MPCs to those who reported a positive income shock and being better off than expected in 2006.

In Figures 5 to 7, we provide graphical counterparts to Table 4, conditional on a variety of continuous household characteristics. More specifically, we show in Figure 5 that the MPC out of both positive and negative income shocks for those over the age of 65 was lower than (or equal to) the MPC of other age groups. Figures 6 and 7 record the mean MPCs associated with gross household income and net liquid asset to income ratios, where we have grouped the sample into 5% bins.¹⁰ For positive shocks, the mean MPC was 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.

As for balance sheet characteristics, borrowers reported higher MPCs than savers out of both positive and negative income shocks, but the asymmetry in MPCs is clearly present for both groups (Table 5). Within borrowers, the MPCs associated with households' LTI and LTV ratios, and debt repayments (both secured and unsecured) as a share of monthly income are presented in Figures 8 to 10. Across these three characteristics, the mean MPC out of positive income shocks was fairly similar for all groups, although there was a small tick up in the average MPC for those households with the highest LTIs (greater than 4 times income) and LTVs (greater than 90%)¹¹. For negative shocks, MPCs appeared to increase gradually with indebtedness across the various metrics.

Finally, 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, the MPCs seem to increase with the size of the shock. The opposite is true for households experiencing a negative income shock, with the MPC falling as the shock size becomes larger.

Transitory income shocks: as has been discussed in Section 4.1, the analysis by shock duration suggests little difference between the mean MPC from a transitory versus a persistent income shock, though it is unclear the extent to which the category 'persistent' may have also included some more 'permanent' income shocks. Here, as a robustness exercise, we repeat the cross-sectional analysis on the subset of shocks that were reported to be transitory. Panel A of Table 4a shows that, on this limited sample, the same patterns emerge in the mean MPC across households who faced positive and

¹⁰ 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.

¹¹ 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.

negative income shocks. For example, weaker balance sheets characterised by credit constraints, income risk, debt concerns and a lack of precautionary savings are all associated with higher MPCs, particularly in the face of negative income shocks. Furthermore, we show in Section 5 that in the case of hypothetical positive and negative income shocks that are clearly transitory, the asymmetry in response is still apparent.

4.3 Sensitivity analysis

Reason for shock: If the nature of the shock affects the MPC, it is possible that the asymmetry we report could partly reflect the fact that the typical reasons for positive income shocks are different to the reasons for negative shocks. We can explore this in the 2012 survey, which is the only wave in which households were asked about the reason behind their unexpected income change.

Positive income shocks were more likely to reflect a new job, higher than expected pay rise and higher pension income. Common negative income shocks were loss of jobs or benefits, higher taxes, lower wages than expected and lower interest income. However, the result that the MPC out of negative shocks was larger than for positive shocks was common across all types of shocks and the reason for the shock does not therefore appear to be a driver of our main finding of asymmetric responses (Table B1 in Appendix B).

Change in cash flow: The survey design is intended to capture unexpected changes in household income over the previous year. But households may also have experienced anticipated changes in their income over that year too, such that even though the unexpected change in income was, say, positive, overall their income still fell. This represents a difference relative to some other studies where the income shock and change in cash flow sign are the same by construction, e.g. quasi-natural experiments such as a tax rebate, or a strategy of asking about hypothetical income changes (which we analyse in the next section).

Around half of households who reported a positive income shock had also seen higher cash flow over the previous year, while for households that reported negative income shocks, three-quarters had seen their disposable income fall.¹² Differences in the sign of the change in cash flow may be correlated with differences in how households report to have changed their spending and so we consider the subset of households for whom the actual change in income had the same sign as their unexpected income change. This does not change the message that households report a very asymmetric response: for positive income shocks the MPC is 0.14 and for negative income shocks it is 0.68. Panel B of Table 4b shows that the cross sectional differences between the MPCs of different households are also

¹² For 2011 and 2012, households were asked about the actual change in their disposable income over the previous year. For 2012, 2013 and 2014 we have a panel for a subset of households from which we can construct the direction of the change in actual disposable income.

qualitatively similar, and that for all groups, the average response out of a negative income shock is significantly larger than for a positive income shock.

Household characteristics: another concern might be that the asymmetry in the results reflects differences in the types of households that report receiving positive versus negative income shocks (an issue that we discuss further in Section 7). One approach to control for this issue is to look at the small number of households from the survey's panel for who we have both a positive and a negative income shock reported in different years of the survey. For this very small subgroup (of 28 households), the mean MPC from the positive income shock was 0.16 and from the negative income shock 0.5, i.e. a similarly asymmetric response to the wider sample. To exploit a relatively larger sample, we can also look at the share of these households that reported an MPC greater than zero following their positive and negative income shock (for which we have 110 observations). For positive income shocks the share of households with an MPC greater than zero is 16% and for negative income shocks it is 60%, which is remarkably similar to the sample averages of 16% and 63% respectively.

5. Hypothetical income shocks

Most survey approaches to the identification of income shocks are vulnerable to misreporting by households. A particular concern in this instance might be whether households can be expected to adequately recall how income had differed relative to expectations. To consider the sensitivity to this issue, we complement and combine our MPC results with those from an alternative (still imperfect) strategy for identification: asking households about how they would respond to hypothetical changes in their income (of both signs). This strategy was also adopted by Jappelli and Pistaferri (2014), but only for a hypothetical *positive* income shock, and we refer to their work for a discussion of the limitations of this alternative approach.

In the 2013 NMG survey, households were asked how they would adjust their spending in response to both an unexpected windfall and an unexpected bill or other one-off expense (see Appendix A for the specific wording of the questions). Households were randomised across the size of the hypothetical shock (between £500, £1000, £2,000 and £10,000) and were given categories from which to choose their spending response, implying MPCs bounded between zero and one by design.

A main concern with questions on a hypothetical income shock is that actual responses may be very different from hypothetical responses (see Graziani, Van Der Klaauw & Zafar, 2013 for evidence of large differences between actual and intended consumption responses). Over the whole sample of hypothetical questions we still do find an asymmetry across positive and negative income shocks,

although this is smaller than for the response to actual income shocks. Furthermore, when comparing these results, we need to take account of the fact that there are differences between the groups that received positive and negative income shocks (discussed in Section 3.2).

One way to ameliorate the second concern is to compute the hypothetical responses of those households that received an actual income shock of the same sign. We will come back to the first concern in the next exercise of the section. Figure 12 shows that for those households that received an actual positive income shock, their mean MPC out of a further hypothetical positive shock was 0.28, and for those that received an actual negative income shock, their MPC out of a hypothetical negative shock was 0.41 – a narrower but still significant asymmetry compared to the actual responses.¹³ We are also able to compare these hypothetical responses for those who did not give sufficient information to compute an MPC out of their actual shock (who were discussed in Section 3.2), and verify that the small differences between the hypothetical responses of the respondents and non-respondents (to the size of their actual income shock questions) are statistically insignificant (Figure 12). This is further evidence that their non-response on the actual MPCs is unlikely to affect significantly our results. We come back to this issue in Section 6.2.

Both survey approaches to estimating MPCs are subject to misreporting: households may report hypothetical responses that are very different to how they would actually respond, and households may have difficulty recalling the actual size of the unexpected income change. Accordingly, we run a further exercise that combines information from both approaches. To the extent that the measurement/mis-reporting errors are uncorrelated across hypothetical and actual responses, the combined strategy should yield more accurate results. More specifically, we consider the subset of households that gave a consistent MPC from both sets of questions, namely whether the MPC based on the hypothetical questions is within 15% of their reported actual MPC. In other words, we ameliorate the concern that the responses to hypothetical and actual income changes may be very different by dropping from our sample households (about 40% of the 2013 sample) whose actual MPC is far off from the hypothetical one.¹⁴

In Figure 13, we report the mean actual MPC for 2013 (with an upper bound of one to be consistent with the hypothetical responses), and compare them to the mean actual MPC for the restricted sample of households who reported an MPC out of a hypothetical shock that was within 15% of their reported

¹³ The mean MPCs are computed based on the mid-points of the buckets (under the assumption that the actual responses were uniformly distributed within each bucket). As the MPCs implied by the hypothetical questions are bounded between zero and one by design, for comparability we have recomputed the average MPCs for actual positive and actual negative income shocks on the restricted sample of actual MPCs between [0,1]: the positive shock average MPC is still 0.14 but the negative shock average MPC lowers to 0.55.

¹⁴ Results below are robust to choosing 5%, 10%, 20% or 25% as cut-off for restricting the sample of actual MPCs based on the distance from the hypothetical MPC. Furthermore, we have verified that the characteristics of households reporting ‘consistent’ and ‘inconsistent’ MPCs across the two approaches do not vary in any particularly systematic way between positive and negative income shocks.

actual MPC. This exercise continues to reveal a large and significant asymmetry, although a little smaller than when we consider the sample as a whole: the mean MPC is 0.07 out of positive income shocks and 0.46 out of negative income shocks using the approach that combines information from the responses to actual and hypothetical income changes.

6. Explaining the response to positive and negative shocks

To explore more formally what drives our main finding of asymmetric spending behaviour with respect to the sign of the shock, in this section we relate the MPCs to household and shock characteristics. We begin with simple OLS regressions, discuss robustness to non-response and then move to alternative specifications which are better suited to deal with possible non-linearity and measurement errors. For each empirical model, we allow household and shock characteristics to have different effects on the MPC depending on the sign of the income shock.¹⁵

6.1. Baseline results

Our OLS regressions use the MPC as the dependent variable and the characteristics of the shock as well as the household characteristics as regressors. We run six separate specifications for positive and negative income shocks (Table 6), all with HAC robust standard errors. In the first five columns, we project the MPC on 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 in order 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 their relative merits.

Several characteristics play a significant role in explaining variation in the MPCs across households. Demographics appear to play a fairly small role: for example, MPCs are estimated to be relatively similar across different working age groups.¹⁶ MPCs for households aged 65+ are estimated to be lower than for the benchmark household (aged between 25 and 44) for both positive and negative income shocks, consistent with the findings in 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.

Column 2 in Table 6 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

¹⁵ 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.

¹⁶ Ideally, we would consider a wider range of demographic controls, but information about education, marital status etc, are not consistently available for most waves of the survey.

negative shocks, the MPC out of income shocks in the top quartile is significantly lower. This might reflect limits on households' ability to smooth through very large income shocks. Less persistent income shocks tend to have an MPC which is only 0.1 lower than more 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 were estimated to have higher MPCs out of both positive and negative shocks, +0.1 and +0.07 respectively. Households who reported some likelihood of a fall in income over the next year (an indicator of income risk) are estimated to have higher MPCs out of a negative shock than those unconcerned about a fall in income, but there is not a significant difference for positive shocks. Finally, respondents who had a buffer of savings for emergencies are estimated to have had 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 income¹⁷, 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). Indeed, households who have a high ratio of liquid assets to income tend to 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 are estimated to have an MPC which is 0.2 lower than the average household in the bottom tertile. On the liabilities side, households who are concerned about their level of debt have a significantly higher MPC than those without concerns, for income shocks of both signs. For positive shocks, households with a loan-to-value ratio above 90% have MPCs which are 0.19 percentage points higher than those with a LTV below 75%, though the results are not monotonic across LTV bands.

The final column includes all of the regressors in our richest specification. As several regressors are correlated with each other, it should not come as a surprise that 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 significantly 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

¹⁷ Net liquid assets is defined as less unsecured debt (excluding credit card balances which the household intends to pay in full over the month)

transitory shock, future income risks and having a buffer of savings remain significant predictors of the MPC in the augmented specification.

6.2 Non-response: We discussed the characteristics of ‘non-respondents’ in Section 3.2, i.e. households that reported receiving an income shock, reported its sign but gave insufficient information to compute an MPC. This group had lower educational attainment, lower net liquid assets, less unsecured debt and some slightly weaker self-reported balance sheet characteristics. One way of assessing the effect that any differences in the sample which did and did not provide sufficient information to compute the MPC may have on our results is to use a Heckman selection model, where the probability of being a non-respondent computed in a first-stage Probit regression is included as a control in the second-stage regression of the MPC on shock and household characteristics. For the first stage, we include household characteristics such as age, education and tenure. For the second stage, we regress the reported MPC on the full set of household characteristics, including the sample selection variable.¹⁸ The coefficient on the sample selection variable is insignificant, and the other regression coefficients are little changed (although the smaller sample – given that the education variable is not available for all years – leads to some loss in significance). The fitted values from this two stage regression continue to reveal a large asymmetry in MPCs (0.06 for positive income shocks and 0.61 for negative income shocks). This exercise suggests that the non-response is not having a significant effect on our results. Furthermore, we will show in the next sub-section that where we use a qualitative indicator of the spending response (in a way that allows us to use both respondents and non-respondents despite the fact that the latter do not report an exact value for the MPC), the importance of different household characteristics in determining the spending response are qualitatively unchanged.

6.3. Nonlinearity and measurement errors

In this section, we discuss the robustness of our findings 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. Our Probit specification instead uses a dummy variable as the dependent variable which has a value of one if the MPC is greater than zero, making the results more comparable to surveys that ask for more qualitative indications of how spending has changed (and so providing robustness to our quantitative approach). This also 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

¹⁸ Shock size and persistence are not available for this group and so are excluded.

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 C and D 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 represent 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.

In summary, 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 7. 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 the coefficients is robust across specifications.

6.4. Summary

Our regressions can 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 in response to a hypothetical income windfall in Italian household-level data.

Turning to the second question, there are also some differences between the estimated regression coefficients between the positive and negative regressions, and so the marginal effect that household characteristics have on the MPC depends on the sign of the income shock. The magnitude tends to be

larger for the negative income shock regressions, possibly reflecting more variation in the MPCs out of negative income shocks, although the sign tends to be the same. The main exception is income risk which is associated with a lower MPC when the shock is positive but a higher MPC when the shock is negative. That might be consistent with a desire not to deplete (or to increase) a buffer of precautionary savings. It is also notable that the main difference in the regressions comes from the intercepts. In the next sections, we consider several hypotheses to account for these differences.

7. What drives the MPC asymmetry? A propensity score approach

A striking feature of our results is the sizable 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 some different hypotheses which might explain the asymmetry that 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 through the presence of occasionally binding borrowing constraints.

First, it is possible that the types of households that received positive shocks are, *ex ante*, different to those who received negative shocks. In Section 4, we showed that there are similarities between the households who received 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 may 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 rather than a negative shock. 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 asymmetric effect of receiving a positive shock rather than a negative one.

Table 7 reports the results of this exercise. The top row gives the unmatched difference between MPCs when a household receives a positive rather than a negative shock 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. 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 an indication of the 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 8 differ according to the specification of the regression to produce the propensity score (Probit or Logit) and the method by which households are matched. It is worth noting that the interpretation of our PSM exercise relies on the presumption that if a set of variables is a significant driver of the MPC asymmetry, then by adding them to the first stage it should reduce the MPC gap between positive and negative income shocks, conditional on this set of characteristics.

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, reported in Table 8 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) are prominent determinants of the observed MPC asymmetry, with a contribution around one quarter of the unconditional MPC gap between positive and negative shocks of 0.50 (i.e. $100 * [-0.50 + 0.37] / [-0.50] = 26\%$).¹⁹

A challenge with this type of propensity score matching 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 so influenced by the shock itself), and found that these balance sheet differences still contribute around 20% of the unconditional asymmetry.

A second possible explanation of the asymmetry between positive and negative shocks is that it does not reflect the household's characteristics at the time of the shock, but rather, that the shock itself changes the household's balance sheet position. In the next section, we will consider a model where an unexpected shock can affect the probability of hitting the borrowing constraint. Here, we look for evidence that negative income shocks might generate a precautionary savings motives, either via

¹⁹ If we were confident that shocks were randomly assigned across households, an alternative approach for understanding the effects of receiving shock of a different sign would be to compute the fitted values for those who received positive income shocks using the negative regressions described in Section 5, and vice versa. The mean fitted values would be 0.19 and 0.52, suggesting a contribution of around a third ($100 * [-0.5 + 0.33] / [-0.5] = 34\%$).

income uncertainty or loss aversion. In particular, a negative income shock might worsen a household's perception about its future income streams, and so cause them to cut spending significantly now in order to preserve consumption smoothing through any future falls. Suggestive evidence that this mechanism might be at play comes from the fact that the MPC for households who received a negative income shock and were concerned about future falls in income (at 0.67) were significantly higher than those that received negative income shocks but were not concerned about further falls (at 0.49). Meanwhile, for positive income shocks, there was no significant difference.

Further possible explanations: finally, we discuss two additional motives for the difference in consumption response to positive and negative income shocks about which it is more difficult to gather direct 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 a survey bias.

Turning to the first, the surveys were conducted between 2011 and 2014, 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 adjusting 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. 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 stable across all years of the survey (Figure 1).

The asymmetry also may reflect a survey bias. As with all surveys, there is the potential for misreporting, though the OLS results were corroborated by the Probit regressions. If misreporting simply reflects human error in recalling what actually happened, 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 when responding to surveys, 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. We cannot rule out this explanation, although as we show in the next section, it is possible to generate the type of asymmetry we observe in our data in a simple theoretical model with occasionally binding constraints.

In summary, a significant portion of the MPC asymmetry appears to reflect differences in the characteristics of the households that received positive and negative income shocks, especially with respect to their household balance sheet position. In the next section, we formalize this specific mechanism through the lens of a simple partial equilibrium model.

8. The role of borrowing constraints: insights from a simple model

In the previous sections, we have shown that household balance sheet characteristics and the presence of liquidity constraints are significant drivers of the MPC variation observed both across households and across positive and negative income changes. It is worth noting, however, that the financial questions in the Bank of England/NMG Consulting survey refer to either *past* or *current* access to credit markets. As such, these questions are silent on the extent to which current expenditure decisions may also be influenced by the likelihood that some financial circumstances (and borrowing constraints in particular) may change in the *future*, possibly as a result of a negative shock.

This section explores the extent to which possible changes in future credit conditions may account for the asymmetry in MPCs reported earlier on, using a partial equilibrium model with an occasionally binding borrowing constraint. A representative household alternates between two regimes. In the first regime, the household is unconstrained and thus is able to borrow sufficient funds to smooth consumption optimally. In the second regime, the household is constrained in the borrowing amount that they can lever relative to income and so behaves in a hand to mouth fashion. The probability of hitting the second regime depends on the size of the shock relative to the distance from the borrowing constraint. For a sufficiently large negative shock, it means that a household who began in the first regime can find itself against the borrowing constraint after the shock. We show 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 NMG household-level survey.

We consider a very simple specification which sets out the decision faced by the household. The representative consumer in the model maximises its lifetime utility subject to a budget constraint:

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

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

Households spend their available resources (i.e. income, y_t , net of housing costs, Hy_t , plus any possible one-period loan b_t) on consumption goods, c_t , and the repayment of debt from the previous

period, b_{t-1} . A fixed share of income, H , is spent on housing expenditure, in line with the observation that higher income households tend to live in larger houses.

The representative agent uses debt, b_t , to smooth consumption intertemporally, which they repay at interest rate, R , in the next period. But they may 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, λ_t , is set to zero and the household optimally smoothes their consumption across time.

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

When the borrowing constraint is binding, households are unable to optimally allocate consumption and the Lagrange multiplier is not zero. In that state of the world, households borrow at the limit of their maximum loan-to-income ratio, M , and the constraint (4) becomes binding. The current period consumption is limited by the borrowing constraint.

Finally, household income in the model is determined by an exogenous autoregressive income process, where ε_t is an i.i.d. normally distributed shock with mean zero and unitary standard deviation while σ represents the standard deviation of income shocks.

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

Since sufficiently large income shocks can 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 well.²⁰ The model is calibrated using annual UK data (Table 8), based on a combination of statistics from survey and national accounts.

In Figure 14, we show the impulse responses to an unexpected positive (in blue) and negative (in red) income shock. The shocks are scaled to 6% of income (the median shock to income in our sample) and assumed to be symmetric as visible in the top panel. The bottom panel reveals that consumption

²⁰ One mechanism which the piecewise linear solution is unable to account for is precautionary savings motives associated with the possibility that the constraint may bind in the future.

responds asymmetrically according to the sign of the shock. When the negative shock is sufficiently large, households hit the borrowing constraint and this forces them to cut their spending back sharply. But when the shock is positive, the borrowing constraint is less likely to bind (or is more likely to ease in the face of a large shock) and consumption rises only a little initially but then stays persistently higher, as spending of the additional income is smoothed across a longer period time. Taking the ratio of the consumption response to the income response over the first year (to be comparable with the annual frequency over which the NMG survey asks about spending out of unanticipated income changes) delivers a marginal propensity to consume of 0.09 to a positive income shock, and 0.59 to a negative income shock. While the model produces MPCs that are slightly lower than in the NMG survey data based on responses about actual income changes (but slightly higher than in the combined approach based also on responses about hypothetical income changes), it is remarkable the extent to which it can replicate—despite its simplicity—the difference in the consumption responses between positive and negative shocks.

The model has been kept deliberately simple to demonstrate that a household balance sheet mechanism such as an occasionally binding borrowing constraint could generate the type of asymmetric consumption responses that we observe in the NMG survey. Extending the mechanism to a general equilibrium model with a collateral constraint (such as in Guerrieri & Iacoviello, 2015b) is likely to generate richer dynamics and an even larger asymmetry.

9. Concluding remarks

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 using 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.

Our main contribution is to highlight how the sign of an income shock affects the spending response: MPCs out of negative income shocks are estimated to be much larger than for positive shocks. Between 2011 and 2014, an unexpected rise in income is associated with MPCs in the range of 0.07 to 0.17 whereas an unpredicted fall in income leads to MPCs between 0.46 and 0.68. These 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 reporting significantly higher MPCs. Sensitivity analysis suggests that an asymmetric consumption response by

sign, and heterogeneity between households is robust to various strategies to deal with survey non-responses, income shock identification and a qualitative measure of the spending responses.

The findings in this paper are consistent with several theoretical mechanisms. 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 a significant share of the observed MPC asymmetry between positive and negative income shocks. It is also possible that the shock itself induces changes in the household balance sheet position. We show that households who see further falls in income following a negative shock are more likely have higher MPCs. And we show that a simple partial equilibrium model with an occasionally binding borrowing constraint can replicate the type of asymmetry we observe in the data.

The asymmetry in how spending responds to positive and negative income shocks has important implications for the household responses to monetary and fiscal policies associated with significant income changes. To the extent that monetary policy influences household resources (Cloyne, Ferreira and Surico, 2015) and engineers a redistribution between borrowers and savers, the asymmetry in MPCs that we have documented here implies that, at least in the short-term, a sufficiently large increase in interest rates would have a larger contractionary impact on aggregate spending than the expansionary effect from an equivalent reduction in rates.²¹ Some caution is needed in applying the MPC estimates from this study directly to changes in monetary policy, since the idiosyncratic income shocks that we observe in the NMG survey are much larger than those typically associated with small changes in interest rates. But they could be more relevant to large changes in monetary policy, such as the 450 basis points cut in interest rates in 2008/09 in the United Kingdom, which would be more comparable to the size of income shocks that we observe in our data. An asymmetry in the consumption response to positive and negative income changes would suggest that the substantial loosening in monetary policy of 2008/09 may have provided less stimulus than was expected on the basis of an “average” MPC for the whole sample which failed to recognize the very significant and sizable heterogeneity across positive and negative income shocks.

²¹ Estimates of MPCs for borrowers and savers were reported in Table 5. One (partial equilibrium) channel through which reducing interest rates can stimulate the economy is by redistributing income away from savers, who make relatively smaller reductions in spending following a change in resources, and giving to borrowers, who increase spending by more than savers reduce it. Stronger growth in the economy would then lead to further increases in income via general equilibrium channels, which in turn would lead to higher spending.

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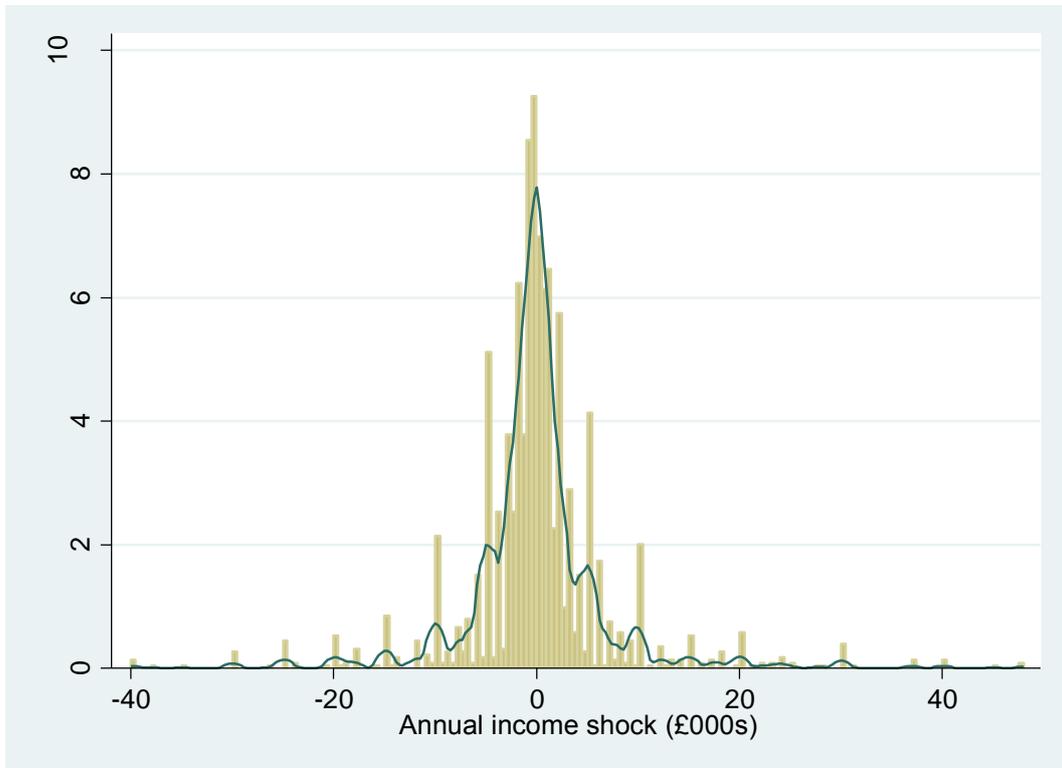
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FIGURES

Figure 1: Size of shocks to annual income^a



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

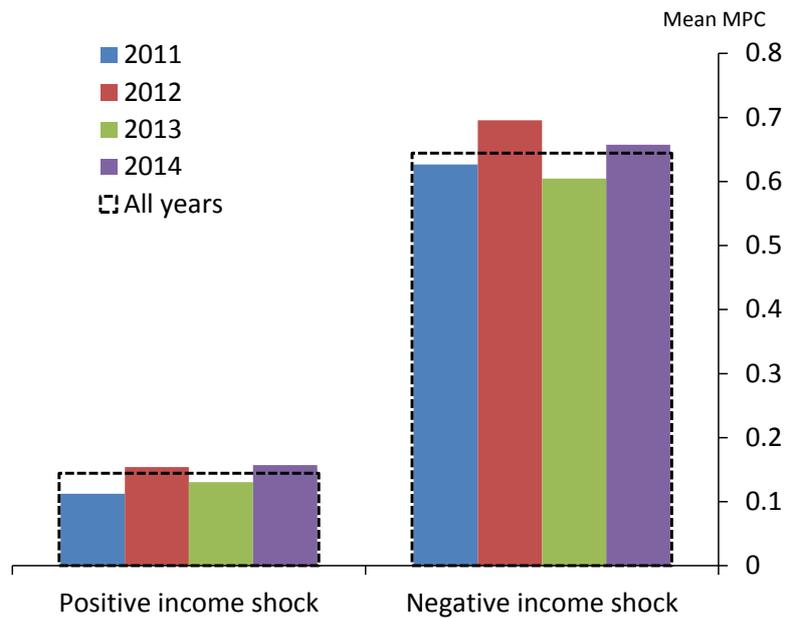


Figure 3: Distribution of reported MPCs

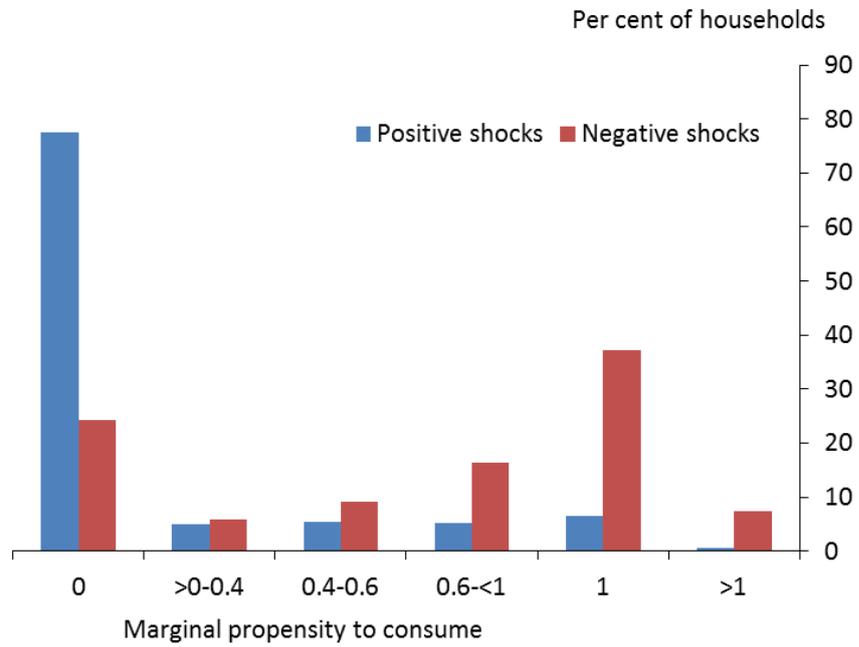


Figure 4: Mean MPC by duration of shock

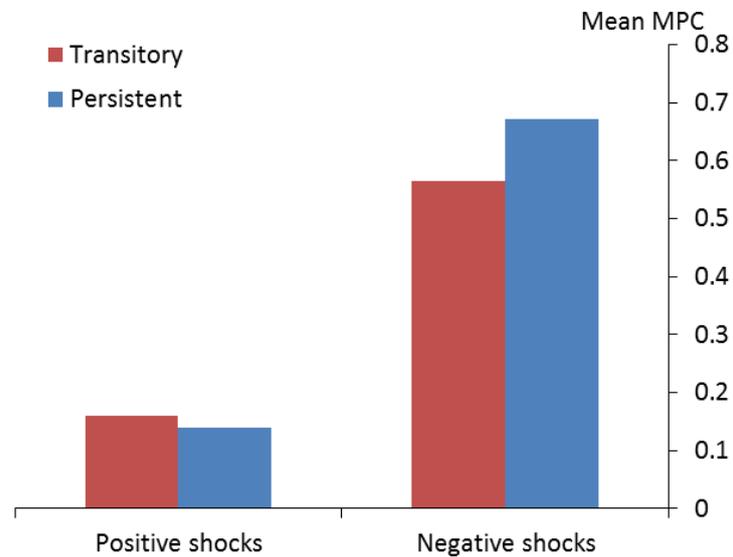


Figure 5: Mean MPC by age group

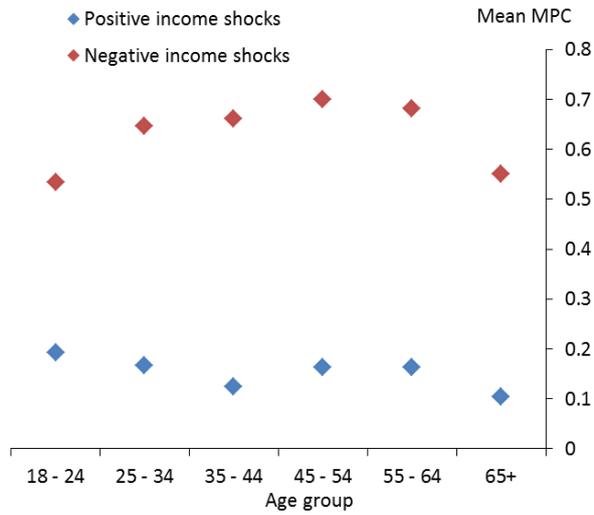


Figure 6: Mean MPC by gross income²²

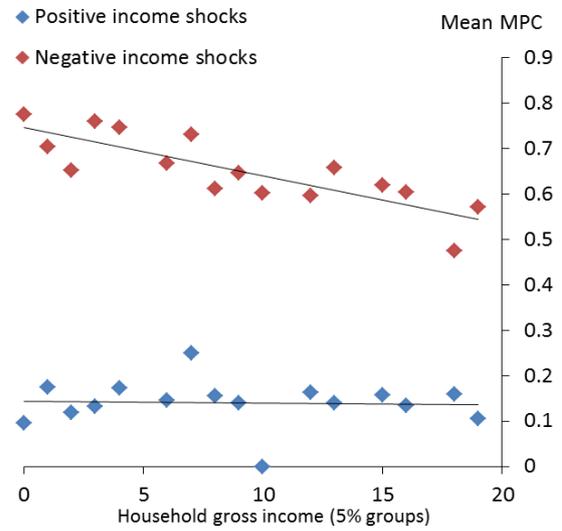
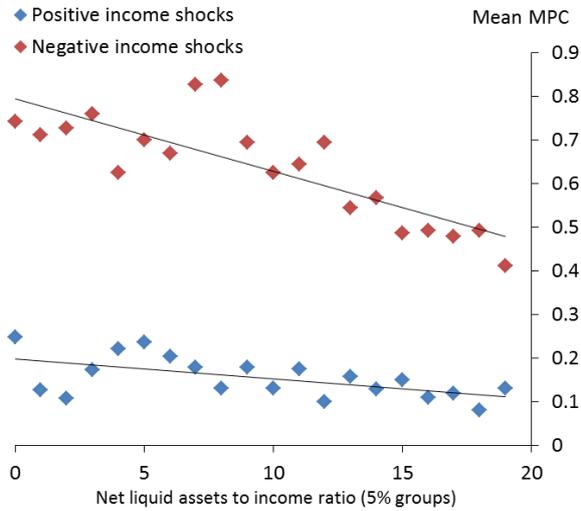


Figure 7: Mean MPC by net liquid assets to income ratio



²² 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

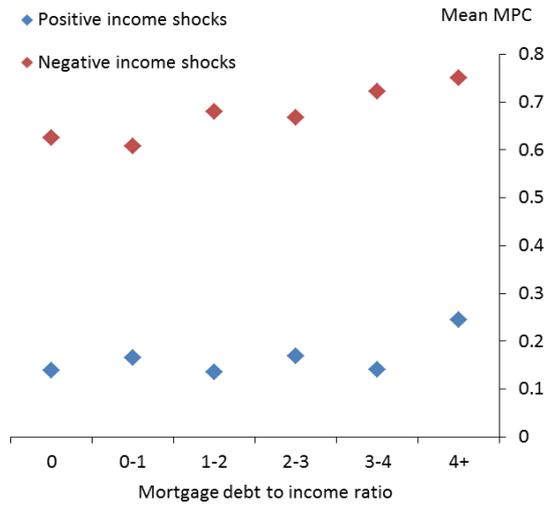


Figure 9: Mean MPC by LTV group

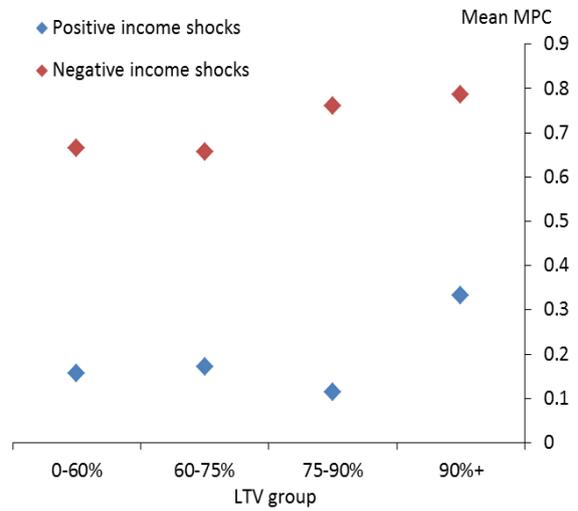


Figure 10: Mean MPC by debt servicing ratio

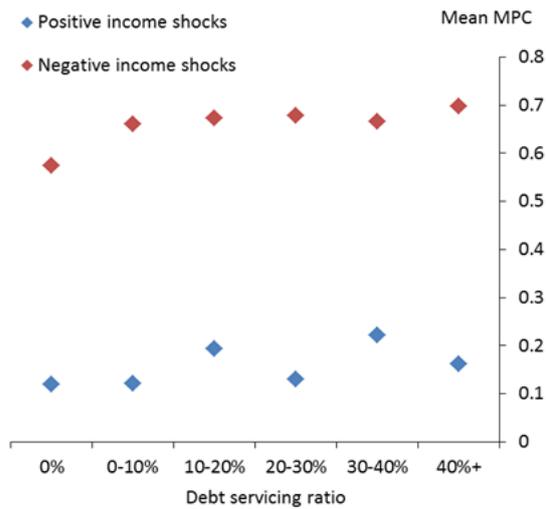


Figure 11: Mean MPC by size of shock

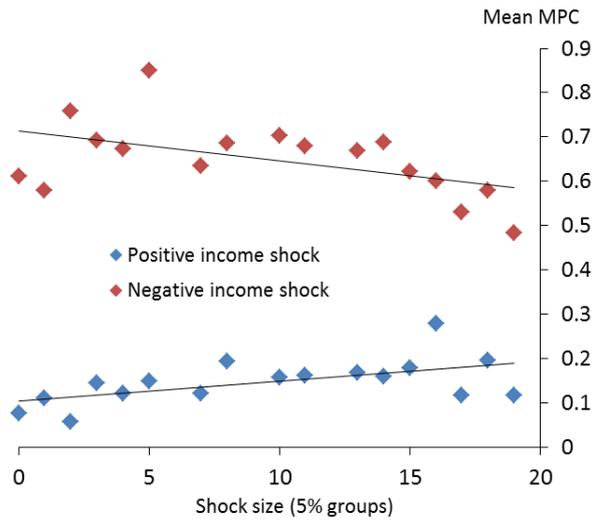
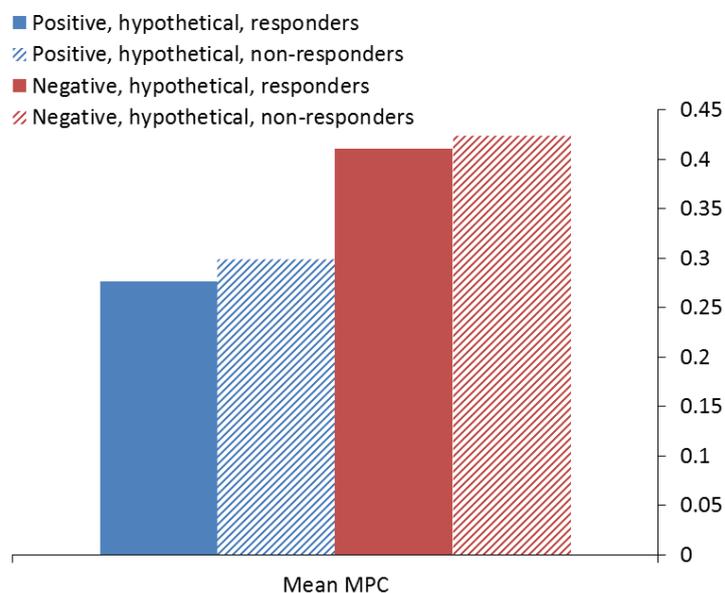
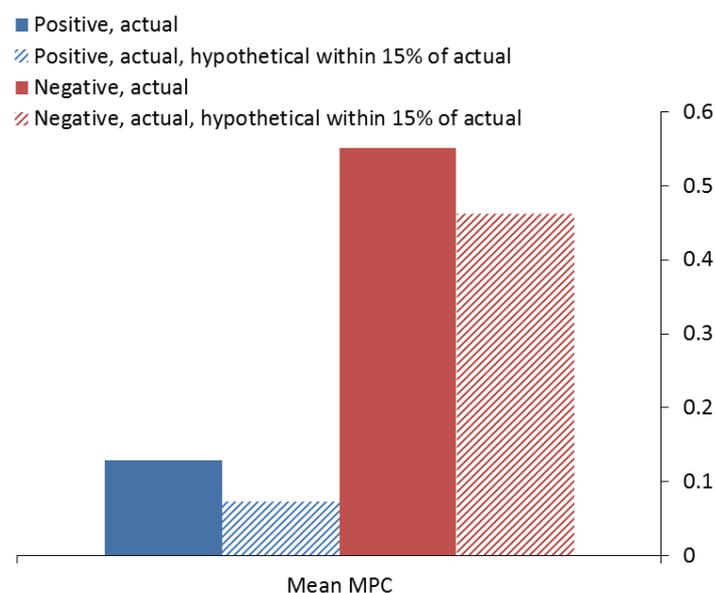


Figure 12: Mean MPC from hypothetical income shocks, for responders and non-responders ^a



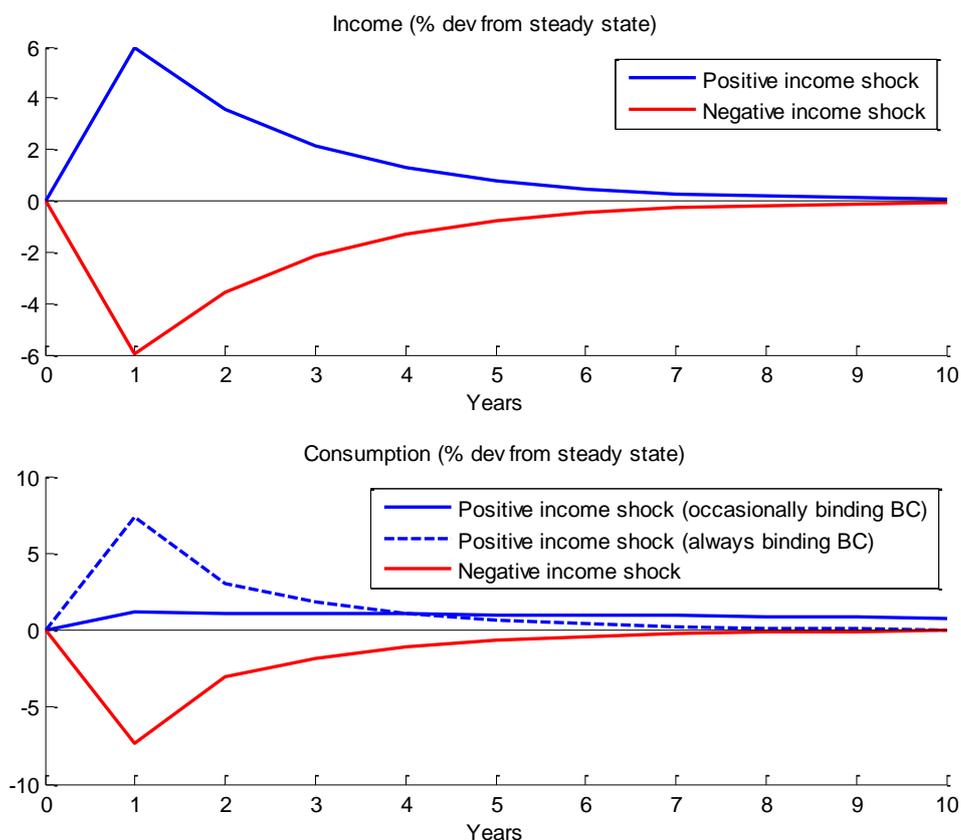
a) Chart reports mean MPC in response to a hypothetical windfall/bill for households that experienced an income shock of that sign in the previous year. Responders refer to households that gave sufficient information to compute an actual MPC, and non-responders refer to those who did not. Hypothetical responses available for 2013 only.

Figure 13: MPC distribution for actual income shocks where hypothetical response within 15% of actual MPC ^a



a) Chart reports mean actual MPCs for households for the year 2013 (the year for which we also have hypothetical responses), conditional on an MPC between zero and one (for comparability with the buckets in the hypothetical questions).

Figure 14: Impulse responses to unexpected income shock from a partial equilibrium model with occasionally binding borrowing constraint



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 2a: Characteristics of households by sign of income shock – continuous variables ^a

	Positive shocks				Negative shocks				Sig diff between positive & negative
	Mean	Median	Interquartile range	Sample	Mean	Median	Interquartile range	Sample	
MPC	0.14	0	[0,0]	1,080	0.64	0.8	[0.1,1]	1,172	Yes***
Age	45	43	[30,61]	1,080	49	50	[38,61]	1,172	Yes***
Annual pre-tax income (£'000)	36.7	33.0	[20.8,45]	0	36.7	30.5	[20.7,46.0]	0	No
Unsecured debt (£'000)	8.2	4.3	[0.9,12.5]	734	8.7	4.3	[0.8,12.5]	758	No
Mortgage debt (£'000)	89.7	75.0	[35,115]	421	91.8	75.0	[40,120]	404	No
Mortgage debt service ratio	19.4	15.0	[9.4,21.4]	476	21	18.0	[12,26.5]	443	No
Loan to value ratio	0.4	0.4	[0.2,0.7]	421	0.5	0.5	[0.2,0.7]	404	No
Loan to income ratio	2.9	2.0	[1.0,2.9]	417	2.4	1.9	[1.1,2.9]	404	No
Net liquid assets (£'000)	43.8	5.5	[-1.8,45]	1,040	29.8	1.2	[-4.0,27.1]	1,118	Yes***
Annual income shock (£'000)	5.0	2.0	[0.8,5]	1,080	-4.2	-2.0	[-5,-1]	1,172	Yes***
Net liquid assets / Annual income	2.7	0.7	[0.1,2.3]	707	1.8	0.4	[0.1,2.3]	675	Yes***

a) Variation in sample sizes across rows reflects different subsamples (e.g. mortgagors only) and response rates to different survey questions. Difference in sample for age and MPC (where we have a response for all households) from Table 1 reflects effects of sample weighting.

Table 2b: Characteristics of households that did not report the size of the income shock and/or spending response, by sign of income shock – continuous variables ^a

	Positive shocks				Negative shocks				Sig. diff between positive & negative
	Mean	Median	Interquartile range	Sample	Mean	Median	Interquartile range	Sample	
Age	41	37	[26,55]	971	46	47	[35,58]	2,208	Yes***
Unsecured debt (£'000)	6.6	2.4	[0.75,8.75]	552	7.1	2.8	[0.75,8.25]	1,201	No
Mortgage debt (£'000)	91.9	75.0	[35,120]	277	85.3	65.0	[35,105]	568	No
Mortgage debt service ratio	18.6	10.6	[3.9,21.5]	570	22.2	13.3	[5.5,27.0]	1,160	No
Loan to value ratio	0.5	0.5	[0.22,0.69]	276	0.5	0.4	[0.22,0.67]	555	No
Loan to income ratio	2.7	1.4	[0.9,3.0]	28	2.3	1.9	[0.9,2.7]	166	No
Net liquid assets (£'000)	21.4	1.5	[-1.5,18]	713	11.0	0.0	[-3.73,5.5]	1,611	Yes***

a) Variation in sample sizes across rows reflects different subsamples (e.g. mortgagors only) and response rates to different survey questions. We are unable to compute pre-tax, pre-shock income for this group of households.

Table 3a: Characteristics of households by sign of income shock – discrete variables ^a

	Positive shocks			Negative shocks			Sig diff between positive & negative
	Per cent of households	Standard deviation	Sample	Per cent of households	Standard deviation	Sample	
Credit constrained	19.01	0.40	1,052	37.38	0.48	1,145	Yes***
Risk of fall in income	48.43	0.5	954	82.7	0.38	958	Yes***
Concerned about debt	31.61	0.47	1,025	52.13	0.5	1,057	Yes***
Buffer stock of savings	68.42	0.47	988	38.79	0.49	995	Yes***
Worse off since 2006	26.41	0.44	814	82.08	0.38	759	Yes***
Temporary shock	35.95	0.48	968	18.29	0.39	995	Yes***
Education GCSE or lower	29.23	0.5	821	34.60	0.48	763	Yes**

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

Table 3b: Characteristics of households that did not report the size of the income shock and/or spending response, by sign of income shock – discrete variables ^a

	Positive shocks			Negative shocks			Sig. diff between positive & negative
	Per cent of households	Standard deviation	Sample	Per cent of households	Standard deviation	Sample	
Credit constrained	23.80	0.43	878	38.75	0.49	1,933	Yes***
Risk of fall in income	54.45	0.50	775	86.93	0.34	1492	Yes***
Concerned about debt	36.01	0.48	872	55.37	0.5	1,929	Yes***
Buffer stock of savings	59.27	0.49	793	29.59	0.46	1,808	Yes***
Worse off since 2006	22.13	0.42	628	83.32	0.38	1,313	Yes***
Education GCSE or lower	36.16	0.48	661	47.54	0.50	1380	Yes***

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

Table 4a: MPC by discrete household characteristics ^a

	Mean MPC				Significant difference?
	Positive shock	Sample	Negative shock	Sample	
Housing Tenure					
Owner occupier	0.10	325	0.56	377	Yes***
Mortgagor	0.16	490	0.68	456	Yes***
Private tenant	0.15	196	0.65	180	Yes***
Social tenant	0.22	65	0.77	158	Yes***
Employment status					
Employed	0.16	656	0.64	606	Yes***
Self-employed	0.12	67	0.65	111	Yes***
Unemployed	0.07	12	0.79	37	Yes***
Retired	0.10	264	0.58	241	Yes***
Credit constrained					
No	0.13	853	0.58	718	Yes***
Yes	0.24	201	0.75	428	Yes***
Risk of fall in income					
No	0.15	492	0.49	166	Yes***
Yes	0.16	464	0.67	793	Yes***
Concerned about debt					
No	0.13	702	0.57	507	Yes***
Yes	0.19	325	0.72	551	Yes***
Buffer of savings					
No	0.21	312	0.74	609	Yes***
Yes	0.12	677	0.50	387	Yes***
Worse off than expected in 2006					
No	0.14	601	0.44	136	Yes***
Yes	0.16	215	0.67	624	Yes***
Shock duration					
Persistent	0.14	621	0.67	814	Yes***
Temporary	0.17	349	0.57	182	Yes***

a) Significance tests compare mean MPC for positive income shocks to that for negative income shocks by characteristic.

Table 4b: MPC by discrete characteristics sensitivity: transitory shocks and households with change in cash flow direction same as income shock ^a

	PANEL A: TRANSITORY SHOCKS				Significant difference?	PANEL B: CASH FLOW DIRECTION SAME AS SHOCK				Significant difference?
	Mean MPC		Sample			Mean MPC		Sample		
	Positive	Negative	Sample	Sample		Positive	Negative	Sample	Sample	
Housing Tenure										
Owner occupier	0.11	0.46	88	46	Yes***	0.12	0.61	80	163	Yes***
Mortgagor	0.20	0.60	170	72	Yes***	0.13	0.70	140	207	Yes***
Private tenant	0.13	0.62	67	47	Yes***	0.14	0.66	50	84	Yes***
Social tenant	0.19	0.56	20	17	Yes**	0.19	0.80	11	81	Yes***
Employment status										
Employed	0.17	0.61	214	101	Yes***	0.14	0.64	183	258	Yes***
Self-employed	0.10	0.51	34	22	Yes***	0.10	0.65	16	51	Yes***
Unemployed							0.85		21	
Retired	0.16	0.42	57	23	Yes***	0.10	0.69	59	115	Yes***
Credit constrained										
No	0.16	0.50	260	119	Yes***	0.11	0.62	224	311	Yes***
Yes	0.21	0.68	80	55	Yes***	0.26	0.77	48	203	Yes***
Risk of fall in income										
No	0.18	0.49	119	43	Yes***	0.09	0.53	126	69	Yes***
Yes	0.17	0.59	200	122	Yes***	0.19	0.72	119	317	Yes***
Concerned about debt										
No	0.16	0.51	209	97	Yes***	0.12	0.66	173	191	Yes***
Yes	0.18	0.63	140	84	Yes***	0.16	0.71	89	240	Yes***
Buffer of savings										
No	0.22	0.68	118	103	Yes***	0.14	0.75	80	270	Yes***
Yes	0.14	0.43	213	74	Yes***	0.12	0.57	172	136	Yes***
Worse off than expected in 2006										
No	0.17	0.47	197	50	Yes***	0.13	0.50	141	22	Yes***
Yes	0.14	0.62	89	87	Yes***	0.11	0.68	50	140	Yes***
Shock duration										
Persistent						0.12	0.72	164	342	Yes***
Temporary						0.16	0.56	82	66	Yes***

a) We omit the mean MPC for unemployed and self-employed households due to particularly small samples. Significance tests compare mean MPC for positive income shocks to that for negative income shocks by characteristic.

Table 5: MPCs for borrowers and savers

	Definition based on buffer of savings		Statistically significant difference?	Definition based on net wealth		Statistically significant difference?	Average MPC based on buffer of savings
	Positive	Negative		Positive	Negative		
Borrower	0.21	0.74	Yes***	0.16	0.70	Yes***	0.48
Savers	0.12	0.50	Yes***	0.14	0.58	Yes***	0.31

Table 6: OLS regression results, dependent variable MPC

VARIABLES	POSITIVE INCOME SHOCKS					NEGATIVE INCOME SHOCKS				
	Demographics ^(a)	Shock characteristics ^(b)	Balance sheet dummies ^(c)	Net liquid wealth ^(d)	All ^(f)	Demographics ^(a)	Shock characteristics ^(b)	Balance sheet dummies ^(c)	Net liquid wealth ^(d)	All ^(f)
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*** (0.04)	0.72*** (0.03)	0.62*** (0.03)	0.62*** (0.07)
Observations	1,029	970	903	1,084	854	1,069	996	875	1,179	817
R-squared	0.012	0.014	0.043	0.008	0.019	0.026	0.026	0.092	0.051	0.037

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-who is unconcerned about debt, responding to the 2012 survey

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



Table 7: Average treatment effect, alternative matching approaches ^a

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
Unmatched	-0.50*** (0.02)	-0.50*** (0.02)	-0.50*** (0.02)	-0.50*** (0.02)	-0.49*** (0.02)
Kernel matching (epanechnikov), Probit					
ATT	-0.48*** (0.02)	-0.47*** (0.02)	-0.37*** (0.03)	-0.37*** (0.03)	-0.36*** (0.03)
Nearest five neighbour matching, Probit					
ATT	-0.53*** (0.06)	-0.49*** (0.03)	-0.36*** (0.03)	-0.36*** (0.03)	-0.36*** (0.03)
Kernel matching (normal), Probit					
ATT	-0.53*** (0.06)	-0.49*** (0.03)	-0.36*** (0.03)	-0.36*** (0.03)	-0.36*** (0.03)
Kernel matching (epanechnikov), Logit					
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

a) Small differences across the columns for the unmatched MPCs reflect the fact that some households did not respond to all of the survey questions.

Table 8: Calibration of occasionally binding constraint model

		Source	Calibrated value
R	Long run real interest rate	Consistent with UK real interest rates since early 1990s	1.02
β	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
ρ	Persistence of autoregressive income process	Consistent with the persistence in annual nominal household income growth (National Accounts)	0.6
σ	Standard deviation of income shocks	Standard deviation of annual income, NMG survey	0.6

Appendix A: 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**²³ 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

²³ 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

HYPOTHETICAL MPC QUESTIONS

Finally, we have [three] last questions to ask you in this survey. These will ask you about a hypothetical situation and we'd like you to think carefully about what you would do if this situation were real.

If your household received an unexpected windfall of [£amount*] tomorrow, what do you think you would do with this extra money?

- I would spend all [£100%] more this year
- I would spend between [£75%] and [£100%] more this year
- I would spend between [£50%] and [£75%] more this year
- I would spend between [£25%] and [£50%] more this year
- I would spend between [£1] and [£25%] more this year
- I would not change spending and save the windfall
- I would not change spending and use the windfall to pay off some of my debt

Households were allocated one of the following amounts at random and the response options quoted a computed per cent of that amount: £500, £1000, £2000, £10000

If you received an unexpected tax bill or other one off expense of [£amount*] tomorrow, how would you change your spending on other items to pay for it?

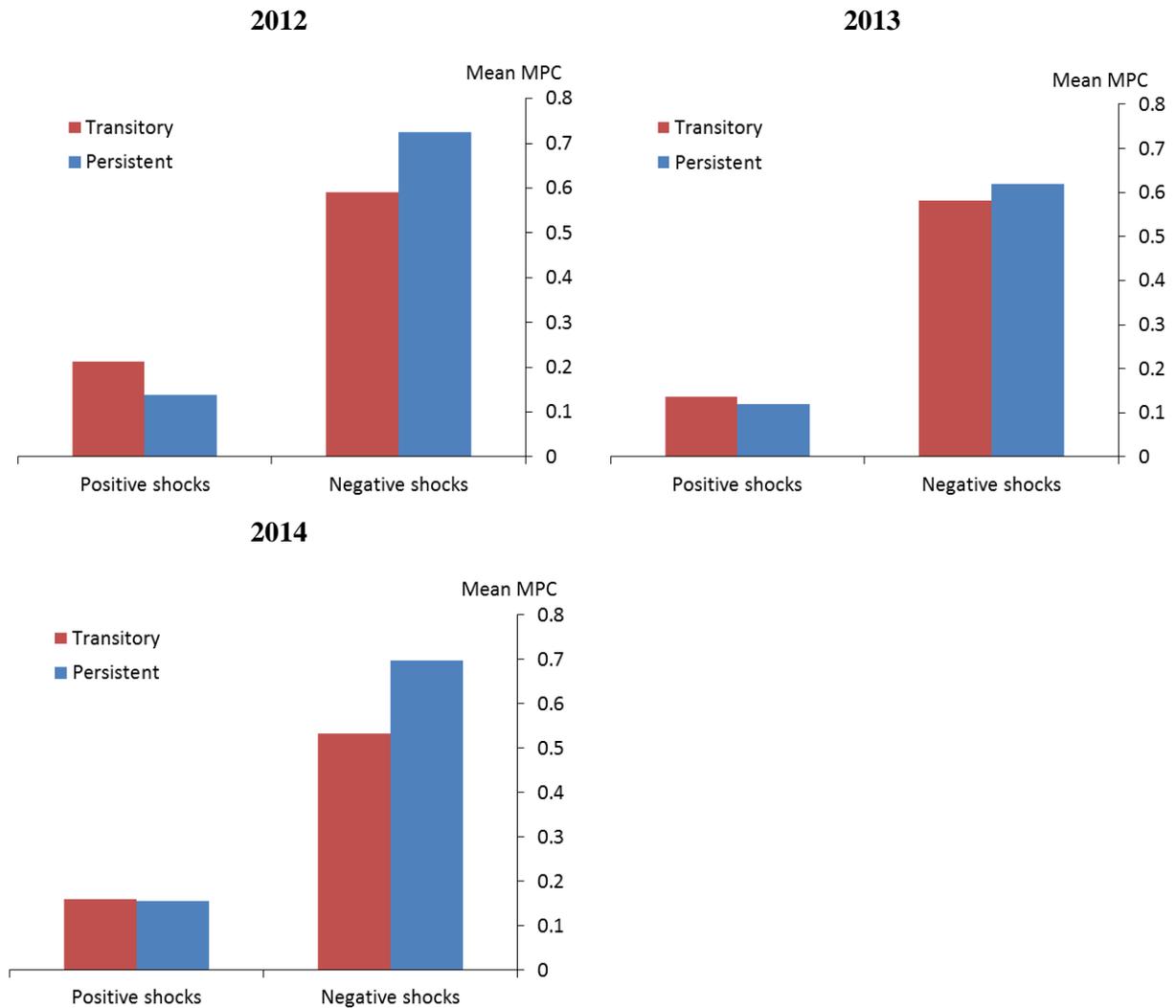
- I would spend [£100%] less this year on other items
- I would spend between [£75%] and [£100%] less this year on other items
- I would spend between [£50%] and [£75%] less this year on other items
- I would spend between [£25%] and [£50%] less this year on other items
- I would spend between [£1] and [£25%] less this year on other items
- I would not change spending on other items and pay for the one off expense out of savings
- I would not change spending on other items and pay for the one off expense by borrowing money

Households were asked about the same amount as for the unexpected windfall, except for those allocated £10,000 who were asked about £2,000.



Appendix B: Additional Descriptive Statistics

Figure B1: Mean MPC by shock duration, by year¹



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

Figure B2: Share of households with MPC greater than zero

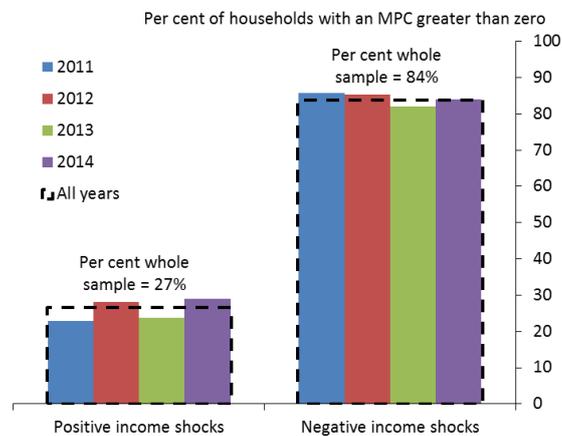


Table B1: Mean MPC and duration by reasons for income shocks in 2012¹

	Positive income shock					Negative income shock			
	Share of shocks (%)	Mean MPC	transitory shocks (%)	Share N		Share of shocks (%)	Mean MPC	transitory shocks (%)	Share N
Higher labour income	30.9	0.14	30.0	63	Lower labour income	17.8	0.64	16.3	54
New job or lifestyle change	17.2	0.20	15.6	35	Lost job or lifestyle change	15.2	0.76	28.6	46
Windfall or lower taxes	14.7	0.19	66.7	30	Higher taxes or lower benefits	39.3	0.71	6.0	119
Other	37.3	0.13	24.3	76	Other	27.7	0.69	20.7	84

1. Categories have been grouped due to small sample. Higher/lower labour income includes higher/lower than expected wages, pay rise and bonus.

Common 'other' reasons for higher income:

- Higher pension income or higher benefits
- Inheritance, gifts from family
- Marriage
- Property income, e.g. higher rent, took in lodger
- Paid off debts

Common 'other' reasons for lower income:

- Lower interest of savings, pension and annuity income or lower dividends
- Death of spouse, divorce/separation, loss of maintenance payments
- Aggregate economic weakness, e.g. loss of demand in sector, fewer hours available
- Higher cost of living

Table B2: Heckman sample selection model ^a

VARIABLES	POSITIVE INCOME SHOCKS		NEGATIVE INCOME SHOCKS	
	OLS	Heckman model	OLS	Heckman model
Age 18-24 dummy	0.05 (0.04)	0.02 -0.05	-0.10 (0.07)	-0.10 -0.09
Age 45-64 dummy	0.02 (0.03)	0.05 -0.03	0.06 (0.04)	0.05 -0.04
Age 65+ dummy	-0.01 (0.03)	-0.01 -0.05	-0.02 (0.05)	-0.01 -0.06
Unemployed dummy	-0.10 (0.08)	-0.11 -0.11	0.09 (0.07)	0.09 -0.08
Shock size in 2nd quartile dummy	0.02 (0.03)		0.05 (0.05)	
Shock size in 3rd quartile dummy	0.08** (0.03)		0.05 (0.04)	
Shock size in top quartile dummy	0.08*** (0.03)		-0.04 (0.04)	
Transitory shock dummy	0.02 (0.02)		-0.07* (0.04)	
Credit constrained dummy	0.09*** (0.03)	0.11** -0.04	0.06 (0.04)	0.04 -0.04
Income uncertainty dummy	-0.04* (0.02)	-0.03 -0.03	0.09** (0.04)	0.06 -0.05
Has buffer of savings dummy	-0.11*** (0.03)	-0.08* -0.03	-0.12*** (0.04)	-0.13** -0.05
2nd tertile of liquid assets to income dummy	0.00 (0.03)	-0.02 -0.03	0.06 (0.04)	0.11* -0.04
Top tertile of liquid assets to income dummy	0.01 (0.03)	-0.02 -0.04	-0.08 (0.05)	-0.09 -0.06
Mortgagor dummy	0.02 (0.03)	-0.01 -0.03	-0.02 (0.04)	-0.01 -0.04
LTV >90% dummy	0.17 (0.11)	0.14 -0.09	0.09 (0.05)	0.03 -0.15
LTV 75%-90% dummy	-0.10** (0.04)	-0.06 -0.05	0.06 (0.07)	0.02 -0.08
Concerned about debt dummy	0.00 (0.03)	-0.01 -0.03	0.02 (0.04)	0.04 -0.05
2013 dummy	-0.06** (0.03)	-0.05* -0.02	-0.08** (0.04)	-0.07 -0.03
2014 dummy	-0.01 (0.03)		-0.03 (0.04)	
Constant	0.18*** (0.05)	0.20 -0.11	0.62*** (0.07)	0.57*** -0.15
Sample selection term		0.05 0.12		0.04 0.12
Observations	854	739	817	650

a) Education variable used in first stage regression is not available in 2012, and so the Heckman model draws on the smaller sample from 2013 and 2014.

Appendix C – Tobit regression results (dependent variable MPC)

VARIABLES	POSITIVE INCOME SHOCKS					NEGATIVE INCOME SHOCKS				
	Demographics ^(a)	Shock characteristics ^(b)	Balance sheet dummies ^(c)	Net liquid wealth ^(d)	All ^(f)	Demographics ^(a)	Shock characteristics ^(b)	Balance sheet dummies ^(c)	Net liquid wealth ^(d)	All ^(f)
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)				0.03 (0.04)		0.09* (0.05)
Top tertile of liquid assets to income dummy				-0.25*** (0.10)				-0.26*** (0.04)		-0.08 (0.07)
Mortgagor dummy									-0.01 (0.04)	-0.03 (0.05)
LTV >90% dummy									0.11** (0.05)	0.13** (0.07)
LTV 75%-90% dummy									0.05 (0.08)	0.08 (0.09)
Concerned about debt dummy									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)	-0.25** (0.12)	-0.13*** (0.04)	-0.11** (0.05)	-0.10*** (0.04)	-0.11** (0.05)	-0.11** (0.05)
2014 dummy	0.06 (0.11)	0.04 (0.11)	0.06 (0.11)	0.10 (0.10)	0.00 (0.11)	-0.04 (0.04)	-0.05 (0.05)	-0.02 (0.04)	-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)	-0.69*** (0.19)	0.66*** (0.04)	0.52*** (0.07)	0.69*** (0.03)	0.53*** (0.04)	0.48*** (0.10)
Observations	1,029	970	903	1,084	854	1,069	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 D: Probit regression results (dependent variable dummy for MPC greater than zero)

VARIABLES	POSITIVE INCOME SHOCKS					NEGATIVE INCOME SHOCKS				
	Demographics ^(a)	Shock characteristics ^(b)	Balance sheet dummies ^(c)	Net liquid wealth ^(d)	All ^(f)	Demographics ^(a)	Shock characteristics ^(b)	Balance sheet dummies ^(c)	Net liquid wealth ^(d)	All ^(f)
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 (0.02)	-0.02 (0.02)	-0.01 (0.02)	-0.03 (0.02)
Probability for benchmark household	0.31 1,871	0.16 1,007	0.31 1,520	0.30 1,963	0.35 1,508	0.86 3,174	0.79 1,071	0.81 2,190	0.87 3,434	0.76 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)

