Asymmetric Consumption Effects of Transitory Income Shocks[#]

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Abstract

We use the responses from a representative sample of Dutch households to a survey that asked how much of an unexpected, transitory and positive income change they would consume, and by how much an unexpected, transitory and negative income change would reduce their consumption. The questionnaire distinguished between relatively small income changes (a one-month increase or drop in income), and relatively larger ones (equal to 3 months of income). The results are broadly in line with models of intertemporal choice with precautionary saving, borrowing constraints, and finite horizons.

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1. Introduction

To evaluate the effect of fiscal policy on consumption requires reliable estimates of the consumption response to income shocks, e.g. the marginal propensity to consume (MPC). Distinguishing whether consumption responds differently to positive as opposed to negative income changes, and whether the response depends on the size of the shock are equally important.

To address these issues, we use the responses from a representative sample of Dutch households to survey questions that asked how much of an unexpected, transitory and positive income change they would consume, and by how much they would reduce their consumption in response to an unexpected, transitory and negative income change. The survey questionnaire allowed respondents to distinguish between relatively small income changes (an increase or reduction equivalent to roughly the monthly income), and relatively larger ones (equivalent to 3 months of income).

The survey allows us to characterize empirically the distribution of the MPC in response to unexpected, transitory positive and negative income changes, and compare the findings with the predictions of intertemporal consumption models. Specifically, we test whether the consumption response to income shocks declines with economic resources, whether the MPC is smaller if the consumer has a relatively long time horizon, whether the consumption response to positive income shocks and negative income shocks differs, and whether the response is stronger for more salient and larger income shocks. The main advantage of using this survey is that it allows us to compare the responses *of the same household* to a hypothetical positive and negative income shock in almost a quasi-experimental setting. In contrast, a realized income shock is either positive or negative, and therefore, comparing the consumption responses to realized positive and negative shocks reflects also the different characteristics (observed and unobserved) of the selected sample that is subjected to a given type of shock (and in most cases, the business cycle context in which the shocks occur).

Our empirical findings are broadly in line with models of intertemporal choice with precautionary saving, borrowing constraints and finite horizons. The average MPC is in the range 15 percent to 25 percent; it is relatively larger for negative income shocks, increases with age,

and is larger at low levels of economic resources. We find also that the MPC distribution is in line with two of the predictions of models with liquidity constraints. First, as shown by simple simulation analysis of a model with income risk and precautionary saving, in the presence of liquidity constraints the MPC from negative income shocks is larger than the MPC from positive shocks. Second, in the presence of liquidity constraints the size of the shock also matters. In the case of large income increases, liquidity constrained consumers are more likely to overcome the constraint (and therefore, the MPC is lower than in the case of small increases) while in the case of income decreases the MPC should be equal to 1 irrespective of the size of the negative income shock. The survey allows us to test these important, and as yet unexplored implications of liquidity constraints.

From a methodological point of view, we contribute to the literature on MPC estimation based on income shocks. One of the difficulties affecting estimation of the MPC is isolating the exogenous income shocks needed to track consumption behavior following a shock. The literature suggests three approaches to deal with this issue (for a survey, see Jappelli and Pistaferri, 2011). The first identifies episodes in which income changes due to unemployment, disability, or tax rebates, and evaluates in a quasi-experimental setting, how consumption reacts to such changes (see for instance Browning and Crossley (2001), Stephens (2001), Souleles (1999; 2002), Agarwal, Liu and Souleles (2007), Misra and Surico (2014)). The second approach relies on the statistical decomposition of income shocks and the covariance restrictions imposed by the theory on the joint behavior of income and consumption, in combination with long panel data to relate income shocks to consumption growth (Blundell, Pistaferri, and Preston, 2008). Survey questions which measure the responses to actual or hypothetical income changes are the third option. For instance, Shapiro and Slemrod (1995; 2003) and Sahm et al. (2010; 2015) asked US households to report how their consumption changed in response to tax rebates, tax credits, and payroll tax changes in the previous 15 years. Jappelli and Pistaferri (2014) analyze how a hypothetical tax rebate affects consumption, focusing on the relation between the MPC and cash-on-hand. However, none of these studies benefits from information on the MPC from negative income changes, and therefore, cannot investigate whether the MPCs from positive and negative changes are symmetric.

The present paper is organized as follows. Section 2 discusses the theoretical predictions related to the MPC, and presents a simple simulation analysis of the effect of positive and negative income shocks on consumption in models with precautionary saving and liquidity constraints. Section 3 describes the data, and presents the questions used in our survey to elicit the MPC. Section 4 provides a descriptive analysis, and the regression results obtained when relating the MPC to demographic variables, household resources, and proxies for credit constraints. In Section 5 we exploit the relation between the distribution of positive and negative income shocks, and information on the size of the shock, to draw implications about the prevalence of liquidity constraints. Section 6 tests the robustness of the empirical results, and section 7 concludes.

2. Theoretical predictions

In a standard life-cycle permanent income model with perfect credit markets, quadratic utility and an infinite horizon, consumption is proportional to lifetime disposable resources, and hence, all consumers respond in the same way to income shocks; that is, there is no heterogeneity in the MPC. Models with a finite horizon introduce a first important source of heterogeneity: the MPC is larger for households with short horizons (typically, older households). In models with precautionary savings and borrowing constraints the relation between cash-on-hand and consumption is concave, and consumers respond differently to changes in their economic resources. Indeed, MPCs are lower for the rich than for the poor, and liquidity constrained consumers exhibit a higher MPC than households that can access credit markets to smooth consumption.

In addition to these level effects, the composition of household resources can also matter. For instance, households burdened with large debt might react to a positive change in income by reducing their debt rather than spending (Dynan, 2012; Mian and Sufi, 2010). Moreover, if most of household wealth is locked into illiquid assets, households should reduce consumption even in the face of a negative transitory income shock (Kaplan and Violante, 2014). In this section, we

explore the implications of liquidity constraints and precautionary saving for the consumption response to positive and negative income shocks.

2.1. Liquidity constraints

The standard life-cycle permanent income with perfect capital markets suggests that the MPC is the same for both negative and positive income shocks. Indeed, individuals can borrow and save at the same interest rate to buffer income fluctuations. However, in the presence of liquidity constraints, the MPC distribution of negative income shocks dominates the MPC distribution of positive shocks.

To see why, let us consider a simple two-period model with consumption in the two periods denoted c_t and c_{t+1}. The utility function is quadratic so there are no precautionary saving effects. Figure 1 shows how consumption responds to a change in first-period income, given second-period income. The 45-degree line is the locus of all solutions where consumption is constant over time ($c_t = c_{t+1}$). The initial distribution of resources is given by $\{ y_t^a , y_{t+1} \}$, and first-period income is lower than second-period income. With a zero interest rate, and a zero rate of time preference, the optimal solution in the absence of constraints is to keep consumption constant in the two periods. If a liquidity constraint is imposed, it will be binding, and households will choose $c_t = y_t^a$ and $c_{t+1} = y_{t+1}$ (the corner solution corresponding to point A in Figure 1).

Suppose now that first-period income increases from y_t^a to y_t^b, and thus, the constraint is relaxed. Since lifetime income increases, the household revises its optimal consumption plan upwards. Despite the rise in income, the liquidity constraint is still binding, and the solution is still a corner one (point B). Since the liquidity constraint is binding, the household attempts to close the gap between desired and actual consumption. To reduce this intertemporal distortion, income changes are entirely consumed (MPC=1). Notice that since the interest rate is equal to the discount factor, if there are no liquidity constraints, the MPC will be equal to 0.5 because the increase in income is divided equally between the two periods.

To overcome the distortions induced by liquidity constraints, income needs to increase substantially. For example, if income rises to y_t^c, the increase is so large that the constraint no

longer binds. In this situation, the household decides to save in the first period, and the MPC is less than 1.

Consider now a situation in which first-period income drops from y_t^a to a lower level. In this case the household can only move to another corner solution, thus MPC=1, regardless of the size of the income shock.

This discussion suggests that liquidity constraints have two implications for the MPC in the case of negative and positive income shocks. First, the MPC in response to negative income changes is greater than the MPC in response to positive changes. The other implication is that with liquidity constraints the size of the shock also matters. For large increases in income, households are more likely to overcome the constraint, and therefore, the associated MPC is likely to be lower than in the case of small changes. In the case of income decreases size should not matter (the MPC is equal to 1 regardless of the size of the shock). Our specially designed set of questions allows us to test these important, and still unexplored, implications of liquidity constraints.[1]

2.2. Precautionary saving

Liquidity constraints are not the only reasons we might expect MPC asymmetries in response to positive and negative income shocks. Indeed, models in which the utility function exhibits prudence predict that the MPC will depend on the level of the household's resources. Carroll (1996) and Carroll and Kimball (1996) show that adding income uncertainty to a standard optimization problem with preferences characterized by prudence produces a concave consumption function in which the MPC from cash-on-hand declines with the level of the cash-on-hand. The intuition is that consumers with less wealth have less ability to protect their

[1] Altonji and Siow (1987) and Shea (1995) note that with liquidity constraints the response of consumption to *anticipated* income changes should be asymmetric, and that "households are more likely to violate the permanent income model when income is expected to grow than when income is expected to fall, since liquidity constraints inhibit borrowing but not saving" (Shea, 1995, p. 196). Altonji and Siow find empirically that households expecting their income to rise exhibit a higher sensitivity of consumption to predictable income than households expecting their income to fall, while Shea finds the opposite pattern. While these papers point to important asymmetries in consumption, their findings are not relevant in our context because they refer to anticipated income changes, while we examine unanticipated income shocks.

consumption against income shocks. Therefore, an unanticipated increase in income, by increasing cash-on-hand, has a smaller effect on consumption than a reduction in income.

To gauge the importance of the asymmetric responses of consumption to income shocks, we simulate the MPC in a version of Aiyagari's (1994) model populated by heterogeneous agents with constant relative risk aversion preferences. The model includes an exogenous borrowing constraint preventing wealth from being negative, and an income process featuring a stochastic component given by the sum of an AR(1) process and an i.i.d. transitory shock.[2] The model is similar to that used by Jappelli and Pistaferri (2014) to characterize the shape of the relation between cash-on-hand and the MPC.

After solving the model using standard calibrated parameters (an interest rate of 4%, a discount factor of 0.95, a risk aversion of 2, an AR parameter of 0.98, a standard deviation of the persistent shock of 0.03, and a standard deviation of the transitory shock of 0.01), we calculate the optimal consumption rule. To mimic the hypothetical income windfall equivalent to 1/12 of the yearly income (as per the survey question), we normalize the mean income to 1, set the transitory shock to 0.1, and compute the distribution of the MPC with respect to transitory shocks implied by the model. We repeat the exercise setting the transitory shock to -0.1. Finally, we increase the size of the shock to 0.3 and -0.3 to mimic larger income shocks.

Figure 2 plots the MPC from positive income shocks. The horizontal line corresponds to the case of certainty equivalence and no liquidity constraints, and thus, the MPC equals the interest rate (4%), regardless of the level of cash-on-hand and the size of the shock. With liquidity constraints and precautionary saving, the consumption function is concave, and the MPC is a decreasing function of cash-on-hand, and ranges from values of 35 percent for low levels of cash-on-hand, to approximately 4 percent for levels of cash-on-hand more than three times larger than the median disposable income. Figure 2 shows also that at low levels of cash-on-hand the MPC from a small positive income shock is larger than the MPC from a large shock. This is because a large income shock makes it more likely that the liquidity constraint is no longer binding.

Figure 3 plots the MPCs in response to negative income shocks. Again, the horizontal line denotes the MPC in the certainty equivalence case, and is identical to the corresponding line in

[2] A detailed description of the model is provided in the Appendix.

Figure 2, that is, in this case there are no asymmetric effects of income shocks. Introducing liquidity constraints and precautionary saving makes the MPC a negative function of cash-on-hand in the case of negative income shocks also. However, note that at low levels of cash-on-hand the MPC in response to a negative shock is much larger than the MPC in response to a positive shock. In particular, for large negative shocks the MPC is equal to 1. Moreover, at low levels of cash-on-hand, the MPC from a large negative shock is greater than the MPC from a small negative shock since the liquidity constraint is more likely to be binding in the former case.

These simple simulations have several implications which we can test empirically: (1) the MPC is higher at low levels of cash-on-hand; (2) the MPC in response to a negative income shock is larger than the MPC in response to a positive shock; (3) the size of the shock introduces further asymmetries in the MPC.

3. The data

We use data from the CentER Internet panel which is sponsored by the Dutch National Bank and maintained by CentERdata at Tilburg University. The baseline survey is conducted once a year via the Internet, and collects detailed information on a range of demographics and asset holdings for a representative sample of Dutch-speaking households in the Netherlands. In addition to the baseline survey, households may be asked during the year to participate in special purpose surveys.

We designed a special purpose survey including questions aimed at measuring the MPC in response to positive and negative income changes, and to relatively small and relatively larger income changes gauging separately the response of non-durable consumption, durable expenditure, debt repayment, and saving. Specifically, we characterize the MPC based on four separate questions addressed to the financial respondent (i.e. the person responsible for the household's finances) in each household participating in the CentER survey.

In July 2015 we administered the first survey which included two questions asking about a relatively small positive income shock, and a negative income shock. To avoid confusing the respondents and affecting their responses, we administered a follow-up survey in October 2015

which included two questions about relatively larger positive and negative income changes. We placed the questions referring to positive and negative changes in different parts of the questionnaire in each survey to minimize the framing of answers.

The two questions on positive income changes refer to a one-off bonus from the government:

Imagine you unexpectedly receive a one-time bonus from the government equal to the amount of net income your household earns in (one-month / three months). In the next 12 months, how would you use this unexpected income transfer? Distribute 100 points over these four possible uses:

1. Save for future expenses [0,…,100]
2. Repay debt [0,…,100]
3. Purchase within 12 months durable goods (cars, home improvement, furniture, jewelry, other durable good) that you otherwise would not have purchased or that you would have purchased later [0,…,100]
4. Purchase within 12 months of non-durable goods and services that do not last in time (food, clothes, travel, vacation, etc.) [0,…,100]
[ ] Do not know

The two questions for negative changes refer to a one-off tax:

Imagine you unexpectedly have to pay a one-time tax to the government equal to the net income your household earns in (one month / three months). In the next 12 months, how would you react to this unexpected reduction in your net income? Distribute 100 points over these four possible actions:

1. Reduce your saving for future expenses [0,…,100]
2. Borrow more money or repay less debt [0,…,100]
3. Cancel or postpone the purchase of durable goods (cars, home improvement, furniture, jewelry, other durable goods) that you otherwise would have purchased in the next 12 months [0,…,100]
4. Reduce spending in the next 12 months on non-durable goods and services that do not last in time (food, clothes, travel, vacation, etc.) [0,…,100]
[ ] Do not know

The survey included a cross-section of 1,484 households, and asked about demographic variables, household income, and wealth (broken down into real assets, financial assets, and debt). Note that, in contrast to questions that ask for qualitative information (mostly save/mostly spend) on how people spend temporary tax rebates, the responses to the questions we posed provide quantitative metrics for a proposed scenario (people are asked what percentage of the

bonus they would spend, and what they would save). Similar to the mostly spend/mostly save questions posed in Shapiro and Slemrod (1995; 2003), our questions refer to a bonus, or to a tax, and thus, reflect a real-life situation.

The advantage of quantitative survey responses is that they overcome problems related to comparing responses across individuals who might interpret the statement "mostly spend/mostly save" in different ways. Another advantage is that if one ties the transfer to income, aggregation is straightforward: the aggregate MPC from a transitory income shock (i.e., the response of aggregate consumption with respect to an increase in national income) is just the sample average of the individual MPCs. Instead, asking for a numerical value of income (in euro) requires additional and ad hoc assumptions to obtain the aggregate MPC.

The design of the survey question also addresses the following potential problem: asking how the respondent would spend a fixed sum of money (i.e., a 500-euro tax rebate) may suffer from a size effect, if the magnitude of the rebate is small relative to the incomes of many households. To overcome this issue, the survey question ties the amount of the transfer received to the monthly income.[3]

Finally, the survey allows us to characterize the MPC for positive and negative income shocks for the same individual. Quasi-experimental data or retrospective data on income shocks identifies households who have experienced positive shocks or households who have experienced negative shocks. This makes it difficult to compare the two distributions because the two samples are likely to represent different segments of the population which differ in terms of resources, socioeconomic characteristics, and preferences. Thus, the comparison in this paper controls effectively also for individual fixed effects.

Several features of the survey questions are noteworthy. First, the questions ask about consumption of non-durables and durables separately (questions on the latter mention cars, home improvements, furniture and jewelry) which allows us to distinguish between the MPC and the marginal propensity to spend.[4] This distinction might be especially relevant for "three-month

[3] Parker et al. (2013) and Sahm, Shapiro and Slemrod (2010) try to tease out the "size effect" by looking at rebates relative to income. Here, we ask different questions for one-month and three-month income changes.

[4] Parker et al. (2013) highlight the importance of distinguishing between non-durable and total spending, and find that households spent between 12% and 30% of their 2008 U.S. stimulus payments on non-durable goods, and this

income changes", as a bonus equivalent to three-months' income might allow the household to purchase more expensive durable goods, while a three-month tax might make it more likely that the household reduces or postpones planned expenditure on durable goods. However, the distinction between durables and non-durables can be ambiguous, and consumers might not fully understand it. Thus, while our baseline results use non-durable consumption, we perform robustness checks where we add durable expenditure to the consumption definition.

Second, consumers are asked how they would increase or cut spending "in the next 12 months". This allows us to rule out that differences in the MPC arise from differences in the timing of planned spending. Each of the reported MPCs can be interpreted as the consumption response to an income change in the coming year. Of course, further adjustments in subsequent years cannot be ruled out. In principle, it would be useful to post similar questions with other timings (e.g. how would consumption change in the second year) but this would increase the complexity of the questionnaire considerably.

Third, the questionnaire was administered in July and October 2015. In 2015, real GDP growth in the Netherlands was 2 percent and was projected to grow by 1.7 percent in 2016. and 2 percent in 2017. In other words, the interviews took place several years after the financial crisis (GDP decreased by 4% in 2009) and the 2011-12 recession. Although business cycle effects can never be ruled out, the period in which the survey was administered should have weakened their impact.

Finally, a possible caveat common to all research eliciting subjective expectations or behavior in hypothetical scenarios, is that respondents might not have correctly understood the questions; consequently, they might display quite different behavior from the reported behavior. To gauge the empirical importance of this issue, we check the robustness of the results by controlling for respondents' financial literacy.

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rose to 50%-90% when durable goods are included. This result is somewhat puzzling in light of a previous study which found that most spending goes on non-durables (Johnson et al., 2006).

4. MPC distributions

In this section, we report descriptive statistics of the distribution of responses to hypothetical income changes, distinguishing between non-durable consumption, durable consumption, debt repayment and saving. We summarize the empirical correlations by employing regression analysis.

4.1. Descriptive analysis

Table 1 reports the summary statistics of the responses to the survey questions. It should be remembered when evaluating responses, that the size of the income change is household-specific, and that the average net monthly household income is 2,833 euro. After a one-month income increase the average respondent would allocate 19.6 percent of the additional income to non-durable consumption, 19.2 percent to durable consumption, 14.7 percent to debt reduction, and save the remaining 46.5 percent. The distribution for a one-month income decline indicates a stronger consumption response: 23.8 percent of the income drop is absorbed by non-durable consumption, 25.8 percent by durables, 7.0 percent by a debt increase and 43.5 percent by reduced saving. Focusing on the MPC non-durables, the median MPC from positive income changes is 10 percent, while it is 20 percent for negative changes. This pattern provides qualitative support for the insights from the simulations of the intertemporal model with precautionary saving and liquidity constraints, suggesting that the MPC in response to negative income shocks is higher than the MPC in response to positive shocks.

The MPC distributions for larger income changes highlight some interesting features: an assumed three-month rise in income is associated with a MPC non-durables of 14.3 percent while the MPC associated with an income decline is 24.0 percent. Therefore, the MPC gap between positive and negative income changes is wider for large changes, again supporting the insights from the model.

An average MPC non-durables of 19.6 percent associated with a one-month income increase is higher than implied by a standard model of intertemporal choice with certainty equivalence. However, the average hides substantial heterogeneity among the responses, and the

median (10%) is more in line with the predictions of models where households smooth a large fraction of the shock. Figure 4 plots the cross-sectional distribution of the MPC non-durables due to a one-month income increase (upper left panel), a one-month income decline (upper right panel), a three-month income increase (lower left), and a three-month income decline (lower right).

The upper left histogram in figure 4 shows that among 1,319 respondents, 472 (36%) reported that they would not spend any of the bonus, and another 15 percent said they would spend 10 percent or less. Only 3 percent reported that they would spend more than 90 percent of the bonus, and only 2.8 percent said they would spend the entire bonus (MPC=1). The histogram also shows a "heaping" at rounded values (5%, 10%, 15%, etc.). It is interesting that heaping is not concentrated in the "50 percent" response, which often is interpreted as indicating respondent indecisiveness. We take this as an indication that the responses to the MPC questions are reliable.

The upper-right panel in figure 4 reports the MPC distribution for one-month negative income changes. We noted that the average MPC corresponding to negative changes is higher (23.8 percentage points) than the average MPC corresponding to positive changes (19.6 percentage points). This higher average is due to a lower fraction of respondents reporting a low MPC (42% report that they would cut consumption by 10 percent of the income drop or less), and a higher fraction of households reporting that they would cut consumption substantially (4% reported they would cut consumption by more than 90% of the income drop, and 3.4% reported a MPC equal to 1).

The lower two histograms in figure 4 report similar distributions for larger income changes. The MPC distribution corresponding to a three-month negative income change is similar to the distribution for a one-month change. In the case of positive income changes, the most visible and interesting feature of the histogram is that only 1 percent of the sample reported an MPC from a three-month income increase of over 50 percentage points, as opposed to the 7 percent reporting a MPC from a one-month income change above 50 percentage points.

Figure 5 reports the MPC distribution corresponding to durables consumption, and shows that around 30 percent of the sample does not intend to spend on durables; only 10 percent intends to spend more than 50 percent of the income change on durables. Figure 6 plots the distribution of the MPC on all goods (derived by summing the MPC durables and non-durables).

Even considering this larger aggregate, the upper-left panel shows that 30 percent of the sample intends to spend less than 10 percent of the income change, and that only 10 percent of the sample intends to devote more than 90 percent of the income change to total consumption. Finally, figure 7 shows that the majority of respondents intend neither to increase nor reduce debt following an income shock.

4.2. Cash-on-hand and age profiles

The next step is to relate the MPC to household resources which we measure empirically using cash-on-hand defined as the sum of current income and financial wealth, net of consumer debt. Figure 8 plots the average MPC non-durables by deciles of cash-on-hand, with a locally weighted regression line superimposed. There is no relation between the MPC and cash-on-hand for positive income changes, regardless of the size of the shock (1 or 3 months of income). Instead, for income declines, the MPC is higher at low levels of cash-on-hand, for both one- and three-month income changes. In the case of a one-month tax increase the MPC declines by about 5 percentage points, from 26 percentage points in the lowest cash-on-hand decile to 21 percentage points for the top cash-on-hand deciles. The MPC for the three-month negative income change also declines with cash-on-hand, from 27 percentage points in the lowest cash-on-hand deciles to 20-22 percentage points in the top deciles.

Figure 9 plots the MPC non-durables against age (grouped in 10-year intervals). Theory predicts a positive relation between age and the MPC, and all four graphs are upward sloping. For instance, the MPC in response to small positive income changes increases from 14 percentage points for the youngest age group (less than 30 years old), to 23 percentage points for the oldest group (over 80 years old). The MPC in response to a one-month income decline increases only for the oldest group. The age-MPC relation for three-month positive and negative changes is also upward sloping, as shown in the lower two graphs in figure 9.

4.2. Regression analysis

To properly characterize the various factors affecting the variability of the MPC, we rely on regression analysis. Summary statistics of the main variables used in the estimation are presented in table 2. Table 3 presents the baseline OLS regression results for non-durable consumption.

Our baseline specification includes only the age dummies (the base category is the oldest one), and the financial respondent's gender, family size, and dummies for cash-on-hand quartiles (the base category is the 4th quartile). The number of observations is not the same in each of the regressions, due to the different number of missing values in the responses to the four questions related to non-durable consumption (positive and negative changes, one and three-month changes).

The age coefficients in table 3 are generally negative and statistically different from zero except for those in column 1, indicating that the youngest group (less than 35 years old) has a lower MPC than the oldest group (65 and over). For instance, for a one-month income increase, the MPC of the youngest group is 10.4 percentage points higher than the MPC for the oldest group. This pattern agrees, at least qualitatively, with the predictions of standard consumption models that the MPC in response to transitory shocks increases with age. The dummy for male is negative and statistically different from zero in three out of four regressions, while the coefficients of family size are never significant.

The pattern of the cash-on-hand quartile dummies confirms the descriptive analysis, that is, that the MPC is negatively associated with cash-on-hand for negative income changes, but there is no relation between the MPC and cash-on-hand for positive changes. In particular, in column 1 the coefficient of the first quartile of cash-on-hand is 5.9, and is statistically different from zero at the 1 percent level (6.5 points in column 3 for the 3-month income drop).

The regression results in table 4 correspond to total consumption, and indicate a higher MPC at the bottom of the income distribution in the case of declines in income. For instance, in the case of a one-month income decline, the MPC in the bottom cash-on-hand quartile is 6.8 percentage points higher than in the top income quartile; for a three-month income decline, the MPC in the bottom cash-on-hand quartile is 12.1 percentage points higher than in the top quartile.

Table 5 reports the regressions for the propensity to increase debt after an income decline, or to reduce debt after an income increase. Two results are worth noticing. First, the propensity to increase or reduce debt falls with age, especially for small income changes. Second, the effects of cash-on-hand are strong and statistically significant for both rises and declines in income. They indicate that households in the first quartile of cash-on-hand adjust debt by 10-15 percentage points in response to income changes, relative to households in the fourth quartile.

5. Tests of liquidity constraints

As discussed in section 2 liquidity constraints are likely to have important effects on the MPC distribution, and in particular, the distribution of negative income shocks is expected to stochastically dominate the MPC distribution of positive shocks, as suggested by the simulation results of our theoretical model shown in figures 2 and 3. Furthermore, in the case of positive income shocks, the MPC from relatively small (1-month) shocks should be greater than the MPC from relatively large (3-month) shocks.

In this section, we provide direct evidence supporting these predictions based on economic theory. We first present a quantile-quantile (Q-Q) plot which compares the MPC distributions for positive and negative income changes by plotting the quantiles of one distribution against those of the other. Specifically, in figure 10 the upper panel depicts the Q-Q plots of the MPC non-durables, and the lower panel depicts the MPCs corresponding to total consumption. In the left-hand side, we show the results for one-month income changes, and in the right-hand side the results for the three-month changes. In each graph, we also plot the 45-degree line.

Note first that in all four graphs, the plots are above the 45-degree line which implies that quantiles of the MPC distribution due to negative income changes are matched to smaller quantiles of the MPC distribution corresponding to positive income changes. In other words, the MPC distribution due to negative changes stochastically dominates the distribution due to positive changes. Note also that this stochastic dominance is larger for three-month than for one month changes. We consider these results as evidence that households with a high MPC are likely to be liquidity constrained.

We also provide formal evidence for the stochastic dominance of the MPC distribution from negative income changes over the corresponding distribution from positive changes, by performing Kolmogorov-Smirnov (K-S) tests of stochastic dominance. The K-S test has three parts: the first tests the hypothesis that the MPC distribution from a positive change dominates the distribution from a negative change (the null denotes no stochastic dominance); the second part tests the hypothesis that the MPC distribution from a negative change dominates the distribution from a positive change (again, the null denotes no stochastic dominance); and the third part tests the hypothesis that the two MPC distributions are equal.

The results of the test (shown in Table 6) are quite clear, as can be seen from the relevant p-values: the first test fails to reject the null, while the second and third tests strongly reject the null - and this applies to the MPC non-durables, durables, and total consumption, and for both one- and three-month changes. Hence, the K-S test results confirm the graphical results in figure 10, and suggest the existence of liquidity constrained consumers, especially in the top of the MPC distributions.

Finally, we provide further evidence that the MPC distributions are consistent with the presence of liquidity constraints by regressing the difference between the MPC in response to negative income changes and the MPC in response to positive changes (to ensure comparability, both MPCs take values ranging from 0 to 100). Notice that since each household reports both MPCs, by differencing we can control effectively for individual effects (such as preferences, or financial sophistication) which might affect both distributions. Table 7 reports separate results for one- and three-month changes, and for two definitions of consumption. The most interesting result is that the coefficients of the lower cash-on-hand quartiles are positive, indicating that the MPC in response to negative income changes has a stronger negative association with cash-on-hand than the MPC in response to positive changes, and thus tends to be larger at low levels of economic resources which is in line with the simulations in figures 2 and 3.

6. Robustness

To check the sensitivity of our results we perform various robustness checks. For reasons of space, we do not show all the results of these tests here but they are available upon request from the authors.

First, we add control variables to our mainline regression specification for non-durable consumption; we include two dummy variables for tertiary and secondary education, and some regional dummies. Their inclusion does not alter the results for the MPC non-durables (see table 8) or the MPC related to total consumption (see table 9). This applies also to the results for debt (available on request).

As a second check, we focus on those in the labor force, as they may experience different constraints and shocks to their resources (e.g., income and unemployment shocks) with respect to older individuals for whom health shocks, bequest motives, and survival risk play more important roles. Excluding households older than 60 makes our results for non-durables slightly stronger for the case of a three-month income decline and a corresponding increase, and slightly weaker for one-month declines. The results for the MPC related to total consumption are not affected, while the propensity to change debt payments is large and significant only for those in the bottom quartile of the cash-on-hand distribution.[5]

The third check is related to the possibility that respondents might find the questions difficult to understand because they might lack knowledge of basic economic concepts. To respond to this concern, we include in our specifications an indicator of financial literacy, derived from the responses to three financial literacy questions widely used in the literature.[6] We measure financial literacy using the number of correct answers to these three questions (i.e., this variable

[5] Meghir and Pistaferri (2010) show that in models with quadratic utility and a finite horizon the MPC with respect to transitory shocks only rises substantially after retirement age.

[6] These questions are widely used in the literature on financial sophistication, see Lusardi and Mitchell (2011). The first question is: "Suppose you had 100 euro in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow? (More than 102 / exactly 102 / less than $102)." The second question is: "Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account? (More than today / the same / less)." The third question is "Please tell me whether this statement is true or false: Buying a single company's stock usually provides a safer return than a stock mutual fund (True / false)."

takes values from zero to 3). We find that controlling for financial literacy does not affect our results in a significant way.

Given that a sizeable share of households in our sample report zero MPCs as figures 4-7 suggest, we examine whether our estimates are robust to censoring by running tobit regressions; our results are unaffected when taking account of censoring of our outcome variables.

Finally, we exclude from our estimation those households reporting responses equal to 50 percentage points which could indicate that they do not know how to respond to the question rather than giving a genuine response (see e.g. Fischhoff and Bruine de Bruin 1999). This reduces our estimation samples by 70 to 150 observations depending on the outcome variable. We find that the results do not change in any significant way after excluding the 50 percentage points answers.

7. Conclusions

We use Dutch survey data to characterize empirically the distribution of the MPC in response to unexpected transitory positive and negative income changes, and to check several predictions of intertemporal consumption models. We find that the consumption response to income shocks declines with economic resources, and that the MPC is smaller if consumers have relatively long horizons. Most importantly, we detect important asymmetries between the MPC in response to positive and negative income shocks. The main advantage of the survey questions is that they allow us to compare the responses to a hypothetical positive and negative income shock for the same household. Instead, in real situations the income shock is either positive or negative, and therefore, the results from comparing the consumption responses due to positive shocks to the consumption responses due to negative shocks reflect also the different characteristics of the households experiencing the shocks.

Our results are broadly in line with models of intertemporal choice with precautionary saving, borrowing constraints and finite horizons. The average MPC corresponding to non-durable consumption is in the range 15 to 25 percentage points, it is relatively larger for negative income shocks, it increases with age, and it is larger at low levels of economic resources. We find

also that the MPC distribution is in line with two of the predictions of models with liquidity constraints. Simple simulation analysis of a model with income risk and precautionary saving shows that in the presence of liquidity constraints the MPC in response to a negative income shock is larger than the MPC in response to a positive shock. Second, in the presence of liquidity constraints the size of the shock also matters. For large increases in income, consumers are more likely to overcome the constraint (and therefore, the MPC is lower than for small increases), while for large decreases the size of the shock should not matter, that is the MPC should be close to 1.

The results have important implications for predicting household responses to tax reforms and redistributive policies, and the potential responses of consumers to direct government (or central bank) money transfers in a low-interest rate environment. Thus, this paper contributes to the recent debate on "helicopter money" in the form of direct transfers to consumers.

Appendix. The simulated model

We assume that agents solve the following problem:

$$\max \sum_t \beta^t \frac{c_t^{1-\gamma}-1}{1-\gamma}$$
$$\text{s.t. } c_t + a_{t+1} \le y_t + a_t(1+r)$$
$$a_{t+1} \ge 0$$

We assume the following income process:

$$y_t = \exp(z_t + \varepsilon_t)$$
$$z_t = \rho z_{t-1} + \eta_t$$

where ε_t and η_t are i.i.d. normal processes with mean zero and respective standard deviations of σ_ε and σ_η. Let $c(a,z,\varepsilon)$ and $a'(a,z,\varepsilon)$ be the optimal decision rules. Normalizing income to 1, an increase (or decline) of ε_t of 10 percent ($\bar{\varepsilon}$=0.1) is akin to the one-month bonus or tax considered in the survey question. An increase (or decline) of ε_t of 30 percent ($\bar{\varepsilon}$=0.3) is akin to the three-month bonus or tax considered in the survey question.

From the budget constraint, we have that

$$\left(c(a,z,\bar{\varepsilon}) - c(a,z,0)\right) + \left(a'(a,z,\bar{\varepsilon}) - a'(a,z,0)\right) = \exp(z)\bar{\varepsilon}$$

Hence, the model's equivalent of the MPC can be obtained directly from the decision rule as:

$$MPC(a,z)^* = \frac{c(a,z,\bar{\varepsilon}) - c(a,z,0)}{\exp(z)\bar{\varepsilon}}$$

For calibration purposes, we use the following parameter values: r=0.04, β=0.95, γ=2, ρ=0.98, σ_ε=0.01, σ_η=0.03. These parameter configurations generate the MPC distributions shown in figures 2 and 3, normalizing cash-on-hand by the median income.

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Figure 1: The response of consumption with liquidity constraints

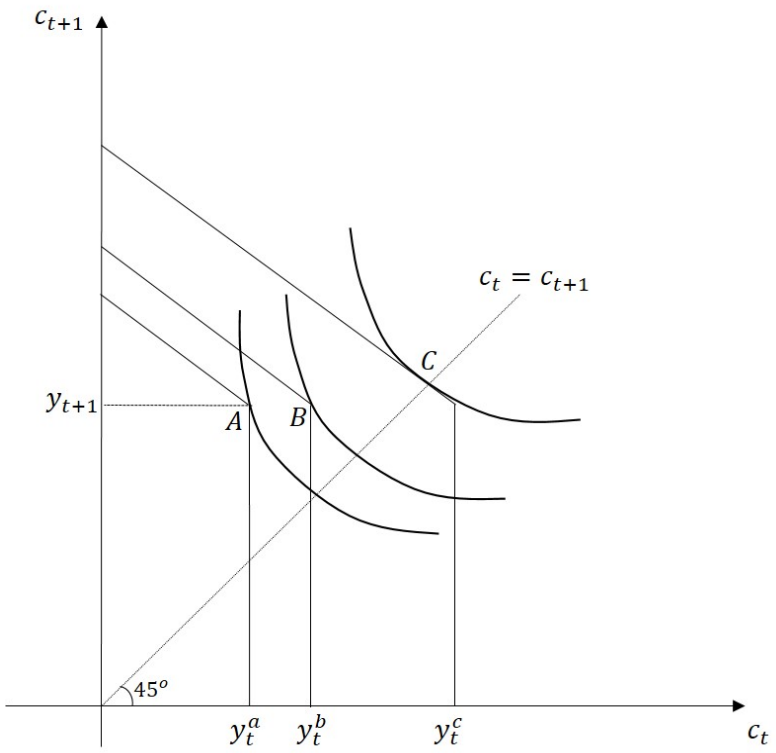


Figure 2. The response of consumption to positive income shocks

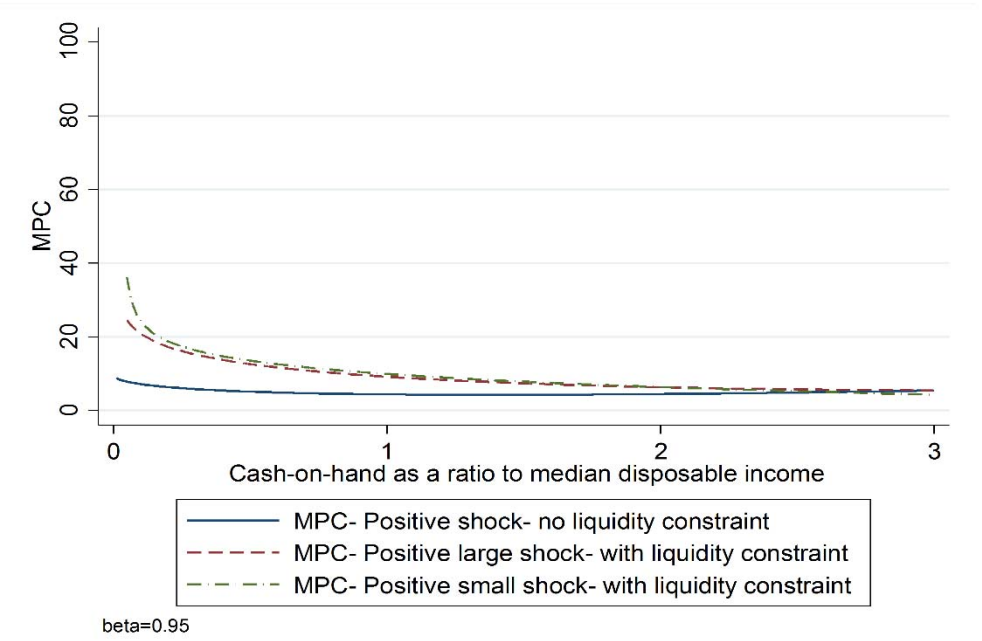


Figure 3. The response of consumption to negative income shocks

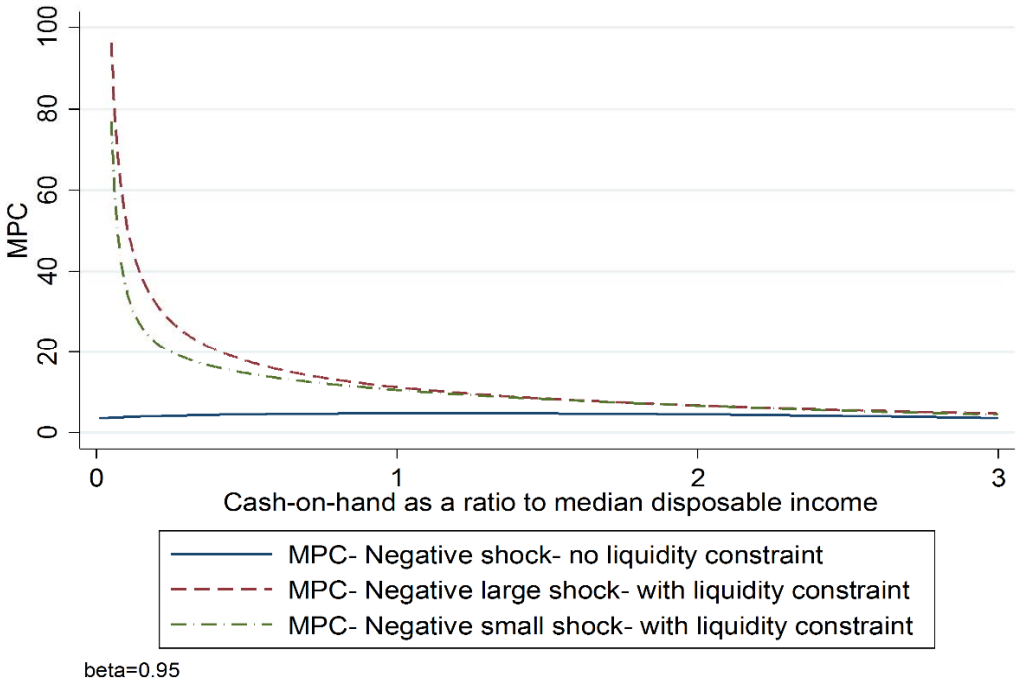


Figure 4. Non-durable consumption

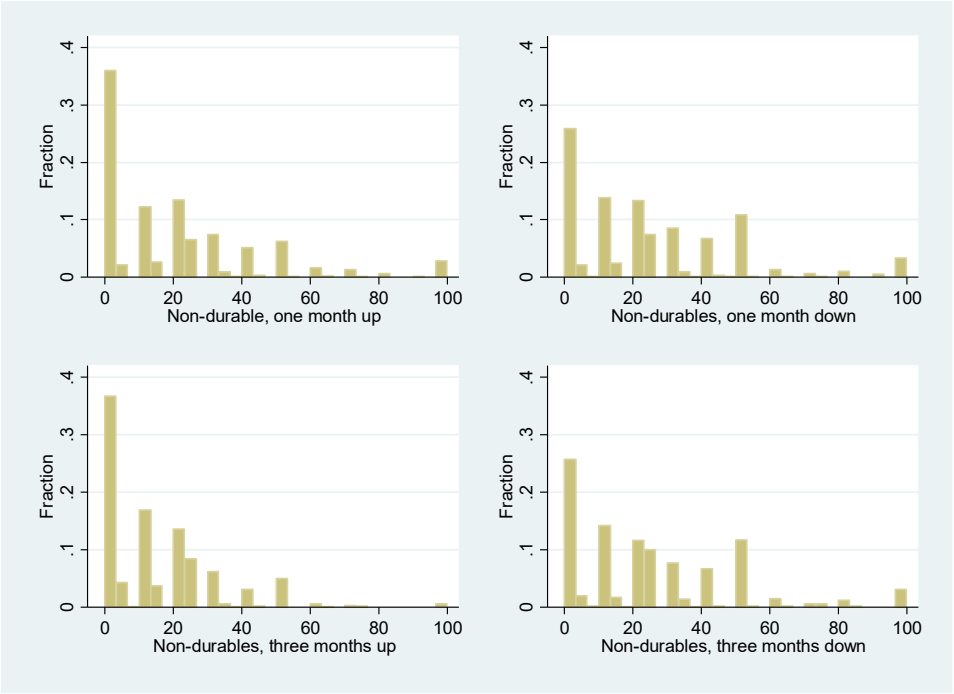


Figure 5. Durable consumption

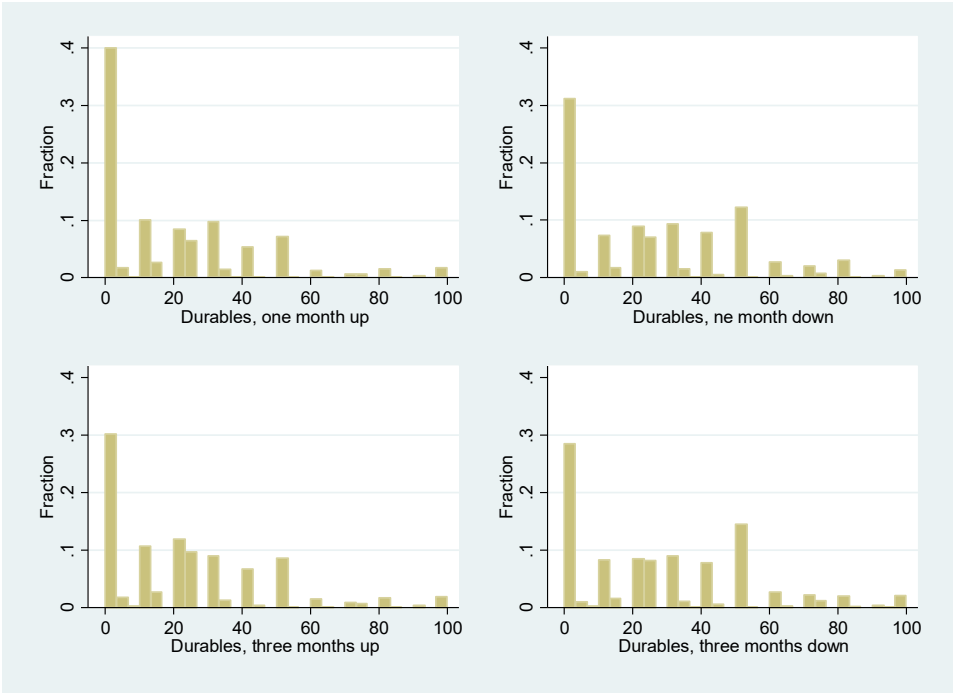


Figure 6. Total consumption

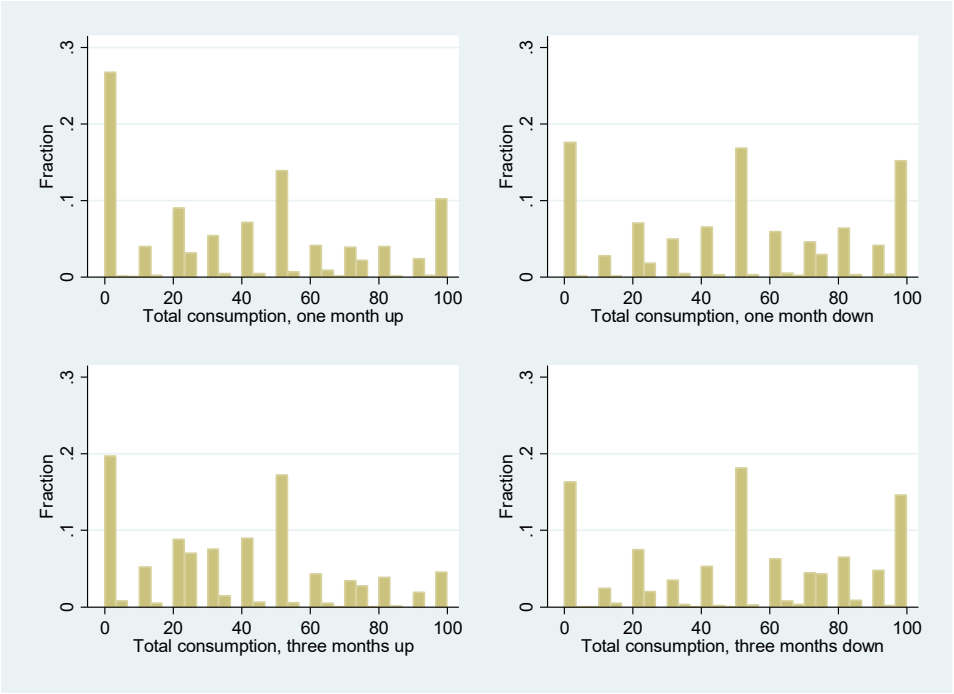


Figure 7. Debt

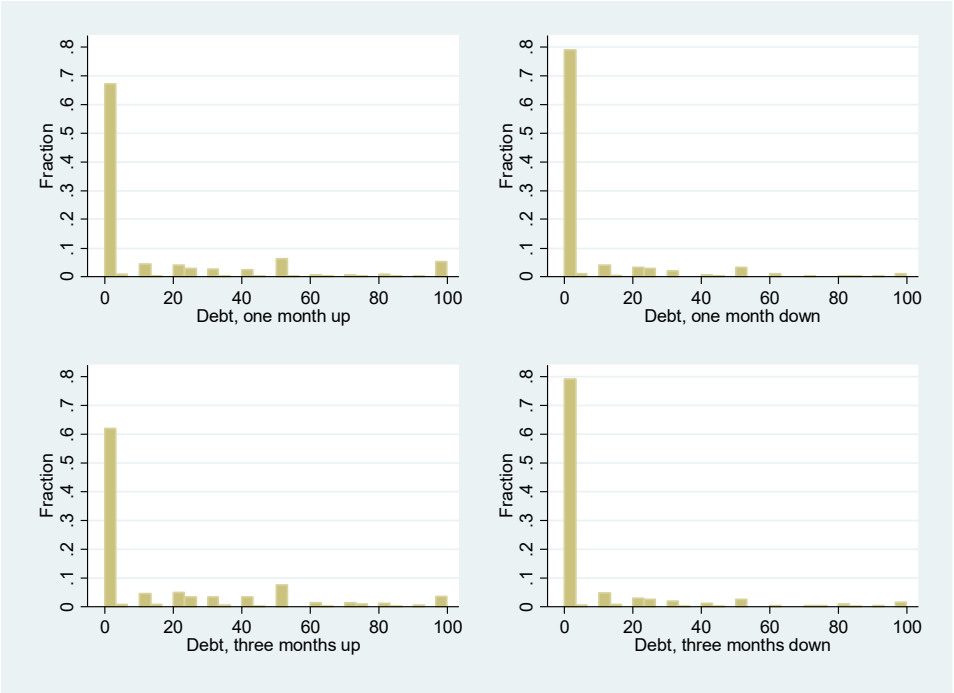
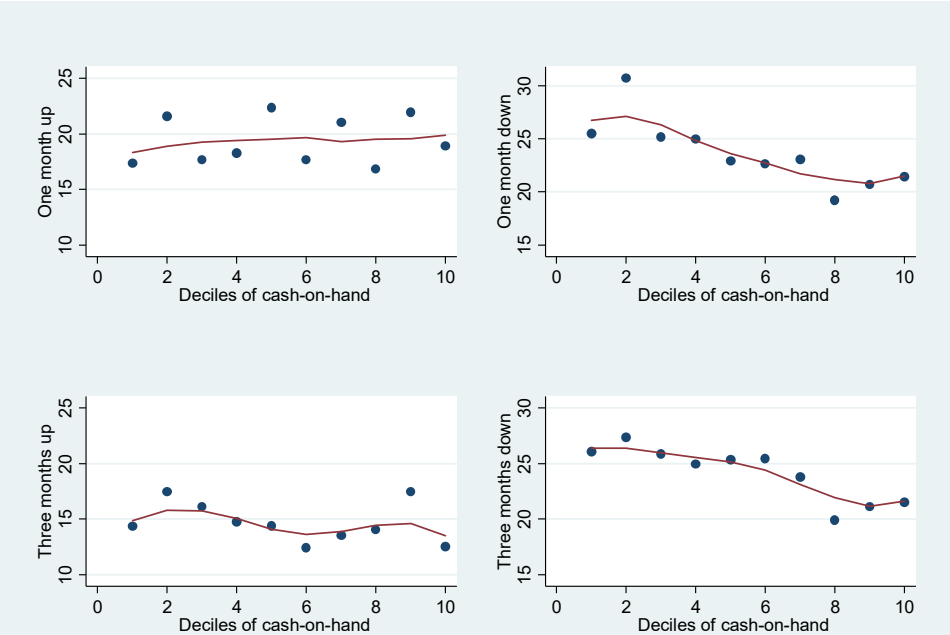
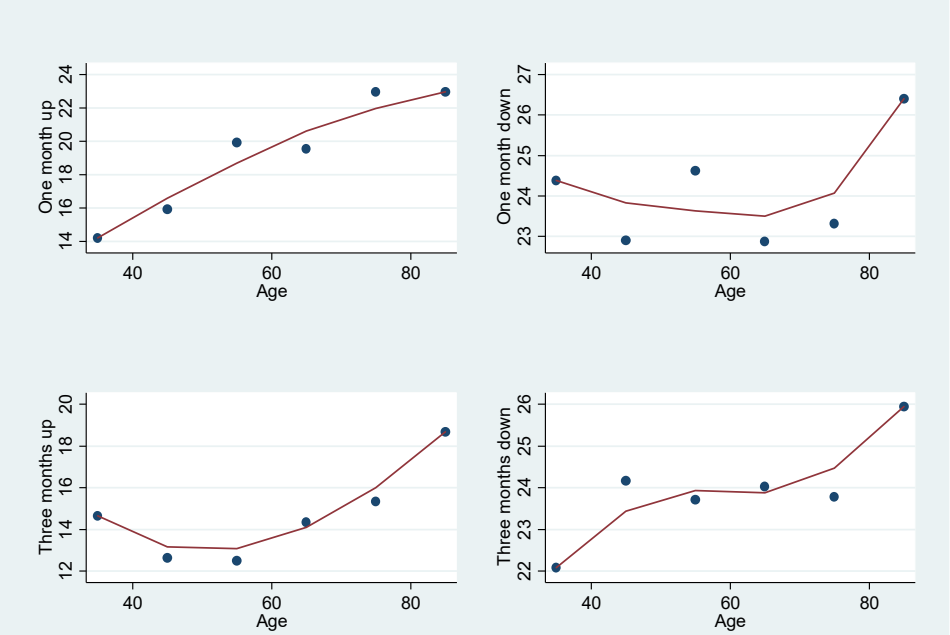


Figure 8. Non-durable consumption, by cash-on-hand deciles



Note: The line in each graph is derived using local weighted regression.

Figure 9. Non-durable consumption, by age



Note: The line in each graph is derived using local weighted regression.

Figure 10. Q-Q plot comparing MPC from positive and negative income shocks

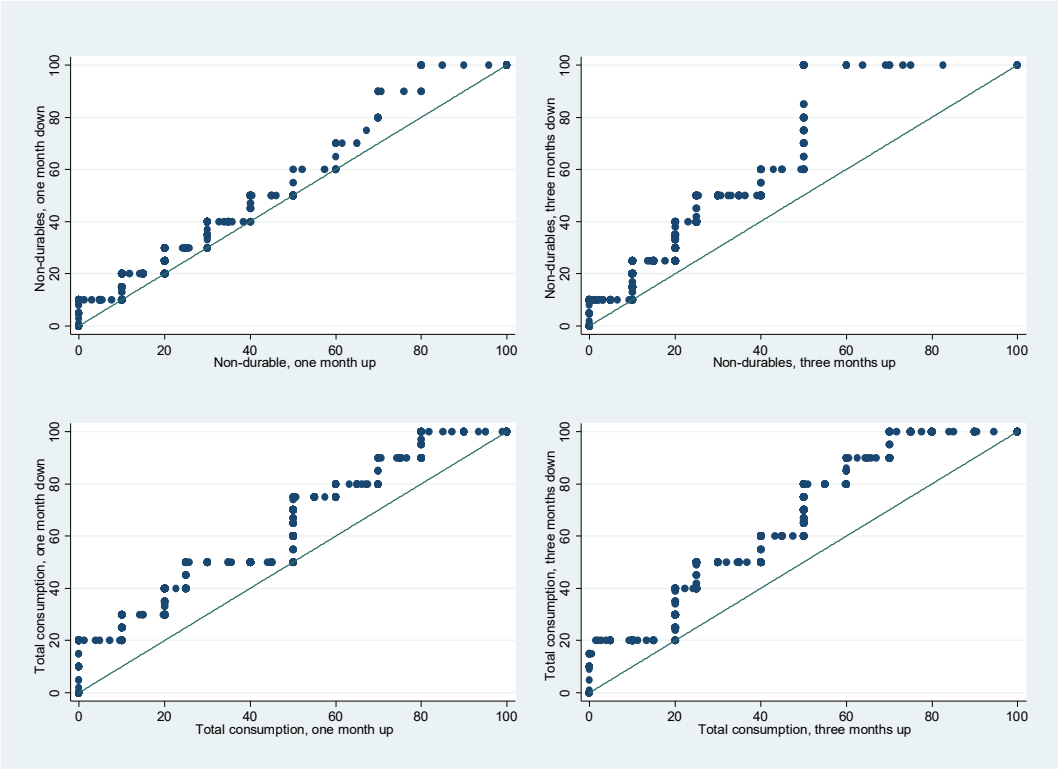


Table 1. Summary statistics

	Mean	*Median*	*S.d*	*N. of observations*
One-month income change				
Income increase				
Increase non-durable consumption	19.59	10	23.01	1,319
Increase durable expenditures	19.24	10	22.87	1,319
Reduce debt	14.71	0	27.33	1,319
Increase saving	46.45	50	34.63	1,319
Income decline				
Reduce non-durable consumption	23.75	20	23.93	1,268
Reduce durable expenditures	25.76	20	24.71	1,268
Increase debt	6.98	0	17.61	1,268
Reduce saving	43.5	40	33.97	1,268
Three-month income change				
Income increase				
Increase non-durable consumption	14.34	10	16.28	1,484
Increase durable expenditures	22.28	20	22.81	1,484
Reduce debt	16.24	0	26.54	1,484
Increase saving	46.96	50	30.51	1,484
Income decline				
Reduce non-durable consumption	23.97	20	23.57	1,358
Reduce durable expenditures	26.99	25	25.02	1,358
Increase debt	7.30	0	18.94	1,358
Reduce saving	41.74	40	33.43	1,358

Note. Mean and median refer to the percentage use of the income change.

Table 2. Sample statistics of variables used in the empirical analysis

Variable	*Mean*	*Standard deviation*	*N. of observations*
Age	56.75	14.57	1,543
Male	0.56	0.50	1,543
Family size	2.30	1.19	1,543
Cash-on-hand	45,798	107,756	1,385
College degree	0.40	0.49	1,543
High school degree	0.32	0.47	1,543
Unemployed	0.03	0.18	1,474
Financial literacy	2.31	0.90	1,434

Table 3. Regressions for the MPC on non-durable consumption

	One month down	*One month up*	*Three months down*	*Three months up*
Age<35	-3.095	-10.447	-5.499	-3.581
	(2.838)	(2.694)***	(2.673)**	(1.816)**
35<=Age<50	-2.760	-5.876	-3.352	-4.268
	(2.092)	(1.997)***	(2.004)*	(1.352)***
50<=Age<65	-3.276	-4.233	-1.817	-2.996
	(1.742)*	(1.661)**	(1.693)	(1.139)***
Male	-1.369	-2.895	-4.155	-2.871
	(1.446)	(1.371)**	(1.384)***	(0.929)***
Family size	0.244	-0.117	0.424	-0.446
	(0.680)	(0.631)	(0.627)	(0.422)
I cash-on-hand quartile	5.932	-0.796	6.487	1.383
	(2.048)***	(1.947)	(1.967)***	(1.313)
II cash-on-hand quartile	3.146	-1.068	4.453	0.116
	(1.968)	(1.882)	(1.895)**	(1.293)
III cash-on-hand quartile	0.876	-2.183	3.320	-2.287
	(1.927)	(1.838)	(1.872)*	(1.279)*
Constant	23.656	26.616	23.943	19.998
	(2.201)***	(2.097)***	(2.148)***	(1.440)***
R2	0.01	0.02	0.02	0.02
N	1,160	1,208	1,230	1,332

Note. Standard errors are reported in parenthesis. *, **, *** indicate significance level at 10%, 5%, and 1%, respectively.

Table 4. Regressions for the marginal propensity to change total consumption

	One month down	*One month up*	*Three months down*	*Three months up*
Age<35	-9.157	-9.494	-8.137	-4.054
	(4.028)**	(3.890)**	(3.782)**	(3.119)
35<=Age<50	-1.889	-6.462	-6.470	-4.381
	(2.969)	(2.884)**	(2.836)**	(2.322)*
50<=Age<65	-5.708	-6.591	-3.819	-4.587
	(2.473)**	(2.399)***	(2.396)	(1.957)**
Male	-4.059	-4.188	-7.269	-3.110
	(2.052)**	(1.980)**	(1.959)***	(1.597)*
Family size	0.046	-0.183	1.078	-1.426
	(0.965)	(0.911)	(0.887)	(0.724)**
I cash-on-hand quartile	6.775	-3.661	12.128	-2.536
	(2.907)**	(2.812)	(2.784)***	(2.255)
II cash-on-hand quartile	4.401	-4.025	10.100	0.060
	(2.793)	(2.718)	(2.682)***	(2.220)
III cash-on-hand quartile	4.039	-2.237	8.700	-1.742
	(2.735)	(2.654)	(2.649)***	(2.197)
Constant	51.254	49.080	49.147	46.354
	(3.125)***	(3.029)***	(3.039)***	(2.474)***
R2	0.01	0.02	0.03	0.02
N	1,160	1,208	1,230	1,332

Note. Standard errors are reported in parenthesis. *, **, *** indicate significance level at 10%, 5%, and 1%, respectively.

Table 5. Regressions for the marginal propensity to change debt

	One month down	*One month up*	*Three months down*	*Three months up*
Age<35	3.640	5.122	-0.201	1.097
	(2.056)*	(3.093)*	(2.073)	(2.838)
35<=Age<50	1.089	4.677	0.998	2.897
	(1.516)	(2.293)**	(1.554)	(2.113)
50<=Age<65	1.539	3.942	-0.118	3.378
	(1.263)	(1.907)**	(1.313)	(1.780)*
Male	2.450	3.495	1.709	4.010
	(1.048)**	(1.575)**	(1.074)	(1.453)***
Family size	0.667	0.608	0.666	1.746
	(0.492)	(0.724)	(0.486)	(0.659)***
I cash-on-hand quartile	12.166	14.576	11.432	15.744
	(1.484)***	(2.236)***	(1.526)***	(2.052)***
II cash-on-hand quartile	2.311	6.605	3.810	7.041
	(1.426)	(2.161)***	(1.470)***	(2.020)***
III cash-on-hand quartile	0.655	5.184	1.214	6.128
	(1.396)	(2.110)**	(1.452)	(1.999)***
Constant	-0.253	1.817	0.478	0.535
	(1.595)	(2.408)	(1.666)	(2.251)
R2	0.08	0.05	0.06	0.06
N	1,160	1,208	1,230	1,332

Note. Standard errors are reported in parenthesis. *, **, *** indicate significance level at 10%, 5%, and 1%, respectively.

Table 6. Kolmogorov-Smirnov (K-S) tests of stochastic dominance

	One-month change	*Three-month change*
	p-value	*p-value*
MPC on non-durables		
Up dominates Down	1.000	1.000
Down dominates Up	0.000	0.000
Equality of the two distributions	0.000	0.000
MPC on durables		
Up dominates Down	0.970	1.000
Down dominates Up	0.000	0.000
Equality of the two distributions	0.000	0.000
MPC on the sum of durables and non-durables		
Up dominates Down	1.000	1.000
Down dominates Up	0.000	0.000
Equality of the two distributions	0.000	0.000

Table 7. Regressions for the difference in the MPC between negative and positive income changes

	Non-durable consumption		*Total consumption*	
Age<35	7.722	-1.913	0.916	-3.478
	(3.234)**	(2.986)	(4.625)	(4.041)
35<=Age<50	3.704	0.837	4.871	-1.529
	(2.379)	(2.236)	(3.402)	(3.026)
50<=Age<65	1.404	1.465	1.130	1.843
	(1.982)	(1.896)	(2.835)	(2.567)
Male	1.543	-1.499	0.252	-4.610
	(1.642)	(1.544)	(2.348)	(2.090)**
Family size	0.308	0.881	0.186	2.391
	(0.769)	(0.698)	(1.099)	(0.944)**
I cash-on-hand quartile	6.009	5.029	9.016	13.311
	(2.327)***	(2.202)**	(3.327)***	(2.980)***
II cash-on-hand quartile	4.218	4.745	8.093	10.358
	(2.238)*	(2.119)**	(3.200)**	(2.868)***
III cash-on-hand quartile	2.197	6.018	5.323	10.425
	(2.191)	(2.095)***	(3.134)*	(2.836)***
Constant	-2.862	3.836	2.717	2.715
	(2.502)	(2.399)	(3.578)	(3.247)
R2	0.02	0.01	0.01	0.03
N	1,142	1,216	1,142	1,216

Note. Standard errors are reported in parenthesis. *, **, *** indicate significance level at 10%, 5%, and 1%, respectively.

Table 8. Regressions for the MPC on non-durable consumption: extended specification

	One month down	*One month up*	*Three months down*	*Three months up*
Age<35	-1.759	-9.435	-3.706	-2.386
	(2.975)	(2.830)***	(2.813)	(1.900)
35<=Age<50	-2.410	-4.944	-2.087	-3.297
	(2.183)	(2.085)**	(2.094)	(1.405)**
50<=Age<65	-3.202	-4.065	-1.346	-2.779
	(1.765)*	(1.683)**	(1.717)	(1.152)**
Male	-1.277	-2.736	-4.006	-2.746
	(1.464)	(1.391)**	(1.400)***	(0.937)***
Family size	0.363	0.122	0.546	-0.293
	(0.693)	(0.643)	(0.637)	(0.428)
I cash-on-hand quartile	5.405	-1.642	5.718	0.967
	(2.095)**	(1.996)	(2.021)***	(1.343)
II cash-on-hand quartile	2.724	-1.688	4.235	-0.184
	(2.005)	(1.923)	(1.931)**	(1.313)
III cash-on-hand quartile	0.440	-2.537	3.128	-2.451
	(1.950)	(1.859)	(1.890)*	(1.289)*
College	-2.818	-3.999	-3.444	-3.106
	(1.842)	(1.755)**	(1.778)*	(1.186)***
High school	-1.230	-3.101	-3.186	-3.154
	(1.908)	(1.810)*	(1.813)*	(1.206)***
Region 1	3.466	4.526	1.960	3.772
	(2.314)	(2.208)**	(2.212)	(1.488)**
Region 2	2.069	1.886	2.140	0.942
	(1.917)	(1.820)	(1.833)	(1.237)
Region 3	-0.461	-0.139	-2.579	-1.625
	(2.457)	(2.327)	(2.358)	(1.573)
Region 4	1.860	1.664	1.368	0.415
	(2.119)	(2.014)	(2.011)	(1.353)
Constant	23.702	27.222	24.850	20.997
	(2.682)***	(2.547)***	(2.606)***	(1.742)***
R2	0.02	0.03	0.03	0.04
N	1,147	1,196	1,219	1,318

Note. Standard errors are reported in parenthesis. *, **, *** indicate significance level at 10%, 5%, and 1%, respectively.

Table 9. Regressions for the MPC on total consumption: extended specification

	One month down	*One month up*	*Three months down*	*Three months up*
Age<35	-9.274	-8.765	-5.795	-4.787
	(4.235)**	(4.078)**	(3.971)	(3.264)
35<=Age<50	-2.769	-5.543	-5.773	-4.321
	(3.107)	(3.004)*	(2.956)*	(2.413)*
50<=Age<65	-5.854	-6.238	-3.644	-4.639
	(2.513)**	(2.426)**	(2.424)	(1.979)**
Male	-4.042	-4.173	-7.147	-3.299
	(2.084)*	(2.004)**	(1.976)***	(1.610)**
Family size	0.165	-0.104	1.184	-1.379
	(0.986)	(0.926)	(0.900)	(0.735)*
I cash-on-hand quartile	6.742	-4.171	10.527	-1.793
	(2.983)**	(2.876)	(2.853)***	(2.308)
II cash-on-hand quartile	4.382	-4.223	8.979	0.691
	(2.854)	(2.771)	(2.726)***	(2.256)
III cash-on-hand quartile	3.565	-2.970	7.928	-1.846
	(2.777)	(2.678)	(2.669)***	(2.215)
College	-0.179	-3.735	-5.282	0.921
	(2.622)	(2.529)	(2.510)**	(2.037)
High school	-0.946	-5.446	-1.412	-2.839
	(2.716)	(2.607)**	(2.559)	(2.071)
Region 1	4.579	5.870	4.875	4.658
	(3.295)	(3.182)*	(3.123)	(2.556)*
Region 2	3.219	3.974	4.741	2.136
	(2.730)	(2.622)	(2.588)*	(2.125)
Region 3	4.419	0.920	0.874	-1.675
	(3.498)	(3.353)	(3.329)	(2.703)
Region 4	3.237	3.505	-1.280	1.892
	(3.017)	(2.901)	(2.839)	(2.325)
Constant	49.022	49.296	49.889	45.222
	(3.818)***	(3.670)***	(3.678)***	(2.993)***
R2	0.02	0.02	0.04	0.03
N	1,147	1,196	1,219	1,318

Note. Standard errors are reported in parenthesis. *, **, *** indicate significance level at 10%, 5%, and 1%, respectively.