

Mental Accounts and Consumption Sensitivity Across the Distribution of Liquid Assets

ONLINE APPENDIX

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A. Data Appendix

In this paper we utilize household-level bank account and transaction data obtained from a large, American financial institution. This section of the Appendix provides data details, our classification and categorization procedures, and further comparisons of the financial institution data to external data sources.

A.1. Identification of Accounts and Account Holders

We utilize an administrative dataset of de-identified household bank accounts and transactions obtained from a large, American financial institution. The complete dataset consists of a panel of 17.2 million U.S. households with active checking accounts over the period 2012 to 2019. We aggregate individual accounts to the primary account holder level and restrict our analysis to primary account holders of working age, 24 to 64. To ensure that we observe the main checking account of a household, we restrict our sample to those with at least five deposit account outflows in each month of a given calendar year.

We compare the number of observed accounts for each household in our dataset to information provided by the 2016 Survey of Consumer Payment Choice (SCPC) (Federal Reserve Bank of Atlanta, 2016). The SCPC asks how many unique checking and savings accounts are held by each consumer. Table A.1 compares the frequencies of different numbers of accounts, conditional on observing at least one checking account. Our transaction data understates both the number of checking and savings accounts held by each consumer. However, the 2016 SCPC also reports that the median account balance in secondary checking accounts is \$0, while the 75th percentile of secondary checking account balances is just \$100. This suggests that primary accounts capture most or all of households’ day-to-day financial activity.

Table A.1: Number of Banking Accounts

	Checking			Savings			
	1	2	3+	0	1	2	3+
SCPC	0.594	0.204	0.076	0.274	0.419	0.176	0.095
BANK	0.879	0.107	0.014	0.610	0.345	0.039	0.012

Source: Authors’ calculations using financial institution data and Survey of Consumer Payment Choice.

A.2. Transactions and Expenditure

For each household in our dataset we observe high frequency transactions associated with their accounts. Using the meta-data associated with these transactions, we first categorize expenditures in accordance with the National Income and Product Accounts Handbook (NIPA) (U.S. Bureau of Economic Analysis, 2023).¹ Expenditures include credit, debit, and deposit outflows categorized according to Merchant Category Codes (MCCs), attributed to the time of purchase. We classify expenditures as follows:

¹See also <https://www.bea.gov/sites/default/files/methodologies/nipa-handbook-all-chapters.pdf>.

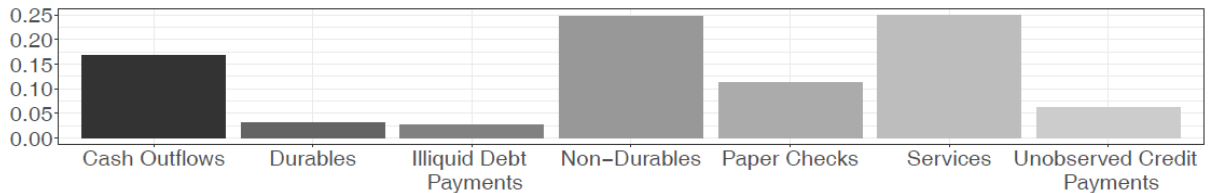
- *Total Expenditure* (e): All account (credit and deposit) outflows excluding account transfers, plus credit card balance payments for which card purchases are observable.

Additionally, we decompose total expenditures into the following sub-categories:

- *Total Non-Durables* (e_{nd}): Groceries, entertainment, fuel, discount and drug stores, direct market catalogs, or services such as utilities, telecommunications, insurance, health expenses, other bills, food services, travel services and other personal and professional services.
- *Non-Durables Goods* (e_{ndg}): Groceries, entertainment, fuel, discount and drug stores, direct market catalogs.
- *Services* (e_s): Education, healthcare, travel, telecommunications, utilities, housing, rent, other bills, financial services, personal or professional services, and food services.
- *Durables* (e_d): Auto purchases, repairs, and parts; healthcare equipment; home improvement goods and appliances.
- *Illiquid Debt Payments* (e_b): student loans, auto loans.

Our data also includes unclassified paper checks, cash outflows, and payments to unobserved credit card accounts. Figure A.1 shows that these unclassified spending categories make up around one third of average monthly total expenditure. In order to allocate this unclassified spending to the observed spending categories in our main empirical analysis, we use a simple imputation procedure as discussed in Section B.2.

Figure A.1: Monthly Shares of Household Outflows



Source: Authors' calculations using financial institution data.

A.3. Incomes

Income inflows in the transactions data is classified as follows

- *Categorized Income*: Labor income (direct deposit and payroll), tax refunds, social security payments, unemployment insurance, investment income.
- *Total Income*: Categorized income plus paper checks and cash deposits.

Around 73 percent of income in the transaction data is categorized by its reported source (e.g. payroll, social security, unemployment insurance, etc.). The remaining income inflows are from paper checks (11 percent), cash (2.5 percent), and bank-to-bank (i.e. ACH) deposits and miscellaneous inflows.

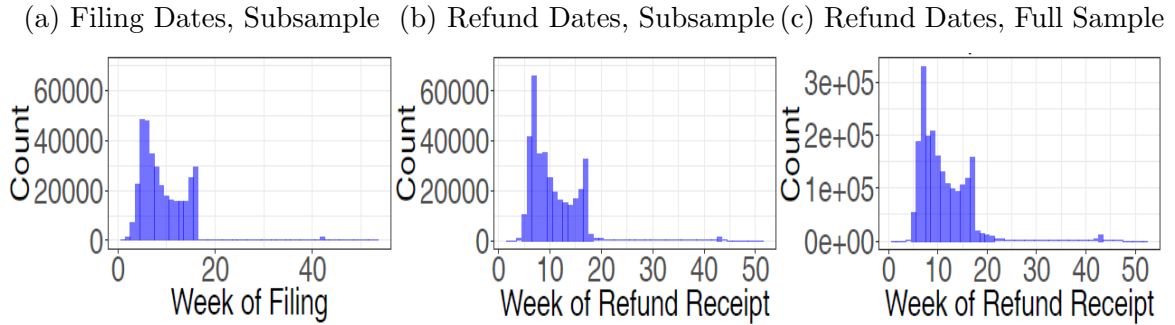
A.4. Tax Refunds and Tax Filing Dates

Tax refunds are identified from transactions to which either a state treasury or the U.S. Department of the Treasury is the counter-party. Since counter-party identification is necessary for transaction identification, individuals reconciling their taxes via paper check are not included in our analysis. For the population receiving refunds, this does not appear to be overly restrictive. In 2018 the IRS reports that around 80% of refunds are paid via direct deposit. However, direct deposit refunds are about 29 percent larger than those returned via paper check.²

Tax filing dates are identified from the first payment of the calendar year that a household makes to either a brick and mortar or online tax service provider. These filing dates are identified for roughly 17.3 percent of households with observed tax refund activity. Figure A.2 shows that the distribution of tax refund dates for this subsample is very similar to the broader population of tax refund recipients.

Panel (c) of A.2 shows that around 50 percent of refunds are received by the end of week 10 (early March), while an additional 13 percent are clustered in the two weeks around the filing deadline. The timing of refund arrival is due to variation in processing times within and across counter-parties, whereas variation in tax payments is driven by individual choices subject to IRS filing deadlines.

Figure A.2: Distributions of Filing Dates and Refund Receipt Dates



Source: Authors' calculations using financial institution data.

We benchmark tax refunds and payments in our dataset with data from the Internal Revenue Service (IRS) (Internal Revenue Service, 2017). Table A.2 shows that average federal tax returns are similar to those in the IRS data, while state and local tax returns are somewhat lower. Tax payments are substantially lower in our data compared to the IRS.

²Direct deposit average refund size is \$3031. Paper check average refund is \$2355. See the 2018 Filing Season Statistics: <https://www.irs.gov/newsroom/filing-season-statistics-for-week-ending-november-23-2018>.

Table A.2: Comparison of Household Incomes Across Data Sources

	Income	Federal Tax Refund	State/Local Tax Refund	Federal Tax Payment
IRS	5776	2950	1608	5371
BANK	5949	2845	1218	1592

Note: Income comparisons using monthly averages from data in 2016.

Source: Authors' calculations using financial institution data, CEX, and IRS.

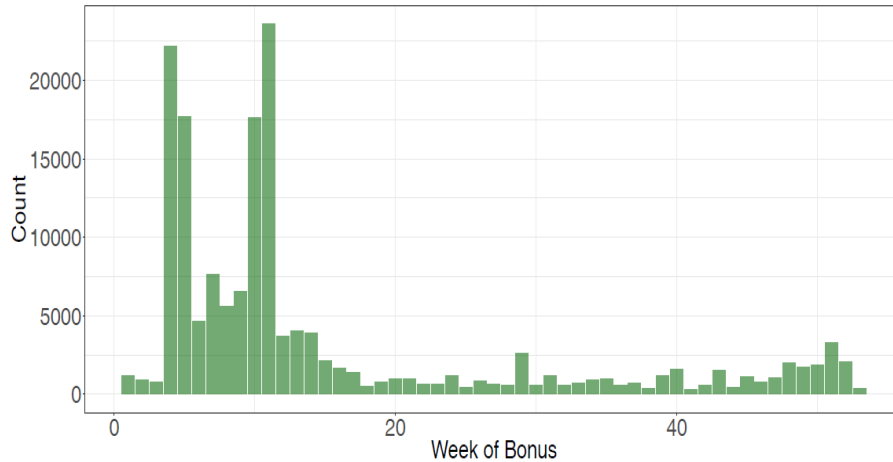
A.5. Bonus Checks

Bonus checks can be identified for a subsample of households in the dataset. Note that employers may combine bonuses with regular pay checks or they may process bonuses separately. It is difficult to separately identify bonus checks folded into regular pay checks that may themselves vary from pay-to-pay. Instead, we restrict attention to large, separate bonus checks.

We first restrict to a subsample of households receiving 90 percent of their paychecks 13 to 17 days apart. We then characterize bonus checks as payments of a certain size received from a household's employer and arriving outside of the regular pay window. We restrict these bonus checks to be at least as big as a household's average paycheck plus the larger of \$100 or a standard deviation of the household's paychecks. We further restrict our subsample to households receiving no more than two such payments in a given calendar year. Our final subsample contains 163,000 households.

Figure A.3 shows that most bonus checks arrive early in the year, many shortly before March 15 which is the federal deadline for companies deducting bonuses from prior year earnings, otherwise known as 409A Day.

Figure A.3: Timing of Bonus Check Receipts



Source: Authors' calculations using financial institution data.

Table A.3 compares summary statistics for households in our broader sample of tax refund recipients and households in our smaller sample of bonus check recipients. As might be expected, bonus check recipients earn more and are wealthier than households in the broader sample. Additionally, the median bonus check is a relatively large payment

of \$5733, which is 93 percent of median monthly income, around 5 times larger than the median tax refund, and is 116 percent of median liquid asset balances.

Table A.3: Summary Statistics for Tax Refund and Bonus Check Recipients

	Mean	25 th	Median	75 th
<i>Panel (a):</i> Sample of tax refund recipients				
Total income	5259	2425	3868	6245
Total liquid assets	7279	581	1828	5699
Expenditure	4949	2323	3677	5882
Tax Refund	2072	360	1120	2993
<i>Panel (b):</i> Sample of bonus check recipients				
Total income	8246	4207	6182	9396
Total liquid assets	12690	2024	4930	13609
Expenditure	8306	4042	6237	9626
Tax Refund	2818	582	1170	3906
Bonus Check	11445	3290	5733	10802

Source: Authors' calculations using financial institution data.

A.6. Assets

Balance sheet variables in the transactions data are classified as follows

- *Transaction Account Balances:* The sum of checking and savings account balances.
- *Total Liquid Balances:* Transaction account balances plus observable brokerage, money market, and certificates of deposit.

Further, inflows and outflows from transaction accounts are completed by defining transfers to illiquid savings accounts and unobserved demand deposit accounts.

While checking and savings accounts are perfectly fungible (money can be transferred immediately between these accounts within the bank), money market and brokerage account transfers operate on some delay (usually one to two business days), while liquidations of retirement accounts and certificates of deposit often entail some cost. Despite these small differences in liquidity across asset classes, we maintain our definition *Total Liquid Balances* throughout our analysis.

We compare transaction account balances in our dataset to the SCF and the SCPC in 2016 (Board of Governors of the Federal Reserve System, 2016; Federal Reserve Bank of Atlanta, 2016). While the SCF measures the total dollar value of accounts held across a household's members, the SCPC asks respondents to exclude accounts exclusively held by spouses or partners and represents the sum of primary and secondary checking accounts. Table A.4 shows that the transaction data substantially understates total liquid balances available to households, but tracks each of checking and savings accounts reasonably closely. The understatement of total liquid assets appears to be more pronounced at higher levels of liquid assets.

Table A.4: Comparison of Liquid Assets Across Data Sources

	Checking			Savings			Liquid Balances			Credit Cards		
	25 th	Median	75 th	25 th	Median	75 th	25 th	Median	75 th	25 th	Median	75 th
SCF	308	1850	6167	0	37	6044	987	4687	19734	0	0	2590
SCPC	150	817	2864	—	—	—	—	—	—	0	0	1900
BANK	338	1251	3687	0	0	300	459	1796	6182	0	0	0

Note: All comparisons made using data from 2016. Liquid balance measures include checking, savings, money market, brokerage accounts, and certificates of deposit (retirement account balances are excluded).
Source: Authors' calculations using financial institution data, Survey of Consumer Finances, and Survey of Consumer Payment Choice.

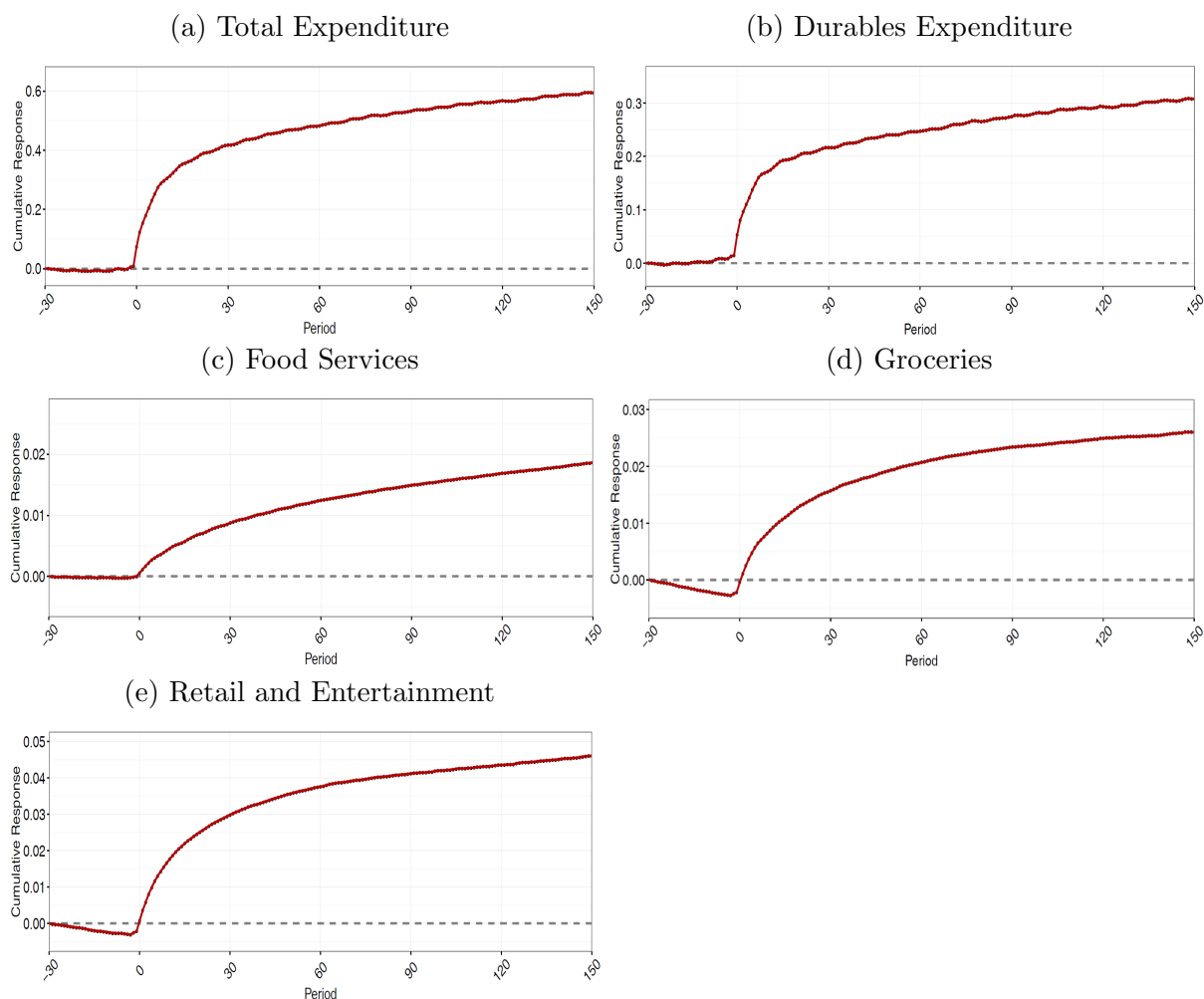
B. Empirical Analysis Appendix

B.1. Expenditure Responses Across Spending Categories

In this section we show that the patterns of expenditure responses to income receipt are similar across all categories of expenditure.

Figure B.1 illustrates the responses of total expenditure, durables expenditure, food services expenditure, groceries expenditure, and retail and entertainment expenditure. First, for each category there is effectively no anticipated spending response to future tax refunds. Note that Panels (d) and (e) appear to show a reduction in spending on groceries and retail and entertainment categories prior to refund receipt, however these reductions are small at less than one third of 1 percent. Second, for each category there is significant front-loading of expenditure to the date of tax refund. Panels (a), (b), (d), and (e) show that 60–70 percent of total, durables, grocery, and retail expenditures occur within the first 30 days after receipt. The only exception is Panel (c), which shows that only around 45 percent of food services spending occurs within the first 30 days.

Figure B.1: Expenditure Responses to Tax Refunds Across Spending Categories



Source: Authors' calculations using financial institution data.

B.2. Partial Imputation of Non-Durables Expenditure

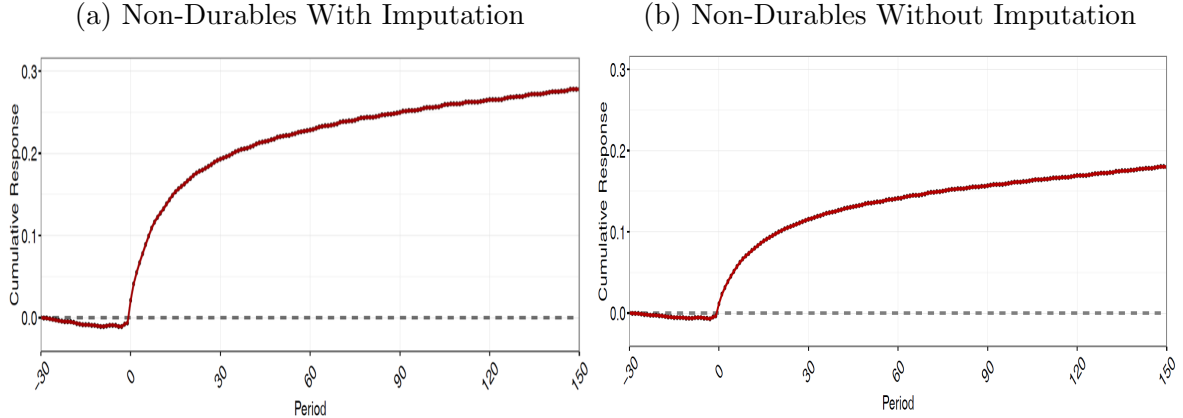
As noted in Section A.2, around one third of all expenditures are unclassified due to the use of paper checks, cash withdrawals, and payments to unobserved credit cards. Rather than discard this information, we use an imputation procedure to allocate a proportion of this spending to non-durables expenditure.

For an individual household i define: e_i as total identified and unidentified expenditures; e_i^{nd} as identified non-durable spending; and e_i^{uc} as unidentified spending due to cash withdrawals, unclassified checks, and payments to unobserved credit cards. Then for individuals i in a population q (e.g. the set of all households, or the subset of those in a particular quantile of the liquid wealth distribution), $\xi_q \equiv \frac{1}{N_q} \sum_{i=1}^{N_q} \frac{e_{i,q}^{nd}}{e_{i,q} - e_{i,q}^{uc}}$ is the average non-durable expenditure share among identified expenditures.

Following our empirical strategy in Section 3.1 of the main paper, we estimate spending responses to income receipts separately for e_i^{nd} and e_i^{uc} . We then construct the total non-durable response to an income receipt by allocating a fraction ξ_q of the unidentified expenditure response to the total non-durable response. The average expenditure shares ξ_q are computed for the relevant populations q using data from the month prior to income receipt.

Our imputation procedure relies on two plausible assumptions. First, the true non-durables share of unidentified spending should be similar to the identified non-durables share ξ_q . Similar to the spending shares in Figure B.2, the 2018 Survey of Consumer Payment Choice (SCPC) reports that around 40 percent of cash and paper check transactions and 36 percent of payment card transactions are allocated towards retail goods, respectively.³ Second, the composition of unclassified spending should not change around the date of income receipt. We discuss this assumption further in Section B.3 below.

Figure B.2: Non-Durable Expenditure Responses With and Without Imputation



Source: Authors' calculations using financial institution data.

Figure B.2 compares the non-durables expenditure response to a tax refund using our imputation procedure (Panel (a)) and without the imputation procedure (Panel (b)). First, note that the shape of spending response is essentially the same with or without imputation. Households do not spend in anticipation of tax refund receipts, and households front-load expenditure with respect to the date of tax refund receipt. Second, the magnitude of spending response is around 30 percent smaller for non-imputed non-durables.

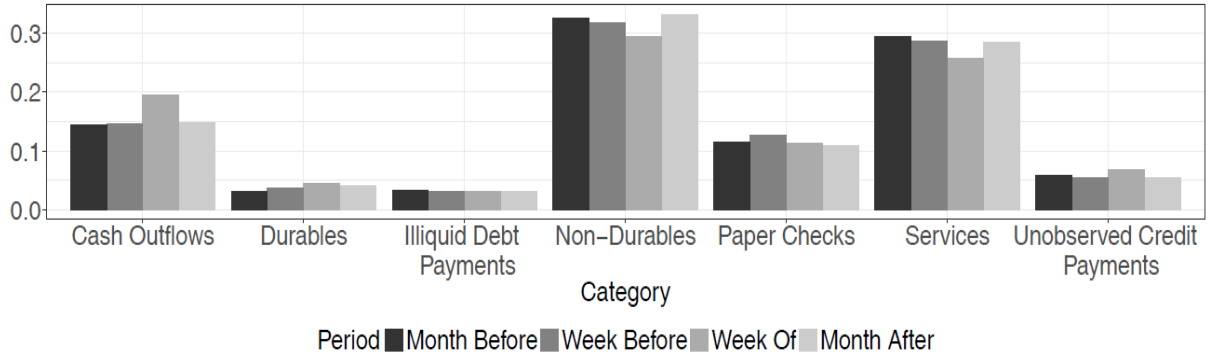
³See Table D in Foster, Greene, and Stavins (2019).

This simply reflects the exclusion of unclassified spending categories, which themselves make up around one third of total spending (again, see Figure A.1).

B.3. Expenditure Composition around Refund Receipt

In this section we examine the average expenditure shares by consumption category around the date of tax refund receipt. As we show, these expenditure shares do not change substantially around tax refund, which helps to alleviate concerns about the use of our imputation procedure (see Section B.2).

Figure B.3: Expenditure Shares Around Date of Tax Refund Receipt

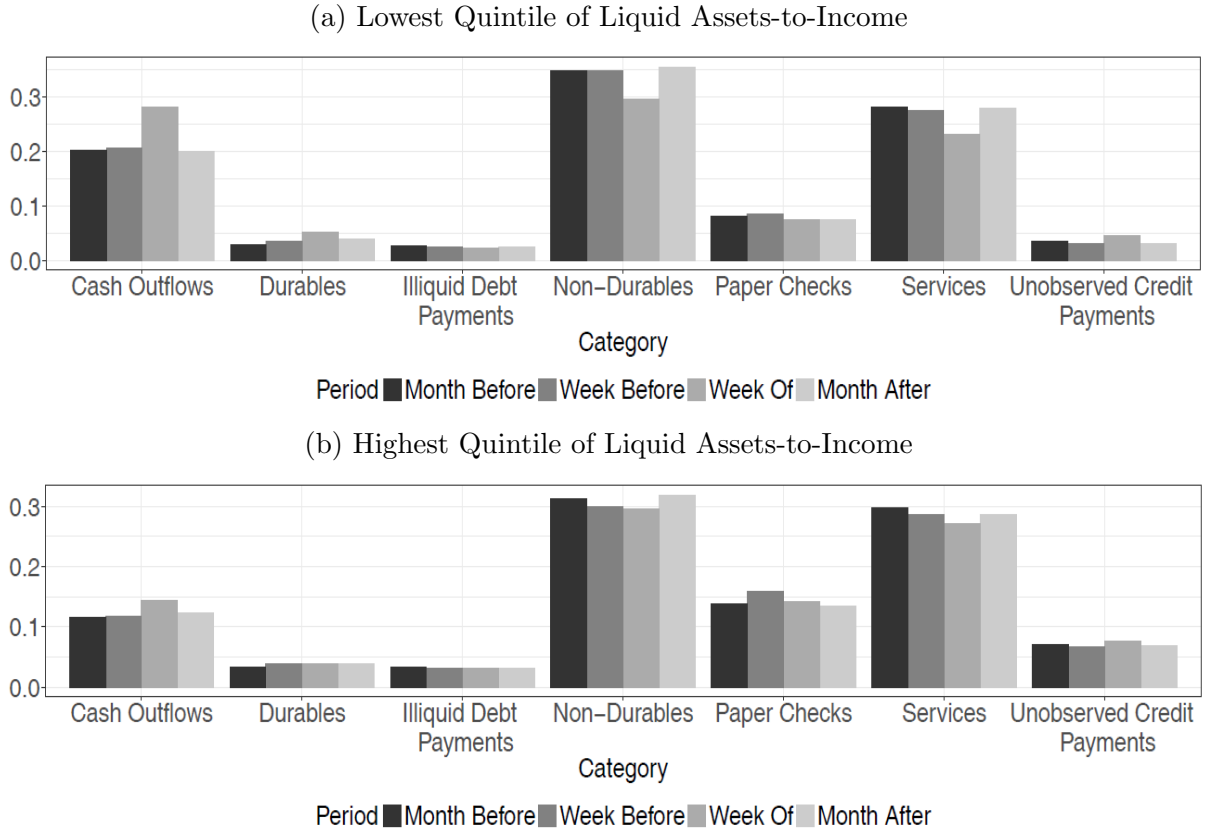


Source: Authors' calculations using financial institution data.

Figure B.3 shows that there is no change in expenditure composition in the week prior to tax refund receipt. In the week of the tax refund receipt, the cash outflow share increases by 5 percentage points and the spending share on durable goods rises. However, the bulk of the compensating response comes through a fall in services spending and thus total non-durables expenditure which includes services (i.e. e_{nd}). We expect that much of the increase in cash withdrawals is spent on non-durables and services, reflecting substitution within those categories but from classified to unclassified spending. In any case, the overall changes in spending shares change are small.

Figures B.4 illustrates changes in the composition of expenditure for households in the lowest and highest quintiles of the liquid assets-to-income distribution. The patterns are very similar to those shown in B.3, however we find that the shift to cash is more pronounced among low wealth households and is more muted among high wealth households.

Figure B.4: Expenditure Shares Around Date of Tax Refund Receipt by Liquidity



Source: Authors' calculations using financial institution data.

B.4. Expenditure Responses to Multiple Tax Refund Receipts

In this section we analyze expenditure responses to tax refunds among those households receiving both state and federal refunds in the same year. This subsample consists of around 700,000 households. In our data, both refunds are significant in magnitude: the average federal refund is \$2845 and the average state refund is \$1218. On average, the two refunds arrive within ten days of one another.

In order to estimate responses to multiple refund events we modify the regression specification from Equation (1) of the main paper. We now estimate the following specification

$$Y_{i,t} = \alpha_i + \lambda_t + \sum_{j=-30}^{150} \delta_j FirstRefund_{i,t+j} + \sum_{j=-30}^{150} \gamma_j SecondRefund_{i,t+j} + \epsilon_{i,t} \quad (B.1)$$

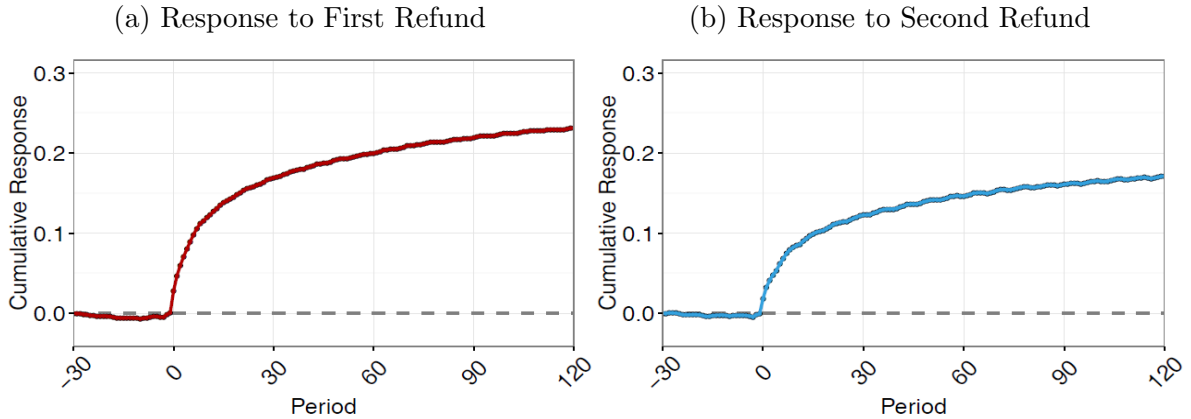
where δ_j are the spending responses to the first tax refund received and γ_j are the spending responses to the second tax refund received. Identification of the spending responses follows the same arguments laid out in Section 3.1 of the main paper. Now, however, we also rely on variation across households in the timing between receipt of the first and second refunds.

Figure B.5 reports the spending responses to the first and second tax refunds. Panel (a) of Figure B.5 is very similar to the results reported in Figure 3 of the main paper for households receiving just one refund. In both estimates, households do not spend in

advance of refund receipt and display significant front-loading of spending with respect to date of refund receipt. Note, however, that the size of spending response is slightly smaller for first refunds among households receiving two refunds. At 30 days, the MPC is 0.19 for single refund recipients (Figure 3) and 0.17 for double refund recipients (Panel (a) of Figure B.5).

Panel (b) of Figure B.5 reports the spending response to second refunds. Once again we find that households do not spend in advance of refund receipt and display significant front-loading of spending with respect to date of refund receipt. However, the size of response to second refunds (Panel (b)) is around 30 percent smaller than the response first refunds (Panel (a)).

Figure B.5: Non-Durable Expenditure Response to Multiple Tax Refunds



Source: Authors' calculations using financial institution data.

B.5. Expenditure Responses to Tax Filing Dates

In this section we analyze expenditure responses to both tax refunds and tax filing dates. The salience of tax filing events for our analysis is due to both the resolution of uncertainty about tax refunds or payments at filing date, and the allocation of attention to incoming tax refunds after this information is known. While the date of tax refund receipt is the source of some uncertainty given variation in processing times and the risk of errors in a household's return, the date of tax filing is known, and indeed chosen, by each household.

Our estimates for this exercise make use of the much smaller sample of households for whom we can identify tax filing dates (see Section A.4). Table B.1 reports summary statistics for our broader sample of tax refund recipients and for our smaller sample with identified tax filing dates. The two samples are similar across income and liquid balances, however the sample with identified filing dates have somewhat smaller first and second tax refund sizes.

In order to estimate responses to tax filing dates and refund events we modify the regression specification from Equation (1) of the main paper. We now estimate the

Table B.1: Summary Statistics for Tax Refund Recipients and Those With Identifiable Filing Dates

	Tax Refund Recipients				Subsample with Filing Dates			
	Mean	25 th	Median	75 th	Mean	25 th	Median	75 th
Income	5259	2425	3868	6245	5329	2624	4088	6389
Liquid Balances	7279	581	1828	5699	7458	815	2292	6366
First Tax Refund	2072	360	1120	2993	1904	338	1038	2661
Second Tax Refund	2057	317	937	2666	1753	292	829	2157

Source: Authors' calculations using financial institution data

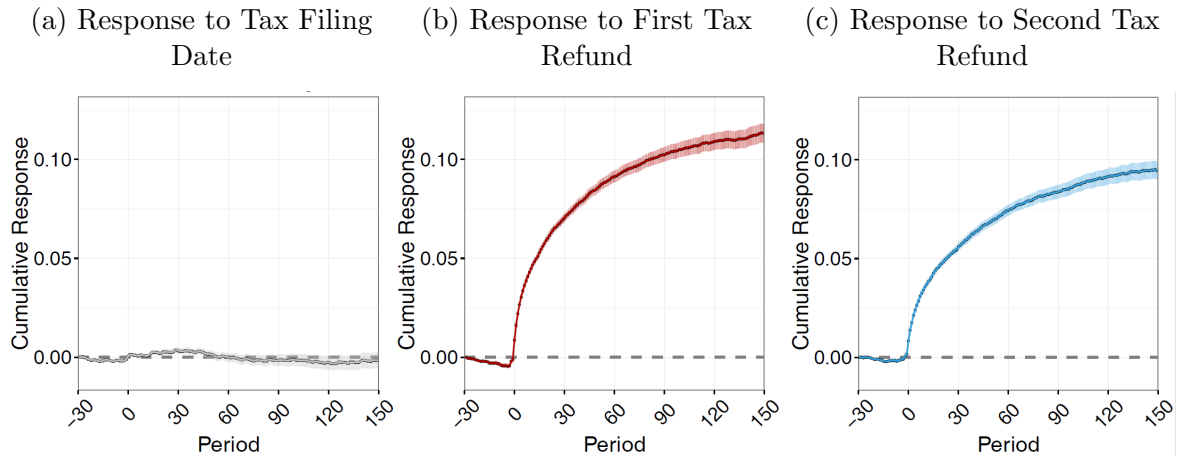
following specification

$$\begin{aligned}
Y_{i,t} = & \alpha_i + \lambda_t + \sum_{j=-30}^{150} \delta_j FirstRefund_{i,t+j} + \sum_{j=-30}^{150} \gamma_j SecondRefund_{i,t+j} \\
& + \sum_{j=-30}^{150} \beta_j FilingDate_{i,t+j} + \epsilon_{i,t}
\end{aligned} \tag{B.2}$$

where $FilingDate_{i,t+j}$ is an indicator variable equal to 1 at a date $t+j$ if household i filed their tax return on that day, and β_j is the spending response to tax filing. Identification of the spending responses follows the same arguments laid out in Section 3.1 of the main paper. Now, however, we also rely on variation across households in the timing between tax filing and tax refund dates.

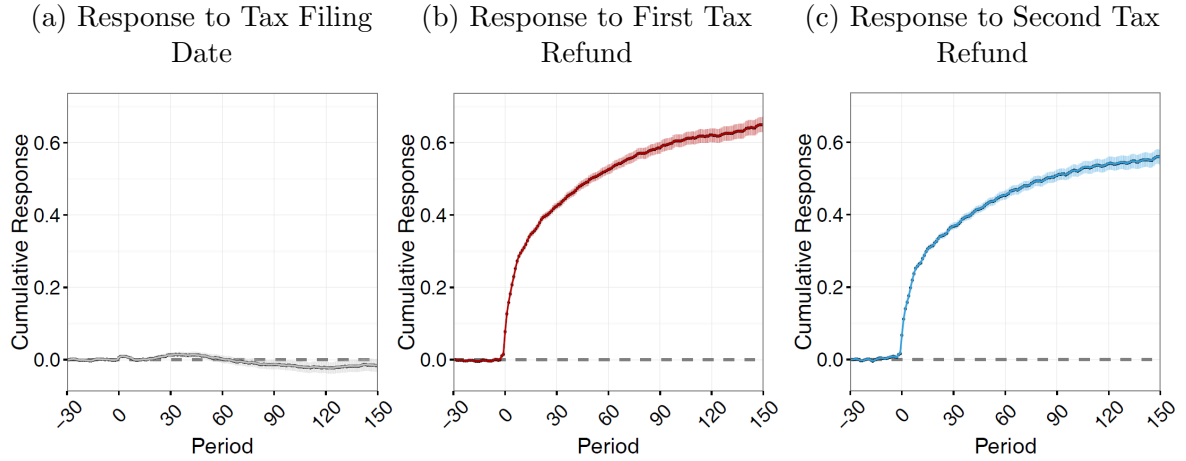
Figure B.6 and B.7 illustrate non-durables and total expenditure responses to tax filing and tax refunds. The main result is that there is no spending response to tax filing date. This is the same result as that reported in Baugh et al. (2021). The second result is that spending responses to tax refunds are largely unaffected by conditioning on tax filing date information.

Figure B.6: Non-Durables Expenditure Response to Tax Filing and Refunds



Source: Authors' calculations using financial institution data.

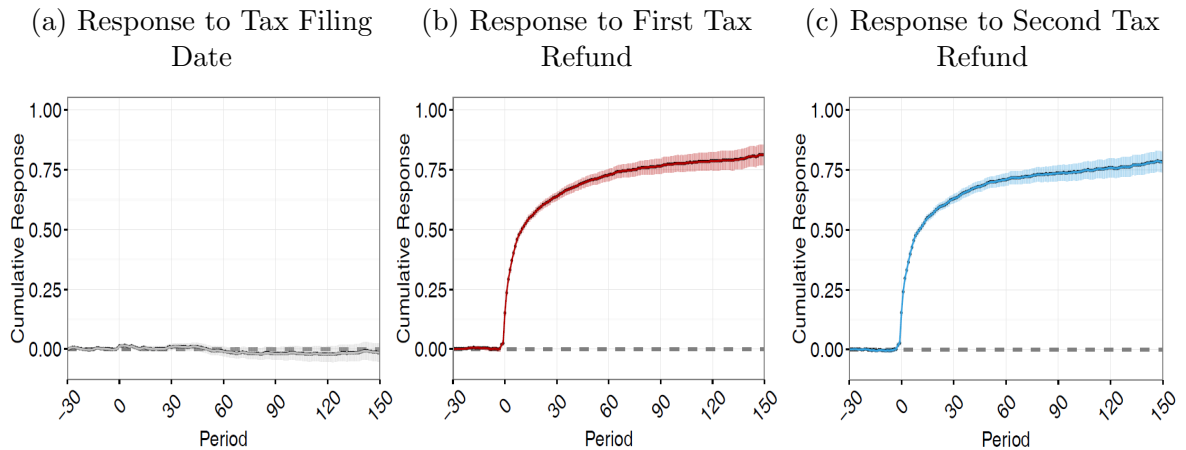
Figure B.7: Total Expenditure Response to Tax Filing and Refunds



Source: Authors' calculations using financial institution data.

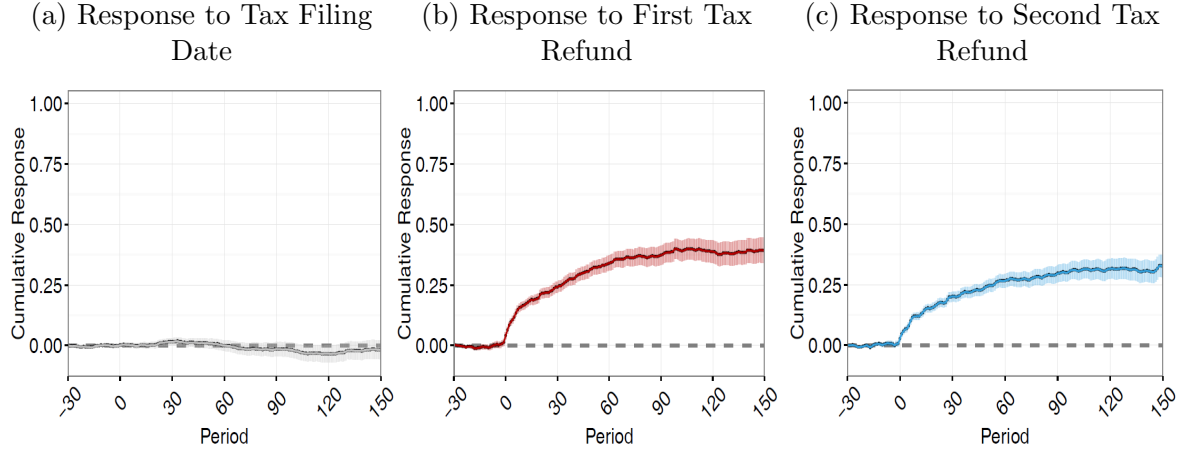
These results could imply that households are extremely liquidity constrained. They learn about an incoming tax refund, but cannot begin spending as they are unable to borrow, and must instead wait until the money is in their account to start spending. However, we show that the lack of expenditure response to tax filing holds for households with very large liquid asset balances. Figures B.8 and B.9 report estimates of the responses to tax filing for both the lowest and highest quintiles of the liquid assets-to-income distribution. Both low and high wealth households choose not to spend after learning about tax refunds at tax filing. This strongly suggests that liquidity constraints are not the primary driver of spending responses to tax filing.

Figure B.8: Total Expenditure Response to Tax Filing and Refunds, Lowest Quintile of Liquidity



Source: Authors' calculations using financial institution data.

Figure B.9: Total Expenditure Response to Tax Filing and Refunds, Highest Quintile of Liquidity



Source: Authors' calculations using financial institution data.

B.6. Expenditure Responses to Tax Refunds by Income and Liquidity

In this section we explore whether spending responses vary by household liquidity after conditioning on income. We conduct a simple exercise to explore this hypothesis. We divide the sample population into low ($< \$40,000$), middle ($\$40,000$ to $\$120,000$), and high ($> \$120,000$) income groups by annual income in the year prior to tax refund. The share of households in each of these groups is 34.5 percent, 56 percent, and 9.5 percent, respectively. We then stratify by liquid assets-to-income within each income group as: below median, median to 75th percentile, and above 75th percentile. Table B.2 reports summary statistics for each of these groups. Importantly, the average size of tax refunds across liquid assets within each income group is fairly similar.

Table B.2: Summary Statistics by Income and Liquidity

	Liquid-to-Income	Income	Liquid Balances	Expenditure	Tax Refund
Low Income	Low	2608	499	2374	1694
($< 40k$)	Middle	2769	1564	2603	1673
	High	2827	5059	2769	1634
Middle Income	Low	5650	1546	5238	2344
($40k - 120k$)	Middle	5897	4763	5649	2388
	High	5738	13823	5646	2417
High Income	Low	13567	5854	12492	3540
($> 120k$)	Middle	13894	14601	13010	3887
	High	13801	35539	13141	4326

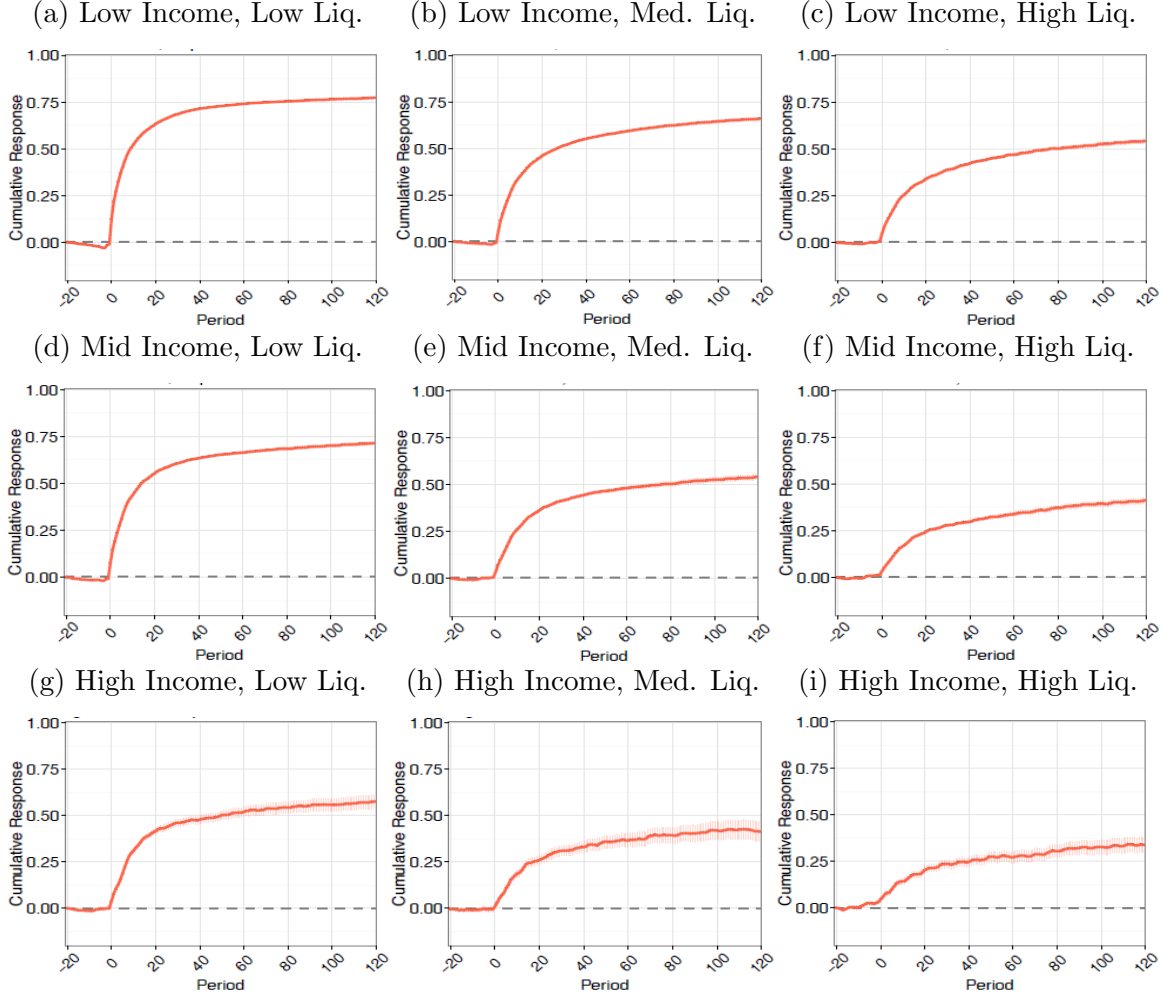
Notes: Median income, liquid balances, and expenditures reported. Mean tax refund reported.

Source: Authors' calculations using financial institution data.

Figure B.10 reports total expenditure responses to tax refunds within each subsample of the population. Once again we find the same patterns of spending response across the population. At all income and wealth levels, households do not spend in anticipation of

tax refund and households front-load their spending toward the date of refund receipt. The only thing that differs across households is the magnitude of spending response. Within each income group, low liquidity households spend almost twice as much as high liquidity households.

Figure B.10: Total Expenditure Responses by Income and Liquidity



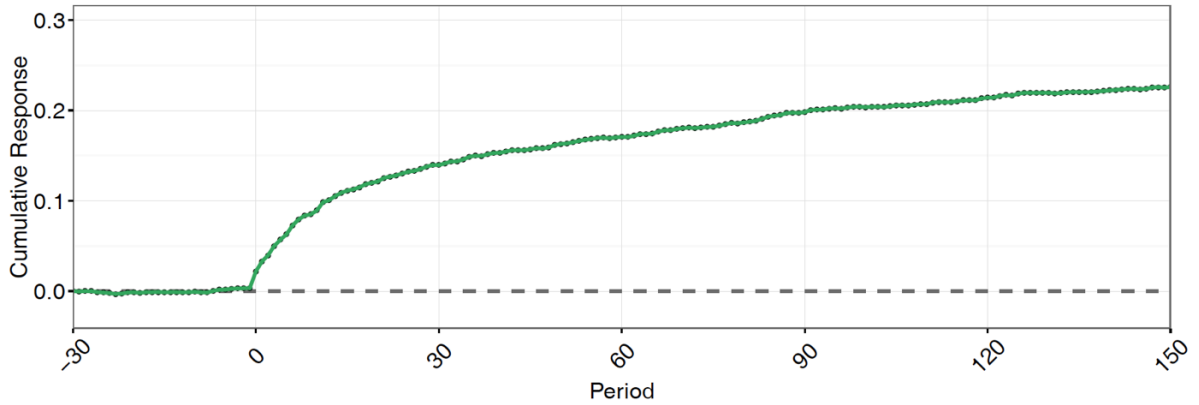
Source: Authors' calculations using financial institution data.

B.7. Expenditure Responses to Bonus Checks

In this section we study expenditure responses to the receipt of bonus checks. Bonus checks are identified for a relatively wealthy subsample of 163,000 households as described in Section A.5.

Figure B.11 shows the response of non-durable expenditure to the receipt of bonus checks. We find that there is no spending response prior to income receipt and significant front-loading of spending with respect to bonus receipt date. With respect to front-loading, 64 percent of the total spending response takes place in the first 30 days after check receipt. While the shape of the spending response is similar across bonus checks and tax refunds, the response to bonus checks is somewhat smaller in magnitude. Figure B.11 shows that the MPCs out of bonus checks at 30 and 90 days are 0.14 and 0.20,

Figure B.11: Non-Durable Expenditure Response to Bonus Checks



Source: Authors' calculations using financial institution data.

respectively. In contrast, Figure 3 in the main paper shows that MPCs out of tax refunds at 30 and 90 days are 0.19 and 0.25, respectively. This difference in magnitude might be expected given our sample of bonus check recipients is significantly wealthier than our sample of tax refund recipients (see Table A.3).

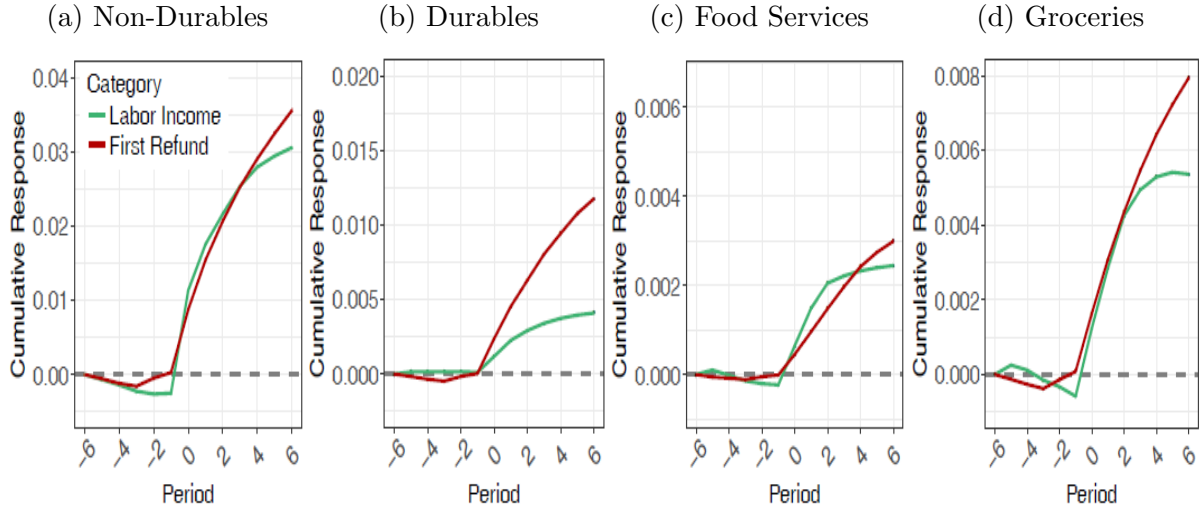
B.8. Expenditure Responses to Regular Paychecks

In this section we compare expenditure responses to regular paychecks. For consistency of comparison, we estimate responses to regular paychecks among our main subsample of households receiving a single tax refund (see Section 2.2 of the main paper). In contrast with tax refunds, regular paychecks are received at regular intervals and the particular day or date of receipt is fully known in advance. While the average tax refund in our sample is \$2072 (see Table A.3), paychecks are smaller on average at just \$1414. Households receive an average of 2.6 paychecks each month, but the actual number for any given household varies according to pay cycles and the number of workers within each household depositing paychecks into the primary transaction account at the financial institution.

Time variation in paychecks is given by variation in pay schedules induced by weekly, bi-weekly, and monthly pay frequencies as well as alterations to these schedules required by public holidays. However, because paycheck receipt may be tied to automatic expenditures such as rent or mortgage payments, we restrict attention to discretionary spending on categories such as non-durable goods and food services. Finally, to avoid the overlap in spending response from one paycheck to the next, we restrict our estimates to the week prior to and week after paycheck receipt.

Figure B.12 compares non-durables expenditure responses to the receipt of regular paychecks and tax refunds. Spending responses to both forms of income are remarkably similar in shape and magnitude. For both receipts, households exhibit no anticipated spending response, households spend rapidly in the days immediately after income receipt, and except for durable goods households spend similar amounts out of paychecks and tax refunds in the first week after receipt. For example, in the first week in response to both forms of income, households spend around 3 cents of every dollar received on non-durable goods and services.

Figure B.12: Expenditure Responses to Regular Paychecks



Source: Authors' calculations using financial institution data.

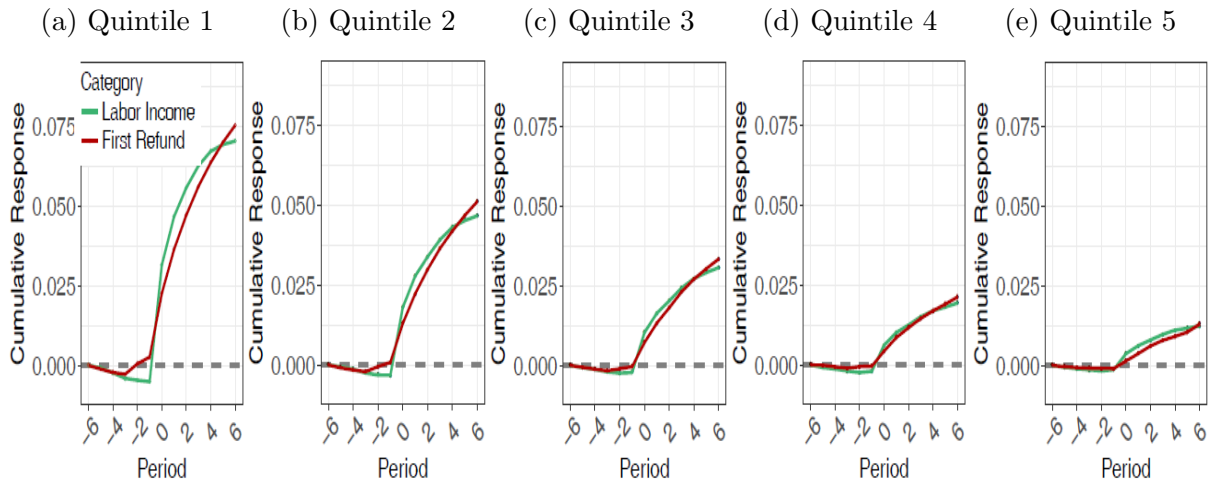
Table B.3: Size of Regular Paycheck by Liquid Assets-to-Income

	Quintile				
	1 st	2 nd	3 rd	4 th	5 th
Average Paycheck	1057	1301	1495	1600	1582

Source: Authors' calculations using financial institution data.

Next we consider spending responses to regular paychecks across the distribution of liquid assets-to-income. Table B.3 reports the average size of paycheck across quintiles of the liquid wealth distribution. Figure B.13 shows the non-durable expenditure response to regular paychecks across quintiles of liquid wealth. As in response to other forms of income we find: no anticipated response to receipt for all levels of wealth; a sharp increase in spending in the days immediately following receipt; and significantly larger spending responses among low-wealth households than among high-wealth households.

Figure B.13: Non-Durables Expenditure Responses to Regular Paychecks by Liquidity



Source: Authors' calculations using financial institution data.

C. Simple Model Appendix

In this section we provide proofs for the results in Section 4 of the paper.

C.1. Derivation of Consumption Function Under Mental Accounts

This subsection provides details of the derivation of the consumption function under mental accounts. Restating the household problem from Section 4.2 of the paper:

$$\begin{aligned} \max_{c_t, a_{t+1}} \quad & \sum_{t=0}^{T-1} \beta^t \left[\frac{c_t^{1-1/\gamma}}{1-1/\gamma} - d(c_t, c_t^d) \right] \\ & c_t + a_{t+1} = y_t + a_t(1+r) \\ & c_t^d = y_t \\ & a_T = 0 \end{aligned}$$

where the penalty function is:

$$d(c, c^d) = \begin{cases} 0 & \text{if } c \leq c^d \\ \psi(u(c) - u(c^d)) & \text{if } c > c^d \end{cases}$$

and $u(c) = \frac{c^{1-1/\gamma}}{1-1/\gamma}$.

The first order conditions under the assumption of interior consumption choices yield the Euler equations:

$$(1 - \psi \mathbb{1}_{c_t > y_t}) c_t^{-1/\gamma} = \beta(1+r)(1 - \psi \mathbb{1}_{c_{t+1} > y_{t+1}}) c_{t+1}^{-1/\gamma} \quad (\text{C.1})$$

By repeatedly substituting the Euler equation into itself, we can express period t consumption c_t as a function of initial period consumption c_0 :

$$c_t = (\beta(1+r))^{\gamma t} \left(\frac{1 - \psi \mathbb{1}_{c_t > y_t}}{1 - \psi \mathbb{1}_{c_0 > y_0}} \right)^{\gamma} c_0$$

And by repeat substitution of the household budget constraint into itself, we can express the intertemporal budget constraint as:

$$\sum_{s=0}^{T-1} \frac{c_s}{(1+r)^s} = a_0(1+r) + \sum_{s=0}^{T-1} \frac{y_s}{(1+r)^s}$$

Substituting the consumption functions c_t into the intertemporal budget constraint yields:

$$c_0 = \frac{(1 - \psi \mathbb{1}_{c_0 > y_0})^{\gamma}}{\sum_{s=0}^{T-1} \beta^{\gamma s} (1+r)^{(\gamma-1)s} (1 - \psi \mathbb{1}_{c_s > y_s})^{\gamma}} \times \left(a_0(1+r) + \sum_{s=0}^{T-1} \frac{y_s}{(1+r)^s} \right)$$

And substituting back into the Euler equation yields the consumption function for a generic period t :

$$c_t = \frac{(\beta(1+r))^{\gamma t} (1 - \psi \mathbb{1}_{c_t > y_t})^{\gamma}}{\sum_{s=0}^{T-1} \beta^{\gamma s} (1+r)^{(\gamma-1)s} (1 - \psi \mathbb{1}_{c_s > y_s})^{\gamma}} \times \left(a_0(1+r) + \sum_{s=0}^{T-1} \frac{y_s}{(1+r)^s} \right)$$

To ease notation, we will express the consumption function as:

$$c_t = \frac{(\beta(1+r))^{\gamma t} (1 - \psi \mathbb{1}_{c_t > y_t})^{\gamma}}{\sum_{s=0}^{T-1} \theta^s (1 - \psi \mathbb{1}_{c_s > y_s})^{\gamma}} \times \left(a_0(1+r) + \sum_{s=0}^{T-1} \frac{y_s}{(1+r)^s} \right) \quad (\text{C.2})$$

where $\theta = \beta^{\gamma}(1+r)^{\gamma-1}$.

We now derive MPCs under two special cases. The first set of assumptions induces constant consumption in all periods in the absence of the income inflow. The second set of assumptions considers a simple life-cycle profile for income and consumption.

C.2. MPCs out of Income Receipt Under Special Case 1

First, we assume that in the absence of the income inflow, $c_t = y_t$ for all t . One such special case occurs when the income profile is constant: $y_t = \bar{y}$ for all t . In this case, we can show that for any $\bar{y}$ there exists a set of model parameters such that $c_t = y_t = \bar{y}$ for all t . For example, assume that $\beta(1+r) = 1$. Then rearranging the consumption function from Equation (C.2), $\bar{y}$ is related to parameters via:

$$\bar{y} = \frac{r(1+r)a_0}{\left(1 + 2r - \left(\frac{1}{1+r}\right)^{T-2}\right) \left(1 - \left(\frac{1}{1+r}\right)^{T-1}\right)}$$

For the derivation, it is sufficient to proceed assuming only that $c_t = y_t$ absent the income inflow. When the inflow is announced at date 0 to be delivered at date h , the consumption smoothing motive induces households to save at h so that $c_h < y_h + \Delta$. Additionally, households increase their consumption in every other period so that $c_t > y_t$ for all $t \neq h$. In everything that follows denote wealth and life-time income, including the income receipt Δ at date h , as:

$$W_0 = \left(a_0(1+r) + \sum_{s=0}^{T-1} \frac{y_s + \mathbb{1}_{s=h}\Delta}{(1+r)^s} \right)$$

where $\mathbb{1}_{s=h}\Delta$ is the additional income received at date h . Then along the income path featuring the income inflow Δ the consumption function becomes:

$$\begin{aligned} c_t &= \frac{(\beta(1+r))^{\gamma t} (1 - \psi \mathbb{1}_{c_t > y_t})^{\gamma}}{\sum_{s=0}^{T-1} \theta^s (1 - \psi \mathbb{1}_{c_s > y_s})^{\gamma}} \times W_0 \\ &= \frac{(\beta(1+r))^{\gamma t} (1 - \psi \mathbb{1}_{t \neq h})^{\gamma}}{\sum_{s=0}^{h-1} \theta^s (1 - \psi)^{\gamma} + \theta^h + \sum_{s=h+1}^{T-1} \theta^s (1 - \psi)^{\gamma}} \times W_0 \\ &= \frac{(\beta(1+r))^{\gamma t} (1 - \psi \mathbb{1}_{t \neq h})^{\gamma}}{(1 - \psi)^{\gamma \frac{1-\theta^h}{1-\theta}} + \theta^h + (1 - \psi)^{\gamma \frac{\theta^{h+1}-\theta^T}{1-\theta}}} \times W_0 \end{aligned}$$

The second equality follows from splitting out the date h term when the dissavings aversion function is not triggered, and the third equality follows from the properties of geometric series. Finally, simplifying the expression yields:

$$c_t = \frac{(1 - \theta)(\beta(1+r))^{\gamma t} (1 - \psi \mathbb{1}_{t \neq h})^{\gamma}}{(1 - (1 - \psi)^{\gamma})(1 - \theta)\theta^h + (1 - \psi)^{\gamma}(1 - \theta^T)} \times W_0 \quad (\text{C.3})$$

To compute the marginal propensity to consume (MPC) at t out of income receipt at h , we take the limit of the consumption function as the income inflow Δ approaches zero from above. This construction of the MPC reflects our study of anticipated income tax refunds. But it also maintains consistency with our argument that the inflow causes households to consume less than current income in period h and more than current income in all periods $t \neq h$. The MPC is given by:

$$\begin{aligned} MPC_t^h &\equiv \lim_{\Delta \rightarrow 0^+} \frac{c_t(y_h + \Delta) - c_t(y_h)}{\Delta} \\ &= \frac{(1 - \theta)\beta^{\gamma t}(1 + r)^{\gamma t - h}(1 - \psi \mathbb{1}_{t \neq h})^\gamma}{(1 - (1 - \psi)^\gamma)(1 - \theta)\theta^h + (1 - \psi)^\gamma(1 - \theta^T)} \end{aligned}$$

C.3. MPCs out of Income Receipt Under Special Case 2

Now we assume that the path of income $\{y_t\}_{t=0}^{T-1}$ follows a hump-shaped life-cycle income profile. Income is low when young, grows until it reaches a peak, and then falls into and through retirement. Let $\tilde{T}$ denote the peak earnings age. We assume income is monotonically increasing until $\tilde{T}$, and monotonically decreasing after $\tilde{T}$.

When income follows this life-cycle profile, households save when young and consume out of savings as income falls later in life. In this case, absent the income receipt Δ , consumption is such that $c_t \leq y_t$ for all $t < \tilde{T}$ and $c_t > y_t$ for all $\tilde{T} \leq t \leq T - 1$.

Suppose the income receipt at date h is large enough to induce saving at date h , $c_h < y_h + \Delta$, but is not so large that it affects the dissaving aversion motive in any other period t . That is, we maintain that $c_t \leq y_t$ for all $t < \tilde{T}$ and $t = h$, and $c_t > y_t$ for all $\tilde{T} \leq t \leq T - 1$ and $t \neq h$. In this case, the consumption function from Equation (C.2) becomes:

$$\begin{aligned} c_t &= \frac{(\beta(1 + r))^{\gamma t}(1 - \psi \mathbb{1}_{t \geq \tilde{T} \wedge t \neq h})^\gamma}{\theta^h + \sum_{\substack{s=0 \\ s \neq h}}^{\tilde{T}-1} \theta^s + \sum_{\substack{s=\tilde{T} \\ s \neq h}}^{\tilde{T}-1} \theta^s(1 - \psi)^\gamma} \times W_0 \\ &= \frac{(\beta(1 + r))^{\gamma t}(1 - \psi \mathbb{1}_{t \geq \tilde{T} \wedge t \neq h})^\gamma}{(1 - (1 - \psi \mathbb{1}_{h \geq \tilde{T}})^\gamma)\theta^h + \sum_{s=0}^{\tilde{T}-1} \theta^s + \sum_{s=\tilde{T}}^{\tilde{T}-1} \theta^s(1 - \psi)^\gamma} \times W_0 \\ &= \frac{(\beta(1 + r))^{\gamma t}(1 - \psi \mathbb{1}_{t \geq \tilde{T} \wedge t \neq h})^\gamma}{(1 - (1 - \psi \mathbb{1}_{h \geq \tilde{T}})^\gamma)\theta^h + \frac{1 - \theta^{\tilde{T}}}{1 - \theta} + \frac{\theta^{\tilde{T}} - \theta^T}{1 - \theta}(1 - \psi)^\gamma} \times W_0 \\ &= \frac{(1 - \theta)(\beta(1 + r))^{\gamma t}(1 - \psi \mathbb{1}_{t \geq \tilde{T} \wedge t \neq h})^\gamma}{(1 - (1 - \psi \mathbb{1}_{h \geq \tilde{T}})^\gamma)(1 - \theta)\theta^h + (1 - \theta^{\tilde{T}}) + (1 - \psi)^\gamma(\theta^{\tilde{T}} - \theta^T)} \times W_0 \end{aligned}$$

Finally, simplifying:

$$c_t = \frac{(1 - \theta)(\beta(1 + r))^{\gamma t}(1 - \psi \mathbb{1}_{t \geq \tilde{T} \wedge t \neq h})^\gamma}{(1 - (1 - \psi \mathbb{1}_{h \geq \tilde{T}})^\gamma)(1 - \theta)\theta^h + (1 - \theta^{\tilde{T}}) + (1 - \psi)^\gamma(\theta^{\tilde{T}} - \theta^T)} \times W_0 \quad (\text{C.4})$$

Note that in the special case when $\tilde{T} = 0$ (i.e. declining income, perhaps for a household past their peak earnings), the expression reduces to Equation (C.3) above.

The MPC under the consumption function in Equation (C.4) is:

$$\begin{aligned} MPC_t^h &\equiv \lim_{\Delta \rightarrow 0^+} \frac{c_t(y_h + \Delta) - c_t(y_h)}{\Delta} \\ &= \frac{(1 - \theta)\beta^{\gamma t}(1 + r)^{\gamma t - h}(1 - \psi \mathbb{1}_{t \geq \tilde{T} \wedge t \neq h})^\gamma}{(1 - (1 - \psi \mathbb{1}_{h \geq \tilde{T}})^\gamma)(1 - \theta)\theta^h + (1 - \theta^{\tilde{T}}) + (1 - \psi)^\gamma(\theta^{\tilde{T}} - \theta^T)} \end{aligned} \quad (\text{C.5})$$

C.4. MPCs out of Income Loss Under Special Case 1

In this subsection we derive MPCs out of anticipated payments or decreases in income, as discussed in Section 4.4 of the paper. For the path of income we assume Special Case 1 from Section C.2. That is we assume that $c_t = y_t$ for all t in the absence of the income change.

When a decline in income $\Delta < 0$ is announced at date 0 to be incurred at date h , the consumption smoothing motive induces households to reduce consumption a little in all periods. This means that $c_t < y_t$ for all $t \neq h$. But at date h income falls by more than consumption so that $c_h > y_h + \Delta$. Note that the household is dissaving in period h . Along the income path featuring the decrease in income the generic consumption function from Equation (C.2) becomes:

$$\begin{aligned} c_t &= \frac{(\beta(1+r))^{\gamma t} (1 - \psi \mathbb{1}_{c_t > y_t})^{\gamma}}{\sum_{s=0}^{T-1} \theta^s (1 - \psi \mathbb{1}_{c_s > y_s})^{\gamma}} \times W_0 \\ &= \frac{(\beta(1+r))^{\gamma t} (1 - \psi \mathbb{1}_{t=h})^{\gamma}}{\sum_{s=0}^{h-1} \theta^s + \theta^h (1 - \psi)^{\gamma} + \sum_{s=h+1}^{T-1} \theta^s} \times W_0 \\ &= \frac{(\beta(1+r))^{\gamma t} (1 - \psi \mathbb{1}_{t=h})^{\gamma}}{\frac{1-\theta^h}{1-\theta} + \theta^h (1 - \psi)^{\gamma} + \frac{\theta^{h+1}-\theta^T}{1-\theta}} \times W_0 \end{aligned}$$

The second equality follows from splitting out the date h term when the dissavings aversion function is not triggered, and the third equality follows from the properties of geometric series. Finally, simplifying the expression yields:

$$c_t = \frac{(1-\theta)(\beta(1+r))^{\gamma t} (1 - \psi \mathbb{1}_{t=h})^{\gamma}}{(1-\theta^T) - (1 - (1-\psi)^{\gamma})(1-\theta)\theta^h} \times W_0 \quad (\text{C.6})$$

where $\mathbb{1}_{s=h}\Delta$ denotes the required payment or loss of income in period h (i.e. with $\Delta < 0$).

To compute the marginal propensity to consume (MPC) at t out of income receipt at h , we take the limit of the consumption function as the decline in income approaches zero from below. This construction of the MPC is consistent with our argument that the income loss causes households to consume more than current income in period h and less than current income in all periods $t \neq h$. The MPC is given by:

$$\begin{aligned} MPC_t^h &\equiv \lim_{\Delta \rightarrow 0^-} \frac{c_t(y_h + \Delta) - c_t(y_h)}{|\Delta|} \\ &= \frac{(1-\theta)(\beta(1+r))^{\gamma t} (1 - \psi \mathbb{1}_{t=h})^{\gamma}}{(1-\theta^T) - (1 - (1-\psi)^{\gamma})(1-\theta)\theta^h} \end{aligned} \quad (\text{C.7})$$

D. Quantitative Model Appendix

D.1. Model Solution Method

As discussed in Section 5.1 of the paper, the value function for the household problem is:

$$\begin{aligned} V_t^i(a, z, e, h) = \max_{c, a'} & \left\{ \frac{c^{1-1/\gamma}}{1-1/\gamma} - d(c, c^d; \psi_i) + \beta \mathbb{E} [V_{t+1}(a', z', e', h')] \right\} \\ \text{s.t. } & c + a' = m(t, z, e, h) + a(1+r) \\ & c^d = m(t, z, e, h) \\ & h' = \min\{h+1, 1\} \\ & a' \geq 0 \end{aligned}$$

and with terminal condition given by

$$V_{T+1}(a) = \kappa \frac{a^{1-1/\gamma}}{1-1/\gamma}$$

For computational purposes, it is convenient to re-express the problem as:

$$\begin{aligned} V_t(a, z, e, h, i) = \max_{c, a'} & \left\{ \frac{c^{1-1/\gamma}}{1-1/\gamma} - d(c, c^d; \psi(i)) + \beta \mathbb{E} [V_{t+1}(a', z', e', h', i)] \right\} \\ \text{s.t. } & c + a' = m(t, z, e, h) + a(1+r) \\ & c^d = m(t, z, e, h) \\ & h' = \min\{h+1, 1\} \\ & a' \geq 0 \end{aligned}$$

where the type of household i is a permanent characteristic or state variable.

We solve the household problem using backward iteration on the value function, which is defined on a discretized state space. The state variables are $\mathbf{s} = [t, a, z, e, h, i]$, where t is current age, a is liquid assets, z is an idiosyncratic productivity shock, e is employment status, and h determines the date of an anticipated income receipt relative to date t .

Minimum and maximum household ages are 25 and 65, respectively. Since model ages are expressed in months, there are $N_t = 40 \times 12 = 480$ model ages. We set the number of liquid asset grid points to $N_a = 250$. The minimum and maximum size asset grid points are $[\underline{a}, \bar{a}] = [0, 120]$, there the maximum is given by 10 times annual median income, which is normalized to 1 in the model. Grid points are distributed according to the following double-log-and-exponentiated scheme:

1. Create a double-logged maximum grid point: $\bar{u} = \log(1 + \log(1 + \bar{a} - \underline{a}))$
2. Construct uniformly spaced grid points between 0 and $\bar{u}$, labelled u_j for $j = 1, \dots, N_a$
3. Construct asset grid points a_j by double-exponentiating the uniformly spaced points: $a_j = \underline{a} + e^{(e^{u_j} - 1)} - 1$ for $j = 1, \dots, N_a$

We discretize the AR(1) idiosyncratic productivity process following the Rouwenhorst (1995) method. We set the number of grid points for approximation to $N_z = 11$. The employment state can take one of two values, $e \in [0, 1]$, so $N_e = 2$. The state variable h containing information about date of income receipt can take three values, $N_h = 3$. These are: $h \in [-1, 0, 1]$, corresponding to: income receipt expected tomorrow ($h = -1$), income receipt today ($h = 0$), no further expected income receipts ($h = 1$). The permanent characteristic i can take two values $h \in [0, 1]$ ($N_i = 2$) reflecting those without and with mental accounts behavior.

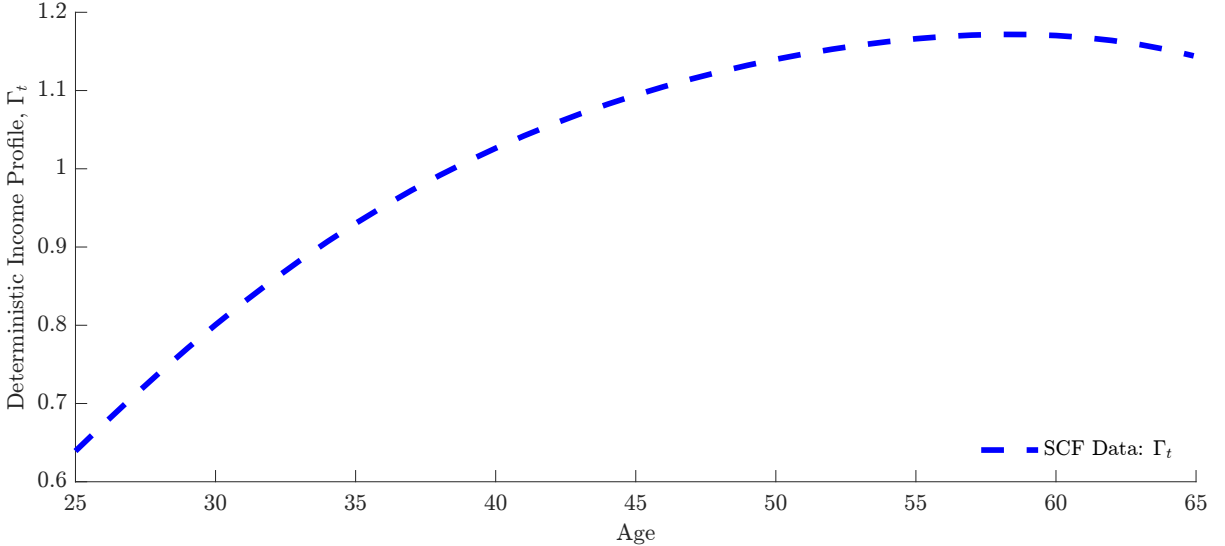
Thus, in total the state space contains $N_t \times N_a \times N_z \times N_e \times N_h \times N_i = 15,840,000$ grid points.

D.2. Calibration and Estimation

We first choose a subset of parameters consistent with information external to the model. We then estimate the parameters $\Theta = \{\beta, \gamma, \kappa, \psi, \pi_i\}$ via Simulated Method of Moments (SMM) to capture household wealth holdings and consumption responses to income receipts. This section provides additional details about the calibration and estimation.

The deterministic life-cycle income profile Γ_t is computed using Survey of Consumer Finances data from 1998–2019. We restrict the sample to employed working-age households earning at least \$500 per year, and compute after-tax, per-capita, real household income using the 2016 federal income tax thresholds and tax rates for single and married households from the Congressional Budget Office (2019). We then regress log-income on cohort fixed effects and a fourth-order polynomial in household age. We use the fitted values and interpolate across months within years to construct the life-cycle income profile. The estimated life-cycle income profile Γ_t is illustrated in Figure D.1.

Figure D.1: Life-Cycle Income Profile Estimated from SCF Data



Notes: Life-cycle profile adjusted so that median model incomes are normalized to 1.

Source: Authors' calculations using Survey of Consumer Finances.

Our SMM algorithm for estimating the parameters $\Theta = \{\beta, \gamma, \kappa, \psi, \pi_i\}$ adopts the

objective function

$$\min_{\Theta} \Omega \times \sum_{l=1}^5 (\mathbf{d}_l^{mpc} - \mathbf{m}_l^{mpc}(\Theta))^2 + (1 - \Omega) \times \sum_{s=1}^5 (\mathbf{d}_s^{liq} - \mathbf{m}_s^{liq}(\Theta))^2 \quad (\text{D.1})$$

as discussed in Section 5.2 of the paper. Model-based statistics $\mathbf{m}_l^{mpc}(\Theta)$, $\mathbf{m}_s^{liq}(\Theta)$ are computed from a simulated panel of 25,000 households.

We first search for a minimum of Equation (D.1) by generating a 750-element Sobol sequence over the parameters $\Theta = \{\beta, \gamma, \kappa, \psi, \pi_i\}$. We then take the set of parameters minimizing the objective function under the Sobol search and conduct a second search using Matlab's **fminsearch** function.

D.3. Additional Fiscal Stimulus Policy Exercises

Section 5.5 in the paper explored the extent to which the effectiveness of fiscal stimulus policies depended on mental accounts preferences and whether stimulus was targeted or untargeted across households. In this Section we also explore size whether aggregate consumption responses depend on the size of the fiscal transfer provided to households.

Figures D.2, D.3, and D.4 illustrate the response of aggregate consumption to our three stimulus policies when the baseline transfers to households are equal to \$500, \$1000, and \$1500, respectively. First, aggregate consumption responses are increasing with the size of transfer. Second, under the mental accounts model untargeted stimulus becomes relatively more effective with the size of transfer. For \$1500 transfers, untargeted stimulus payments are the most effective form of stimulus. In contrast, the relative effectiveness of targeted vs. untargeted stimulus under the heterogeneous discount factor model changes very little with the size of transfers.

Figure D.2: Response to Stimulus Payments: \$500 Transfers

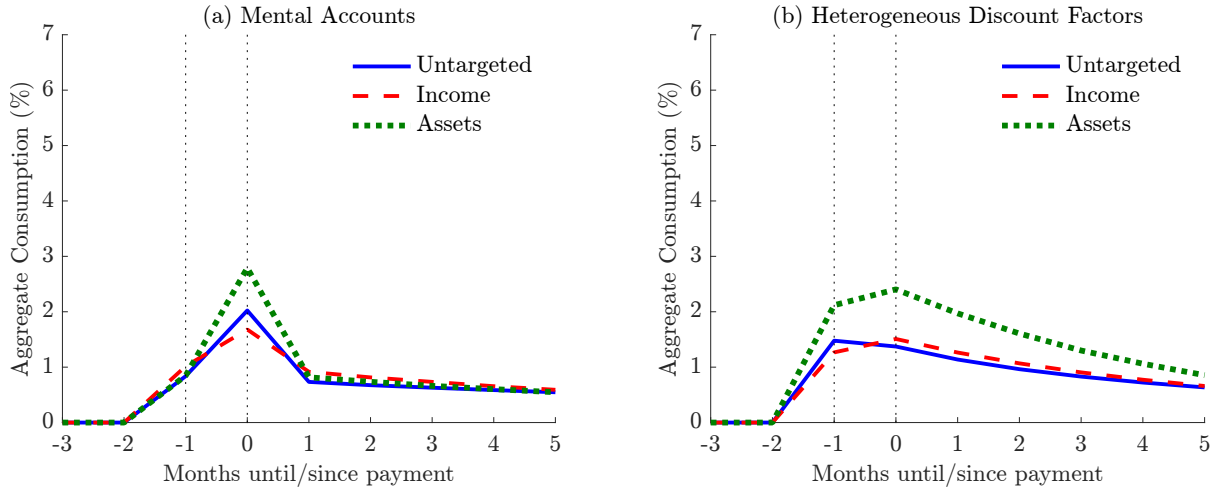


Figure D.3: Response to Stimulus Payments: \$1000 Transfers

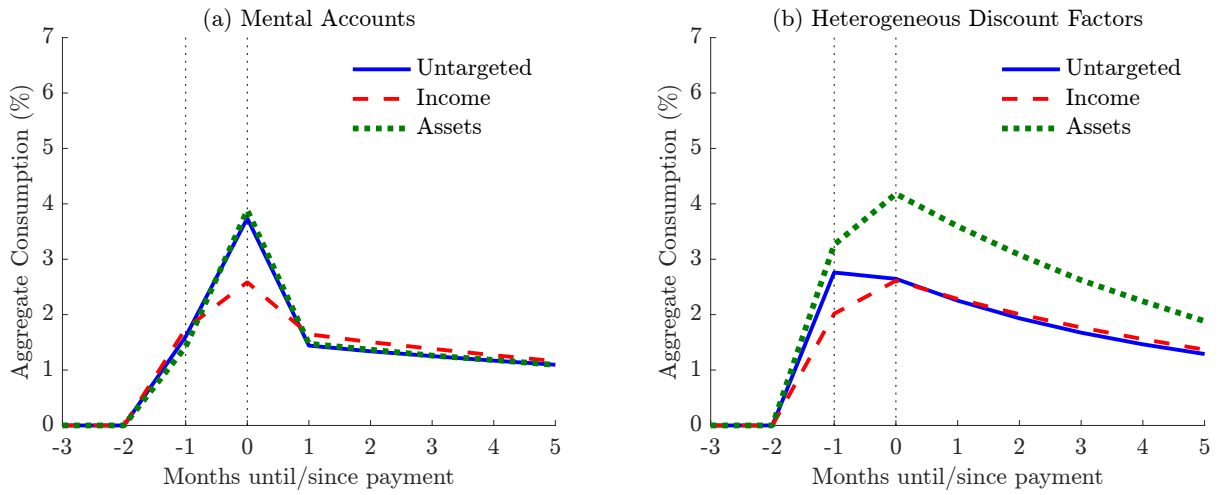
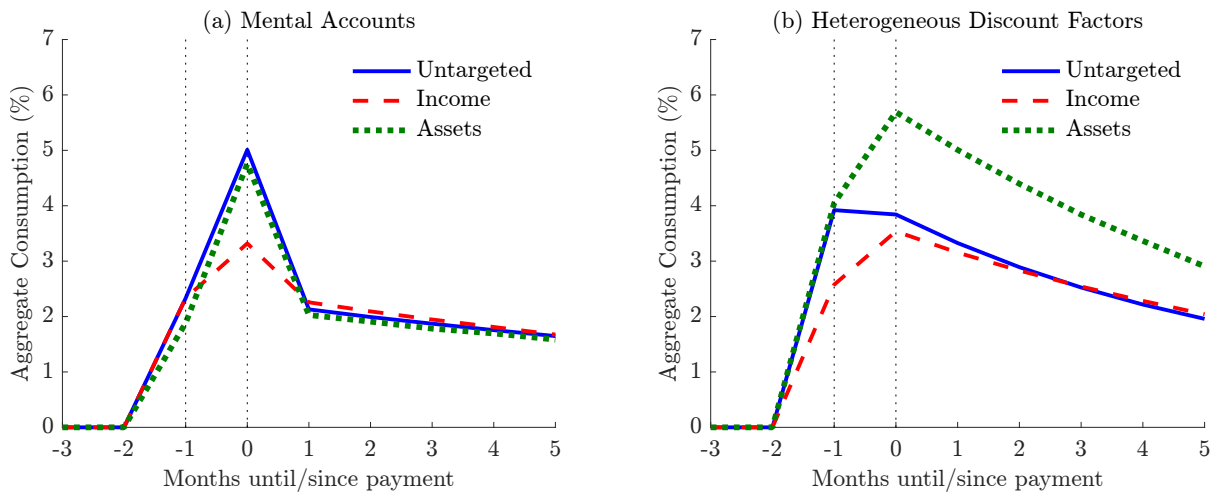


Figure D.4: Response to Stimulus Payments: \$1500 Transfers



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