Supplemental Appendix to "Stimulus through Insurance: the Marginal Propensity to Repay Debt"

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A Proofs

Proof of Proposition 1.

First, we rewrite the Euler equation in the form of an elasticity of the interest rate:

$$\frac{\partial u(c_1)}{\partial c_1}(1+\frac{\frac{\partial q(a_2)}{\partial a_2}}{q(a_2)}a_2) = \frac{\beta}{q(a_2)}\frac{\partial u(c_2)}{\partial c_2}$$
$$\frac{\partial u(c_1)}{\partial c_1}(1+\varepsilon_q(a_2)) = \frac{\beta}{q(a_2)}\frac{\partial u(c_2)}{\partial c_2}$$

We consider CRRA utility $u\left(c\right) = \frac{c^{1-\sigma}-1}{1-\sigma}$ and replace consumption with the budget constraints. Income is deterministic and y_2 is independent of y_1. If $q = \frac{1}{1+r}$, then

$$a_2\left\{(\beta(1+r))^{\frac{-1}{\sigma}} + \frac{1}{1+r}\right\} = y_1 - (\beta(1+r))^{\frac{-1}{\sigma}}\, y_2$$

That is, a_2 is linear in initial cash on hand and, therefore, $MPA = \frac{\partial a_2}{\partial y_1}$ is constant. From the budget constraint it follows that the MPC is also constant.

For q non-constant, we focus our attention on $a_2 < 0$. First, we rewrite the Euler equation such that:

$$\xi = \beta\left(\frac{y_1 - q\left(a_2\right)a_2}{y_2 + a_2}\right)^{\sigma} = q\left(a_2\right) + \frac{\partial q(a_2)}{\partial a_2}a_2 > 0$$

Differentiating by y_1, assuming that y_2 is independent of y_1:[1]

$$\sigma\left(\frac{y_1 - q\left(a_2\right)a_2}{y_2+a_2}\right)^{\sigma-1}\left[\frac{(y_2+a_2)\left(1-\frac{\partial q(a_2)}{\partial a_2}\frac{\partial a_2}{\partial y_1}a_2 - \frac{\partial a_2}{\partial y_1}q\left(a_2\right)\right) - \left(y_1 - q\left(a_2\right)a_2\right)\frac{\partial a_2}{\partial y_1}}{\left(y_2+a_2\right)^2}\right] = \frac{1}{\beta}\left[2\frac{\partial q(a_2)}{\partial a_2}\frac{\partial a_2}{\partial y_1} + \frac{\partial^2 q(a_2)}{\partial a_2^2}\frac{\partial a_2}{\partial y_1}a_2\right]$$

$$\sigma\left(\frac{y_1 - q\left(a_2\right)a_2}{y_2+a_2}\right)^{\sigma}\left(\frac{y_1 - q\left(a_2\right)a_2}{y_2+a_2}\right)^{-1}\left[\frac{(y_2+a_2)\left(1-\frac{\partial a_2}{\partial y_1}\xi\right) - \left(y_1 - q\left(a_2\right)a_2\right)\frac{\partial a_2}{\partial y_1}}{\left(y_2+a_2\right)^2}\right] = \frac{1}{\beta}\frac{\partial a_2}{\partial y_1}\Gamma$$

where $\Gamma = \left[2\frac{\partial q(a_2)}{\partial a_2} + \frac{\partial^2 q(a_2)}{\partial a_2^2}a_2\right]$.

Collect further using the Euler equation to get finally:

$$\underbrace{\sigma\left(\frac{\xi}{\beta}\right)^{1-\frac{1}{\sigma}}}_{>0} = \frac{\partial a_2}{\partial y_1}\left\{\frac{1}{\beta}\Gamma\underbrace{(y_2+a_2)}_{>0} + \underbrace{2\sigma\left(\frac{\xi}{\beta}\right)^{2-\frac{1}{\sigma}}}_{>0}\right\}$$

[1] Or, equally, differentiate by a transitory income shock in period 1.

which shows that $\frac{\partial a_2}{\partial y_1} \geq 0$ as long as $\Gamma > 0$.

Consider now a generic functional form $q = \frac{1}{1+r} - \phi_1 \left(-a_2\right)^{\phi_2}$. Then, $\xi = q + \frac{q - \frac{1}{1+r}}{\phi_2}$. We then impose log-utility ($\sigma = 1$), to get:

$$\sigma = \frac{\partial a_2}{\partial y_1} \left\{ \frac{1}{\beta} \Gamma \left(y_2 + a_2\right) + 2 \left(\frac{\xi}{\beta} \right) \right\} \tag{A.1}$$

With our functional form, ξ is always increasing in y_1, as long as $\frac{\partial a_2}{\partial y_1} \geq 0$. Recall that this happens when $\Gamma > 0$, which is now $\Gamma = \phi_2 \phi_1 \left(-a_2\right)^{\phi_2 - 1} \left(1 + \phi_2\right) = \frac{\partial q}{\partial a_2} \left(1 + \phi_2\right) > 0$ since $\phi_2 > -1$ and q increases with net assets. Moreover, Γ is (weakly) increasing in y_1 as long as $\frac{\partial q}{\partial a_2}$ is. Recalling that we are considering $a_2 < 0$, and differentiating Γ by a_2, this happens when $\phi_2 \phi_1 \left(1 - \phi_2^2\right) \geq 0$. For $\phi_1 > 0$, this requires $0 < \phi_2 \leq 1$, meaning that q is increasing and weakly convex in net assets. Finally, $y_2 + a_2$ is also increasing in y_1. Hence, all terms in the RHS brackets are increasing in y_1, implying that $\frac{\partial a_2}{\partial y_1}$ is decreasing in y_1.

What about the MPC? Recall from the budget constraint that $MPC = 1 - q(a_2) \frac{\partial a_2}{\partial y_1} - \frac{\partial q(a_2)}{\partial a_2} \frac{\partial a_2}{\partial y_1} a_2$. From this, with our parameter choices, the MPC increases with y_1.
■

B Data appendix

B.1 Summary statistics

Table B.1: Sample Characteristics for the SCE June 2020 Special Module

	June 2020 SCE	US population	p-value
Male	0.49	0.50	0.33
White	0.88	0.78	0.00
Age	52.18	52.29	0.79
	(15.83)	(17.05)	
College	0.54	0.39	0.00
Married	0.62	0.51	0.00
Have child under age 6	0.13	0.11	0.02
Have child under age 18	0.30	0.27	0.01
Working FT	0.46	0.46	0.79
Working PT	0.11	0.12	0.57
HH income $<$ \$50k	0.44	0.40	0.00
HH income $<$ \$100k	0.81	0.59	0.00
HH income $\geq$ \$100k	0.19	0.28	0.00
Liquid financial assets $\geq$ \$20k	0.50	0.39	0.00
Gross unsec. debt $\geq$ \$20k	0.33	0.32	0.28
Net liquid wealth $\geq$ \$200k	0.10	0.12	0.13
N	1423		

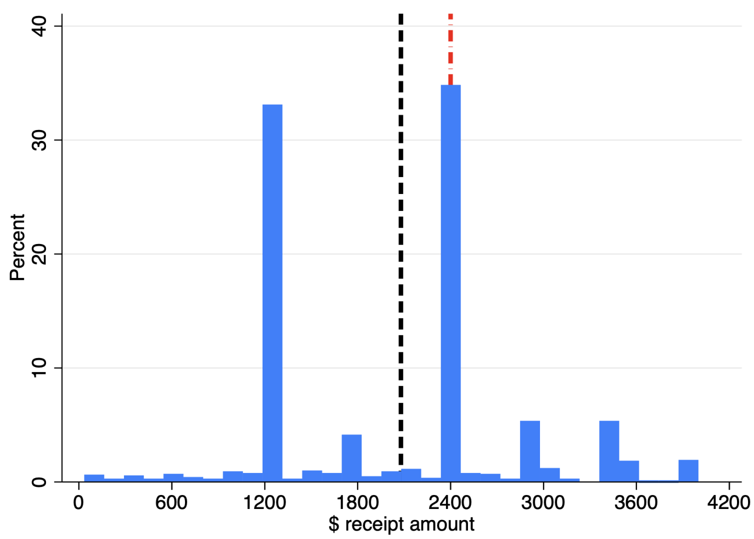
Notes. The first column shows statistics from the June 2020 special SCE module using the respondents who rotated out of the SCE panel, the second column shows the statistics from the June 2020 CPS or the 2019 SCF for the last three rows, and the third column shows the p-value of the differences between the two columns. For age we report the sample mean (standard deviation). June 2020 CPS has 39,075 observations and the 2019 SCF has 28,885 observations.

Table B.2: Sample Characteristics for the SCE Household Spending Module

	SCE	CPS	p-value
Male	0.52	0.51	0.00
White	0.85	0.78	0.00
Age	51.08	51.39	0.02
	(15.24)	(17.10)	
College	0.56	0.35	0.00
Married	0.64	0.50	0.00
Have child under age 6	0.13	0.13	0.99
Have child under age 18	0.29	0.28	0.11
Working FT	0.56	0.49	0.00
Working PT	0.13	0.13	0.02
HH income $<$ \$50k	0.36	0.48	0.00
HH income $<$ \$100k	0.71	0.66	0.00
HH income $\geq$ \$100k	0.28	0.22	0.00
N	13212	3,622,389	

Notes. The first column shows statistics from the SCE Household Spending module for the dates between August 2015 and April 2019. This module is fielded every 4 months. The second column shows the statistics from the CPS, for the same dates as the SCE Household Spending module. The third column shows the p-value of the differences between the first two columns.

Figure B.1: Distribution of Reported Receipt Amount

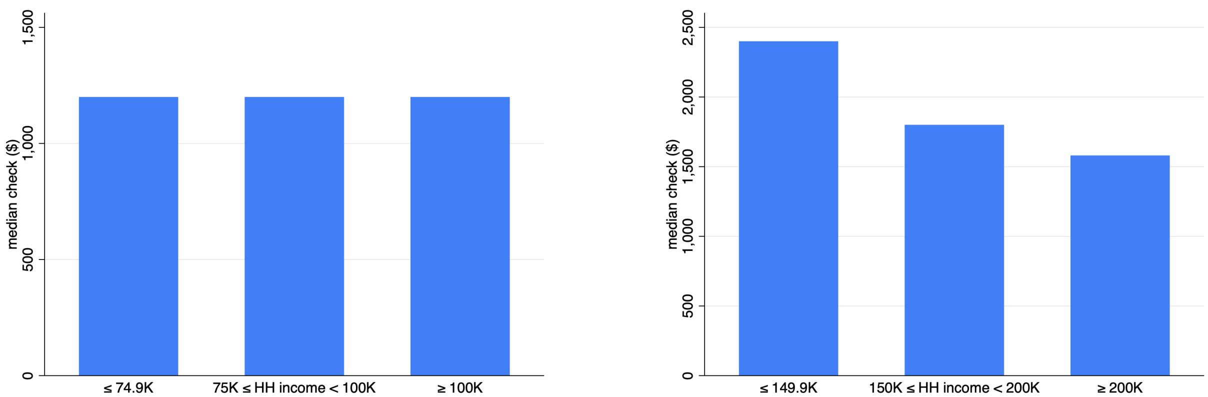


Notes. This figure shows the distribution of reported stimulus check amounts received among those who reported receiving the checks. The distribution is conditional on reporting a receipt amount below \$4200. The black dashed line corresponds to the mean while the red dash-dotted line corresponds to the median.

B.2 Additional results

Figures B.4–B.5 and Tables B.3–B.4 show additional results using the baseline sample and SCE questions discussed in Section 2.1.

Figure B.2: Reported Stimulus Amount Received by Households with no Children

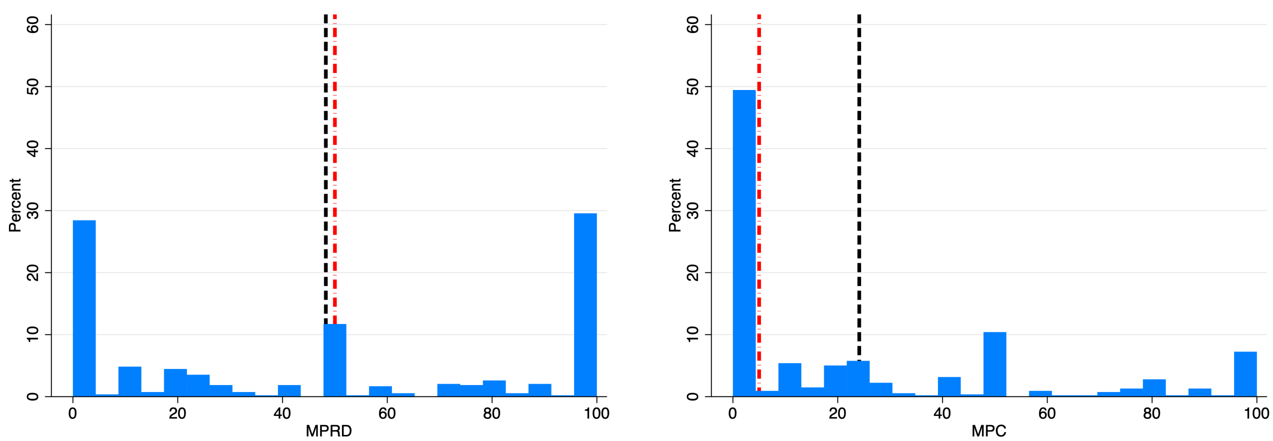


(a) Non-Married

(b) Married

Notes. Panel (a) shows the histogram of the median reported stimulus amount among the three different income groups for non-married households with no children. Panel (b) shows the histogram the median reported stimulus amount among the three different income groups for married households with no children.

Figure B.3: Histograms of MPRD and MPC for those with negative net liquid wealth



(a) MPRD, negative net liquid wealth

(b) MPC, negative net liquid wealth

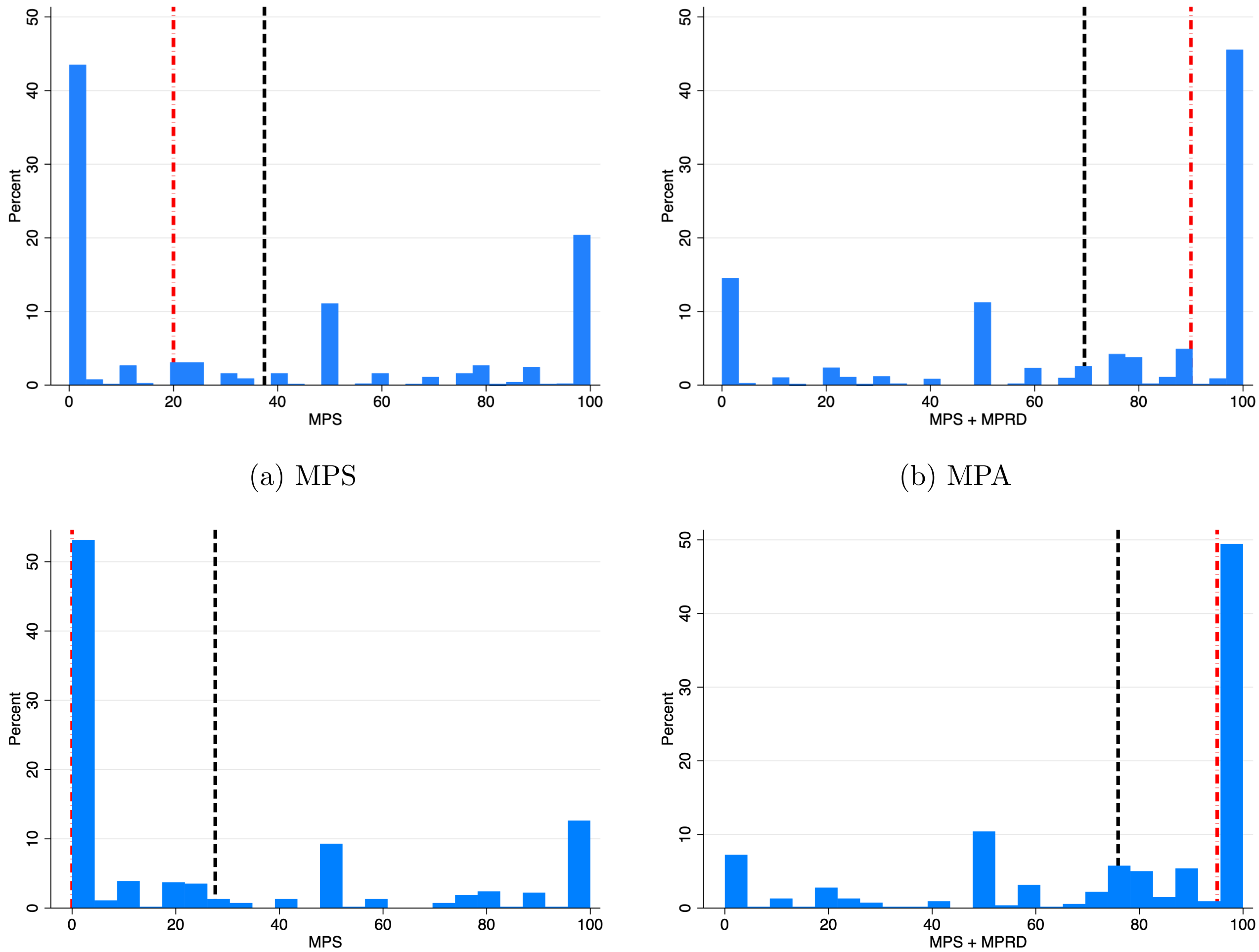
Notes. Panel (a) shows the histogram of self-reported MPRDs (the share of government payment used to pay down debts) for the sample with negative net liquid wealth. Panel (b) shows the histogram of self-reported MPCs (the share of government payment used to spend or donate) when we limit the sample to respondents with negative net liquid wealth. Figures B.4c-B.4d repeat the analysis for the MPS and MPA. In each figure, the black dashed line corresponds to the mean, while the red dash-dotted line corresponds to the median.

B.3 Main results in the Survey of Income and Program Participation

We use information from the 2020 and 2021 waves of the Survey of Income and Program Participation (SIPP) as another robustness check for our findings from the SCE. These waves include information on households' asset positions in December 2019 and on how they used the 2020 EIPs. We use this information to construct similar measures of net liquid wealth-to-income and gross unsecured debt-to-income ratios as we do for the SCE.

The primary difference between the SIPP and SCE is in the way the surveys ask about EIP

Figure B.4: Histograms of MPS and MPA



(a) MPS

(b) MPA

(c) MPS, negative net liquid wealth

(d) MPA, negative net liquid wealth

Notes. Panel (a) shows the histogram of self-reported MPSs (the share of government payment used to save) for the full sample of check recipients. Panel (b) shows the histogram of self-reported MPAs (the share of government payment used to save or pay down debt). Panels (c) and (d) show the same objects when we limit the sample to respondents with negative net liquid wealth. In each figure, the black dashed line corresponds to the mean, while the red dash-dotted line corresponds to the median.

usage. The SCE elicits the share of payments used to save, spend and to pay down debt, while the SIPP does not elicit quantitative shares and rather asks about whether the payment was mostly spent, saved or used to paid down debt. Specifically, the SIPP asks, “Did respondent mostly spend, save, pay off debt, or give away the EIP(s) received?”

Even with this underlying difference, the results from the SIPP are consistent with our findings from the SCE. We once again find that the average MPRD (38%) is as large as the MPC (33%), the MPRD falls with the net liquid wealth-to-income ratio (and rises with gross unsecured debt-to-income ratios) and that the MPC is (weakly) lower for those with lower net wealth-to-income ratios. We attribute the difference in coefficients to the different in the way the MPx are elicited between the two surveys.

Table B.3: MPRD, MPC, MPS, MPA & Net Liquid Wealth to Income Ratio

	(1) MPRD	(2) MPRD	(3) MPC	(4) MPC	(5) MPS	(6) MPS	(7) MPRD+MPS	(8) MPRD+MPS
Net liq w-to-inc	-4.51**	-4.17**	2.87**	3.18***	1.64	1.00	-2.87**	-3.18***
cond. on net liq w-to-inc <0	(1.95)	(1.95)	(1.14)	(1.21)	(1.81)	(1.84)	(1.14)	(1.21)
Net liq w-to-inc	-1.36***	-1.16***	0.80	0.52	0.56	0.64	-0.80	-0.52
cond. on net liq w-to-inc ≥0	(0.38)	(0.40)	(0.52)	(0.53)	(0.53)	(0.55)	(0.52)	(0.53)
Demographics		X		X		X		X
Region Dummies		X		X		X		X
Dep. Var. Mean	32.13	32.13	30.43	30.43	37.44	37.44	69.57	69.57
R^2	0.11	0.16	0.02	0.05	0.04	0.08	0.02	0.05
Observations	1387	1387	1387	1387	1387	1387	1387	1387

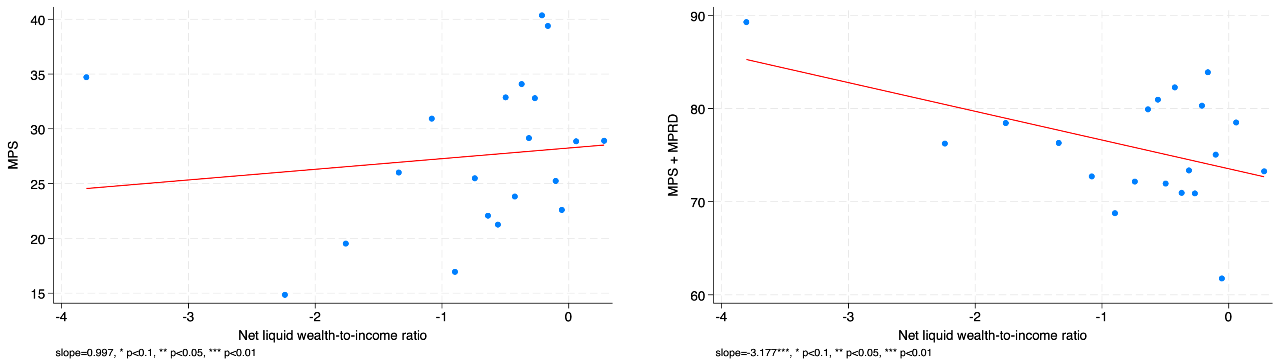
Notes. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Demographic controls include having a child under age 6, having a child under age 18, the marital status, gender, race, and age group of the household head, whether the household head lost their job between March 2020 and June 2020, and whether the household experienced a decline in income between March 2020 and June 2020.

Table B.4: MPRD, MPC, MPS, MPA & Other Household Balance Sheet Measures

	(1) MPRD	(2) MPC	(3) MPS	(4) MPRD+MPS
Panel A. Net Liquid Wealth				
Log net liq wealth	-3.07*	2.25*	0.82	-2.25*
cond. on net liq wealth<0	(1.59)	(1.32)	(1.43)	(1.32)
Log net liq wealth	-2.12***	-0.34	2.46***	0.34
cond. on net liq wealth≥0	(0.80)	(0.91)	(0.93)	(0.91)
Demographics	X	X	X	X
Region Dummies	X	X	X	X
Dep. Var. Mean	32.13	30.43	37.44	69.57
R^2	0.17	0.05	0.09	0.05
Observations	1387	1387	1387	1387
Panel B: Gross Unsecured Debt				
Log Gross Unsec.	2.60***	-0.98***	-1.62***	0.98***
Debt	(0.22)	(0.23)	(0.25)	(0.23)
Demographics	X	X	X	X
Region Dummies	X	X	X	X
Dep. Var. Mean	32.09	30.38	37.52	69.62
R^2	0.15	0.04	0.08	0.04
Observations	1403	1403	1403	1403
Gross Unsec.	10.11***	-5.02***	-5.08***	5.02***
Debt-to-Inc.	(1.52)	(0.95)	(1.47)	(0.95)
Demographics	X	X	X	X
Region Dummies	X	X	X	X
Dep. Var. Mean	32.09	30.38	37.52	69.62
R^2	0.10	0.04	0.05	0.04
Observations	1403	1403	1403	1403

Notes. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Demographic controls include having a child under age 6, having a child under age 18, the marital status, gender, race, and age group of the household head, whether the household head lost their job between March 2020 and June 2020, and whether the household experienced a decline in income between March 2020 and June 2020. In panel A, log net liquid wealth conditional on negative liquid wealth is $-\log(|a|+1)$, to facilitate the interpretation of the coefficients.

Figure B.5: MPSs, MPAs and net liquid wealth-to-income ratio for those with negative liquid wealth



(a) MPS (b) MPA

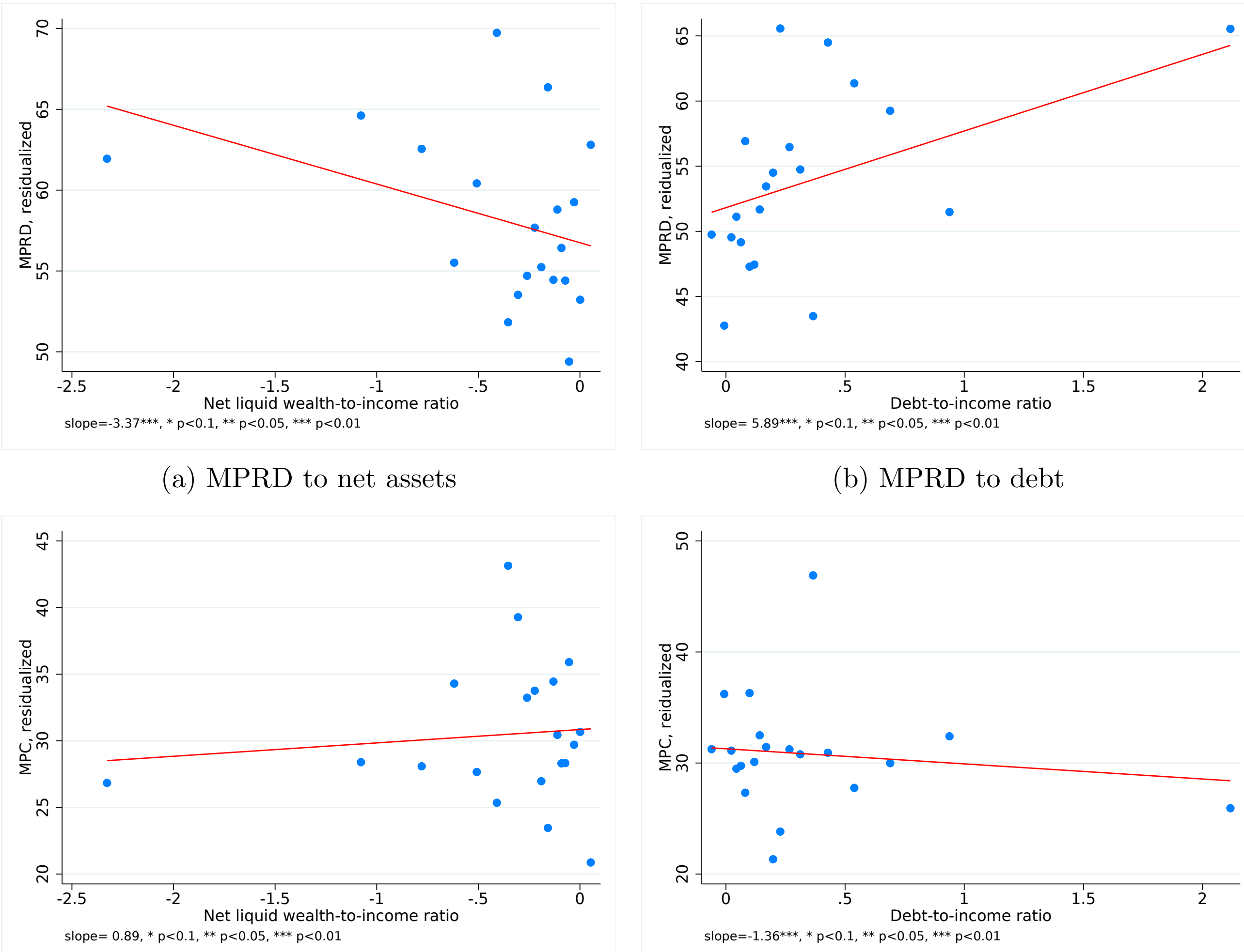
Notes. Panel (a) shows a bin scatter of the self-reported, residualized MPS by residualized net-liquid wealth to income ratio from the June 2020 SCE special survey. Panel (b) shows a bin scatter of the self-reported, residualized MPA by residualized net liquid wealth-to-income ratio from the same module. The controls include having a child under age 6, having a child under age 18, marital status, gender, race and age group of the household head, whether the household head lost their job between March 2020 and June 2020 and whether the household experienced a decline in income between March 2020 and June 2020.

Table B.5: MPRD, MPC, MPA & Net Wealth and Debt in the SIPP

	(1) MPRD	(2) MPRD	(3) MPC	(4) MPC
Panel A. Net Liquid Wealth				
Net liq w-to-inc	-3.59***	-3.37***	1.24**	0.89
cond. on net liq w-to-inc <0	(0.59)	(0.58)	(0.55)	(0.55)
Net liq w-to-inc	0.43	0.96	0.23	-0.19
cond. on net liq w-to-inc ≥ 0	(0.58)	(0.59)	(0.55)	(0.55)
Demographics		X		X
Region Dummies		X		X
Dep. Var. Mean	53.81	53.81	30.82	30.82
R^2	0.02	0.04	0.00	0.01
Observations	27175	27175	27175	27175
Panel B: Gross Unsecured Debt				
Unsecured	6.55***	5.88***	-1.84***	-1.36***
Debt-to-income ratio	(0.57)	(0.56)	(0.52)	(0.51)
Demographics		X		X
Region Dummies		X		X
Dep. Var. Mean	53.81	53.81	30.82	30.82
R^2	0.00	0.02	0.00	0.01
Observations	27175	27175	27175	27175

Notes. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Demographic controls include having a child under age 6, having a child under age 18, the marital status, gender, race, and age group of the household head, and whether the household experienced a decline in income between March 2020 and June 2020.

Figure B.6: MPRDs and MPCs against net liquid wealth-to-income ratio and unsecured debt-to-income ratio in the SIPP



(a) MPRD to net assets

(b) MPRD to debt

(c) MPC to net assets

(d) MPC to debt

Notes. The figures show residualized binned scatter plots of the self-reported, MPRD and MPC by net liquid wealth-to-income and unsecured debt-to-income ratios combining the 2020 and 2021 waves of the SIPP.

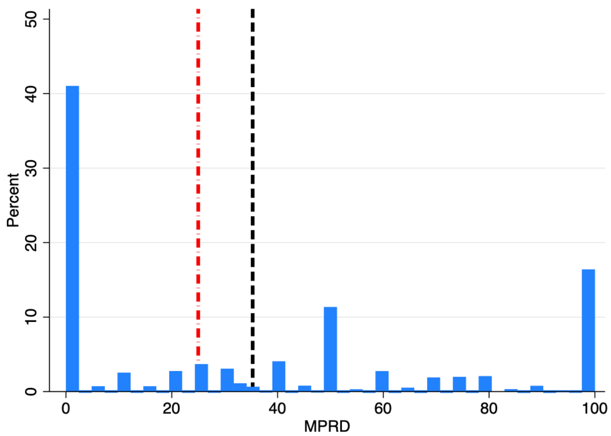
B.4 Responses to hypothetical scenarios

We consider two sets of responses to hypothetical scenarios, as discussed in Section 2.2. First, we use the Household Spending module that has been collected every 4 months since August 2015 as part of the NY Fed's SCE. In this module, households were asked to think about a hypothetical 10% increase in their household income and to report which fraction of it they would use to spend, save, or pay down debt. Figure B.7 show the histograms for the hypothetical MPRD, MPC, MPS, and MPA. We use the SCE's annual Housing Survey that is fielded annually since February 2014 to construct the net liquid wealth measure.[2] We define net liquid wealth as the difference between liquid assets and gross unsecured debt. Differently from the baseline measure in our paper, the wealth questions are elicited in bins and we assign each respondent

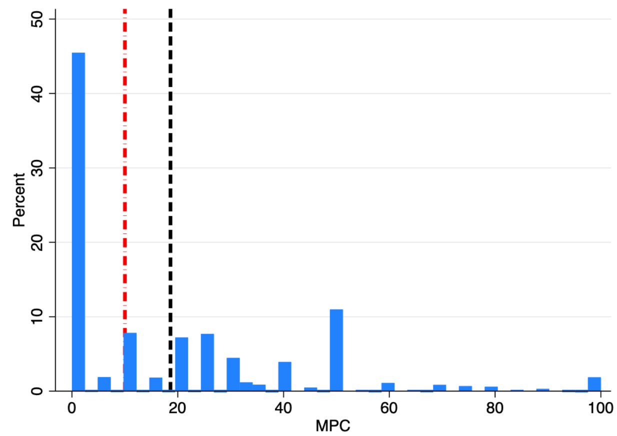
[2]Note that the wealth questions were continuously included in the survey only until 2020. We restrict the sample to December 2019.

the mid-point of their selected bin. Since both numerator and denominator are elicited in bins, using net liquid wealth-to-income ratios can come with (not necessarily classical) measurement error. Thus, we run the same specification as in Appendix Table B.4 controlling for household income. The results in Table B.6 confirm our main findings hold outside of COVID as well.

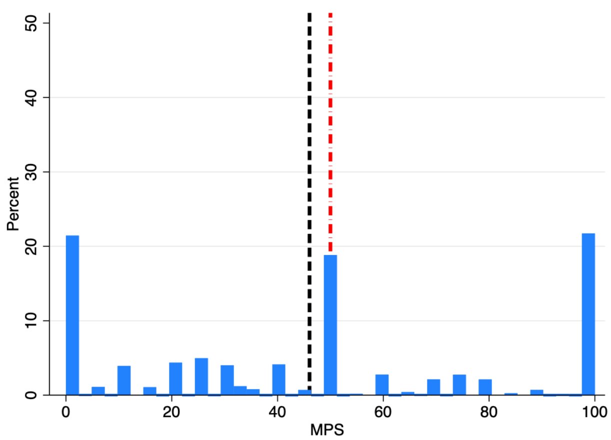
Figure B.7: Histograms of hypothetical MPRD, MPC, MPS, and MPA



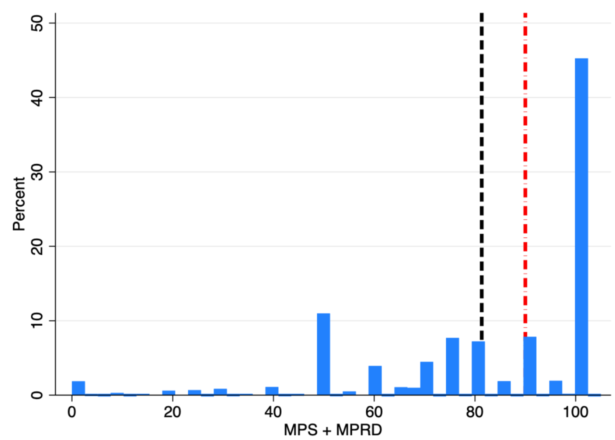
(a) MPRD



(b) MPC



(c) MPS

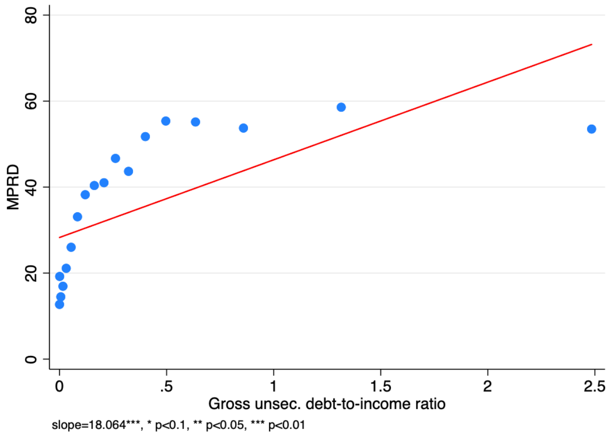


(d) MPA

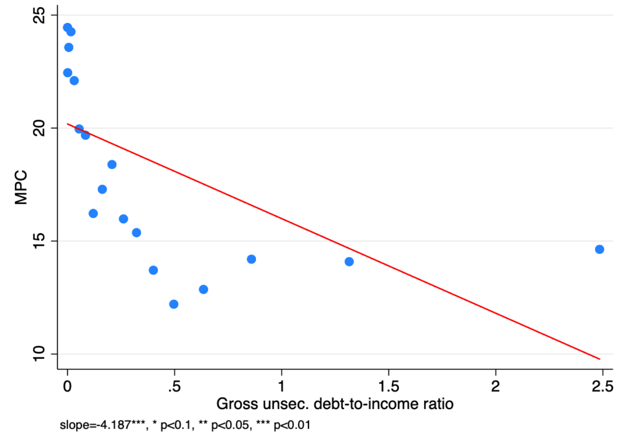
Notes. Panel (a) shows the histogram of self-reported MPRDs (the share of the additional household income used to pay down debt) out of a hypothetical 10% additional household income. Panel (b) shows the histogram of self-reported MPCs (the share of the additional household income used to spend or donate), panel (c) shows the histogram of self-reported MPSs (the share of the additional household income saved), and panel (d) shows the histogram of MPAs (the share of the additional household income used to pay down debts or saved) for the same question. In each figure, the black dashed line corresponds to the mean, while the red dash-dotted line corresponds to the median.

Using the SCE Credit Access module, we also construct a measure for gross unsecured debt. Figures B.8 confirm our main results for this measure too.

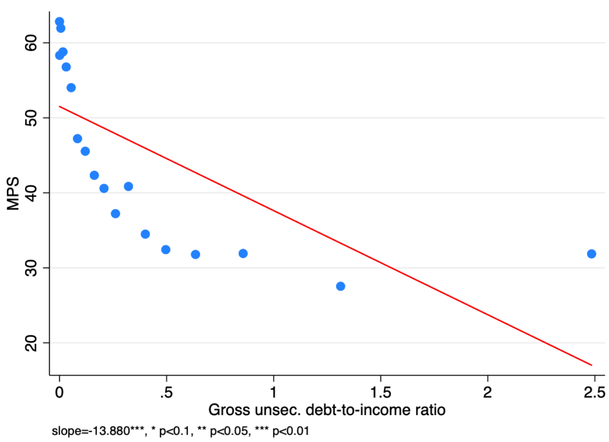
Figure B.8: Hypothetical MPRDs, MPCs, MPSs, MPAs and gross unsecured debt-to-income ratio



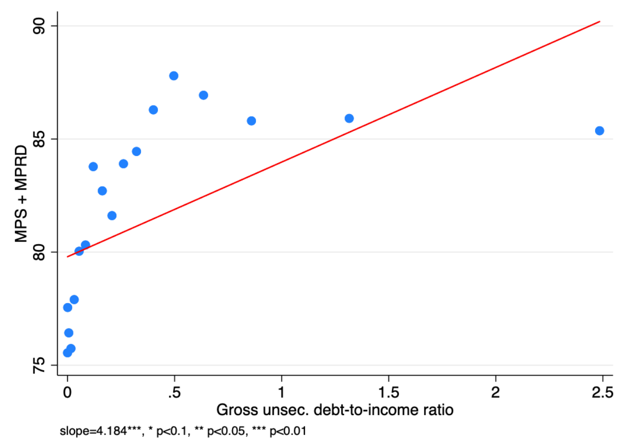
(a) MPRD



(b) MPC



(c) MPS



(d) MPA

Notes. The figures show binned scatter plots of the self-reported MPRDs, MPSs, MPCs and MPAs out of a hypothetical 10% additional household income by gross unsecured debt-to-income ratio from the SCE panel between August 2015 and March 2020.

Table B.6: Hypothetical MPRD, MPC, MPS, MPA & Net Liquid Wealth

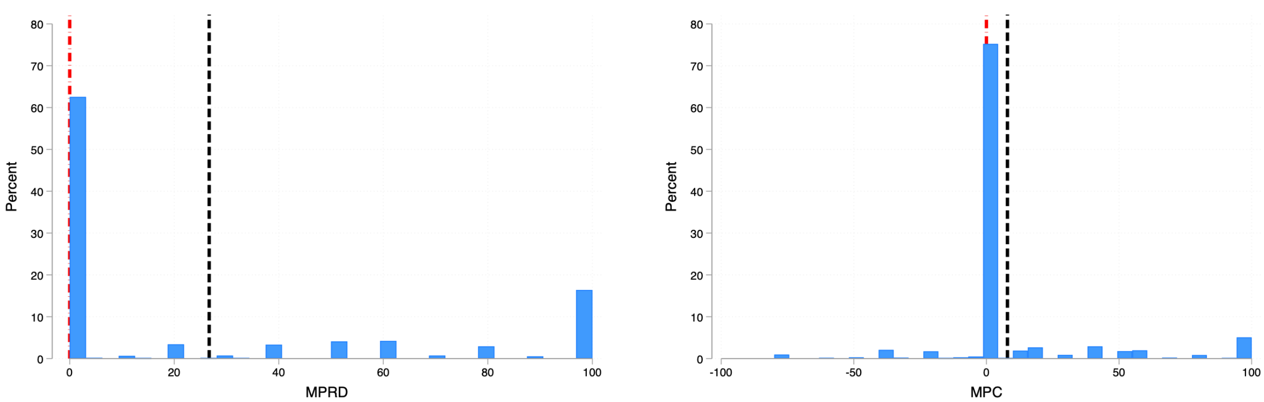
	(1) MPRD	(2) MPC	(3) MPS	(4) MPRD+MPS
Log net liq wealth	-2.72***	0.71**	2.01***	-0.71**
cond. on net liq wealth<0	(0.59)	(0.35)	(0.53)	(0.35)
Log net liq wealth	-1.94***	0.33***	1.61***	-0.33***
cond. on net liq wealth≥0	(0.15)	(0.10)	(0.15)	(0.10)
Demographics	X	X	X	X
Region Dummies	X	X	X	X
Dep. Var. Mean	34.78	18.66	46.56	81.34
R^2	0.16	0.02	0.11	0.02
Observations	5568	5568	5568	5568

Notes. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Demographic controls include having a child under age 6, having a child under age 18, the marital status, gender, race, and age group of the household head.

As an additional analysis, we consider the approach used in Fuster et al. (2021) to elicit spending responses in hypothetical scenarios. To do this, we use data collected by Fuster et al. (2021) as part of the SCE in 2016 and 2017. We construct MPCs and MPRDs closely following their approach, including winsorization of these measures at the 2.5th and 97.5th percentiles. There are two key differences in the way Fuster et al. (2021) elicit MPRDs, MPCs and MPSs from the previously discussed hypothetical questions: First, here the hypothetical unexpected income gain is lump sum ($500 in the measure we consider) and its size is equal for all households, rather than a fraction of their income. Second, these scenarios ask households to report whether they would use this gain to spend (or save or pay down debt) more (the same, or less) than they would if they had not received the income windfall. Then, the households are asked to quantify the extent of their adjustment in spending, saving or debt repayment behavior. That paper includes more details on their questions.

Based on the survey responses, we find that households report an average MPC of 7%, an average MPRD of 26.7% and an average MPA of 48%. When we limit the sample to respondents with negative net liquid wealth-to-income ratios, we find that the average MPC is again 7%, while the average MPRD becomes 34.1%. Hence, these measures are in line with our baseline results on the MPRD distribution. The histograms presented in Figure B.9 show that around 75% of the respondents report a zero MPC and around 62% report a zero MPRD.

Figure B.9: Histograms of hypothetical MPRD and MPC from Fuster et al. (2021)



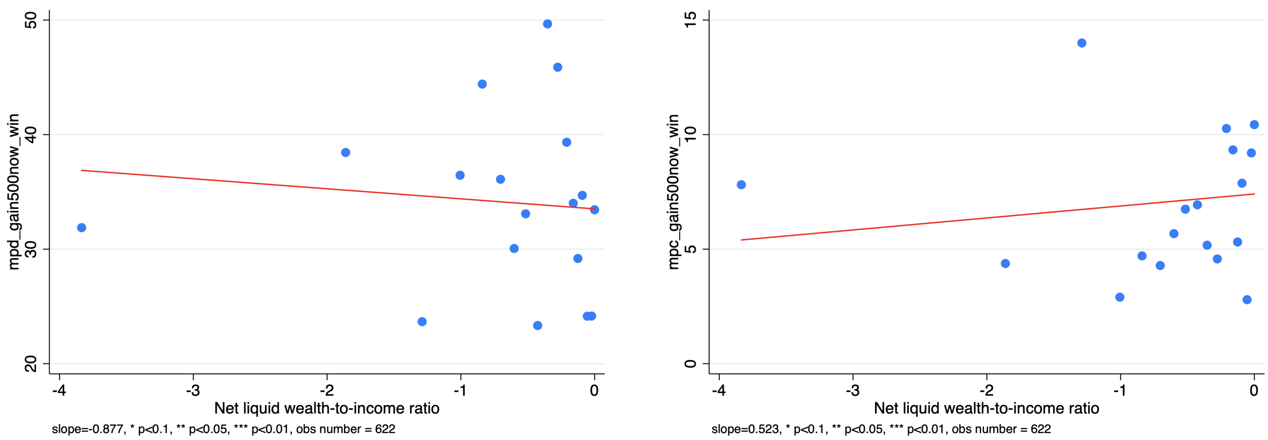
(a) MPRD (b) MPC

Notes. Panel (a) shows the histogram of self-reported MPRDs in the following 3 months out of a hypothetical, one time, $500 payment. Panel (b) shows the histogram of self-reported MPCs for the same question. This measure of MPRD shows the change in the amount of debt payment compared to the case of no $500 payment. Similarly, this measure of MPC shows the change in respondents' consumption when they receive a one time $500 payment, compared to a case where they don't receive any additional payments. Both measures are calculated using the data by Fuster et al. (2021). In each figure, the black dashed line corresponds to the mean, while the red dash-dotted line corresponds to the median.

Figure B.10 confirms that MPRDs decrease and MPCs increase with the net liquid wealth-to-income ratio, although this relationship is statistically insignificant,[3] when we limit the sample to those with negative net liquid wealth-to-income ratios. Fuster et al. (2021) also note that MPCs out of gains are rarely statistically related with explanatory characteristics. One explanation

[3]Here we consider responses to a hypothetical $500 gain, but results are similar for the $2500 gain, but with an even smaller sample size.

Figure B.10: Hypothetical MPRD, MPC (from Fuster et al. (2021)), and net liquid wealth-to-income ratio



(a) MPRD

(b) MPC

Notes. The figures show binned scatter plots of the self-reported MPRDs and MPCs using the data by Fuster et al. (2021), by net liquid wealth-to-income ratios.

for this observation could be that the vast majority of households report zero MPCs. Another would be that the sample size is relatively low. The figure also might suggest a U-shaped pattern of MPCs (except for one extreme outlier bin), which would also be consistent with our model in which borrowing constraints might affect the very bottom of the distribution. We also find that the MPA is negatively related with net liquid wealth-to-income ratios, confirming our main findings.

The same module fielded by Fuster et al. (2021) also includes the following question: "In case of an unexpected decline in income or increase in expenses, do you [or your spouse/partner] have at least two months of covered expenses available in cash, bank accounts, or easily accessible funds?". We recode this variable such that a "No" is 1 and "Yes" is 0. In columns (1) and (4) of Table B.7 we regress MPRD and MPC out of a one-time \$500 windfall on this binary variable. We find that MPRDs are statistically larger for households that do not have two months of covered expenses. For consistency with the model, we restrict the sample to respondents with weakly negative net liquid wealth in these regressions, but our results are unaffected if we instead include all households in our analysis.

We also use responses to questions on time discounting from the SCE Housing module of February 2016 as Fuster et al. (2021) to construct discount factors. Respondents in this module were asked to choose between \$160 in a month from today or various smaller amounts of money now. We closely follow the approach by Fuster et al. (2021) and label respondents as having a "high discount factor" if they prefer any of the smaller amounts of money today to \$160 in a month, described in greater detail in their paper. Columns (2) and (5) in Table B.7 show that respondents with larger discount factors – those who are more patient – have lower MPRDs and MPCs, but these relationships are not statistically significant.

Finally, in columns (3) and (6) we show that MPRDs and MPCs are uncorrelated with measures of risk aversion. The risk aversion measure we use is derived from a Likert-scale of 1 to 7, where 1 refers to "not willing to take risks regarding financial matters" and 7 refers to being "very willing to take risks regarding financial matters". We construct a dummy variable for having above-median risk aversion from these responses to include in our regression. Again, we do not find a statistically significant relationship between risk aversion and either the MPRD or the MPC.

Table B.7: MPRD, MPC and preference heterogeneity

	(1) MPRD	(2) MPRD	(3) MPRD	(4) MPC	(5) MPC	(6) MPC
Not having 2 months of covered expenses available in cash	14.48***			-1.51		
	(2.95)			(2.07)		
Having a high discount factor		-4.36			-0.34	
		(2.65)			(1.98)	
Above-median risk aversion			1.62			0.40
			(1.91)			(1.40)
Constant	21.36***	28.05***	25.88***	9.81***	9.46***	7.73***
	(1.44)	(2.09)	(1.35)	(1.14)	(1.55)	(0.98)
Dep. Var. Mean	25.36	25.48	26.69	9.39	9.26	7.93
R^2	0.03	0.00	0.00	0.00	0.00	0.00
Observations	905	884	1677	905	884	1679

Notes. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. No demographic controls are included. The results are very similar when we control for having a child under age 6, having a child under age 18, marital status, gender, race and age group of the household head.

B.5 Interpretation of survey questions

In April 2025, we fielded open-ended response questions after the hypothetical MPC questions in the SCE, in order to shed light on households' interpretation of reported allocations of hypothetical income windfalls. Specifically, if the respondent reported a non-zero share of saving or debt payment in the hypothetical questions, we asked them what kind of debt(s) they would pay down or what form of saving or investment they would engage in with the extra income, separately. The responses show that households think about paying their credit card debt, car loans, personal loans, and in some cases, student loans and mortgages when they report they would pay down their debt. On the contrary, with respect to saving, respondents cite putting the extra income in high-yield savings accounts, bonds and CDs, and in some cases retirement accounts such as IRAs and 401ks. All in all, households appear to understand that debt repayment is a distinct action from saving, and also distinct from spending. Crossley et al. (2024) also elicit open-ended responses to understand reported MPCs. They find that very few high-MPC individuals misclassified debt repayments as spending. They confirm our findings that low liquidity individuals often report debt repayments as a reason for their low MPCs. Moreover, across the distribution of household balance sheets, we do not observe any differences in the way MPRDs are interpreted. The homogeneity of interpretation suggests that our results are not driven by heterogeneity in (reporting) bias, as we expand on below.

One common worry in survey responses is whether the respondents misreport their own behavior to conform with social desirability bias Bursztyn et al. (2025). In our June 2020 survey, since respondents were asked detailed questions about their household balance sheets *before* they respond to questions about how they used their stimulus checks, the responses may suffer from desirability bias, which in turn might impact the reported MPRDs. However, there should be limited (if any) social desirability bias in the SCE hypothetical questions because these modules do not include any questions about the respondents' household balance sheets at all. Therefore, the fact that the data from hypothetical questions also display a similar relationship between MPRDs and households' net liquid wealth positions suggests that desirability bias is not driving our results. In addition to this, we validate the MPRD responses using a question asked earlier in the same June 2020 survey. Specifically, respondents were asked about their current credit card debt levels and how these compared to their debt levels in February 2020. Those who reported their credit card to have decreased between February and June 2020 were then asked about the factors that played a role in this decline, with the following options (respondents were asked to select all that apply): reduction in spending, increase in household income, use of government stimulus payment, skipping mortgage payment(s) due to forbearance programs, skipping student debt payment(s) due to forbearance programs. We find that there is a positive and economically and statistically significant relation between the share of respondents reporting to have used the stimulus payment to pay down their credit card debt and their reported MPRDs. Those who report using stimulus checks to pay down their credit card debt have 16pp higher MPRDs. Since the reported use of stimulus check for the reason of a decline in unpaid balances should not suffer from a social desirability bias, this cross-validation shows the reported MPRDs are consistent with respondents' reported behavior.

B.6 Debt repayments and interest rates

B.6.1 Data

In this section we describe the Consumer Credit Panel (CCP) data and details of the empirical analysis on debt repayments and interest rates, presented in Section 4.1.1.

We start by selecting a 0.01% random sample of Social Security Numbers from the tradeline–level CCP maintained by the Federal Reserve Bank of New York. The data is at the (credit card) account level with quarterly frequency.[4] We observe an anonymized identifier for the account owner. The dataset contains information for a maximum of 10 credit cards per individual at each point in time.

We restrict the attention to the period 2017–2024, for which we have data at quarterly frequency. Then we drop duplicated accounts that we cannot follow over time.[5] Next, we drop accounts that are never classified as CCAR in any of the time periods.[6] We drop accounts that are ever classified as "open" (the entire balance is due each month) or "installments" (i.e., fixed number of payments). For the few observations in which the balance is less than the minimum payment, we replace the balance with the payment. We drop any accounts for which the balance is equal to 0 for every quarter in the time series.

To construct our interest rate measure, we follow Guttman-Kenney and Shahidinejad (2024) and use the fact that minimum monthly credit card payments – which we observe in the CCP – are deterministically calculated as

$$m_t = \max\{\mu, \theta B_t + f_t\}, \tag{B.2}$$

where m_t is the monthly minimum payment, μ is the "floor" dollar amount determined by the

[4] The data is a "snapshot" of a credit card account taken on the last available date of a quarter (i.e, the last available credit card statement in the quarter).

[5] Duplicates in the dataset can occur if an individual opens multiple accounts in the same month.

[6] The Comprehensive Capital Analysis and Review (CCAR) is a regulatory framework that requires banks

creditor, θ is a percentage determined by the creditor, $B_t = b_t - f_t$ is the statement balance *before* financing charges and f_t the financing charges, which typically combine fees and interest rate payments.[7] b_t is the overall statement balance, which we observe in the CCP. We can rewrite this relationship as follows, where we followed Guttman-Kenney and Shahidinejad (2024) and assumed that in the case that balances are below the floor amount μ, the balance rather than the floor is owed:

$$m_t = \begin{cases} b_t & \text{if } b_t \leq \mu \\ max\{\mu,\ \theta b_t + (1-\theta) f_t\} & \text{if } b_t > \mu \end{cases} \tag{B.3}$$

To make the method operative, we need to pick values for μ and θ. Guttman-Kenney and Shahidinejad (2024), using data up to December 2012, find that the most common combination parameters is $\mu = \$25$ and $\theta = 0.01$. Manually inspecting various credit card agreements collected by Consumer Financial Protection Bureau (CFPB), we find that, for more recent agreements, there are other very common values of μ, such as 30, 35, 39, 40, 41.

We set μ in the following way: For every quarter-TLID pair that has a minimum payment (m_t) equal to any value between 25 and 41 dollars, we set μ equal to the observed minimum payment. Note that this is conservative because it is likely biasing financing charges to zero for some of these small payments. If an observation does not have a minimum payment equal to such a value, we assign μ to be the most recent, previous, non-missing μ value in the specified range. We set $\theta = 0.01$.

We then proceed to estimate account-quarter level financing charges f. If $b \leq \mu$, $f = 0$. If both b and m are above μ, the equation implies that $f = \frac{m-\theta b}{1-\theta}$ if $m > \theta b$; we set $f = 0$ otherwise. If m is exactly equal to μ, we make a conservative choice and assume that $f = 0$. Finally, if $m < \mu$, we conjecture that μ is not the correct floor value, and thus replace μ with m which thefore implies that $f = 0$.

In our empirical analysis, we further exclude observations for which the balance is equal to the minimum payment when the balance is greater than μ. These are likely to be "charge cards", for which the entire balance is due at every period and thus the formula we use above does not apply. We also drop all instances of delinquency, the observations in which the balance is equal to 0, and individuals with credit score below 500. This leaves us with about 835,000 account-time observations.

We define our proxy for the effective interest rate, for each account and each quarter, as $r = \frac{f}{B}$, which is the analog of what we measure in the model. We annualize r by multiplying it by 12 and express it in percent. To deal with measurement error, we winsorize r at 50% AR. Finally, we aggregate r at the individual level, for each quarter, in two ways: the average r (across accounts, at a point in time, for each individual) and the marginal r (the maximum interest rate across accounts, at a point in time, for each individual). Balances are the sum across accounts for each individual at each time period.

B.6.2 Empirical evidence

With the dataset described above, we uncover three sets of findings that provide direct support for our mechanism.

to report information to the Federal Reserve.

[7]Note that without observing actual payments, it is not possible to disentangle card fees from interest rate

First, we find that interest rates are increasing and concave in credit card balances, as shown in Figure 6 of Section 4.1.1. This is exactly consistent with the convex price schedule $q(\cdot)$ that comes out of our model calibration.

Second, we find that decreases in balances (i.e., debt repayments) are associated with declines in interest rates, as we show in Table B.8. This provides direct empirical support of our model mechanism that personal interest rates decline, at a quarterly frequency, when debt is repaid. To quantitatively map these results to our model, we have standardized debt balances both in the model and in the data, such that they have the same unit.[8] In the model, we run the exact same regression as in the data and we find a coefficient of 2.19, which lies well within our empirical estimates of Table B.8.

Table B.8: Sensitivity of interest rates to debt repayments

	Δ Interest rate					
	(1) Average	(2) Marginal	(3) Average	(4) Marginal	(5) Average	(6) Marginal
Δ Balance (standardized)	1.50***	2.65***	1.48***	2.62***	1.16***	2.23***
	(0.14)	(0.24)	(0.14)	(0.24)	(0.23)	(0.41)
R-squared	0.006	0.009	0.006	0.010	0.005	0.010
Observations	381,902	381,902	381,902	381,902	131,633	131,633
Time FE			✓	✓	✓	✓
Pre-Covid Only					✓	✓

Notes. Source: NY Fed CCP / Equifax. Data is at the individual level, between 2017-q4 and 2024-q4. Interest rates and debt balances defined as in the text and in Figure 6. Debt is standardized as described in the text. Columns (5) and (6) restrict the sample to end in the last quarter of 2019.

Third, the relationship is concave, even within individuals. We regress changes in the interest rate an individual faces on changes in balances at different balance quantiles, and plot the regression coefficient estimates in Figure 7 of Section 4.1.1. We find that this sensitivity declines with the balance, once again consistent with the convex $q(\cdot)$ function in our model. Quantitatively, the coefficients are also broadly in line with the equivalent regression coefficients in the model.

One channel through which effective interest rates are sensitive to debt repayments is the extensive margin. As the balance increases, the number of credit accounts associated with positive financing charges rises, as we show in Table B.9 below. By operating along this extensive margin, debt repayments allow individuals to move along an effectively concave schedule of interest rates.

payments in financing charges. However, card fees are generally fixed amounts, they are mostly paid in the form of initiation fees or once a year as card fees, and they are relatively low compared to the interest payments especially at higher balances. In addition, card fees do not tend to vary with the balance of the card. For these reasons, the relationship we uncover between the effective interest rates and the balances at the cross section and the individual level should not be affected by fees.

[8]That is, we divide the balance by the overall standard deviation of all debt balances.

Table B.9: Extensive margin adjustment

	Number of Cards with Positive Financing Charges		
	(1)	(2)	(3)
Total Balance	0.07***	0.07***	0.05***
	(0.00)	(0.00)	(0.01)
R-squared	0.728	0.729	0.805
Observations	423,871	423,871	154,065
Individual FE	✓	✓	✓
Time FE		✓	✓
Pre-Covid Only			✓

Notes. Source: NY Fed CCP / Equifax. Data is at the individual level, between 2017-q4 and 2024-q4. Interest rates and debt balances defined as in the text and in Figure 1. Debt is in thousand of dollars. The dependent variable in the regression estimates in the table is the number of credit cards with associated positive financing charges that an individual holds in a given quarter.

C Supplemental quantitative results

C.1 Constant q recalibration

Figure C.1 repeats the analysis of Section 4.2.1 in a model with constant q and where households face an exogenous borrowing limit equivalent to the one generated in our baseline model. We recalibrate β to match the empirical share of households with negative net liquid wealth.

C.2 Optimal Policy

When the planner can only target rebates based on income, she solves:

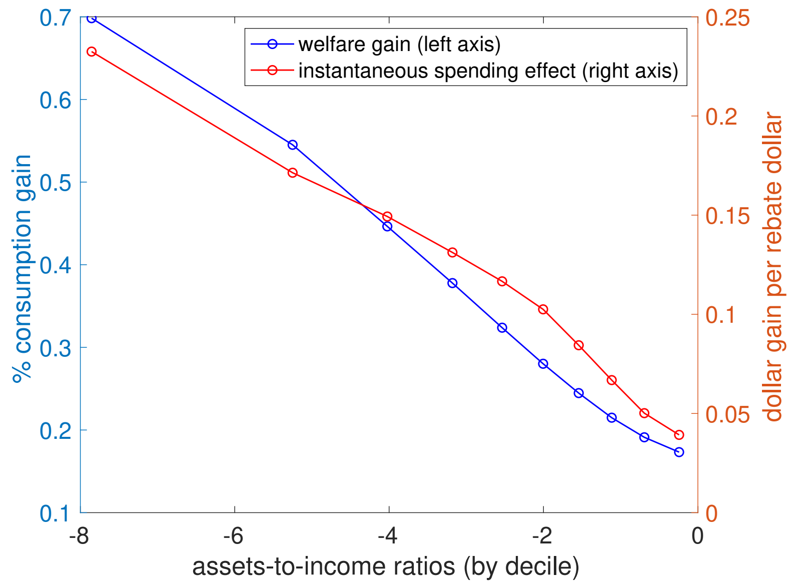
$$\max_{\{\tau(\epsilon,z)\}} \sum_a \sum_z \sum_\epsilon f\left(a,z,\epsilon\right) \Omega\left(a+\tau\left(\epsilon,z\right),\epsilon,z\right)$$
$$\text{subject to} \sum_a \sum_z \sum_\varepsilon f\left(a,z,\varepsilon\right) \tau\left(\epsilon,z\right) \leq H$$

where H is the total aggregate size of the fiscal package, f is the steady state distribution of households across assets, permanent, and transitory income in the model being considered, and $\Omega\left(a+\tau\left(\epsilon,z\right),\epsilon,z\right)$ is equal to either welfare $V\left(a+\tau\left(\epsilon,z\right),\epsilon,z\right)$ for the welfare-maximizing objective, or upon impact consumption $c_0\left(a+\tau\left(\epsilon,z\right),\epsilon,z\right)$ for the consumption-maximizing objective.

The following exercise compares rebates to debt-service targeting, and assumes that households either receive the rebate or not. For the rebate, the planner solves:

$$\max_{\{\mathbf{I}(a,\epsilon,z)\}\in\{0,1\}} \sum_a \sum_z \sum_\epsilon f\left(a,z,\epsilon\right) \Omega\left(a+\mathbf{I}\left(a,\epsilon,z\right)\bar{\tau},\epsilon,z\right)$$
$$\text{subject to} \sum_a \sum_z \sum_\varepsilon f\left(a,z,\varepsilon\right) \mathbf{I}\left(a,\epsilon,z\right)\bar{\tau} \leq H$$

Figure C.1: Stimulus vs insurance across households - constant q



Notes. Model with constant q and exogenous borrowing limit set to the minimum admissible level of net assets in the baseline model. To match the share of households with negative net liquid wealth, $\beta = 0.9875$. We bin the stationary distribution of households' assets–to–income ratios, conditional on $a < 0$, by 10 deciles of equal mass. For each decile, we plot the average welfare gain due to the transfer, in blue, and the dollar-for-dollar spending effect of the transfer upon impact, in red.

where $\bar{\tau} = \$1200$. This differs from the problem above since the planner chooses indicators for receipt for each a, ϵ, z and a given $\bar{\tau}$ rather than choosing continuous rebate amounts for ϵ, z. For the debt-service targeting, the planner solves:

$$\max_{\{\mathbf{I}(a,\epsilon,z)\}\in\{0,1\}} \sum_a \sum_z \sum_\epsilon f(a,z,\epsilon)\,\Omega\left(a + \mathbf{I}(a,\epsilon,z)\,\hat{\tau}(a,\epsilon,z), \epsilon, z\right)$$

$$\text{subject to} \sum_a \sum_z \sum_\varepsilon f(a,z,\varepsilon)\,\mathbf{I}(a,\epsilon,z)\,\hat{\tau}(a,\epsilon,z) \leq H$$

where here $\hat{\tau}(a,\epsilon,z) = -a'(a,\epsilon,z)\left(1 - q\left(a'(a,\epsilon,z)\right)\right)\mathbf{I}(a'(a,\epsilon,z) < 0)$, that is, the debt-service payment for household (a,ϵ,z).

The aggregate welfare gains of Table 3 are constructed as follows. The post-transfer value of a household is $V(a+\tau,\epsilon,z) = \sum_{t=0}^{T} \beta^t u\left((1+\lambda(a,\epsilon,z))\,c_t\right)$. Using log-utility, maximizing aggregate welfare is equivalent to maximizing $\Phi = \int_a \int_z \int_\epsilon \frac{1}{1-\beta} \log(1+\lambda(a,\epsilon,z)) f(a,\epsilon,z) d\epsilon dz da$, where $f(\cdot)$ is the stationary distribution of households. The upper panel of the table reports the transfer-induced percent gain in aggregate welfare, which is equivalent to $100 * \frac{\Phi}{\int_a \int_z \int_\epsilon V(a,\epsilon,z) d\epsilon dz da f(a,\epsilon,z)}$. The lower panel reports the percent gain in aggregate consumption.

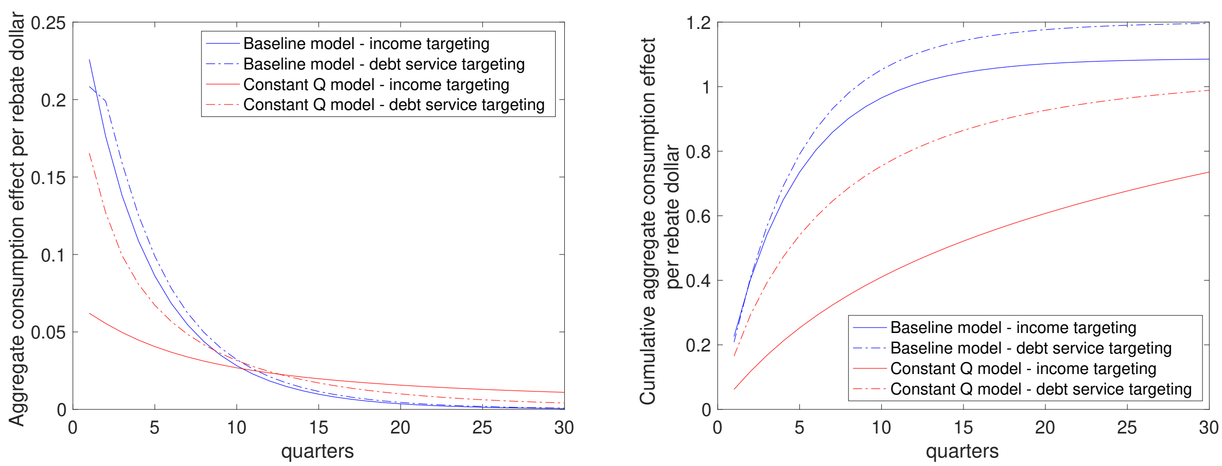
The 2020-EIP exercise presented in Column III of Table 3 is structured as follows. We treat each model agent as a single-earner household without kids, so if their adjusted gross income was less than or equal to $75,000 in 2019, they received a payment of $1,200, which we approximate with 10% of average quarterly income. In accordance with data from the IRS, Statistics of Income Division (November 2021) on the distribution of single filers' income in

2019, we allocate the $1200 check to the first 88 percentiles of the income distribution, phasing out the check thereafter; agents in the top 6.5% of the income distribution receive no payment since their income exceeds $100,000 per year and they are thus ineligible. Analogously, in Figure 11, the size of the package is equivalent to 88% of the population receiving a check of 10% of their quarterly income.

Figure C.2 below shows the dynamics of fiscal multipliers in the baseline model and in a model with a constant $q(\cdot)$, under income-targeted transfers and debt service targeting, both discussed in Section 4.2.3. We show this via aggregate intertemporal MPCs: hence, the vertical axis shows, for each time period, the aggregate consumption effects per rebate dollar transferred to households.[9]

Our baseline model delivers bigger upon-impact increases in aggregate consumption. However, these effects are also more persistent, as evident by the cumulative impulse responses on the right-hand side. As such, our analysis suggests that debt-sensitive prices not only matter for the short-run persistence of intertemporal MPCs, but also for the amplification of fiscal policy several years out. This is particularly true for the debt-service allocation. Seven years after the rebate, 20% more than the overall size of the fiscal package has been spent by households, consistent with the large welfare effects showed in Table 3.

Figure C.2: Aggregate spending effects of a transfer: optimal policy



Notes. In the constant q model, $\beta = 0.9875$ to match the empirical share of households with negative net liquid wealth.

C.3 Interest rate wedges in the quantitative model

As described in Section 4.1.1, the incomplete markets literature sometimes features a wedge raising the interest rate at which households borrow relative to their rate when saving. This interest rate wedge, ϕ_0, is a simple form of $q(\cdot)$ menu in which $q'(\cdot) = 0$ nearly everywhere except

[9]The dynamics would be the same if we plotted the percent effect normalized by the size of the transfer, as we did in Table 3; only the scale differs.

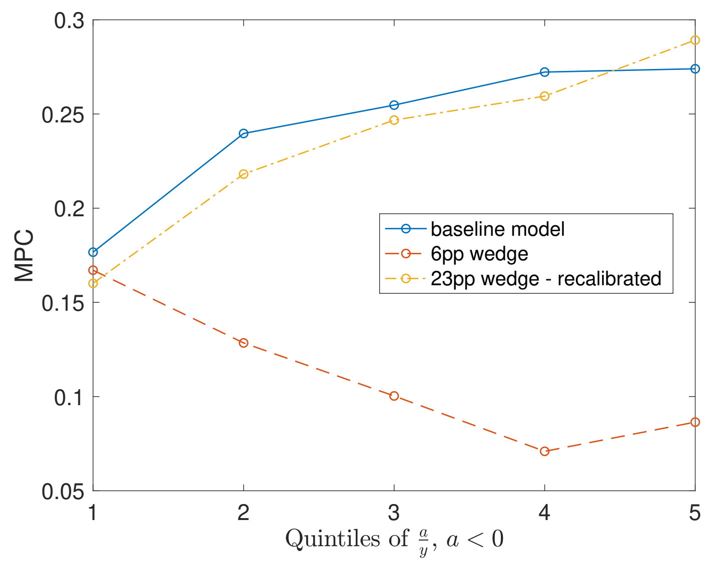
in the neighborood of $a' = 0$:

$$\frac{1}{q(a')} - 1 = \begin{cases} r + \phi_0 & a' < 0 \\ r & a' \geq 0 \end{cases}$$

This makes the consumption function convex at least locally near zero assets. In Section 4.1.1 we described how wedges of various sizes performed in our quantitative model: here we provide additional detail.

We explored wedges of 6% and 23% (annualized), the former being the calibrated value in Kaplan et al. (2018) and the latter being the value of ϕ_0 that best fits our pattern of MPCs against assets-to-income ratios. In this second case, we also recalibrate β to 0.966, which delivers the best fit among this class of models. Figure C.3 shows the MPC for both of these economies next to our baseline case with the flexible $q(\cdot)$ schedule. While the 6% wedge does create some region of increasing MPCs very close to the $q'(\cdot)$ discontinuity at 0, the MPC is mostly downward sloping through the negative asset space.

Figure C.3: MPC with calibrated wedges and the baseline $q(\cdot)$



Notes. For each model, we bin the stationary distribution of households' assets–to–income ratios, conditional on $a < 0$, by 5 quintiles of equal mass. For each quintile, we plot the average MPC. We plot in blue the baseline calibrated model, in dashed red a model with a 6 percentage-point interest rate wedge and β fixed at 0.97, and in dash–dotted yellow a 23 percentage-point wedge and β recalibrated to 0.966.

By increasing the wedge ϕ_0 to 23% we can increase the upward sloping region. On the one hand, a higher wedge increases the MPC of households near zero debt. Moreover, it expands the asset portion over which the wedge, in expectation, affects the consumption function. On the other hand, a higher wedge lowers the MPC in the lowest net-assets-to-income quintile. This is because the natural borrowing limit – and expectation of coming near it – affects very few households. At the same time, these low asset holders are relatively less affected by the interest rate wedge, because they are far away from it in the asset space. Hence, these households are in a gap between two locations where their Euler Equation would be distorted and act nearly like permanent income households. As we noted in the text, this outcome is quantitatively dependent on the income process, since the latter determines in what portion of the negative asset domain the wedge meaningfully distorts the Euler Equation.

D Endogenous default model

In this section, we discuss in detail how our main results hold in a model of endogenous default, where interest rates (or, equivalently, q) are determined endogenously in equilibrium. We proceed in three steps. First, we use a general model of endogenous default to fix ideas and show that with the correct choices of functional forms, the endogenous default model essentially nests our main baseline model. Second, we specialize the model – following the literature – and show how and why MPCs are still increasing with net liquid wealth, in a two-period framework like the one of Section 3.1. Third, we extend the model to a quantitative setting in infinite horizon, and show that not only are MPCs still increasing with net liquid wealth, but also that our main macro results from Section 4.2 hold with endogenous default.

D.1 From preferences to interest rates in a default model

To start, we present what is mostly a canonical model of household default. It has a few differences which we highlight that make analytical results simpler. For example, rather than a discrete choice of full bankruptcy, we allow for partial default, so the choice variable is a continuous one, d, as in Herkenhoff (2019) or Arellano et al. (2023). Moreover, instead of a dynamic cost of default or delinquency, the cost is felt immediately as a utility term $\psi(d, a, y)$. The disutility from default happens in the period the household does not pay, but the debt does not roll over, and there is no exclusionary period from markets.

The household problem can then be written as

$$V(a, y) = \max_{c,a',d} u(c) - \psi(a, d, y) + \beta E V(a', y') \tag{D.4}$$

$$\text{s.t.} \quad c + a' q(a', y) = y + a(1 - d) \tag{D.5}$$

As in many of these models, we will assume that lenders are risk-neutral and that there is free entry. Hence, the interest rate charged on borrowing a' is actuarially fair:

$$q(a', y) = \frac{1}{1 + r} E[1 - d'(a', y')] \tag{D.6}$$

where q depends only on a' if y is iid.

When there is an interior solution to d and a', the solution is defined by a modified Euler equation and a static first-order condition on d. This means that households equate the marginal utility of consumption with the negative marginal utility of default

$$-u'(\cdot)a = \frac{\partial \psi}{\partial d}(a, d, y) \ .$$

The Euler equation is as follows:

$$u'(c)\left(q(a', y) + \frac{\partial q(a', y)}{\partial a'} a'\right) = \beta E\left[u'(c')(1 - d') - \frac{\partial \psi(a', d', y')}{\partial a'}\right] \tag{D.7}$$

This is very similar to our initial generalized Euler equation except that there are two additional terms that lower the right side: $1-d'$ interacts with the next-period marginal utility of consumption, and $\frac{\partial \psi}{\partial a'}$ shifts its level.

From here, we can establish that ψ can imply nearly any interest rate schedule. This is particularly easy to see if we specialize its form to be $\psi(a,d,y) = (1-d)\check{\psi}(a)$ and that q is only a function of a'. In this case, our first-order conditions become

$$u'(c)\left(q(a') + \frac{\partial q(a')}{\partial a'}a'\right) = \beta E\left[(1-d')\left(u'(c') - \frac{\partial \check{\psi}(a')}{\partial a'}\right)\right] \tag{D.8}$$

In the simplest version, for which we can almost get a closed-form solution, we will assume that y is i.i.d and that, in expectation, consumption and default choices are uncorrelated, which could happen if d is not chosen strategically, for example. To be clear, this simplification is just to illustrate the isomorphism with our exogenous q model more clearly, but the logic applies without this assumption. Rearranging and using our equilibrium condition $q(a') = \frac{1}{1+r}E[1-d']$, invoke orthogonality $E[u'(c')(1-d')] = E[u'(c')]E[(1-d')]$ to arrive at:

$$u'(c)\frac{\frac{\partial q(a')}{\partial a'}a' + q(a')}{\beta(1+r)q(a')} = E[u'(c')] - \frac{\partial \check{\psi}(a')}{\partial a'}$$

To interpret this expression, the expected growth in marginal utility on the left-hand side is the elasticity of the $q(\cdot)$ function, but as modified by this $\frac{\partial \check{\psi}(a')}{\partial a'}$ term. For instance, if we want marginal utility to grow more quickly (i.e. consumption to grow less quickly) then we need the delinquency cost to increase more quickly ($\check{\psi}'$ larger).

Solving for $\frac{\partial \check{\psi}(a')}{\partial a'}$, we have

$$\frac{\partial \check{\psi}(a')}{\partial a'} = u'(c)\frac{q(a') + q'(a')a'}{\beta(1+r)q(a')} - E[u'(c')] \tag{D.9}$$

As a check, if the elasticity of q is 0 and $\beta(1+r) = 1$ then we get $\frac{\partial \check{\psi}(a')}{\partial a'} = 0$ iff $u'(c) = E[u'(c')]$.

Looking at Equation D.9, the entire right-hand side is a function of the current state duplet (a, y), which determines a', so with enough flexibility on $\check{\psi}'(a')$ we can match any form for $q(a')$. In the more generic case, in which d', c' and y, y' are not orthogonal, we would need full flexibility of $\psi(d', a', y')$ in Equation D.7. Then, we can solve implicitly for $\psi(d', a', y')$ so that for any given function $q(a')$ left and right sides equate. In the next sections, we do not allow for such flexibility and instead assume that $\psi(\cdot)$ is only a function d such as in Herkenhoff (2019). Nonetheless, with enough freedom on the shape of this function, we are able to match the same moments we target in the baseline model in a model with endogenous default.

D.2 A two-period version

As for the baseline model in the main text, most of the insights can be seen in a two-period model in which debt may be defaulted in the second period.

Relative to the complete model, we will assume that (i) defaulted debt disappears after the second period, (ii) utility is constant relative risk aversion (iii) income is deterministic (iv) and initial assets $a_1 = 0$. We also specialize the functional form of $\psi(a, d, y)$ to depend only on d, following much of the literature such as Herkenhoff (2019). To allow flexibility in both first and second derivatives, we use $\psi(d) = \kappa_1 d^{\kappa_2}$. The budget constraints are:

$$c_1 + q(a_2)\, a_2 = y_1 \tag{D.10}$$
$$c_2 = y_2 + (1 - d_2)a_2 \tag{D.11}$$
$$\tag{D.12}$$

and our first order condition on asset accumulation is

$$\frac{\partial u(c_1)}{\partial c_1}\left(q(a_2) + \frac{\partial q(a_2)}{\partial a_2}a_2\right) = \beta\left[\frac{\partial u(c_2)}{\partial c_2}(1 - d_2)\right] \tag{D.13}$$

Without risk, the equilibrium condition simplifies to

$$(1 + r)q(a_2) = (1 - d_2) \tag{D.14}$$

Figure D.4 shows the key features of the two-period environment with endogenous default.[10] Just as in Section 3.1, the solution to this problem has a convex consumption function. And similarly to our baseline model, this convex consumption function arises because of the new term on the left-hand-side of the generalized Euler Equation. From the convex consumption function, the concave asset accumulation function is a natural corollary. Differentiating the consumption function then gives us our increasing MPC pattern.

Note however, that the MPC is no longer strictly higher than the constant q canonical case. The MPC increases but now it crosses that line. This can be seen by plugging in the equilibrium condition that $(1 - d_2) = (1 + r)q(a_2)$ into the first order condition. In the paper's baseline, without default, we had $u'(c_1) = \beta\frac{u'(c_2)}{q(a_2)+q'(a_2)}$ and so the level of $q(a_2) \leq \frac{1}{1+r}$ shifted that whole side and changed the *level* of the MPC in addition to its slope. Now, both right and left-hand sides have a $q(a)$ in levels so they cancel but the elasticity does not. Hence, we have

$$u'(c_1)\,(1 + \varepsilon_q(a_2)) = \beta(1 + r)u'(c_2)$$

so the elasticity of the interest rate to a_2 remains, $\varepsilon_q(a) = \frac{dq}{da}\frac{a}{q}$, but not its level.

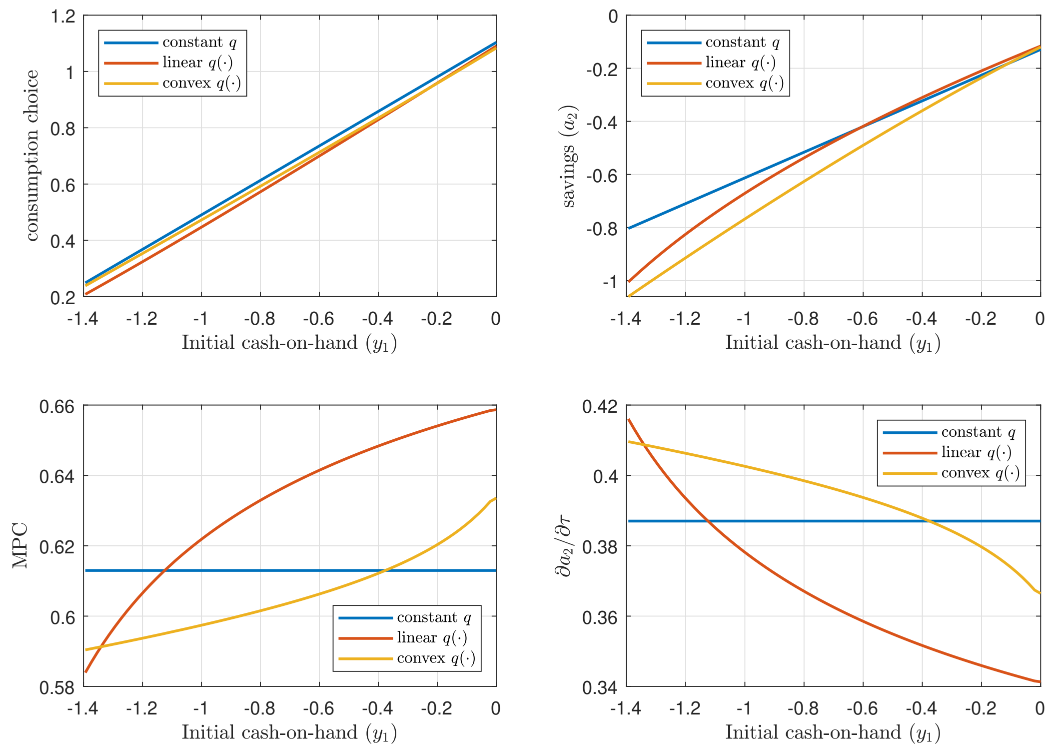
D.3 Quantitative version with macroeconomic outcomes

In this section, we extend the framework presented thus far to feature infinitely lived households and stochastic income, calibrate it to the same empirical targets as our baseline model, and use it to show the same macroeconomic outcomes as in our baseline model with exogenous interest rates. In this sense, this section shows that our exogenous, non-constant, $q(\cdot)$ function was a reasonable approximation of the richer model that generates it endogenously because they both have the same quantitative properties. The main difference is that the medium-run aggregate consumption effects of fiscal stimulus are slightly dampened with endogenous default.

As in our baseline model, earnings are generated by a persistent and transitory component, z, ϵ, so the model becomes

[10] For both a linear and convex $q(\cdot)$ function, we solve for the equilibrium default rate. Given the default rate implied by the interest rate schedule we can then backwards engineer a $\frac{d\psi(d)}{dd}\frac{dd_2}{da_2}$ for every value of a_2 that would be consistent. We then pick (κ_1, κ_2) to minimize the sum of squared errors across the a_2 domain.

Figure D.4: The consumption and savings functions in an endogenous default version of our two-period model.



$$
\begin{aligned}
V(a,z,\epsilon) = &\max_{c,a',d} u(c) - \psi(d) + \beta E V(a',z',\epsilon') \\
&\text{subject to:} \\
&c + a' q(a',z) = e^{z+\epsilon} + a(1-d) \\
&z' = \rho z + \eta
\end{aligned}
$$

The equilibrium interest rate depends on z, because of its persistence:

$$q(a',z) = \frac{1}{1+r} E[1 - d(a',z',\epsilon')] \tag{D.15}$$

As discussed in the previous section, the cost of default depends on d as in the literature, and we use a general functional form, $\psi(d) = \kappa_1 d^{\kappa_2}$, so that we can control both the level and curvature.

The first success of our endogenous default model is that it can fit our main facts just as well as our baseline, reinforcing that our q function was a suitable reduced-form version of the more detailed default model. Again, the model is hitting the SCE facts for the share of households with negative net liquid assets and the MPC at the bottom and top of the debt distribution. Relative to our baseline calibration, β is slightly smaller, 0.95 instead of 0.97, essentially because the utility cost of default is slightly more punitive than the interest rate cost, so a lower β still allows enough households to be in debt. Just as the interest rate function was quite sharply declining, we find a very convex cost function, with κ_2 around 6.

Table D.1: Endogenous Default Calibration

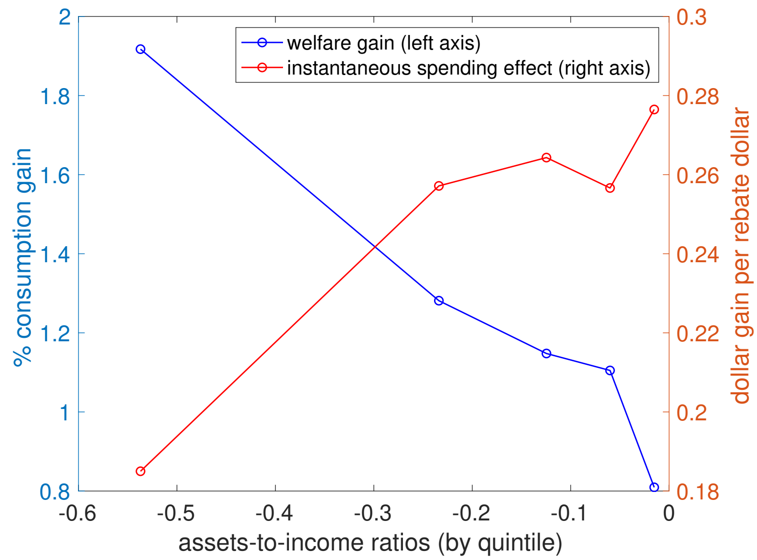
Internally calibrated parameters		
β	0.95	
κ_1	21.58	
κ_2	6.12	
Pre-defined parameters		
r	0.0074	
γ	1	
ρ	0.9923	
σ_η	0.0985	
σ_ϵ	0.2285	
Targeted moments	Data	Model
Share of Households with $a < 0$	0.386	0.387
MPC (bottom quintile of $\frac{a}{y}$, $a < 0$)	0.195	0.194
MPC (top quintile of $\frac{a}{y}$, $a < 0$)	0.266	0.271

The endogenous default model also has the highest welfare gain but lowest short-run consumption gain at the bottom of the asset distribution, like our baseline, but in stark contrast to the constant q model. This divorce between the welfare and consumption motives is shown in Figure D.5 and is very similar to that shown in Figure 8. Much like our baseline model, the most indebted households have very high welfare gains from a transfer and, despite having very high marginal utility of consumption, pay down debt rather than instantaneously consuming. The welfare gain for this group in the endogenous default model is slightly higher than in the baseline model, as lowering default directly improves utility through ϕ, beyond the usual effect through consumption. These level differences, however, should not be taken too literally, as it is comparing utility levels across models. The spending effect is, again, much lower for the highest debt quantile and rises nearly monotonically with asset-to-income.

The main way in which the default model departs from our baseline is in the intertemporal MPC. Even with endogenous default, improvements in debt positions resulting in lower interest rates imply that the cumulative aggregate spending (per rebate dollar) is large already a few quarters after the receipt of the transfer. This consumption propagation, however, is dampened relative to our baseline model. The intuition is that improving one's asset position only helps future consumption to the extent that these debts would have been paid. In other words, for every unit saved today (less borrowing due to transfer), only $(1 - d)$ units are available for consumption tomorrow. This naturally implies a smaller cumulative consumption effect.

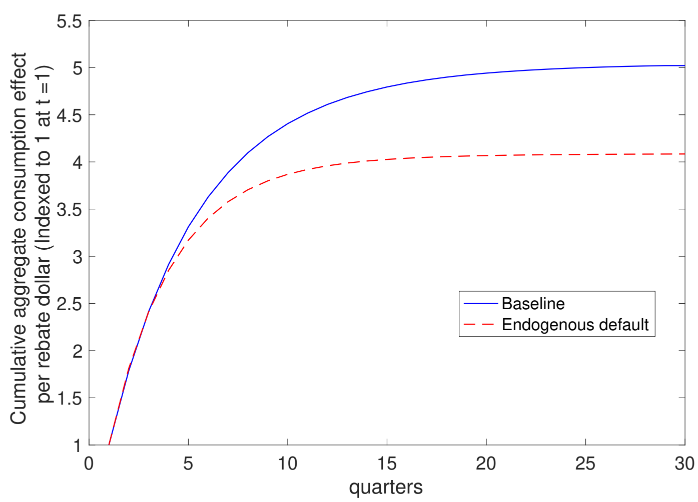
Figure D.6 shows the paths of cumulative consumption for the baseline and default models next to each other. We normalize the instantaneous spending effect to be 1 in both, since differences in that are only due to slight misses on the calibration to the distribution of MPCs and small differences in the underlying distribution of assets. After seven years, the overall spending effect is about 20% lower in the endogenous default model than the baseline.

Figure D.5: Stimulus vs insurance across households in the endogenous default model



Notes. We bin the stationary distribution of households' assets-to-income ratios, conditional on $a < 0$, by 5 quintiles of equal mass. For each quintile, we plot the average welfare gain due to the transfer, in blue, and the dollar-for-dollar spending effect of the transfer upon impact, in red. Portions of the line where there are more points, i.e. quantiles are closer together, imply there is more mass.

Figure D.6: Aggregate spending effects of a transfer: endogenous default



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