

Household Heterogeneity and Unanticipated Income Shocks

by

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Dissertation submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy
in the Department of Economics
in the Graduate School of
Duke University

2021

ABSTRACT

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Abstract

In this dissertation, I study how individual households respond to unanticipated changes in income. I focus on two recent fiscal programs, the Economic Stimulus Act (ESA) of 2008 and the Coronavirus Aid, Relief, and Economic Security (CARES) Act of 2020.

In the first chapter, I study the ESA. I demonstrate when Economic Stimulus Payments were being distributed to households, the macroeconomic environment was characterized by three main facts: (1) household income had yet to fall, (2) households were anticipating worsening economic conditions, and (3) consumer credit markets were already tightening. I modify the standard Permanent Income Hypothesis consumption-saving model to incorporate these three facts and assess the model's prediction for the household response to unanticipated income in the form of Economic Stimulus Payments. This modified model predicts that borrowing constrained households that receive the stimulus wish to increase consumption, but are forced to deleverage. Depending on the degree of indebtedness, size of the stimulus and recession, and size of the credit crunch, households may either increase or decrease consumption. Using micro-level household data from the Survey of Income and Program Participation, I find that consistent with the Permanent Income Hypothesis model, changes in behavior are most sensitive for households near their borrowing constraint. The empirical results suggest that constrained households used most of the stimulus to deleverage, but also increased spending. The more indebted is a household, the more likely it is to use the stimulus to repay debt, and the less likely it is to increase consumption or savings. This is inconsistent with the standard model but is consistent with the model incorporating the full macroeconomic environment in 2008.

In the second chapter, I study the CARES Act. As part of the Act, the IRS distributed \$300 billion in Economic Impact Payments (EIPs) directly to US house-

holds. In the Census Bureau's Household Pulse Survey, almost 75% of households receiving an EIP reported using it to mostly pay for expenses. Separating respondents based on labor income interruptions, 84% of unemployed households reported mostly spending their EIPs, compared to 63% of employed households. I contribute to studying the trade-off between the timeliness and specificity of government transfer programs. Since the consumption responses for employed and unemployed households are similar, I conclude that a more targeted program at the expense of timeliness may not have had a larger aggregate spending response. I find larger differences between households sorted on income, regardless of employment status, suggesting that income may be the more important determinant of EIP usage. Overall, I conclude that Economic Impact Payments played an important role in stabilizing aggregate spending.

In the final chapter, I build and estimate a quantitative model that generates a distribution of consumption responses similar to those observed in the data. I build and estimate a quantitative model of bounded rationality consistent with two motivating facts. First, highly liquid households have large consumption responses out of income shocks that cannot be driven by borrowing constraints. Second, larger income shocks induce smaller consumption responses and more intertemporal smoothing. In the model, a household responds to an income shock by reoptimizing over a planning horizon chosen to trade off benefits of consumption smoothing against cognitive planning costs. The optimal planning horizon is increasing in income, wealth, and the magnitude of the income shock. Estimated using the Economic Stimulus Act of 2008, the model implies that fiscal policies targeting more households with smaller payments induce less intertemporal smoothing and have the largest aggregate spending impact.

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I am also grateful to the many classmates and friends at Duke with whom I was able to share my passion for economics. I will hold especially fond memories of discussing economics while walking around the quad with David Min and spending hours at the Fuqua School of Business with Mory Elsaify and James Pinnington.

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Chapter 1

Introduction

How do households respond to unexpected changes in income? This deceptively simple question underpins much of modern macroeconomics. Most exogenous shocks to the economy can be directly or indirectly decomposed into changes in household economic, and a substantial fraction of government policy directly or indirectly affects household income.

This dissertation focuses on the marginal propensity to consume (MPC) out of income shocks: for a marginal change in income, how does consumption change? I also provide evidence on the marginal propensities to save (MPS) and to repay debt (MPRD) out of income shocks. Importantly, these propensities are functions of the broader economic environment, the household's characteristics, and the income shock's characteristics. My main contribution is characterizing the MPC in light of heterogeneity along these three dimensions.

In the first two chapters, my empirical analysis centers on two policy programs which allow for researchers to cleanly identify the impact of (positive) income shocks on consumption, saving, and repayment of debt: the Economic Stimulus Act of 2008 and the CARES Act of 2020. In both cases, I emphasize the broader macro-environment and how we might expect consumers to respond.

In the final chapter, I contribute a quantitative model that centers on how households form plans over finite planning horizons in response to unanticipated changes in income. The optimal planning horizon depends on both the characteristics of the shock and the characteristics of the household, and the resulting distribution of MPCs displays significant heterogeneity.

Chapter 2

An Analysis of the Economic Stimulus Act (ESA) of 2008

On January 17, 2008, Federal Reserve Chair Ben Bernanke testified before congress that “a fiscal stimulus package should be implemented quickly and structured so that its effects on aggregate spending are felt as much as possible within the next twelve months or so.” Less than a month later, on February 13, 2008, President George W. Bush signed into law the Economic Stimulus Act of 2008. The largest component of the Act was to allocate approximately \$100 billion in tax rebates to 130 million tax filers in the United States. Individual filers received between \$300 and \$600, joint filers received between \$600 and \$1,200, and households with eligible children received additional funds. The rebate was targeted towards low- and medium-income families and eligibility phased out for adjusted gross income of \$75,000 for individuals or \$150,000 for couples.

The IRS was tasked with disbursing the rebate payments to eligible tax filers. Given the sheer number of rebates, the IRS disbursed rebates based on the last two digits of the (main) filer’s Social Security Number. If the filer’s 2007 tax return contained direct deposit information, the rebate was deposited into their account between May 2 - 16, 2008. Otherwise, paper checks were mailed between May 16 and July 11, 2008. According to the Bureau of Economic Analysis, almost 98% of the stimulus was received by consumers in May, June, and July 2008.¹

Macroeconomists have no laboratory. Instead, they rely on large, natural exper-

¹See Table 2.1. The remaining 2% of stimulus is recorded as being received in April and August, 2008

Table 2.1: Fiscal Stimulus Payments in 2008

Month	Rebate Payments (\$ billions)
April	23.3
May	577.1
June	334.4
July	164.1
August	12.4

Source: Bureau of Economic Analysis, Personal Income and Outlays, August 2008. Billions of annualized dollars.

iments to study the effects of macroeconomic policies. The fiscal stimulus of 2008 appears to be a prime candidate for understanding the effects of unexpected and transitory income shocks on household consumption. Less than three months elapsed between the Economic Stimulus Act's enactment and the first disbursement to eligible households. The tax rebate was clearly advertised as a one-time special payment, unlike, for example, the 2001 stimulus payment, which occurred from the retroactive application of new (permanent) tax rules. Most importantly, conditional on being eligible for a rebate, the timing of receiving the rebate was as-good-as random, facilitating comparison between households who received the rebate early relative to those who received it later.

However, to make valid inferences about the Economic Stimulus Act of 2008, it is of first order importance to understand the macroeconomic environment during which the stimulus was enacted, received by households, and eventually used by households. Otherwise, conclusions drawn from this natural experiment are externally invalid, and cannot be used to make inferences about unexpected and transitory income shocks.

The first part of this chapter establishes three empirical facts that are crucial in properly contextualizing household behaviour with respect to the Economic Stimulus Act of 2008. At the same time that stimulus payments were being disbursed between May and July 2008,

1. household income had not decreased,
2. households anticipated worsening economic conditions in the near future, and
3. households were facing tighter credit conditions relative to earlier in the business cycle.

In macroeconomic terms, in addition to the income shock from the stimulus, households were also subject to an expectations shock and a credit availability shock. Analysis of the stimulus that does not directly account for these additional shocks risks confounding the effects of the income shock.

The empirical evidence for these three facts is laid out in section 2.1. Although the NBER officially dates the recession as beginning in December 2007, it is well documented that “households faced a one-two punch during the recession” (Mian and Sufi, 2010), punctuated by the financial system meltdown in September 2008. Prior to this date, household income and the labor market more generally were strong. On September 7, 2008, the federal government seized control of Fannie Mae and Freddie Mac, and on September 15, 2008, Lehman Brothers went bankrupt, causing the Dow Jones to drop by 504 points, its largest decline in seven years. These events occurred more than two months after the final stimulus funds had been distributed to households.

Although income had yet to fall when stimulus payments were disbursed, households were expecting worsening economic conditions. Using the survey data available in 2007 and 2008, it is clear that although consumers were beginning to feel the effects of the recession in mid-2008, they expected worse times ahead.

Similarly, even prior to September 2008, commercial banks had begun to tighten consumer borrowing standards. This is especially true for unsecured borrowing on credit cards. Commercial banks increased standards for extending new credit, decreased credit limits, and even raised payments required on existing credit. Together,

these amount to a “credit crunch” in the unsecured consumer debt market, leading to a decrease in the supply of available credit.

The second part of this chapter incorporates these facts into a simple stylized model of household consumption and saving. The model is used to study the fiscal stimulus payments of 2008 in the larger macroeconomic context of that time period. This chapter uses a simple, two-period Permanent Income Hypothesis model with no uncertainty to study the effects of the three macroeconomic features surrounding the Economic Stimulus Act of 2008. Household income is deterministic and upward sloping, growing at a constant and known rate between the first and second periods. The comparative statics analyzed arise from assuming that the household had some optimal choices for consumption and saving. Then, they learn about the new environment, and re-optimize. Comparisons are drawn between the initial plan and the newly formed plan.

In a standard model of intertemporal optimization, concavity of the utility function implies a consumption smoothing motive, and lifetime consumption smoothing requires lifetime income smoothing. Agents with downward sloping income profiles save for the future, while agents with upward sloping income profiles borrow against future income. Lifetime income smoothing implies that unexpected transitory payments, such as those from an economic stimulus package, should be divided amongst all future periods. Thus the prediction of the simplest PIH model is that economic stimulus will increase lifetime consumption but, divided over many periods, the initial impact will be very small.

In reality, however, it may be difficult for agents with upward sloping income profiles to borrow against future income. These borrowing constrained agents are thus unable to achieve the optimally smooth consumption profile. Relative to the optimal consumption profile, they will consume too little in early periods and too much in later periods. In attempt to attain the optimal consumption profile, borrowing

constrained agents will choose to consume a large portion an unexpected transitory payment. This is the argument relied upon to justify fiscal stimulus in a world where the PIH holds. If enough agents in the economy face upward income profiles and are borrowing constrained, then fiscal stimulus packages will have large initial impacts on consumption.

This argument assumes that the one-time stimulus payment is the only change in the household's intertemporal optimization. However, this was not the case during the time that the Economic Stimulus Act of 2008 was disbursed to households. To properly analyze the effect of the stimulus given the broader macroeconomic environment, the one-time stimulus payment is modeled as a positive change in income in the first period, and the recession is modeled as a negative income change in the second period. As in Guerrieri and Lorenzoni (2017) and Lanteri and Gavazza (2018), the credit crunch is modeled as a tightening of the exogenous borrowing rate.

The key insight is that the second-period recession and first-period stimulus lessen the slope of the (positively sloped) income profile. This has two effects. On one hand, constrained agents use the temporary stimulus payment to increase first period consumption towards the optimal lifetime consumption target. On the other hand, the lifetime consumption target has decreased because the recession decreases lifetime income. As the severity of the recession relative to the stimulus payment increases, the second effect increasingly dominates, and consumption increases by less. If the recession is sufficiently severe, the income profile becomes negatively sloped, and even borrowing constrained consumers wish to save in anticipation of the harsh future ahead.

This result is important for interpreting the marginal propensity to consume estimated from the use of fiscal payments. The model shows that estimates from this large-scale natural experiment will downwardly bias the true marginal propensity to consume because of the savings motive induced by expectations of a future recession.

This model's main prediction regarding fiscal stimulus rings similar to that of the basic PIH model. If the household is a net saver, it will continue to save most of the stimulus. A borrowing constrained household will consume a relatively larger portion of the stimulus in the first period, but may save some of it if the second-period recession is sufficiently large. Intuitively, if the household is relatively more borrowing constrained, it will consume a relatively more in the first period and save relatively less for the second period.

The third ingredient of the model, the credit crunch, reverses this result. An exogenous tightening of the borrowing constraint forces the constrained household to deleverage, decreasing first-period consumption. All else equal, the borrowing constrained household is now even further from the lifetime consumption target, which is determined independently of the borrowing constraint. The household uses the economic stimulus to increase first period consumption towards the lifetime consumption target, but the reduction in consumption from deleveraging may be sufficiently large such that even borrowing constrained households consume less in the first period, regardless of the severity of the recession. The more borrowing constrained is a household, the more likely that they will use the first-period stimulus to deleverage, resulting in a net decrease in consumption.

Using detailed data from the Survey of Income and Program Participation, this chapter documents differences in fiscal stimulus usage across households with different balance sheet characteristics. In particular, the analysis centers on liquid wealth in the form of deposits on the asset side and credit cards on the debt side. As detailed in chapter 1, at the same time that households were receiving fiscal stimulus payments, they had yet to experience decreases in income, were anticipating worsening economic conditions, and were being forced to deleverage their credit card debt. Given this context, the observed behavior of households is reconciled with the predictions of the stylized model developed above.

The model's main prediction is that households on or near their borrowing constraint are most sensitive to the income generated from fiscal stimulus payments. These households are responsible for the immediate aggregate effect of the stimulus, as unconstrained households are expected to smooth the additional funds over their lifetimes. It is essentially impossible to observe households' true borrowing constraints. In the empirical literature, low net worth is commonly used as a proxy for borrowing constraints (citation). More recently, the literature has further decomposed wealth in an attempt to identify which households are truly borrowing constrained. For example, Kaplan, Violante and Weidner (2014a) analyze households that have high net worth in illiquid assets, but are relatively illiquid otherwise. These high net worth but illiquid households behave like poorer borrowing constrained households, and thus proxying borrowing constraints by total net worth misses an important group of constrained households that are also highly sensitive to temporary income shocks.

Using more than 14,000 households from the SIPP data, a multinomial logit regression predicts that liquid wealth is far more important than illiquid wealth for determining whether households use the stimulus payment to increase spending, increase saving, or repay debt. This is consistent with the literature. The first contribution of the empirical analysis is to show that further decomposing liquid wealth into liquid assets yields important insights into household behavior. Consistent with the predictions of the stylized model in Chapter 1, more indebted households are more likely to use the stimulus to repay debt, allocating away from using the stimulus to increase consumption. Additionally, for a given level of liquid net worth, households with higher liquid debt (and higher liquid assets) are more likely to use the rebate to repay debt.

Another contribution of the analysis is to demonstrate that household behavior is much more sensitive to changes in liquid debt than liquid assets. In the model, house-

hold sensitivity to income shocks is related to proximity to the borrowing constraint, and thus the empirical result suggests that borrowing constraints are more sensitive to debt than to assets. This is consistent with a growing literature documenting that borrowing constraints are more sensitive to debt and income than to net worth or assets. This result highlights an important disconnect that plagues any analysis using net worth as a proxy for borrowing constraints. In the data, net worth is almost perfectly correlated with assets and thus, by extension, borrowing constraints are proxied essentially by assets. However, the evidence suggests that the true borrowing constraint is more closely related to debt than to assets, and thus net worth as an empirical proxy is not representing the unobservable borrowing constraint it is intended to capture.

Consider an example where two households have \$3,000 in liquid wealth. One has \$3,000 in cash and no credit card debt. The other has \$3,500 in cash and \$500 in rolling credit card debt.² Liquid wealth is highly correlated with liquid assets, masking the fact that the second household is more heavily indebted. All else equal, this household is closer to its borrowing constraint than the household with no credit card debt, even though both households have the same level of liquid wealth and the more borrowing constrained household even has more liquid assets.

Further, when considering the liquidity of a household, it is important to think carefully about the fact that households simultaneously hold liquid assets and liquid debt. For whatever reason, whether it be to pay for goods that can only be purchased using cash (Telyukova and Wright, 2008), or as short-term saving for a future purchase (Campbell and Hercowitz, 2018), households make the conscious decision to hold low-yield bank deposits and high-cost credit card debt. This is a clear arbitrage opportunity, and the fact that it is not exploited implies that there is some strong

²This paper does not address the so-called “credit card puzzle,” namely the fact that a significant portion of households carry revolving credit card debt while simultaneously holding large levels of cash in their bank accounts. See, for example, Telyukova (2013).

motive to hold these assets and not liquidate them to pay off debt. Thus these “liquid” assets are not truly liquid in that adjusting them yields some cost, even if it cannot be observed.

The empirical analysis focuses on ratios of wealth to income. This is an important normalization that paints a more complete picture of households’ financial status. It is clear that \$5,000 of credit card debt will affect a household with \$50,000 of yearly income differently than a household with \$100,000 of yearly income. Since wealth is a stock and income is a flow, the two cannot be directly compared, but the ratio is interpretable as the number of pay periods required to accumulate the given level of wealth. For example, if a household holds \$10,000 in assets and earns \$1,000 per pay period, the asset to income per pay period ratio is 10, since it would take 10 months of saving to accumulate this level of assets.

This paper is related to a large literature that attempts to estimate the relationship between household characteristics and the marginal propensity to consume. For a detailed summary, see Appendix Table 1 of Hassan (2016). Though many papers find that borrowing constrained households are more likely to use the stimulus to increase consumption, the literature is far from consensus. This paper and the analysis in Chapter 1 highlight that much of the disagreement may arise from disregarding the larger macroeconomic context during which fiscal programs were enacted. This paper provides evidence that, indeed, borrowing constrained households are those most sensitive to receiving fiscal stimulus, but that they may not necessarily increase consumption. The stimulus may still be useful, however, in that in the counterfactual, consumption may have decreased by even more had there been no stimulus, though entertaining this question requires a structural model.

Two of the clearest examples of papers that find borrowing constrained households increase consumption in response to unexpected and transitory income shocks are Kaplan et al. (2014a) and Jappelli and Pistaferri (2014a). These papers are often

cited when discussing the efficacy of fiscal stimulus during recessions, and the title of Jappelli and Pistaferri (2014a) is “Fiscal Policy and MPC Heterogeneity.” However, these papers are likely the least externally valid with respect to fiscal policy since they use non-fiscal-stimulus data. Kaplan et al. (2014a) use household data from the Panel Study of Income Dynamics to estimate an income process and use the residuals as unexpected and transitory income shocks. Regressing changes in consumption on the income shocks yields an estimate for the marginal propensity to consume. They find that regardless of overall wealth, households with lower liquid wealth have higher estimated marginal propensities to consume than households with high liquid wealth. Jappelli and Pistaferri (2014a) find very similar results using data from the 2010 Italian Survey of Household Income and Wealth. Households were asked how much of a hypothetical temporary increase in income would be used to spend versus save. They document a strikingly clear and positive relationship between illiquidity and the reported marginal propensity to consume. Though these results are interesting and consistent with the theoretical predictions of a standard PIH model with borrowing constraints, it is difficult to relate conclusions from these papers to how households might react to fiscal stimulus during a recession.

Section 2.4 establishes the three facts claimed to be central in understanding the macroeconomic environment in 2008. Section 4.3 begins with the standard Permanent Income Hypothesis model, and builds in each of these facts, culminating in a simple model that includes fiscal stimulus, expectations of a future recession, and a tightening of consumer borrowing standards. Section 3.3 discusses the SIPP data used in the empirical analysis. Section 2.4 presents the empirical strategy and main results, and 2.5 discusses the claim that a household’s borrowing constraint is closely related to its indebtedness.

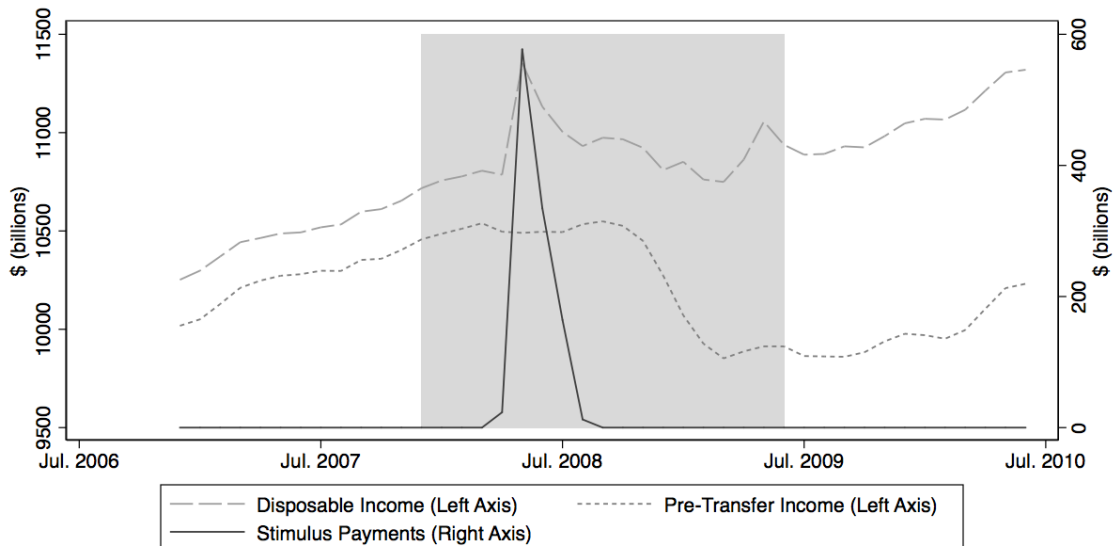
2.1 The Macroeconomic Context During the Economic Stimulus Act of 2008

This section establishes that while payments from the Economic Stimulus Act of 2008 were being distributed, (1) household income had yet to begin decreasing, (2) households were anticipating worsening economic conditions, and (3) consumer credit conditions were tightening.

2.1.1 Fact One: Non-Decreasing Household Income

Using data from the Bureau of Economic Analysis, Figure 2.1 plots total monthly total disposable income, pre-transfer income, and stimulus payments. In this figure and all that follow in this section, values are presented in billions of annualized dollars, and grey bars represent NBER recession periods.

Figure 2.1: Personal Income and Stimulus Payments



Notes: Source: Bureau of Economic Analysis.

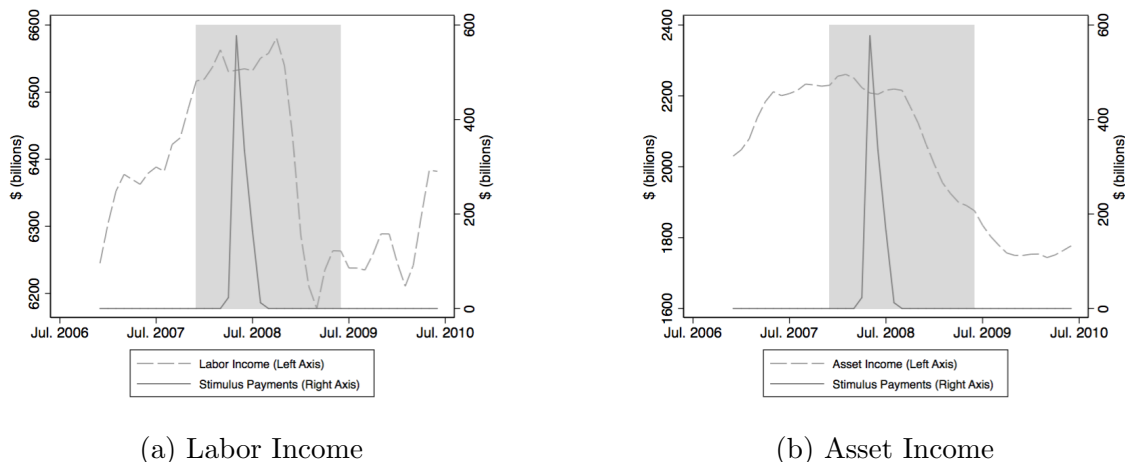


Figure 2.2: Components of Personal Income and Stimulus Payments

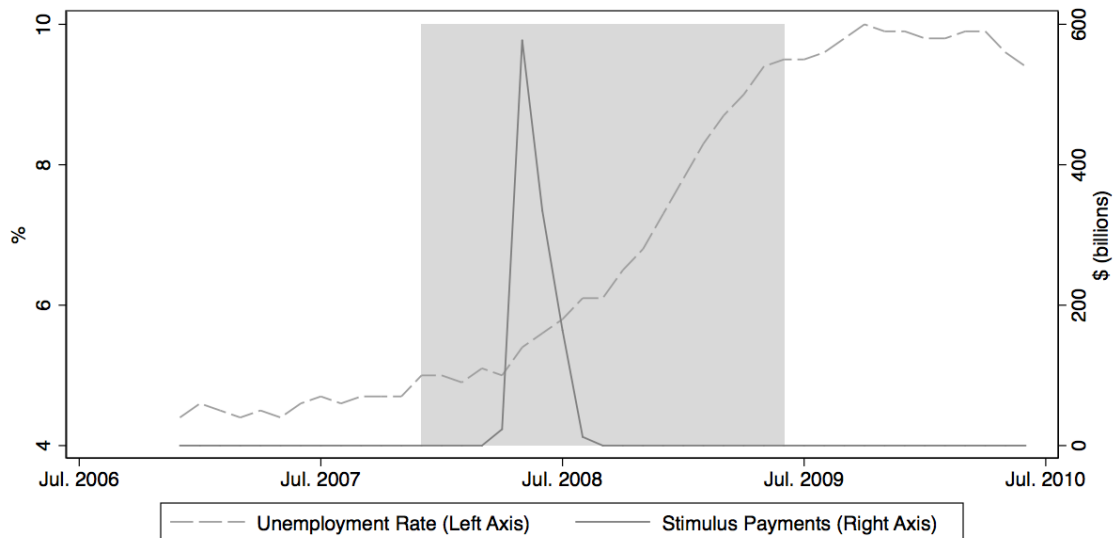
Notes: Source: Bureau of Economic Analysis.

As expected, disposable income rises sharply as economic stimulus payments are sent to households between May and July 2008. After this, disposable income decreases somewhat, but quickly recovers near the end of the recession. Pre-transfer income, constructed as disposable income excluding net government transfers, behaves very differently. While stimulus payments are being distributed, pre-transfer income stays essentially flat, but then plummets after September 2008. The fact that disposable income decreases by not nearly as much as pre-transfer income is by virtue of automatic stabilizers such as unemployment insurance and progressive income tax rates.

Figure 2.2 decomposes pre-transfer income into labor income and asset (i.e. investment-related) income. Together, these account for more than 80% of pre-transfer income in this period. In panel (a), labour income, the largest single component of pre-transfer income, remains fairly steady while economic stimulus payments are distributed. Labor income only begins to fall in September 2008. In panel (b), asset income is also steady while stimulus payments are being distributed, though begins to decrease slightly before September 2008. Together, it is clear that the primary components of earned pre-transfer income had not begun to decrease while stimulus payments were

being sent to households.

Figure 2.3: Unemployment Rate and Stimulus Payments



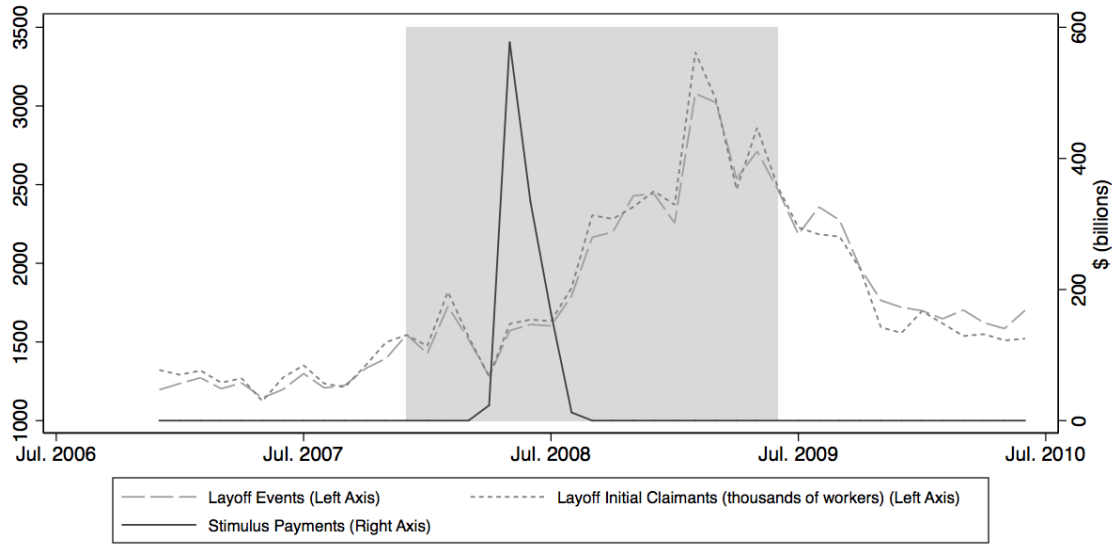
Notes: Source: Bureau of Labor Statistics.

Turning from the income to the labor market more generally, Figure 2.3 uses data from the Bureau of Labor Statistics to illustrate the relationship between the civilian unemployment rate and stimulus payments. The unemployment rate began ticking up in early 2008, reaching 5.4% in May 2008. By the time stimulus payments were 98% disbursed in July 2008, the unemployment rate had only increased to 5.8%, much lower than the 9.5% unemployment rate in June 2009, when the recession officially ended. Though some households had begun losing their jobs, the majority of job losses came later in the cycle, well after the stimulus had been disbursed.

To illustrate this point more clearly, Figure 2.4 shows the relationship between mass layoff events and stimulus payments. The BLS declares a mass layoff when an establishment has at least 50 initial claims for unemployment insurance filed against it during a five-week period. Beyond the unemployment rate, which confounds labor force participation, discouraged workers, and true unemployment, mass layoffs are more indicative of the job losses that might be expected during an economic recession.

The number of layoff events is slightly elevated at the beginning of the recession

Figure 2.4: Mass Layoffs and Stimulus Payments



Notes: Source: Bureau of Labor Statistics.

relative to earlier in 2007, but remains fairly constant while stimulus payments are being disbursed. The number of layoffs increases significantly in the later stage of the recession, coinciding with the massive loss in household income and significant rise in the unemployment rate detailed above.

It may be the case that although the number of layoff events does not increase, but each layoff is more severe in that more workers are laid off. In the figure, however, we see that the number of laid off workers, calculated as the number of workers claiming unemployment benefits for the first time, rises in close tandem with the number of mass layoffs. This implies that the average number of laid off workers per mass layoff event is stable. The overwhelming majority of layoffs during the Great Recession occurred after stimulus payments had been fully disbursed, both in terms of layoff events and laid off workers.

2.1.2 Fact Two: Expectations of Future Recession

In the first half of 2008, before household income dropped or unemployment increased, there was a heightened sense of uncertainty about the future. Though many households had already begun experiencing hardship and believed the economy was performing poorly, households believed that the worst was still ahead.

The earliest evidence of these sentiments is an Associated Press Poll conducted by Ipsos Public Affairs between February 4 and 6, 2008.³ Almost two thirds of respondents believed that the US economy was already in recession. However, of those employed, one third reported that they were worried about losing their jobs. Almost two thirds reported worrying that the value of their stocks and retirement investments would drop, and about 45% reported they were worried about being unable to pay bills.

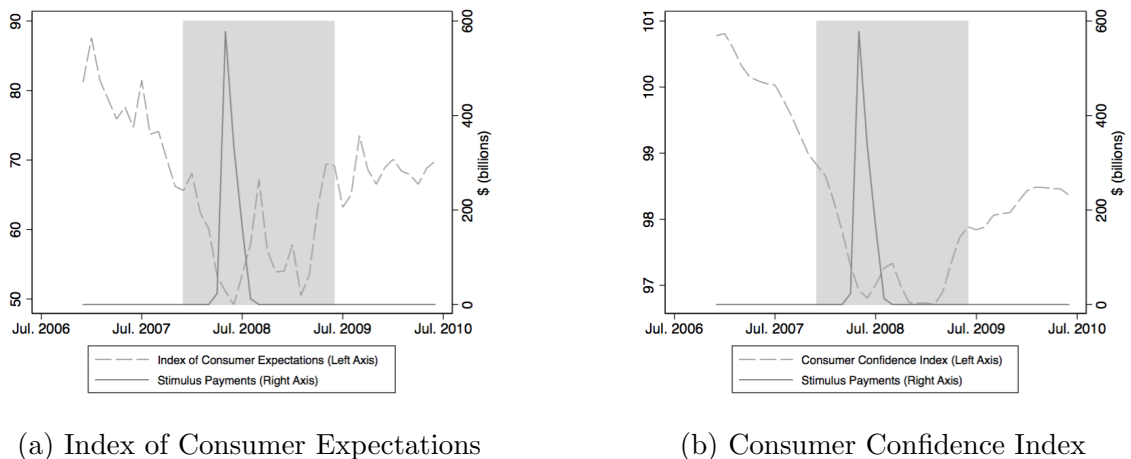


Figure 2.5: Consumer Expectations and Stimulus Payments

Notes: Sources: (a) University of Michigan Survey of Consumers, (b) OECD.

Figure 2.5 plots two surveys of consumer expectations that are available dating back to the beginning of the Great Recession in 2008. In panel (a), the University of Michigan's Index of Consumer Expectations is one of two components that feeds into

³Ipsos reports that 1,006 adults were interviewed, and the margin of error for each answer is ± 3.1 percentage points.

the popular Index of Consumer Sentiment. The Index of Consumer Expectations combines data from three Survey questions soliciting expectations about personal finances, the state of the economy, and plans to buy durable goods.

Panel (b) plots the OECD’s Consumer Confidence Index, which “provides an indication of future developments of households consumption and saving, based upon answers regarding their expected financial situation, their sentiment about the general economic situation, unemployment and capability of savings.”

In both panels, consumer sentiment about the future state of the economy was extremely low while the IRS was distributing the economic rebate. Independent of the current state of the economy, households anticipated worsening economic conditions in the future. Consumer expectations about the future begin to increase after stimulus payments are fully paid out (which may in part be to the added financial security from the stimulus payments), but drop again in September 2008, after the financial sector’s troubles came into full view.

2.1.3 Fact Three: Consumer Credit Tightening

It is well established that as a direct result of the collapse in house prices and sharp increase in defaults, there was a large tightening of secured credit in the form of mortgages and home equity lines of credit. Importantly, however, credit tightening carried over into the realm of unsecured credit, especially on credit cards.⁴

Agarwal, Gross and Mazumder (2016) use the Federal Reserve Bank of New York’s Equifax Consumer Credit Panel to document that between 2008 and 2010, the average number of credit cards per person decreased from 2.2 to 1.7, and total borrowing limits on all credit cards decreased by just over 15%, from \$25,000 to \$21,000. Mian and Sufi (2010) analyze hundreds of counties across the United States and provide evidence

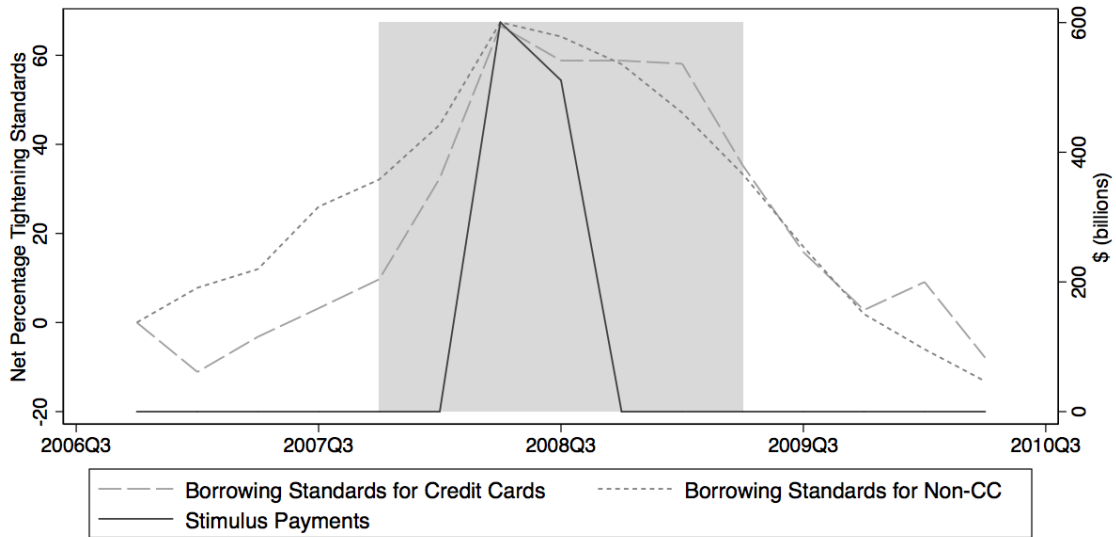
⁴The focus on credit cards is due to their close resemblance to the one-period unsecured debt commonly featured in macroeconomic models.

that for credit card availability decreased significantly for all types of households.

The Federal Reserve’s Survey of Senior Loan Officers interviews commercial banks and solicits changes in the standards they use to extend credit to consumers. Specifically, for a variety of categories, the survey asks the respondent commercial bank whether they have tightened, left unchanged, or loosened their borrowing standards, relative to the previous quarter. In each of the following figures, the value presented is the net percentage of banks that reported tightening their standards relative to the previous quarter.

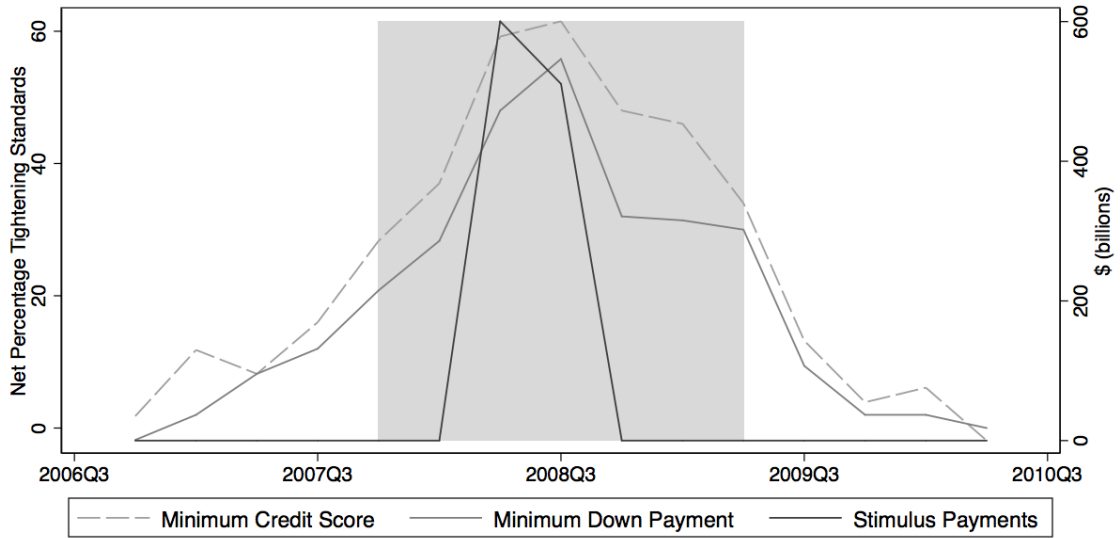
Figure 2.6 plots overall credit standards for consumer borrowing, divided into credit card and non-credit card debt. The two series track each other closely. Standards are tightening while stimulus payments are being distributed and even before the financial meltdown in the third quarter of 2008. Figure 2.7 plots two specific measures of standards for non-credit card debt: the minimum credit score and minimum down payment required to secure a loan. Both standards tighten while stimulus payments are being disbursed by the IRS.

Figure 2.6: Consumer Borrowing Standards and Stimulus Payments



Notes: Source: Survey of Senior Loan Officers.

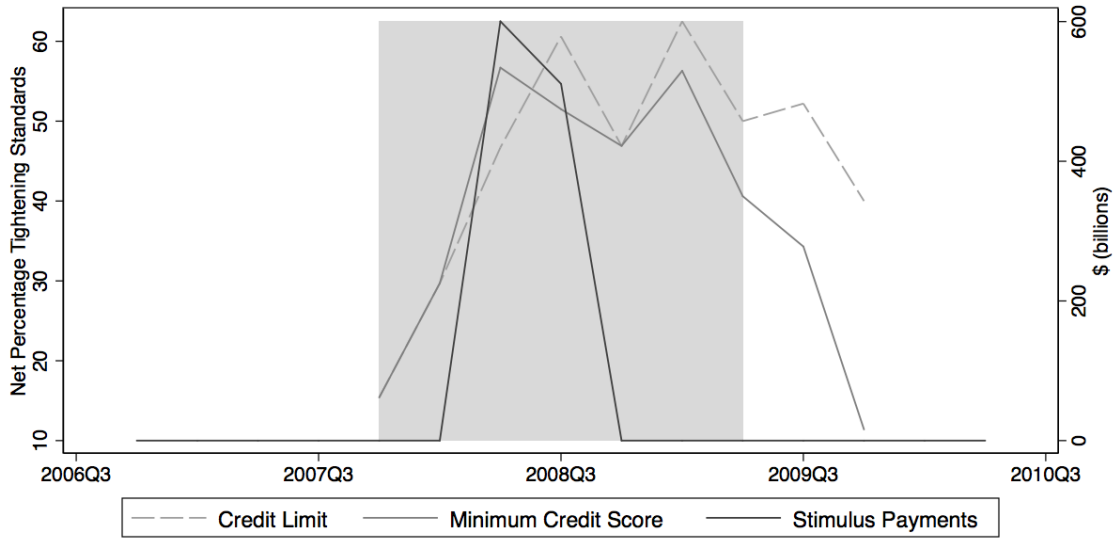
Figure 2.7: Non-Credit Card Borrowing Standards and Stimulus Payments



Notes: Source: Survey of Senior Loan Officers.

Similarly, Figure 2.8 illustrates two measures of credit tightness for credit card debt: the minimum credit score required to open a new credit card account and the credit limit on all credit cards. These two questions were not asked prior to the fourth quarter of 2007. Again, both measures are elevated while the stimulus is being disbursed. The limitation of this question is that it is unclear whether this tightening of credit card limits applies only to new credit cards or to all credit cards. Luckily, the Survey of Senior Loan Officers for the third quarter of 2008 specifically asks about credit limits on existing credit accounts for prime and nonprime borrowers. Just over one-fifth (net) of surveyed banks said that they decreased credit limits for existing prime borrowers, and almost two-thirds said that they decreased credit limits for existing nonprime borrowers.

Figure 2.8: Credit Card Borrowing Standards and Stimulus Payments



Notes: Source: Survey of Senior Loan Officers.

2.2 Model

2.2.1 A Simple Model of the Permanent Income Hypothesis

Consider a household that lives for two periods, derives utility from consumption according to $u(c)$, discounts the future at β , and faces an exogenous borrowing rate $1 + r$. Formally, the household's optimization problem is

$$\max_{c_1, c_2} u(c_1) + \beta u(c_2) \quad \text{s.t.} \quad y_1 + \frac{y_2}{1+r} = c_1 + \frac{c_2}{1+r},$$

where savings, $a_2 = y_1 - c_1$, has been used to combine the individual period budget constraints into one lifetime budget constraint. Assuming no borrowing constraint, the Euler equation is standard. We further assume that that $\beta(1+r) = 1$, and since there is no uncertainty, then for any consumption function, $c_1 = c_2 = c$, where c will be referred to as the lifetime consumption target.

Income is a deterministic process composed of a permanent and temporary component. The permanent component is y^P and grows at rate g . The temporary income can be thought of as unusual deviations from the path of permanent income. In the baseline case with no temporary income deviations, $y_1 = y^P$ and $y_2 = (1 + g)y^P$. Lifetime total income is then given by

$$\left[1 + \frac{1 + g}{1 + r}\right] y^P.$$

Combining this equation with the Euler, the lifetime consumption target is given by

$$c = \left[1 + \frac{g}{2 + r}\right] y^P,$$

where the coefficient multiplying lifetime income is greater than one, but less than $(1 + g)$. Thus consumption in the first period is greater than income in the first period, and consumption in the second period is less than income in the second period. Then saving is negative and given by

$$a_2 = y_1 - c_1 = - \left[\frac{g}{2 + r}\right] y^P.$$

Consider the case where the borrowing limit is set to zero, i.e. $a_2 \geq 0$. Then, as long as $g > 0$, the household is borrowing constrained and the model collapses to autarky, with $c_1 = y^P$, $c_2 = (1 + g)y^P$, and $a_1 = 0$.

PIH Model with Permanent and Temporary Income

This section extends the baseline case to include deviations from the path of permanent income, namely $y_1 = y^P$ and $y_2 = (1 + g)y^P$. Denote these deviations as

temporary payments, though since they are known with certainty at the time that the agent optimizes, they are technically no different than the permanent part of the income process. As stated above, comparisons will be made between the baseline case with no deviations from permanent income and different settings with non-zero temporary payments. The assumption is that the household forms an optimal plan for consumption assuming no temporary payments. Then, the household discovers that there will be non-zero temporary payments and forms a new optimal plan.

Temporary payments in each period, denoted y_t^T , are modeled as constant factors of the permanent income component, i.e. $y_t^T = \kappa_t y^P$. Anticipating ahead, this allows interpreting the stimulus or recession as a fraction of permanent income. Lifetime income is given by

$$\left[1 + \frac{1+g}{1+r}\right] y^P + \left[\kappa_1 + \frac{\kappa_2}{1+r}\right] y^P.$$

The lifetime consumption target is now given by

$$c = \left[1 + \frac{g}{2+r}\right] y^P + \frac{1+r}{2+r} \left[\kappa_1 + \frac{\kappa_2}{1+r}\right] y^P,$$

and savings by

$$a_2 = - \left[\frac{g}{2+r}\right] y^P + \frac{1}{2+r} (\kappa_1 - \kappa_2) y^P.$$

Unsurprisingly, just as with permanent income, the agent aims to smooth the temporary income across consumption of both periods. In terms of saving, the difference between the two temporary payments determines whether savings increases or decreases. In particular, note that the difference enters the savings equation positively, and thus if the first payment is large enough and the second small enough, the agent may switch from desiring borrowing to desiring saving.

2.2.2 Fiscal Stimulus

To see this, first consider a temporary stimulus plan by the government in the first period and no temporary income payments in the second period. Suppose the stimulus program is for a fraction ω of permanent income, so $\kappa_1 = \omega$. Then the lifetime consumption target increases to

$$c = \left[1 + \frac{g}{2+r}\right] y^P + \frac{1+r}{2+r} \omega y^P,$$

and the agent's savings are

$$a_2 = - \left[\frac{g}{2+r} \right] y^P + \frac{1}{2+r} \omega y^P.$$

Relative to the baseline, savings increase by $\frac{1}{2+r} \omega y^P$. If $\omega > g$, then the income profile is now downward sloping, since first period income is $(1 + \omega)y^P$ and second period income is $(1 + g)y^P$, and, as a result, the agent flips from a borrower to a saver. If $\omega < g$, the agent remains a borrower, though borrowing decreases relative to the case with no stimulus plan. In either case, consumption in both periods increases by $\frac{1+r}{2+r} \omega y^P$, which is the smoothed component of the temporary stimulus payment. This quantity is the marginal propensity to consume (out of the stimulus payment). Since the interest rate is small, this change is essentially equivalent to an increase of

$$\frac{1}{T} \times \omega y^P,$$

where in this simple model with $T = 2$ time periods, the stimulus payment, ωy^P , is divided equally amongst those periods.

In a more realistic model with larger T , the stimulus payment is spread across all T

periods. Thus the effect of the stimulus on consumption in any period, including the period in which it is disbursed, becomes negligible as T increases. Optimizing agents should smooth the stimulus across their lifetimes, and this is this is the argument for why the marginal propensity to consume out of stimulus payments should be close to zero.

Consider instead the same temporary economic stimulus in a model where the borrowing constraint is $a_2 \geq 0$. Since the household is consuming below its lifetime consumption target, the household uses the stimulus to increase consumption. Thus the marginal propensity to consume out of the stimulus payment is unity, and this is the argument for why fiscal stimulus appears to have a non-zero effect on household consumption behavior. To the extent that the economy in reality is populated by both constrained and unconstrained households, empirical estimates of the marginal propensity to consume should be roughly in line with the fraction of constrained households.

Constrained Borrowers and Large Fiscal Stimulus

If the stimulus package in the first period is larger than the growth in permanent income, i.e. $\omega > g$, the income profile becomes downward sloping and the constrained borrowing household optimally becomes an unconstrained saver. The lifetime consumption target increases and is attained in both periods. Relative to the baseline model with a constrained borrower and no stimulus package, consumption in the first period increases by

$$\underbrace{\left[1 + \frac{g}{2+r}\right] y^P + \frac{1+r}{2+r} \omega y^P}_{\text{unconstrained } c_1 \text{ with stimulus}} - \underbrace{y^P}_{\text{constrained } c_1 \text{ without stimulus}}$$

$$= \left[\frac{g}{2+r} \right] y^P + \frac{1+r}{2+r} \omega y^P > 0.$$

Both terms in this expression are positive, and thus consumption in the first period unambiguously increases. Note that the first term in this expression is exactly the optimal level of borrowing for the unconstrained borrower. Previously, the household was unable to borrow this portion, since it had no savings and thus net savings would be negative. Though the total income profile is downward sloping, the permanent income portion of the profile is still upward sloping, and the first term represents the portion of lifetime income that the household is bringing forward from the future. This was previously inaccessible. The second term is the portion of the stimulus package that is allocated to the first period. The remaining stimulus is saved for the second period, and since $\omega > g$ is assumed, net savings are positive.

In the second period, consumption changes by

$$\underbrace{\left[1 + \frac{g}{2+r}\right] y^P + \frac{1+r}{2+r} \omega y^P}_{\text{unconstrained } c_2 \text{ with stimulus}} - \underbrace{(1+g)y^P}_{\text{constrained } c_2 \text{ without stimulus}}$$

$$= \left[\frac{1+r}{2+r}\right] \omega y^P - \left[\frac{1+r}{2+r}\right] g y^P > 0.$$

Since $\omega > g$ is assumed, consumption in the second period increases. The first term is the added consumption stemming from the stimulus payment, while the second term represents the portion of permanent income used to fund first period consumption.

Summary

The overall effect of the stimulus is summarized in Tables 2.2 and 2.3. Unconstrained households spend a small fraction of the rebate in each period, smoothing the additional income over their lifetimes. Constrained households spend the entire rebate in the first period in an effort to reach the lifetime consumption target. If the stimulus is sufficiently large such that the income profile becomes downward sloping, borrowing constrained households become net savers, but also increase consumption in each

period. However, their increase in first-period consumption is relatively less than households that remain constrained even after receiving the stimulus.

Table 2.2: Summary of Consumption and Savings in Model with Stimulus

	Unconstrained	Constrained
c_1	$\left[1 + \frac{g + (1+r)\omega}{2+r}\right] y^P$	$(1+\omega)y^P$
c_2	$\left[1 + \frac{g + (1+r)\omega}{2+r}\right] y^P$	$(1+g)y^P$
a_2	$\left[\frac{\omega - g}{2+r}\right] y^P$	0

Notes: The model with first-period stimulus equal to ωy^P is described in section 2.2.2. In the first column, there is no borrowing constraint, and unconstrained households attain the lifetime consumption target in each period by borrowing against future income. In the second column, households cannot borrow, and thus constrained consumption in each period is equal to income.

2.2.3 Fiscal Stimulus and an Upcoming Recession

It is important to account for the fact that while receiving stimulus payments and enjoying higher temporary income, households anticipated a negative income shock in the future. In the context of this model, the first-period stimulus payment and second-period recession both served to decrease the slope of the initially upward sloping income profile. Since the addition of the second-period recession affects the income profile in the same way as the first-period stimulus payment, the effects analyzed in section 2.2.2 are strengthened.

Specifically, let γ denote the severity of the recession, so that $y_2^T = -\gamma y^P$.⁵ As before, income in the first period is $y_1 = (1+\omega)y^P$. Thus the income profile is

⁵Generally, a recession is considered a decrease in income relative to trend, and thus it may be the case that $\gamma < g$ and $y_2 > y_1$. This is still considered a recession.

Table 2.3: Differences Between Between Baseline and Stimulus Models

	Uncon. → Uncon.	Con. → Con.	Con. → Uncon.
c_1	$\frac{1+r}{2+r}\omega y^P$	ωy^P	$\left[\frac{g+(1+r)\omega}{2+r}\right]y^P$
c_2	$\frac{1+r}{2+r}\omega y^P$	0	$\left[\frac{(1+r)(\omega-g)}{2+r}\right]y^P$
a_2	$\frac{1}{2+r}\omega y^P$	0	$\left[\frac{\omega-g}{2+r}\right]y^P$

Notes: Differences in consumption and saving between the model with first-period stimulus and the baseline model. In column one, the baseline and stimulus model both have no borrowing constraints, and thus the household is unconstrained. In the second column, households cannot borrow in both models, and the household is a net constrained borrower in both models. In the third column, households cannot borrow in both models, but the stimulus is large enough that in the model with stimulus, the household is optimally a net saver and thus unconstrained. Full derivations are in sections 2.2.2 and 2.2.2.

downward sloping if $\omega + \gamma > g$. As the size of the recession increases, the smaller is the stimulus package required to induce increased saving.

To see this, consider a constrained borrower in the baseline model who reoptimizes given the first-period stimulus package and second-period recession. The new level of optimal saving is given by

$$a_2 = -\left[\frac{g}{2+r}\right]y^P + \left[\frac{\omega + \gamma}{2+r}\right]y^P.$$

If $\omega + \gamma < g$, the agent remains a constrained borrower, consuming the entire stimulus in the current period, $c_1 = (1 + \omega)y^P$, and saves nothing for the next period, $a_2 = 0$, where consumption is $c_2 = (1 + g - \gamma)y^P$.

If instead $\omega + \gamma > g$, the consumer becomes an unconstrained net saver. The

lifetime consumption target is

$$c = \left[1 + \frac{g}{2+r}\right] y^P + \left[\frac{(1+r)\omega - \gamma}{2+r}\right] y^P.$$

In the first period, the difference between this and the formerly constrained consumption is

$$\underbrace{\left[1 + \frac{g}{2+r}\right] y^P + \left[\frac{(1+r)\omega - \gamma}{2+r}\right] y^P}_{\text{unconstrained } c_1 \text{ with stimulus and recession}} - \underbrace{y^P}_{\text{constrained } c_1 \text{ in baseline model}}$$

$$= \left[\frac{g + (1+r)\omega - \gamma}{2+r}\right] y^P.$$

The sign of this expression depends on the sign of $g + (1+r)\omega - \gamma$. Thus first period consumption can either increase or decrease relative to the baseline model.⁶ Holding the other parameters fixed, the more severe is the recession, the more likely is consumption to decrease relative to the baseline constrained model. Even though the household is unconstrained and reaches the new lifetime consumption target, the severe recession decreases lifetime income such that the new consumption target is less than the previous level of constrained consumption. Alternatively, for a sufficiently mild recession and large stimulus package, the household is able to both increase consumption in the first period and increase saving in anticipation of the recession.

Summary

Tables 2.4 and 2.5 summarize the baseline model and model with first-period stimulus and a second-period recession. This analysis highlights the importance of considering the timing of the stimulus package relative to beliefs of a future recession. The

⁶The assumption made thus far is that $\gamma > g$, and the case being analyzed, $\omega + \gamma > g$, further imposes a relationship between these three parameters. Even given these restrictions, the sign of $g + (1+r)\omega - \gamma$ can be either positive or negative.

recession lowers the lifetime income profile and, in turn, the lifetime consumption target. Given that the recession is in the future, even constrained borrowers have added incentive to use the stimulus to increase saving, and thus use less stimulus to increase consumption. In fact, if the recession is sufficiently severe, a borrowing constrained household may choose to decrease consumption in the current period to smooth consumption in the second period. Contrast this with the model with only stimulus, where first period consumption rose unambiguously, even if savings rose.

Table 2.4: Summary of Choices in Model with Stimulus and Recession

	Unconstrained	Constrained
c_1	$\left[1 + \frac{g}{2+r}\right] y^P + \left[\frac{(1+r)\omega - \gamma}{2+r}\right] y^P$	$(1 + \omega)y^P$
c_2	$\left[1 + \frac{g}{2+r}\right] y^P + \left[\frac{(1+r)\omega - \gamma}{2+r}\right] y^P$	$(1 + g - \gamma)y^P$
a_2	$-\left[\frac{g}{2+r}\right] y^P + \left[\frac{\omega + \gamma}{2+r}\right] y^P$	0

Notes: The model with first-period stimulus and a second-period recession is described in section 2.2.3. In the first column, there is no borrowing constraint, and unconstrained households attain the lifetime consumption target in each period by borrowing against future income. In the second column, households cannot borrow, and thus constrained consumption in each period is equal to income.

2.2.4 PIH Model with Credit Crunch

In this section, the borrowing limit is increased from zero to some positive level, $\phi > 0$, such that $a_2 \geq -\phi$. As a result, depending on the parameterization of the model, the household can be a net saver if $a_2 > 0$, an unconstrained borrower if $a_2 \in [-\phi, 0]$, or a constrained borrower if $a_2 < -\phi$.

It is important to again note that lifetime consumption target is completely in-

Table 2.5: Differences Between Baseline and Stimulus + Recession Models

	Uncon. \rightarrow Uncon.	Con. \rightarrow Con.	Con. \rightarrow Uncon.
c_1	$\left[\frac{(1+r)\omega - \gamma}{2+r} \right] y^P$	ωy^P	$\left[\frac{g + (1+r)\omega - \gamma}{2+r} \right] y^P$
c_2	$\left[\frac{(1+r)\omega - \gamma}{2+r} \right] y^P$	$-\gamma y^P$	$\left[\frac{g + (1+r)\omega - \gamma - g(2+r)}{2+r} \right] y^P$
a_2	$\left[\frac{\omega + \gamma}{2+r} \right] y^P$	0	$-\left[\frac{g}{2+r} \right] y^P + \left[\frac{\omega + \gamma}{2+r} \right] y^P$

Notes: Differences in consumption and saving between the model with first-period stimulus and second-period recession and the baseline model. In column one, both models have no borrowing constraints. In the second column, households cannot borrow in both models. In the third column, households cannot borrow in both models, but the optimizing agent in the model with stimulus and a recession is a net saver and thus unconstrained. Full derivations are in sections 2.2.2 and 2.2.2.

dependent of the borrowing constraint. Changing the borrowing constraint will only affect whether households with upward sloping income profiles are able to borrow enough to reach the consumption target. If $a_2 \geq -\phi$, the household is unconstrained, and the optimal choices for assets and consumption are the same as in the baseline model in 2.2.1. If instead optimal $a_2 \leq -\phi$, the household is constrained, but can still borrow up to $a = -\phi$. Thus the constrained household's choices are

$$c_1 = y^P + \phi$$

$$c_2 = (1+g)y^P - (1+r)\phi$$

$$a_2 = -\phi.$$

Naturally, setting $\phi = 0$ yields the same optimal outcomes as in the case with a zero borrowing constraint. This is the baseline model that will be compared to in this

section.

2.2.5 Stimulus, Recession, and Credit Crunch

Suppose that initially the borrowing limit is set to $\phi = \phi_H$, and then the agent receives the stimulus funding, anticipates the upcoming recession, and is subject to a credit crunch, where ϕ decreases to $\phi_L < \phi_H$.

As before, the new optimal level of savings is given by

$$a_2 = - \left[\frac{g}{2+r} \right] y^P + \frac{1}{2+r} (\omega + \gamma) y^P.$$

The presence of the credit crunch does not affect this equation and, as above, the additional saving pushes the agent away from the borrowing constraint. If the recession and stimulus are large enough that the income profile becomes negatively sloped, the agent will become a net saver. Alternatively, the agent may still be a (constrained or unconstrained) net borrower.

The credit crunch is relevant in that it directly pushes the household closer to the borrowing constraint. If the household is a saver, the tightening is irrelevant. If the household is a constrained borrower, the credit crunch will induce a deleveraging effect, as the household must drop to the lower debt level, foregoing consumption in the process. In particular, the constrained household's optimal choices are now given by

$$c_1 = (1 + \omega) y^P + \phi_L$$

$$c_2 = (1 + g - \omega) y^P - (1 + r) \phi_L$$

$$a_2 = -\phi_L.$$

Relative to the baseline constrained borrower, consumption in the first period changes by

$$\omega y^P - (\phi_H - \phi_L).$$

On the one hand, the borrowing constrained agent uses the stimulus to increase consumption in the current period. On the other hand, the agent is forced to deleverage because of the tighter borrowing limit, and this deleveraging comes at the cost of consumption. If the tightening of credit, $(\phi_H - \phi_L)$, is sufficiently large, then consumption in the first period will decrease, despite the stimulus payment. Though the consumer optimally allocates the stimulus to increasing consumption, the forced deleveraging more than offsets this increase. Savings changes by the same amount as the tightening of credit, and consumption in the future period benefits from a lower debt repayment.

Consider the case in which the household was an unconstrained net borrower, but the credit crunch is sufficiently large such that the borrower becomes constrained. Relative to the unconstrained borrower, consumption in the first period changes by

$$\underbrace{[(1 + \omega)y^P + \phi_L]}_{\text{constrained borrower } c_1 \text{ with stimulus, recession, and credit crunch}} - \underbrace{\left[1 + \frac{g}{2 + r}\right] y^P}_{\text{unconstrained borrower } c_1}$$

$$= \omega y^P - \left[\left(\frac{g}{2 + r} \right) y^P - \phi_L \right].$$

The first term is the additional consumption induced by the stimulus. The second term is the deleveraging effect induced by the new binding borrowing limit, ϕ_L . This expression is very similar to the expression for the constrained household that becomes further constrained. On the one hand, the household wishes to consume the stimulus to increase consumption toward the lifetime consumption target, but at the same time, the household is forced to leverage. The net effect is again ambiguous.

2.3 Data and Summary Statistics

I now turn to the empirical analysis of the simple model presented above. I use data from the the Survey of Income and Program Participation (SIPP), an annual survey administered by the US Census Bureau. Each iteration of the survey contains a nationally representative sample of households who are continuously interviewed over a four year period. In the 2008 survey, the Census Bureau inserted questions about the economic stimulus plan into the first and fourth waves. The main sample used in the analysis consists of the 14,663 households that reported receiving the stimulus. Conditional on having reported receiving the stimulus, the survey asks:

Did the federal rebate lead . . .

- 1. Mostly to increase spending*
- 2. Mostly to increase savings*
- 3. Mostly to pay off debt*

Overall, 25.6% of households reported using the rebate to increase spending, 16.8% reported increasing savings, and 57.4% reported using the rebate mostly to pay off debt. These figures are consistent with the answers reported in other surveys that asked about the 2008 economic stimulus program (see Sahm, Shapiro and Slemrod (2010a)).

The goal is to use these survey answers to make inferences about marginal propensities to consume, save, and repay debt. To do this, interpret the sample as a single representative household that allocates the stimulus payment between consuming, saving, and repaying debt. This representative household uses a little less than two thirds of the rebate to repay debt, a quarter of the rebate to increase saving, and the remainder to increase consumption.

The SIPP also solicits detailed data on household balance sheet characteristics. For most of the wealth distribution, the quality of this data is comparable to that of the Federal Reserve's Survey of Consumer Finances, widely regarded as the gold standard. The SIPP appears to poorly match the SCF for households at the top of the wealth distribution. Given that these households were unlikely to have received stimulus from the Economic Stimulus Act of 2008, the lack of high quality data at the top of the wealth distribution is not an issue for the analysis in this paper.

Table 2.6 outlines household balance sheet data in the SIPP. Assets are divided into liquid and illiquid assets based both on the type of asset and, for financial assets, the account type. Stocks and mutual funds held in retirement or other registered financial accounts appear as illiquid financial accounts. It is unclear whether stocks and mutual funds directly held should be classified as liquid assets. In today's world, liquidating these assets requires little more than a phone call or a few taps on a mobile device. At the same time, they are inherently less liquid than the assets held in a common bank account. Taking a conservative stance, stocks are classified as illiquid assets.

Debt is divided into secured and unsecured debt. Housing, vehicles, real estate, and business equity is represented on both sides of the balance sheet. Stock and mutual fund debt (i.e. borrowing occurring as the result of margin trading) is secured, even though the underlying asset is liquid. Bank loans are also unsecured, but are usually subject to predefined terms and payment plans. For these reasons, liquid debt is restricted solely to credit card debt. All other debt is illiquid debt. Table 2.7 summarizes the breakdown between liquid and illiquid assets and debt.

Table 2.6: SIPP Household Balance Sheet

Assets	
<hr/>	
Illiquid Assets	
<hr/>	
	Housing
	Vehicles
	Real Estate
	Business
	Illiquid Financial*
	Stocks and Mutual Funds
Liquid Assets	
<hr/>	
	Deposits
Debt	
<hr/>	
Secured Debt	
<hr/>	
	Housing
	Vehicles
	Real Estate
	Business
	Stocks and Mutual Funds
Unsecured Debt	
<hr/>	
	Credit Cards
	Bank Loans
	Other Unsecured Debt

* Includes IRA, KEOGH, 401k, and Thrift accounts.

Table 2.7: Breakdown of Liquid and Illiquid Assets and Debt

Liquid Wealth	
Liquid Assets	Liquid Debt
Deposits	Credit Card Debt

Illiquid Wealth	
Illiquid Assets	Illiquid Debt
Housing	Housing
Vehicles	Vehicles
Real Estate	Real Estate
Business	Business
Stocks and Mutual Funds	Stock and Mutual Fund
Illiquid Financial*	Bank Loan Debt
	Other Unsecured Debt

* Includes IRA, KEOGH, 401k, and Thrift accounts.

2.3.1 Ratios

The empirical analysis focuses on balance sheet items relative to a household's income. The balance sheet records the stock of each item at a given point in time, while income is the flow of payments to the household. Balance sheet gives information about a household's wealth, but their income is also very relevant in their decision making. This will be particularly evident in section 2.5 when evidence is provided that borrowing constraints are largely functions of the ratio between debt and income.

Stocks and flows can't be directly compared because they are in different units. Taking the ratio, however, yields a common unit:

$$\frac{\text{stock of financial instrument}}{\text{flow of income}} = \frac{\text{dollars}}{\text{dollars / time}} = \text{time.}$$

The flow used in the analysis is biweekly income. Using data from the Bureau of Labor Statistic's Consumer Expenditure Survey, Kaplan et al. (2014a) calculate

that between 1990 and 2010, 52% of respondents were paid biweekly, 32% weekly, and the remainder monthly or lower frequencies. Each ratio should be interpreted as the number of biweekly pay periods needed to accumulate the household's stock of the asset or debt instrument.

Ratios are also often used to define hand-to-mouth households. Kaplan et al. (2014a), which summarizes a large research agenda by those authors on the presence of wealthy and poor hand-to-mouth countries in more than a half dozen countries, implicitly define households using ratios of wealth to income. In their analysis, a household is wealthy if their total net wealth is positive, and poor if it is zero or negative. Hand-to-mouth depends on the the stock of liquid wealth, defined as above, relative to the flow of biweekly income. If liquid wealth is less than biweekly income, the household is hand-to-mouth; similarly, if the ratio of liquid wealth to biweekly income is less than unity, then the household is hand-to-mouth.⁷

This paper also takes the stance that the ratio of liquid wealth to income is an important margin on which household behavior changes. However, instead of assuming an abrupt and dichotomous change at a specific threshold, the regressions directly include the ratios, utilizing their continuity and wide range to study how behavior changes across the entire spectrum of liquid wealth to income ratios.

2.3.2 Summary Statistics of Household Balance Sheets

Table 2.8 contains summary statistics for income, wealth, assets, and debt. Average biweekly income in the sample is \$2,080, or approximately \$54,080 per year, and the median value is similar. The standard deviation of biweekly income is \$1,900, highlighting the large variation in household income.

⁷Their analysis is somewhat more complicated by their hypothesis about the presence of borrowing non-hand to mouth. They reason that if the ratio of liquid wealth is between 0 and negative unity, then the household is borrowing but not hand-to-mouth. Letting LWI denote liquid wealth to biweekly income, their criteria for being hand to mouth is given by $\{LWI < 1\} \cap LWI \notin (0, -1)$.

Table 2.8: Summary Statistics for Income and Main Balance Sheet Items

	Level (\$ thousands)			Ratio (to Biweekly Income)		
	Median	Mean	SD	Median	Mean	SD
Biweekly Income	2.08	2.48	1.90	–	–	–
Wealth	79.7	183.6	290.4	36.8	123.0	616.2
Total Assets	194.3	291.1	343.0	86.3	186.9	736.0
Total Debt	64.0	107.5	133.4	29.4	63.9	227.7
Liquid Wealth	0.00	8.48	38.3	0.00	4.73	53.0
Liquid Assets	1.00	12.6	37.3	0.47	7.56	52.3
Liquid Debt	0.49	4.12	7.62	0.20	2.83	10.8

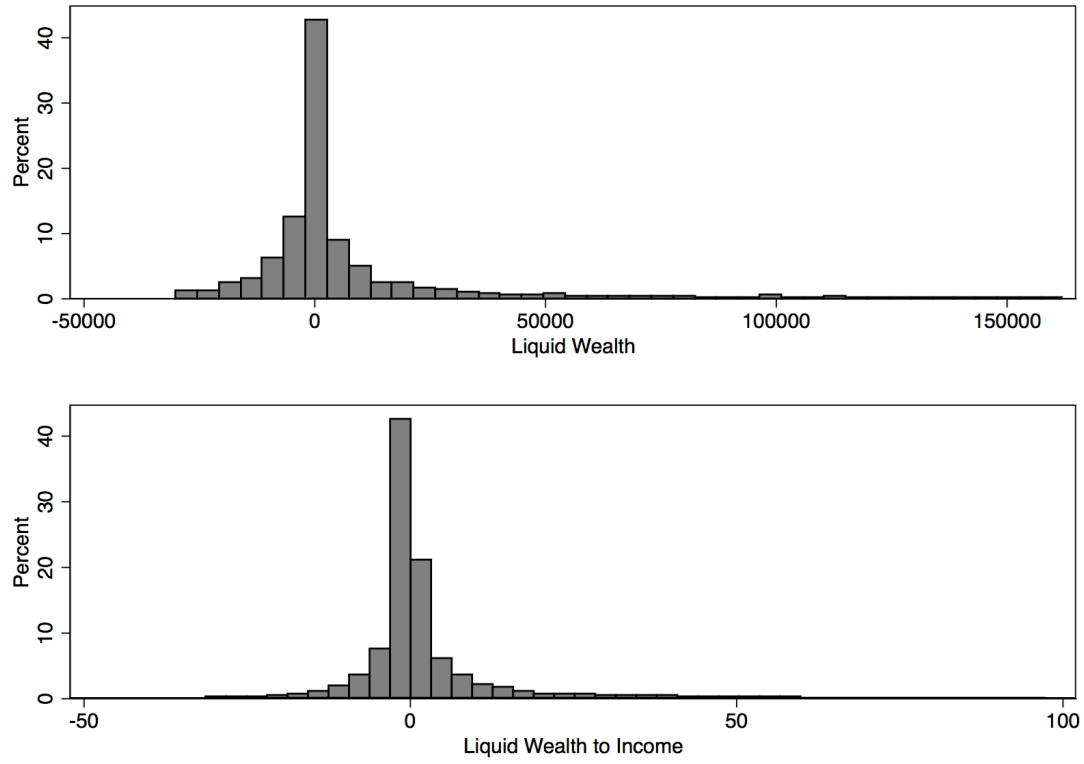
$N = 14,663$. Levels are in thousands of dollars. Ratio is to biweekly income, calculated as yearly income divided by 26 biweekly periods.

Median wealth is approximately 80,000 and average wealth is approximately \$184,000. This reflects the well-known right skew of the wealth distribution. The standard deviation of wealth is \$290,000, again reflecting significant variation in household wealth. Similar patterns emerge for assets and debt: the median is much smaller than the average, and the standard deviations are very high.

Dividing these balance sheet groups by biweekly income maintains the same general pattern. Median wealth to income is 36.8, the average is 123.0, and the standard deviation is 616.2, reflecting the fact that the distribution of wealth to income has even more variation. This is unsurprising given that the income distribution also has high variation. Figure 2.9 shows the distributions of liquid wealth and liquid wealth to income, excluding the first and 99th percentiles, which serve only to stretch the tails.

Liquid wealth to income (hereafter LWI), liquid assets to income (LAI), and liquid debt to income (LDI) are the most important items for the analysis. Median LWI is 0.0, reflecting the fact that most households have both very little assets and debt; median LAI is 0.5, and median LDI is 0.2. The averages of these ratios are much larger: the average LWI is 4.7, average LAI is 7.6, and average LDI is 2.8, and these

Figure 2.9: Distributions of Liquid Wealth and Liquid Wealth to Income



Notes: Excludes first and 99th percentiles.

values are again driven by large right tails, as evident by the large standard deviations. The average household is thus a net liquid saver, though simultaneously carries both liquid assets and liquid debt. This has been regarded elsewhere as the “credit card puzzle.” Since liquid debt carries a much higher penalty than the interest on liquid assets, it is unclear why so many households simultaneously hold both. Further, in the sample, an astonishing 24% of households hold positive liquid assets but are net liquid borrowers.

Table 2.9 reports correlations between wealth, assets, and debt. This table highlights a fact that is important to keep in mind for the analysis of the borrowing constraint: wealth, both in levels and as a ratio to income, is almost perfectly correlated with assets, and only weakly negatively correlated with debt. Though intuitive,

Table 2.9: Correlations Between Balance Sheet Groups

	Wealth	Assets	Debt		LWI	LAI	LDI
Wealth	1.000			LWI	1.000		
Assets	0.980	1.000		LAI	0.979	1.000	
Debt	-0.230	-0.032	1.000	LDI	-0.164	0.040	1.000

Notes: LWI is liquid wealth to biweekly income ratio, LAI is liquid assets to biweekly income ratio, and LDI is liquid debt to biweekly income ratio.

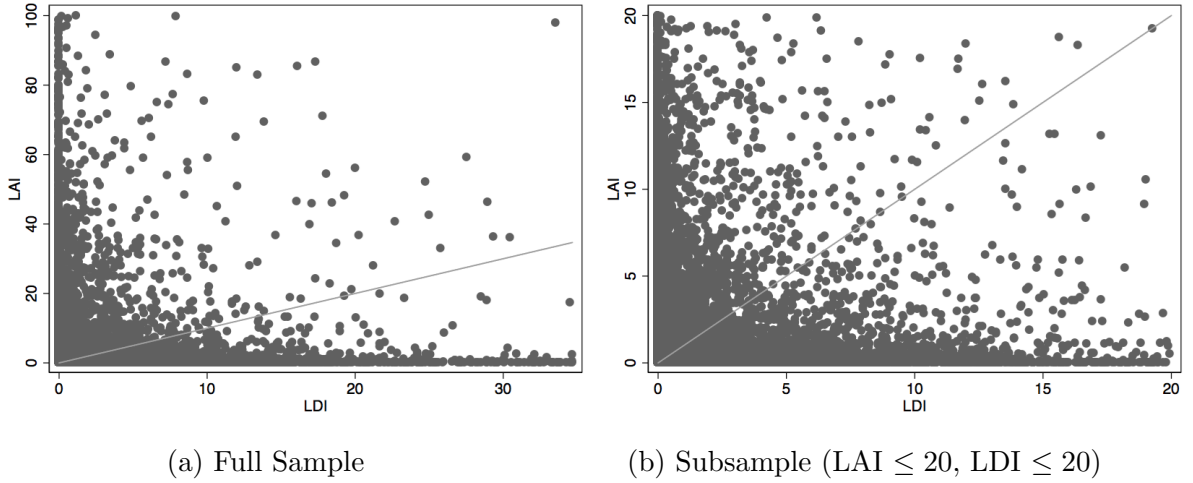
it is worth highlighting that this relation is not mechanical, but is instead the outcome of the fact that borrowing is often costly and constrained, while accumulating assets yields profit and is unconstrained.

2.3.3 Heterogeneity within Liquid Net Worth

The analysis in this paper centers on separating liquid net worth into liquid assets and liquid debt. This is because there is significant heterogeneity in assets and debt underlying a given level of net worth, and, previewing results in the next section, there is evidence that the heterogeneity in debt is more important for understanding the behavior of households near their borrowing constraints. For example, the average LWI is 4.7, and there are 156 households within a half-unit interval around this level (i.e., 4.7 ± 0.25). Of these, the LAI ranges from 4.5 to 22.9, and the LDI correspondingly ranges from 0.0 to 18.3.

Figure 2.10 plots liquid assets and liquid debt for each household in the sample. In each panel, the solid grey line plots $LAI = LDI$, or households with zero (liquid) net worth. Panel (a) excludes the 279 observations for which either the LAI or LDI are outside the first and 99th percentiles. The dark mass in the lower left region of the panel illustrates that the majority of households are in this area. Panel (b) further restricts the sample to the 93% of households with an LAI and LDI both less than or equal to 20. A large 15% mass of households have zero net worth, with 97% of these

Figure 2.10: Breakdown of Liquid Wealth into Liquid Asset and Debt Ratios



Notes: Panel (a) excludes 279 observations for which either the LAI or LDI are outside the first and 99th percentiles

households holding neither liquid assets nor debt.

2.4 Empirical Analysis

2.4.1 Regression Estimations

The main analysis centers on a multinomial logit regression of the fiscal stimulus usage on balance sheet items, demographic controls, and controls related to the size of the rebate, date it was received, and means by which it was received (cheque or direct deposit). The demographic controls are for age, race, education, family structure, and region. Families whose head is not between the ages of 25 and 65 are excluded. In each regression, the covariates are difference, but together represent the entire household balance sheet, thus summing to household net worth.

The Census Bureau provides weights to control for sampling variation. These ensure that the estimates are valid for the population of households that received rebates. Being selected into this population is not random, but is irrelevant for this

analysis because inferences are made using only within-group variation.

The multinomial regression produces estimated probabilities that a given household will use the stimulus to increase spending, increase saving, or repay debt. The coefficients from the regressions are not reported. Instead, tables 2.10, 2.11, and 2.12 present estimates of the marginal changes in the covariates. The marginal changes are estimated relative to the average household and presented as semi-elasticities. Each cell in the table represents the percentage point change in the predicted probability for a 10% change in the ratio of the balance sheet item to income. Again relying on the interpretation of the sample as a single representative household, changes in predicted probabilities are interpreted as changes in predicted marginal propensities.

The estimates are reported as semi-elasticities because the goal is to examine how movement along the distribution of wealth and individual balance sheet items induces changes in marginal propensities to consume, save, and repay debt. Although each balance sheet item is in the same currency, the variation between each item is several orders of magnitude. For this reason, looking at changes in levels is less informative than changes in percentages.

Table 2.10 includes each individual balance sheet item in Table 2.6 as a separate regressor. Two regressors stand out: deposits and credit card debt. Indeed, these are the two primary underlying components of liquid wealth, already giving credence to the notion that liquid wealth is the relevant margin for understanding how households balance sheets matter for the use of fiscal stimulus.

A 10% increase in the deposits to income ratio, relative to the average, is an increase of 0.76. The standard deviation of the deposits to income ratio is 52.3, thus representing a roughly 0.01 standard deviation change. The model predicts that the marginal propensity to consume increases by 0.07 percentage points, the marginal propensity to save increases by 0.05 percentage points, and the marginal propensity to repay debt decreases by 0.12 percentage points. All three estimates are precisely

Table 2.10: Regression Results for All Items on Household Balance Sheet

Assets	P(Spend)	P(Save)	P(Repay Debt)
Illiquid Assets			
Housing	-0.025 (0.031)	-0.015 (0.023)	0.040 (0.041)
Vehicles	0.101** (0.032)	0.018 (0.026)	-0.119* (0.048)
Real Estate	-0.011 (0.006)	-0.004 (0.003)	0.015* (0.007)
Business	-0.011 (0.008)	-0.000 (0.004)	0.012 (0.008)
Illiquid Financial*	0.011 (0.017)	0.016 (0.012)	-0.027 (0.027)
Liquid Assets			
Deposits	0.066*** (0.019)	0.054*** (0.012)	-0.120*** (0.028)
Stocks and Mutual Funds	0.012 (0.008)	0.014* (0.006)	-0.026* (0.013)
Debt			
Secured Debt			
Housing	-0.030 (0.033)	-0.044 (0.023)	0.074 (0.040)
Vehicles	-0.034* (0.017)	-0.037 (0.027)	0.071* (0.034)
Real Estate	0.006 (0.003)	0.003 (0.003)	-0.009* (0.004)
Business	0.009 (0.005)	-0.002 (0.005)	-0.007 (0.007)
Stocks and Mutual Funds	0.001 (0.001)	-0.000 (0.001)	-0.001 (0.001)
Unsecured Debt			
Credit Cards	-0.059* (0.024)	-0.217*** (0.038)	0.276*** (0.037)
Bank Loans	-0.002 (0.007)	-0.018* (0.009)	0.020* (0.009)
Other Unsecured Debt	-0.010 (0.007)	-0.006 (0.008)	0.015 (0.011)

Regression with $N = 14,663$. Demographic and rebate controls. Marginal changes from multinomial logit, evaluated at mean values. Semi-elasticities. 10% change in the independent variable yields percentage point change. Values presented are multiplied by 100. Standard errors in parentheses. * denotes $p < 0.05$, ** denotes $p < 0.01$, and *** denotes $p < 0.001$.

Table 2.11: Regression Results for Liquid and Illiquid Wealth

	P(Spend)	P(Save)	P(Repay Debt)	P(Spend)	P(Save)	P(Repay Debt)
Liquid Wealth	0.064*** (0.013)	0.047*** (0.008)	-0.112*** (0.020)			
Liquid Assets				0.068*** (0.018)	0.054*** (0.011)	-0.122*** (0.027)
Liquid Debt				-0.054* (0.025)	-0.220*** (0.038)	0.275*** (0.037)
Illiquid Wealth	-0.017 (0.012)	-0.008 (0.007)	0.025 (0.017)			
Illiquid Assets				0.001 (0.023)	0.022 (0.016)	-0.023 (0.036)
Illiquid Debt				-0.004 (0.033)	-0.079*** (0.023)	0.083 (0.043)

Regression with $N = 14,663$. Marginal changes from multinomial logit, evaluated at mean values. Semi-elasticities. 10% change in the independent variable yields percentage point change. Values presented are multiplied by 100. Standard errors in parentheses. * denotes $p < 0.05$, ** denotes $p < 0.01$, and *** denotes $p < 0.001$.

Table 2.12: Regression Results for Liquid Wealth and Housing

	P(Spend)	P(Save)	P(Repay Debt)	P(Spend)	P(Save)	P(Repay Debt)
Liquid Assets	0.069*** (0.018)	0.052*** (0.011)	-0.122*** (0.027)	0.071*** (0.018)	0.057*** (0.011)	-0.128*** (0.026)
Liquid Debt	-0.056* (0.025)	-0.232*** (0.038)	0.288*** (0.037)	-0.051* (0.025)	-0.222*** (0.038)	0.273*** (0.037)
Illiquid Wealth Ex. Housing	-0.006 (0.009)	0.003 (0.005)	0.003 (0.013)	-0.004 (0.009)	0.004 (0.005)	0.000 (0.013)
Net Housing Equity	0.001 (0.016)	-0.003 (0.011)	0.002 (0.022)			
Housing Assets				0.006 (0.029)	-0.001 (0.021)	-0.005 (0.041)
Housing Debt				-0.029 (0.031)	-0.059** (0.021)	0.088* (0.042)

Regression with $N = 14,663$. Marginal changes from multinomial logit, evaluated at mean values. Semi-elasticities. 10% change in the independent variable yields percentage point change. Values presented are multiplied by 100. Standard errors in parentheses. * denotes $p < 0.05$, ** denotes $p < 0.01$, and *** denotes $p < 0.001$.

estimated and significant at less than the 0.01% level.

Turning to credit card debt, a 10% increase in the ratio of credit card debt to income is an increase of approximately 0.28 or 0.03 standard deviations. The marginal propensity to consume decreases by 0.06 percentage points, though this estimate is only significant at the 5% level. The marginal propensity to increase savings decreases by 0.22 percentage points, and the marginal propensity to repay debt increases by 0.28 percentage points.

It is evident that similar percent changes in credit card debt induce much larger changes in the propensities to save and repay debt. Further, directly comparing level changes, the larger debt effect is induced by a smaller level change. Comparing levels is reasonable in this case because credit card debt and deposits are of similar orders of magnitude.

Given that deposits and credit card debt are the two components of liquid wealth, table 2.11 collapses the balance sheet into liquid and illiquid wealth, as defined in Table 2.6. The first three columns are from the regression including only liquid and illiquid wealth to income ratios. The estimated marginal changes are economically and statistically significant for all three marginal propensities. Increasing liquid wealth by 10% increases the marginal propensity to consume by 0.06 percentage points, the marginal propensity to save by 0.05 percentage points, and decreases the marginal propensity to repay debt by 0.11 percentage points. Thus the analysis falls in line with the literature that predicts marginal propensities to consume are *increasing* in liquid wealth.

The contribution of this paper is to take the analysis one step further. In the second set of three columns, liquid and illiquid wealth are broken down into assets and debt. Recall that liquid assets are deposits, and liquid debt is credit card debt. The estimated changes from liquid assets are almost identical to those on liquid wealth. This is not surprising given that the correlation between wealth and assets is

almost unity. Interestingly, the estimated changes from liquid debt are large and the opposite sign. This indicates that the dynamics of debt are important in determining how households use fiscal stimulus, but are completely ignored by estimates that do not decompose wealth into assets and debt.

Increasing liquid assets by 10% increases the marginal propensity to consume by 0.07 percentage points, the marginal propensity to save by 0.05 percentage points, and decreases the marginal propensity to repay debt by 0.12 percentage points. Increase liquid debt by 10%, which is a smaller change in levels, decreases the marginal propensity to consume by 0.05 percentage points, decrease the marginal propensity to save by 0.22 percentage points, and increases the marginal propensity to repay debt by 0.28 percentage points.

Together, simultaneously increasing liquid assets and liquid debt of the average household by 10% each, the approximate net effect would be to increase the marginal propensity to consume by 0.01 percentage points, decrease the marginal propensity to save by 0.17 percentage points, and increase the marginal propensity to repay debt by 0.15 percentage points.⁸

These estimates imply that for two households with similar liquid wealth but different underlying compositions of assets and debt, the more indebted household is less likely to increase saving, slightly more likely to increase consumption, and more likely to repay debt. This is a key contribution of the analysis in this paper.

Dividing illiquid wealth into illiquid assets and illiquid debt is also fruitful. While illiquid wealth was neither economically nor statistically significant in the first regression, the estimated effect of changing illiquid debt is now important. Specifically, increasing illiquid debt by 10% decreases the marginal propensity to save by 0.08%, and this estimate is significant at less than the 0.01% level. The estimated change in

⁸Changing both liquid assets and debt by 10% would yield a slightly larger net worth since the level change in debt, 0.28, is smaller than the level change in assets, 0.76. Increasing the change in debt such that the change in net worth is zero only serves to magnify the point that the elasticity with respect to debt is larger than with respect to assets.

the marginal propensity to repay debt is large but not estimated precisely. Together, these estimates imply that as households become accumulate more illiquid debt, they are more inclined to use the stimulus to repay debt, and less inclined to increase savings.

A 10% increase in illiquid debt to income, relative to the average, is an increase of 6.1, or approximately 0.03 standard deviations. Thus a 10% change in illiquid debt is incomparable to a similar percentage change in liquid assets or liquid debt, but yields a predicted change of similar size.

Motivated by the fact that housing debt is, on average, 70% of all illiquid debt in the sample, a model with liquid assets, liquid debt, and illiquid wealth divided into housing and non-housing is estimated. In the first three columns, include are two covariates: illiquid wealth excluding housing and net housing equity. In the second set of three columns, net housing equity is decomposed into housing assets and debt. In all six columns, the estimates for liquid assets and debt are similar, indicating insensitivity of these estimate to different decompositions of illiquid wealth.

In the model with net housing equity as a regressor, the estimated changes are small and imprecise. However, when net housing equity is further decomposed into housing debt and assets, the estimates on housing debt are large and statistically significant, and in fact very similar to the estimates for total illiquid debt.

Increase housing debt to income by 10% decreases the marginal propensity to save by 0.06 percentage points and increases the marginal propensity to repay debt by 0.09 percentage points. Again, households with more housing debt are more likely to use the stimulus to repay debt, and less likely to increase savings. In levels, this 10% change is an increase of 4.4, or approximately 0.03 standard deviations, and changes total net worth significantly. Just as above, this change is incomparable to similar percentage changes in liquid assets or debt, but yields a predicted change of similar size.

2.4.2 Changes Along the Wealth Distribution

The marginal changes in the tables above represent how the average household will respond to a 10% change in different balance sheet items. Given the nonlinear nature of the multinomial model, however, the marginal changes are different for households at other parts of the distribution.

Marginal Propensity to Consume

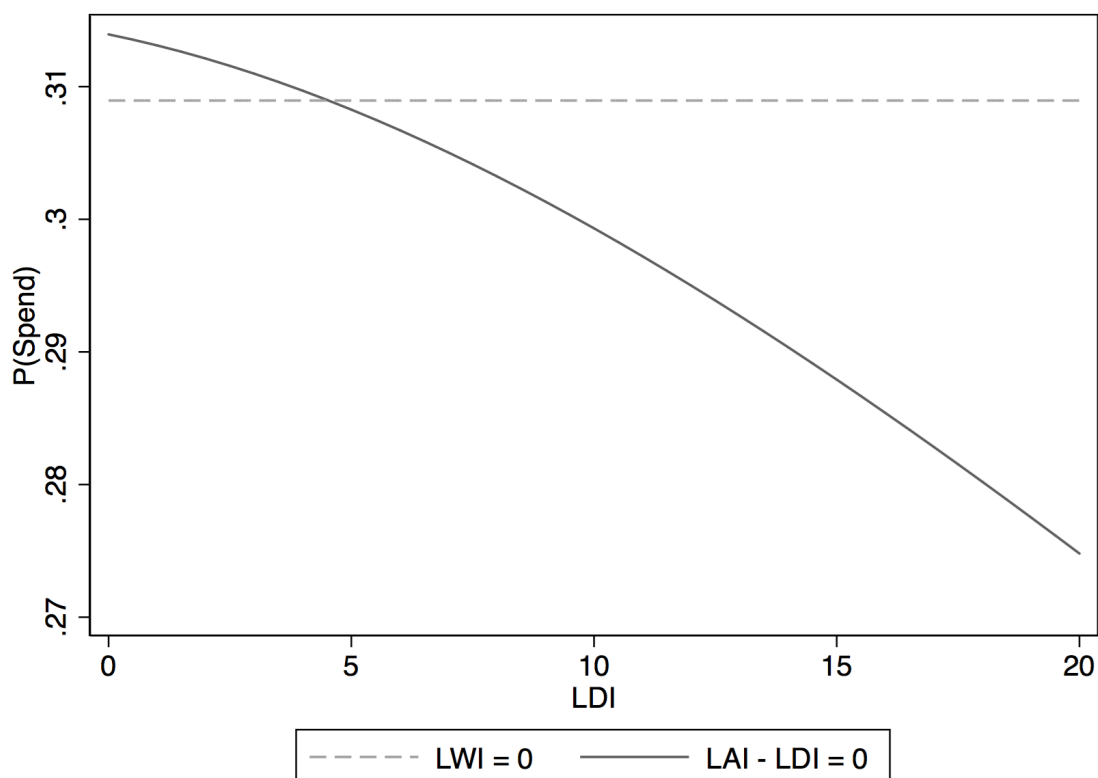
Figure 2.11 plots the predicted marginal propensity to consume as the liquid debt to income ratio, LDI, varies. The solid line shows the estimated marginal propensity as the LAI varies with the LDI to keep liquid net worth constant at zero, i.e. $LWI = LAI - LDI = 0$. The dashed line shows the estimated marginal propensity to consume from the model that did not decompose liquid wealth into liquid assets and debt. This line is horizontal because as the LDI and LAI vary but keep liquid wealth constant, the predicted marginal propensity is the same. At any point on these two lines, liquid wealth is zero.

This figure highlights the importance of allowing the composition of assets and debt to vary for a given level of liquid net worth. Looking solely at liquid net worth to income, the model predicts a marginal propensity to consume of approximately 0.308. The model with liquid assets and debt predicts that a household with zero liquid net worth can have a marginal propensity to consume ranging between 0.314, when $LAI = LDI = 0$, to 0.275, when $LAI = -LDI = 20$.

Figure 2.12 plots the predicted marginal propensity to consume as LDI varies but the LAI is kept constant at either $LAI = 0$ or $LAI = 20$. In this figure, as liquid debt varies but liquid assets are held fixed, liquid wealth also varies. Recall that 93% of households in the sample have both the LAI and LDI between 0 and 20.

This figure shows illustrates that fiscal stimulus usage is more elastic with respect

Figure 2.11: Predicted $P(\text{Spend})$ for Varying Liquid Debt and Zero Liquid Wealth

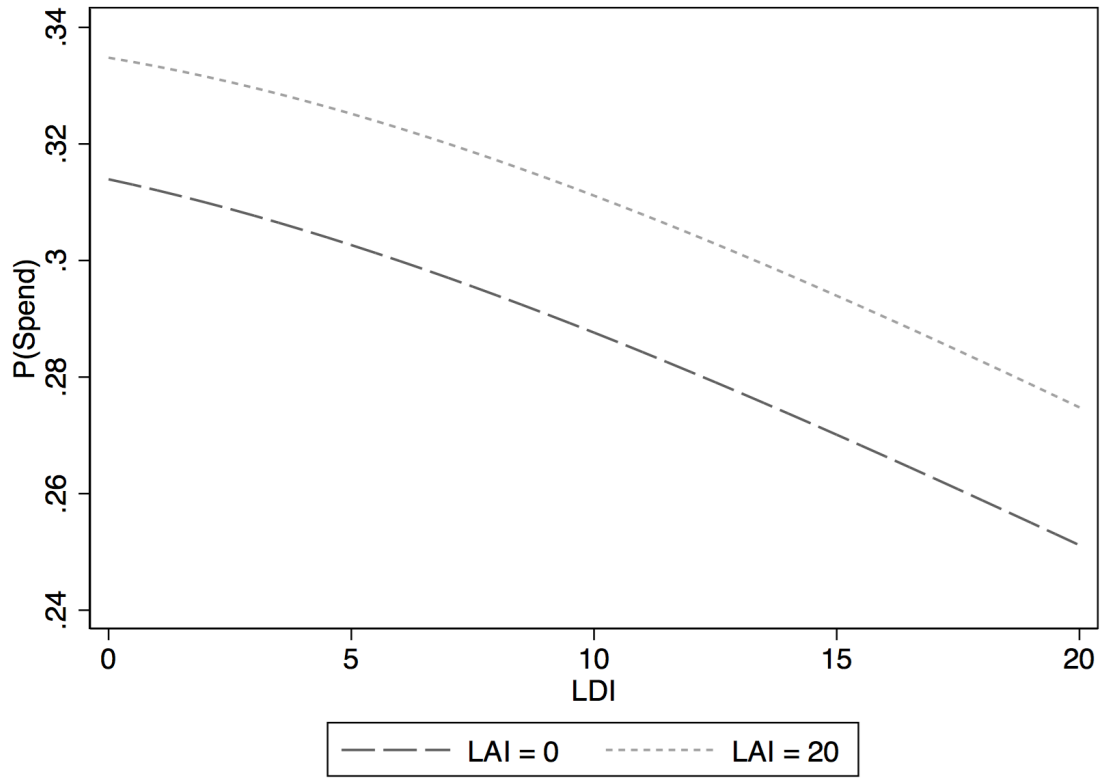


Notes: The dashed line is from the model with liquid wealth as a regressor. The solid line is from the model that includes liquid assets and liquid debt as two separate regressors. Along both lines, LWI is held fixed at zero.

to debt than assets. Consider a household with zero liquid debt and a liquid asset to income ratio of 20, corresponding to the leftmost point on the $LAI = 20$ line. This household's liquid net worth to income ratio is also 20. If assets decrease to $LAI = 0$, the leftmost point on the $LAI = 0$ line, the decrease in the marginal propensity to consume is the vertical distance between the leftmost point on each line, which is approximately -2.09 percentage points. With zero debt and now zero assets, this household's liquid net worth is zero.

Alternatively, suppose the household's liquid net worth decreases to zero because it increases its liquid debt such that $LDI = 20$, corresponding to the rightmost point on the $LAI = 20$ line. The change in the marginal propensity to consume is now

Figure 2.12: Predicted $P(\text{Spend})$ for Varying Liquid Debt and Assets



Notes: Along both lines, as LDI varies on the horizontal axis, LAI is held constant at either $\text{LAI} = 0$ or $\text{LAI} = 20$.

approximately -6.00 percentage points, almost triple that of decreasing liquid assets. These changes are summarized in the first row of Table 2.13.

This figure plots only two LAI curves. In general, for any value of liquid wealth given by a pair of LAI and LDI, when moving to a different liquid wealth, holding LAI fixed and moving LDI along the LAI curve will yield a larger change in marginal propensity to consume than holding LDI fixed and moving between LAI curves.

Marginal Propensity to Save

Figure 2.13 plots the predicted marginal propensity to save as the liquid debt to income ratio varies but liquid wealth is held fixed at zero. The dashed line is from the model with only liquid wealth, and thus for any value of LDI and corresponding

Table 2.13: Changes in Predicted Probabilities When Decreasing Liquid Wealth

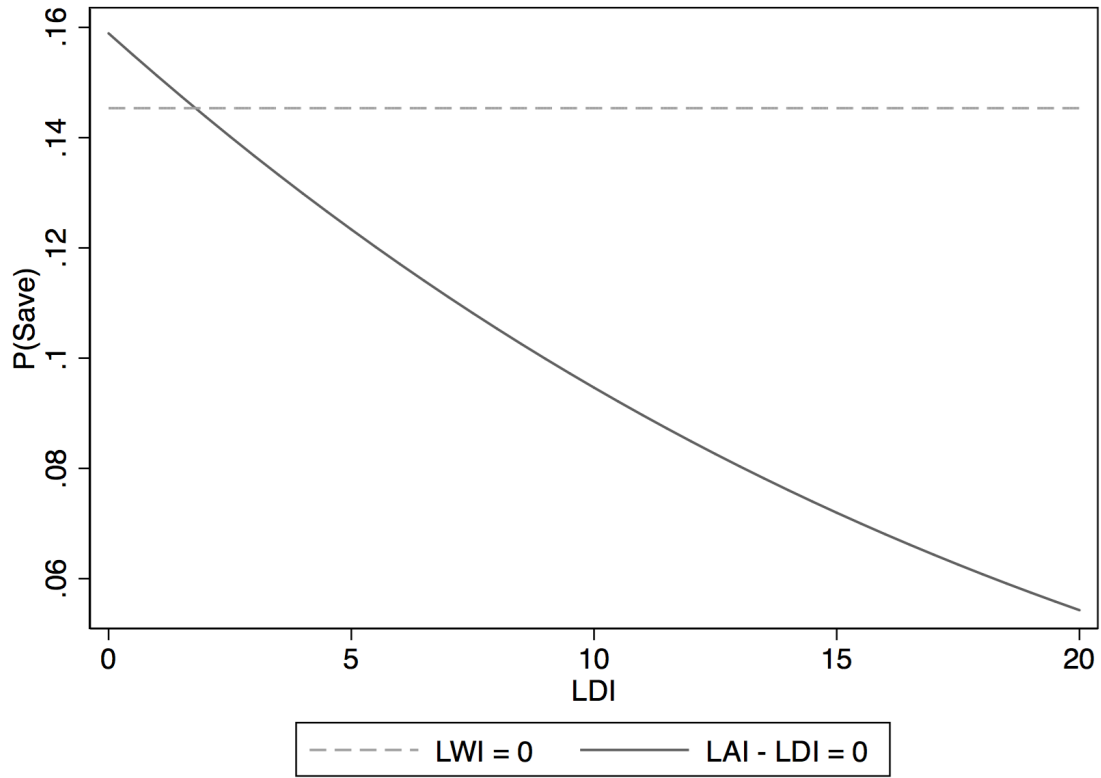
	$\Delta \text{LAI} = -20$	$\Delta \text{LDI} = 20$	Ratio of ΔLDI to ΔLAI
$\Delta \text{P}(\text{Spend})$	-2.09	-6.00	2.9
$\Delta \text{P}(\text{Save})$	-1.40	-12.0	8.6
$\Delta \text{P}(\text{Repay Debt})$	3.49	17.9	5.1

Changes in predicted probabilities for a household moving from $(\text{LWI}, \text{LAI}, \text{LDI}) = (20, 20, 0)$ to $\text{LWI} = 0$. In the first column, the change is accomplished by decreasing liquid assets to income to zero, resulting in $(\text{LWI}, \text{LAI}, \text{LDI}) = (0, 0, 0)$. In the second column, the change is accomplished by increasing liquid debt to income to 20, resulting in $(\text{LWI}, \text{LAI}, \text{LDI}) = (0, 20, 20)$.

LAI, the predicted marginal propensity to save is 0.145. The solid line is from the model that decomposes liquid wealth into liquid assets and debt, and thus as LDI varies, LAI varies such that $\text{LWI} = \text{LAI} - \text{LDI} = 0$. The predicted marginal propensity thus varies from 0.159 at low levels of assets and debt to 0.054 at high levels of assets and debt. This is a significant range and highlights the importance of separately analyzing liquid assets and debt.

Figure 2.14 illustrates the predicted marginal propensity to save as LDI varies but the LAI is fixed at two values, $\text{LAI} = 0$ or $\text{LAI} = 20$. Here, the comparative elasticity between changing debt versus assets is even larger than the estimated propensity to consume. Consider again a household with $\text{LWI} = 20$ from a liquid asset to income ratio of 20 and no debt. If the household's liquid assets decrease to zero, the estimated marginal propensity to save decreases by the vertical distance between the leftmost points of the two lines, which is approximately -1.40 percentage points. This household's liquid net worth is now zero. If instead the household's liquid net worth decreases to zero because it increases liquid debt such that $\text{LDI} = 20$, the marginal propensity to save decreases by the movement along the $\text{LAI} = 20$ curve from the leftmost to rightmost points, or approximately -12.0 percentage points. This household's liquid worth is also zero, but the change is more than eight times

Figure 2.13: Predicted $P(\text{Save})$ for Varying Liquid Debt and Zero Liquid Wealth



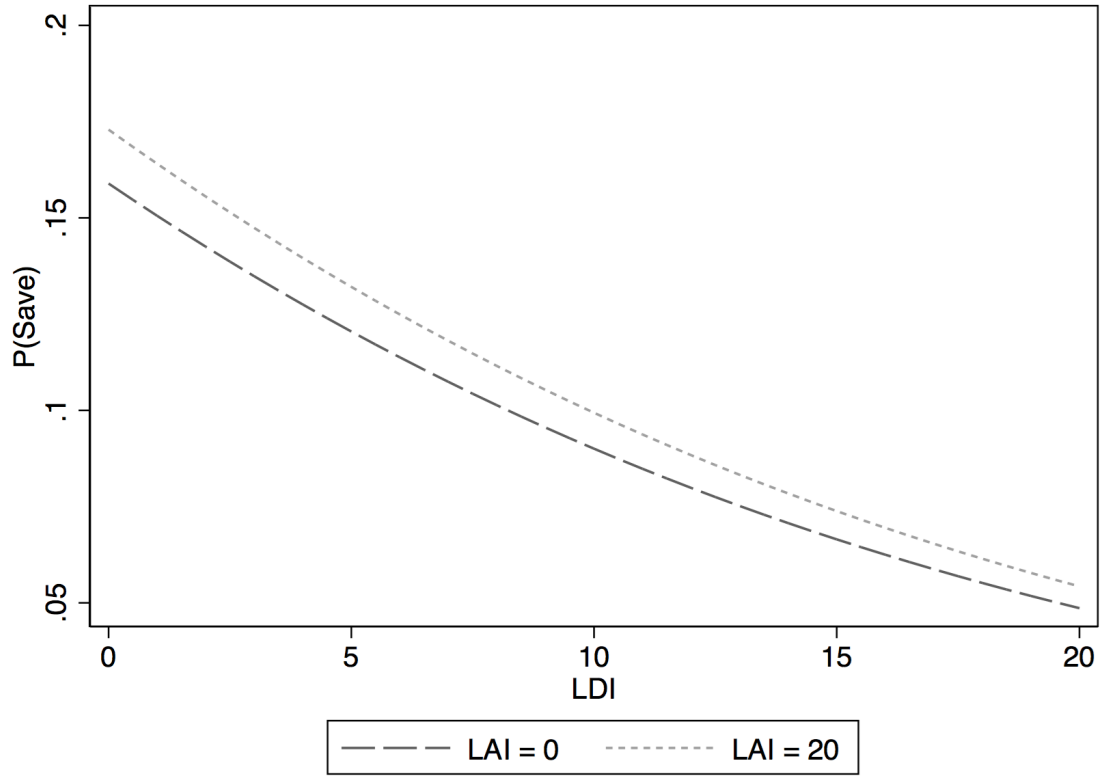
Notes: The dashed line is from the model with liquid wealth as a regressor. The solid line is from the model that includes liquid assets and liquid debt as two separate regressors. Along both lines, LWI is held fixed at zero.

larger from increasing debt than decreasing assets. The second row of Table 2.13 summarizes the changes in this example. Again, this pattern again holds for any change in liquid wealth: changing liquid debt yields a larger change in predicted propensity to save than changing liquid assets.

Marginal Propensity to Repay Debt

Figure 2.15 plots the predicted marginal propensity to repay debt for liquid wealth fixed at zero and varying levels of liquid debt to income. The dashed line is from the model with only liquid wealth, and thus regardless of the underlying composition of liquid assets and debt, the predicted marginal propensity to repay debt is 0.546. The

Figure 2.14: Predicted P(Save) for Varying Liquid Debt and Assets

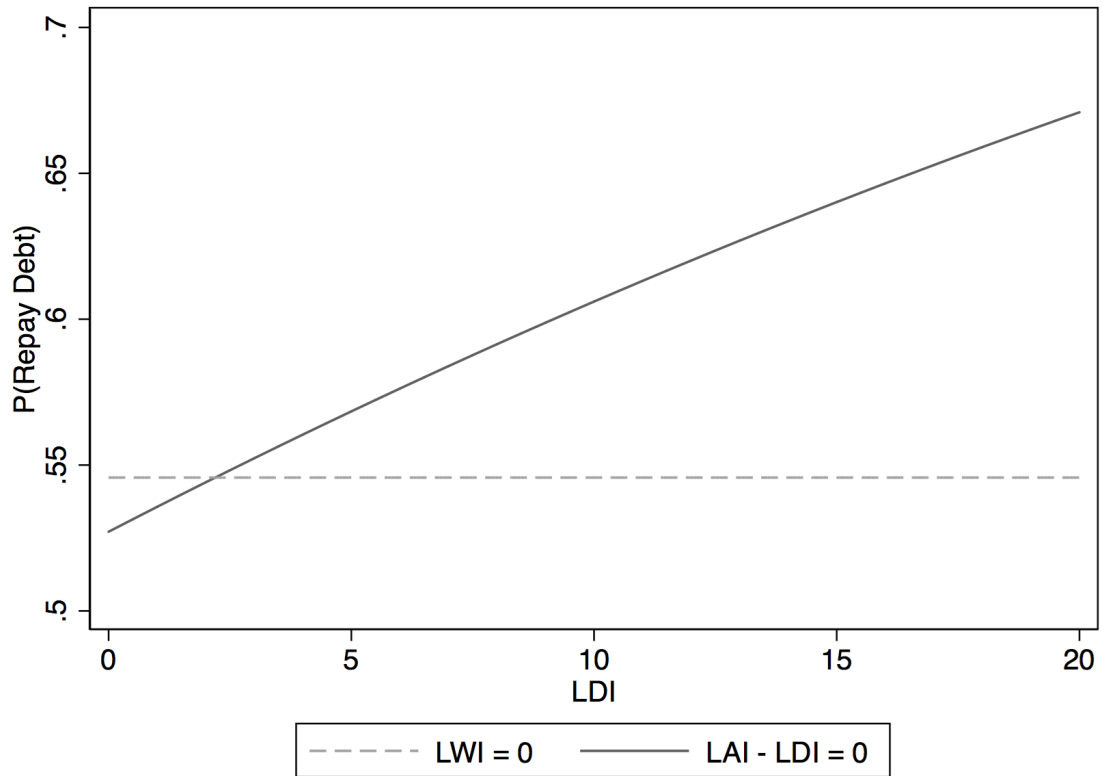


Notes: Along both lines, as LDI varies on the horizontal axis, LAI is held constant at either LAI = 0 or LAI = 20.

solid line is from the model with liquid assets and debt. As liquid debt varies, liquid assets vary such that liquid wealth remains fixed at zero. The predicted marginal propensity to repay debt varies from 0.527 at low levels of assets and debt to 0.671 at high levels of assets and debt. Again, this is a large range, and underlines the important of decomposing liquid wealth into liquid assets and debt.

Figure 2.16 illustrates the predicted marginal propensity to repay debt as liquid debt varies but liquid assets is held fixed at LAI = 0 or LAI = 20. Again, consider a household with LAI = 20 and LDI = 0, so that LWI = 20. If this household's liquid assets (and therefore liquid wealth) decrease to zero, the estimated propensity to repay debt increases by the vertical distance between the leftmost points of the two lines, which is approximately 3.49 percentage points. Suppose instead that the

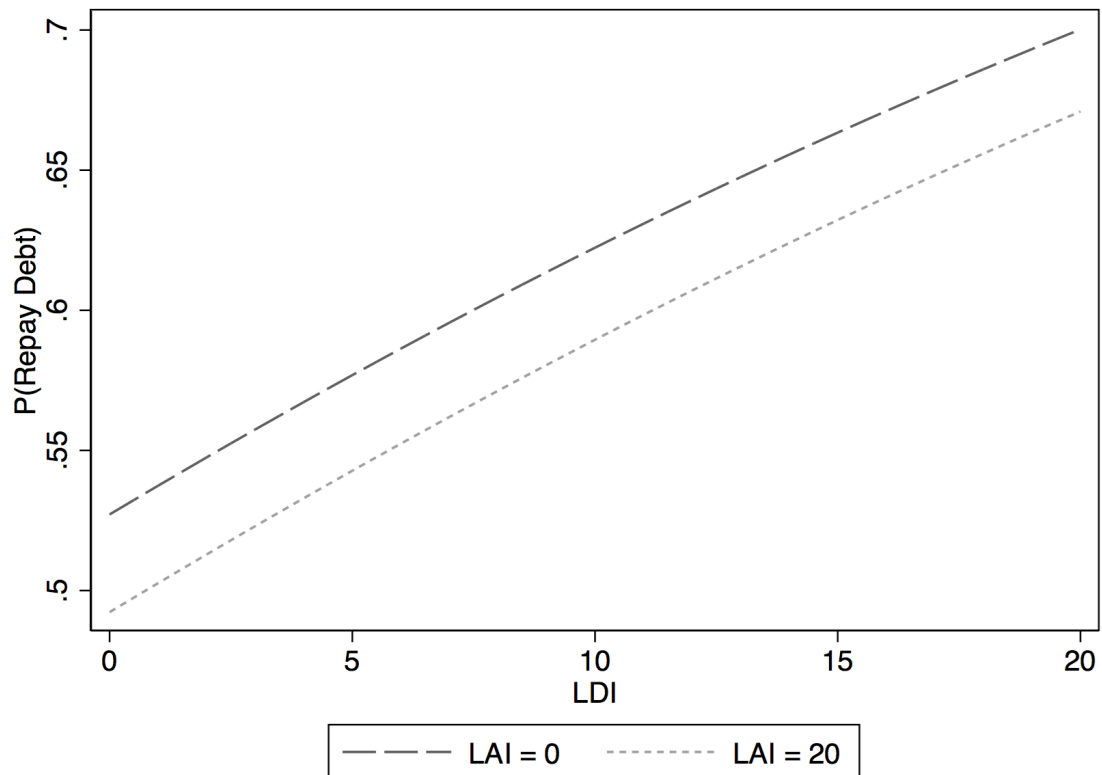
Figure 2.15: Predicted P(Repay Debt) for Varying Liquid Debt and Zero Liquid Wealth



Notes: The dashed line is from the model with liquid wealth as a regressor. The solid line is from the model that includes liquid assets and liquid debt as two separate regressors. Along both lines, LWI is held fixed at zero.

household's liquid net worth decreases to zero because it increases its liquid debt such that $LDI = 20$. The change in marginal propensity to repay debt increases by the distance between the leftmost and rightmost points of the $LAI = 20$ curve, which is approximately 17.9 percentage points. The increase in debt induces a change in the estimated propensity to repay debt approximately five times larger than the change in assets.

Figure 2.16: Predicted $P(\text{Repay Debt})$ for Varying Liquid Debt and Assets



Notes: Along both lines, as LDI varies on the horizontal axis, LAI is held constant at either $\text{LAI} = 0$ or $\text{LAI} = 20$.

2.5 Why is Liquid Debt More Important than Liquid Assets?

Economic theory says that borrowing constrained households are those that should respond the most to fiscal stimulus. The empirical analysis above points to the liquid debt to income ratio as the most important margin in determining how households use their fiscal stimulus. This finding is consistent with a growing body of literature that argues borrowing constraints are largely functions of debt and income.

Johnson and Li (2010) provide strong evidence that the debt payment to income ratio is an indicator of borrowing constraints. Using data from the Survey of Con-

sumer Finance and Consumer Expenditure Survey, they find that the debt payment to income ratio is useful in predicting whether households are turned down for credit. Households with higher debt payment to income ratios also display excess consumption sensitivity to income volatility, indicating less consumption smoothing, a key trait of borrowing constrained households. Similarly, Baker (2018) uses a proprietary dataset of household financial information and finds that consumption is more sensitive to changes in debt rather than assets.

Greenwald (2018) finds that in addition to standard loan-to-value collateral borrowing limits, payment-to-income constraints are crucial for understanding mortgage borrowing. In the corporate finance literature, Lian and Ma (2018) and Greenwald (2019) study borrowing constraints faced by firms. In addition to standard collateral constraints, they find that earnings-based borrowing constraints are important and often the binding borrowing limit.

2.5.1 Mortgage Payment to Income

In addition to the existing evidence, a survey question in the SIPP can also shed light on whether debt-to-income ratios are relevant for borrowing constraints. The SIPP asks households whether they currently have a mortgage and, if so, what their monthly mortgage payment is. Using this data where available, a monthly mortgage payment to monthly income ratio is constructed for 8,185 households. Though mortgages are not the only monthly debt service payments that households make, they are likely a significant contributor. The average household (with a mortgage) allocates 29.2% of its monthly income to paying the mortgage, with a standard deviation of 56.7%.

Table 2.14 presents estimated marginal changes from a multinomial logit model, as defined extensively in section 2.4.1. From the first row, a 10% increase in the payment to income ratio decreases the marginal propensity to save by 0.20 percentage points

Table 2.14: Estimated Changes from Regressions with Mortgage Payment Ratio

	P(Spend)	P(Save)	P(Repay Debt)
(1) PTI	-0.024 (0.046)	-0.200* (0.081)	0.224** (0.071)
(2) PTI	-0.060 (0.093)	-0.217** (0.077)	0.277* (0.111)
(3) PTI	-0.003 (0.068)	-0.181* (0.079)	0.184* (0.083)
(4) PTI	-0.054 (0.060)	-0.240*** (0.055)	0.294*** (0.074)

Regressions with $N = 8,185$. Each specification has the same controls, the mortgage payment to income (PTI), and possibly additional covariates. (1) includes no additional covariates. (2) has all the balance sheet items. (3) has housing assets and housing debt. (4) has liquid assets and liquid debt. Marginal changes from multinomial logit, evaluated at mean values. Semi-elasticities. 10% change in the independent variable yields percentage point change. Values presented are multiplied by 100. Standard errors in parentheses. * denotes $p < 0.05$, ** denotes $p < 0.01$, and *** denotes $p < 0.001$.

and increases the marginal propensity to repay debt by 0.22. The estimated change in the marginal propensity to consume is small and imprecisely estimated. Recalling the results from above, these are large changes. The remaining rows serve as checks for robustness and do not change the estimated effects significantly; the second row includes every balance sheet item separately, the third row includes housing assets and housing debt, and the fourth row includes liquid assets and liquid debt.

2.5.2 Credit Card Rejections

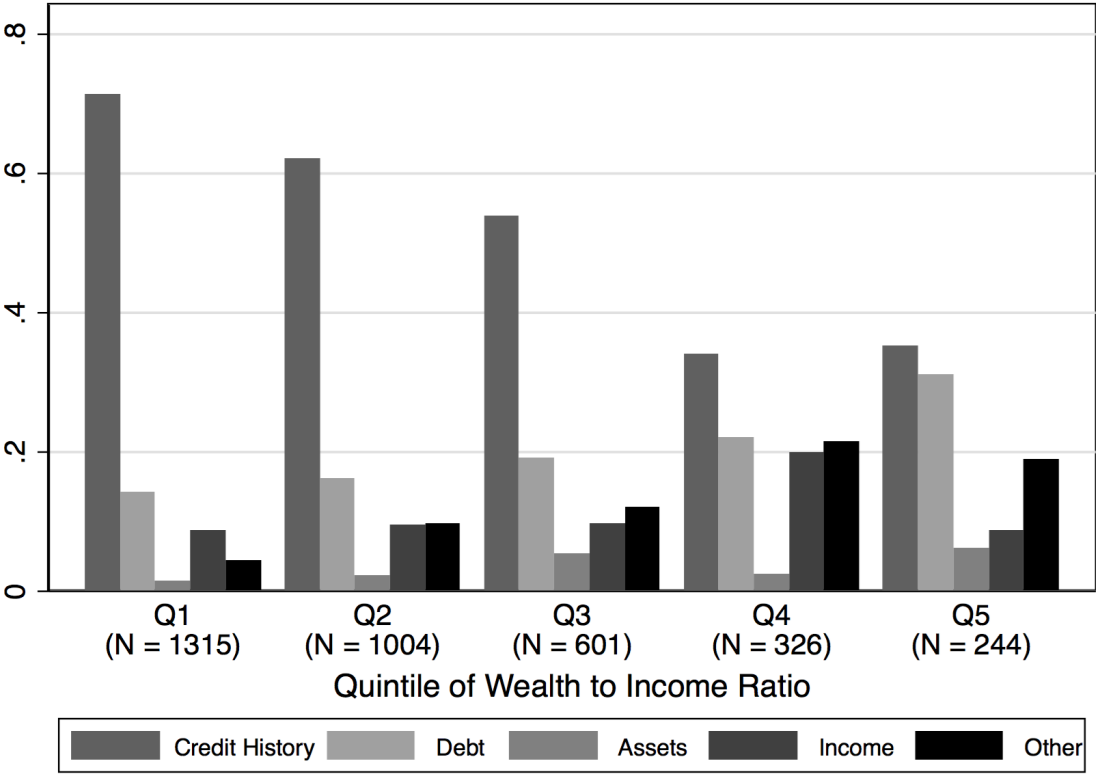
The Survey of Consumer Finances includes a question that asks households if they have applied for and been rejected for a credit card, and, if so, the primary reason for the rejection. Figure 2.17 divides households into quintiles of the wealth to income ratio and reports frequencies for the four most common answers: poor credit history, too much debt, not enough assets, and not income income.

In every wealth quintile, the most common answer is a poor credit history. FICO scores are the most common form of credit history and take into account various factors in five areas to determine credit worthiness: payment history (35%), amounts owed (30%), length of credit history (15%), credit mix (10%), and new credit (10%).⁹ A household's current level of debt represent a large portion of its FICO score in two ways. First, the amount owed directly contributes to 30% of the FICO score. Second, the largest component, payment history, is likely a function of both income (the means to make payment) and debt (the level of the payment).

Following a poor credit history, the most common reason households provide for being rejected for credit is too much existing debt. This implies that though the household's FICO score was sufficiently high, the lender still believed the household was over leveraged and refused any more credit. It is important to note that

⁹See <https://www.myfico.com/credit-education/whats-in-your-credit-score> for more details.

Figure 2.17: Household Wealth to Income and Reasons for Being Denied Credit

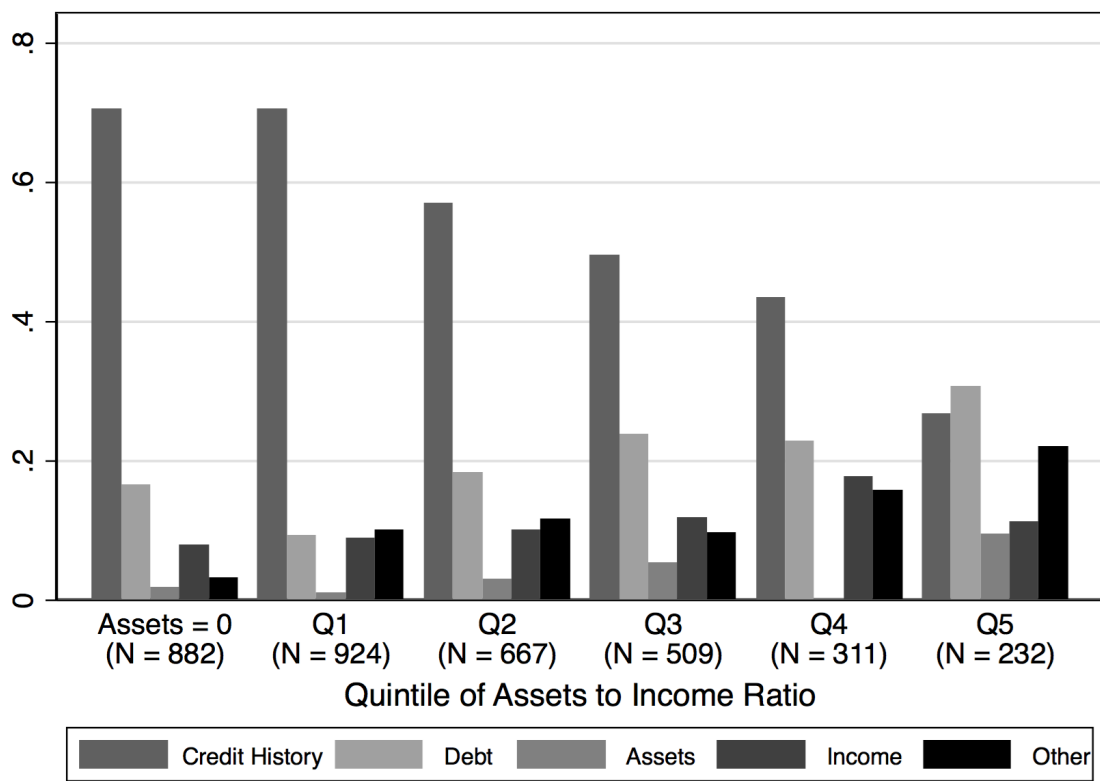


Notes: Source: Survey of Consumer Finances (2016).

this pattern holds even for the most wealthy households. Naturally, there are fewer wealthy households rejected for credit, but conditional on being wealthy and rejected for credit, the evidence suggests that high levels of indebtedness are the culprit, and not a lack of assets or income.

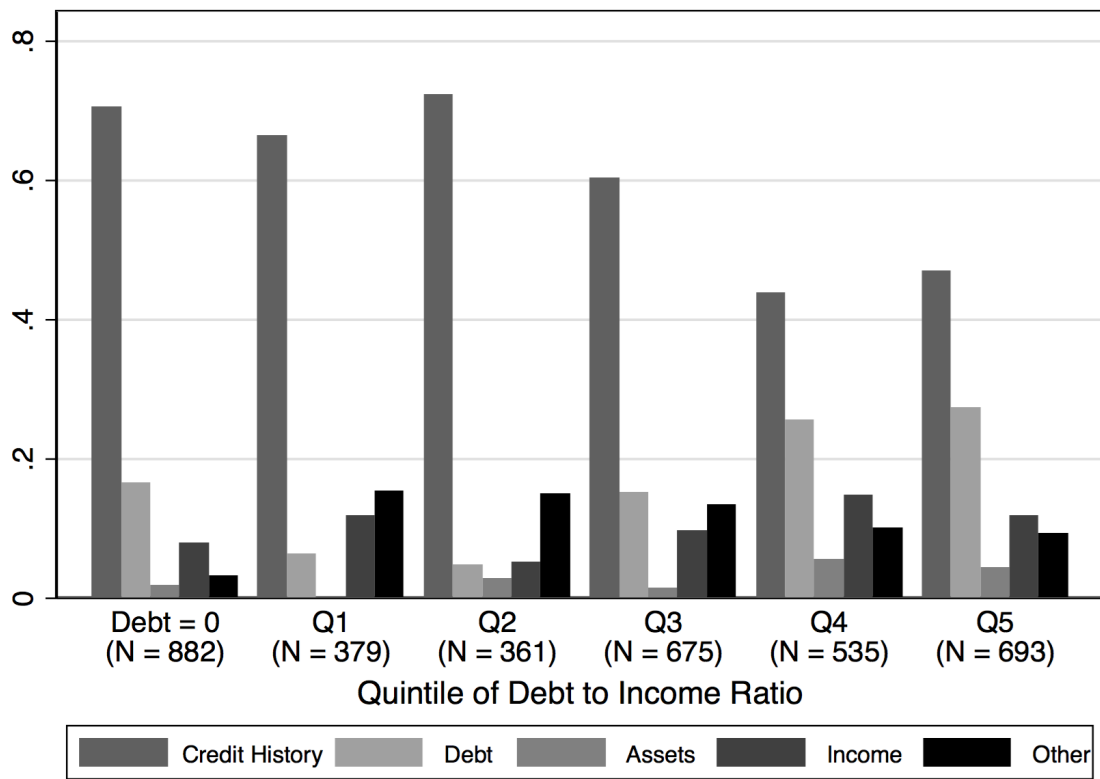
This pattern holds true in Figure 2.18, where households are divided by assets to income. Again, conditional on being a high-asset household and rejected for credit, high levels of indebtedness are the cause, at least more so than insufficient assets or income. Unsurprisingly, then, grouping households by debt to income in Figure 2.19 reiterates this point. As indebtedness increases, households are more likely to be rejected for holding too much debt, and less likely for having too few assets or too little income.

Figure 2.18: Household Assets to Income and Reasons for Being Denied Credit



Notes: Source: Survey of Consumer Finances (2016). Note: Quintiles are conditional on having positive assets. Households with zero assets are collected in the first bar and labelled as such.

Figure 2.19: Household Debt to Income and Reasons for Being Denied Credit



Notes: Source: Survey of Consumer Finances (2016). Note: Quintiles are conditional on having positive debt. Households with zero debt are collected in the first bar and labelled as such.

Chapter 3

An Analysis of the Coronavirus Aid, Relief, and Economic Security (CARES) Act in 2020

3.1 Introduction

On March 27, 2020, President Donald Trump signed into law the Coronavirus Aid, Relief, and Economic Security (CARES) Act. The \$2.2 trillion economic stimulus bill is the largest of its kind in US history, surpassing the \$831 billion stimulus programs designed in response to the Great Recession. The Act included \$300 billion in direct and untargeted Economic Impact Payments (EIPs) to individuals in the form of a refundable tax credit. Critics of the program have argued for programs more targeted towards those most severely affected, while conceding that the timeliness of the program was due to its relatively simple design (see, for example, International Monetary Fund (2020)).

In this paper, I address two questions. First, did households primarily use their Economic Impact Payments to pay for expenses, add to savings, or pay off debt? Using data from the Census Bureau's new Household Pulse Survey, I find that almost 75% of households who received an EIP reported using it mostly to pay for expenses. Only 11% reported using the EIP to mostly add to saving, and 14% reported using the EIP to mostly pay off debt. I estimate that the aggregate marginal propensity to consume (MPC) under several sets of assumptions is between 0.62 and 0.84.

Second, how did households facing unemployment use their Economic Impact Pay-

ments? Studying these households sheds light on the potential impact of a more targeted fiscal program. I find that 84% of households facing (or anticipating) lockdown-related labor income interruptions reported using their Economic Impact Payments mostly to pay for expenses, compared to 63% of households remaining employed. Instead, I find larger slightly larger differences when grouping households by income. Over 85% of low-income households earning less than \$35,000 per year reported using the EIP mostly to pay for expenses, compared to 56% of high-income households earning \$200,000 or more, with most of the difference coming from a larger fraction of high-income households mostly adding to savings using their EIPs.

My analysis is separated into two parts. In the first, I present three findings using the survey questions on how households used their Economic Impact Payments. First, both employed and unemployed households reported large spending responses. Approximately 63% of employed households reported using the EIP mostly to pay for expenses, compared to 84% of unemployed households. The majority of both types of households reported spending the EIP on expenditure categories related to consumption, such as food, clothing, and household supplies.

Second, 74% of unemployed households reported using their EIP to make regular payments for housing (rent or mortgage), utilities, and vehicles, compared to 44% of employed households. Third, employed households used their EIP to explicitly improve their balance sheets more than unemployed households. Only 11% of unemployed household reported using the EIP mostly to pay off debt, compared to 18% of employed households, and almost 19% of employed households reported using the EIP mostly to add to savings, compared to just 5% of unemployed households.

In the second part, I construct each household's expenditure basket using their survey responses and estimate the average MPC. In the baseline estimate, I assume that the household equally divides the EIP across each expenditure category, and in the preferred alternate estimate, I assume that if the household selects any saving or

debt repayment expenditure category, it allocates 50% of the EIP towards saving or debt repayment and the remainder towards consumption. Under these assumptions, the aggregate MPC is between 0.62 and 0.69. When vehicle and housing payments are included as consumption, as opposed to debt repayment, the estimated MPC increases to between 0.78 and 0.84.

The estimated MPC for employed households is between 0.59 and 0.65, compared to between 0.64 and 0.73 for unemployed households. When vehicle and housing payments are included as consumption, these ranges increase to between 0.70 and 0.75 and 0.83 to 0.90 for employed and unemployed households, respectively. These estimates are driven by two factors: the majority of households selected four or less expenditure categories, and, as noted above, a small fraction of households selected the categories corresponding to explicitly saving or repaying debt.

I contribute to the literature on self-reported usage of Economic Impact Payments. While my analysis focuses on how households divided their payments between paying for expenses, adding to saving, or paying off debt, two recent surveys poll households on whether they used their payments to *increase* spending, *increase* saving, or pay off debt. Unsurprisingly, responses to these questions differ significantly to those in the Household Pulse Survey, as the majority of households did not report *increasing* spending. Using an insert in the University of Michigan's May and June 2020 editions of the Survey of Consumers, Sahm, Shapiro and Slemrod (2020) find that 18% of households reported using their payments mostly to increase spending, 38% mostly to increase saving, and 44% mostly to pay off debt. Coibion, Gorodnichenko and Weber (2020) attach a questionnaire to the July 2020 Nielsen Homescan panel and find similar results: 15% of households reported using their payments mostly to increase spending, 33% mostly to increase saving, and 52% mostly to pay off debt. Taken together, these results indicate that households spent a large fraction of their Economic Impact Payments without increasing total spending. For example, of the

75% of households in my sample that reported using their EIPs mostly to pay for expenses, more than 80% reported spending on quasi-fixed monthly expenditures such as rent or mortgage payments, vehicle payments, and utility or telecommunication bills. In agreement with this interpretation are estimates of the spending response using quantitative survey questions or high-frequency transactional data, which indicate that households immediately spent between 25-50% of their Economic Stimulus Payments (Baker, Farrokhnia, Meyer, Pagel and Yannelis, 2020; Karger and Rajan, 2020).

A large literature studies similar stimulus programs in 2001 and 2008 that distributed direct transfers to households (Shapiro and Slemrod, 2003; Johnson, Parker and Souleles, 2006; Agarwal, Liu and Souleles, 2007; Shapiro and Slemrod, 2009; Sahm, Shapiro and Slemrod, 2010b; Parker, Souleles, Johnson and McClelland, 2013a; Broda and Parker, 2014) using a variety of self-reported survey data and consumption data, which have been demonstrated to produce consistent results (Parker and Souleles, 2019). The spending response in previous programs appears to have been somewhat smaller, which is likely due to the differing macroeconomic conditions and the state-dependency of the marginal propensity to consume out of stimulus payments (Parker, 2011). In 2020, relative to 2001 and 2008, payments were distributed simultaneously with one of the largest declines in consumption spending, both in the US and elsewhere (Dunn, Hood and Driessen, 2020; Andersen, Hansen, Johannesen and Sheridan, 2020; Chen, Qian and Wen, 2020).

3.2 CARES Act and Economic Impact Payments

US citizens and resident aliens received EIPs of \$1,200 for individual filers or \$2,400 for joint filers. Qualified taxpayers also received \$500 per child. Further, several groups of taxpayers, such as eligible retirees and recipients of some Social Security

benefits who do not file tax returns, received a \$1,200 payment automatically.

Above specified thresholds, EIPs were reduced by 5% of adjusted gross income (AGI) above the threshold. These thresholds were \$150,000 for joint filers, \$112,500 for head of household filers, and \$75,000 for individual filers. As a result, EIPs were not distributed to individual filers with no children and income above \$99,000 and joint filers with no children and income above \$198,000. To calculate eligibility and the amount of the EIP, the IRS used tax returns from 2018 or 2019. When 2020 returns are filed, filers who were eligible for a smaller EIP will have their overpayment forgiven, while filers eligible for a larger EIP will receive the difference.

3.3 Data

I use data from the US Census Bureaus Household Pulse Survey (HPS). The HPS was designed to quickly measure the impact of COVID-19 on US households. Unlike other survey products designed by the Census Bureau, the HPS was mainly distributed via text and email. As with other survey products, the HPS begins by selecting a sample from the Bureaus Master Address File. Anticipating lower response rates, the sample is selected such that even with response rates less than 5%, the Bureau is able to create estimates at the national, state, and MSA level. Households are surveyed for up to three consecutive waves of the HPS.

I use the 12th wave of the HPS, which was in the field from July 16 to July 21 and received responses from 86,792 households. Using the national weights provided by the Census Bureau, the survey represents 249,170,916 adults in households.¹ Households were also asked several demographic questions such as race, education level, income, and number of adults and children in the household.

¹For more details on the sample selection and weighting procedure used by the Census Bureau, see Fields, Hunter-Childs, Tersine, Sisson, Parker, Velkoff, Logan and Shin (Forthcoming).

More than 99% of surveyed households answered questions regarding current employment status, expected employment status, and the Economic Impact Payment. In what follows, the labels attached to each question are for referencing in this paper, and not the labels attached to the questions in the HPS.

Questions About Employment With respect to employment, households were asked:

Question 1: Have you, or has anyone in your household experienced a loss of employment income since March 13, 2020?

Question 2: Do you expect that you or anyone in your household will experience a loss of employment income in the next 4 weeks because of the coronavirus pandemic?

For both questions, households were able to select either “yes” or “no”. Note that both questions is about any individual in the household, not just the respondent. I label households answering “no” to Q1 and “no” to Q2 as “employed & not anticipating unemployment”. I label households answering “no” to Q1 and “yes” to Q2 as “employed & anticipating unemployment”. Finally, I label households answering “yes” to Q1 as “unemployed,” although it may be the case that individuals in the household who “experience a loss of employment income,” as stated in the question, do not become unemployed in the usual sense. Approximately 51% of households reported experience a loss of employment income since March 13, 2020. Just over 45% of households reported not experiencing a loss of employment income nor expecting to lose employment income, and 3.5% reported not experiencing a loss of income but expecting to do so in the next four weeks.

In the first wave of the HPS, the proportion of households that are employed and anticipating no employment loss is 47%, which is similar to the 45% in the 12th wave

of the survey. There are larger differences in the other two groups. The proportion of employed households anticipating unemployment peaks at 6% in the first wave of the survey, while the proportion of unemployed households is at its lowest value, 47%. As the survey progresses, households appear to move from being employed and expecting unemployment to being unemployed. I verify that this occurs for the subset of households that appear in multiple panels of the survey.

Questions About the EIP Beginning in the 7th wave of the HPS, the Census Bureau asked households about Economic Impact Payments. Households were asked about their majority use of the EIP:

Question 3: If you, or anyone in your household, already received, or plan to receive a “stimulus payment,” that is the coronavirus related Economic Impact Payment from the Federal Government, did or will you use it:

1. Mostly to pay for expenses (food, clothing, shelter, etc.)
2. Mostly to pay off debt (car loans, student loans, credit cards)
3. Mostly to add to savings
4. Not applicable, I did not and do not expect to receive the stimulus payment

Households were instructed to select one of these four options. For consistency with the existing literature, I relabel “mostly pay for expenses” as “mostly spend,” “mostly to pay off debt” as “mostly repay debt,” and “mostly to add to savings” as “mostly save.” If the household selected one of the first three options, the survey asked about more specific uses of the EIP:

Question 4: What did, or will, you and your household spend the “stimulus payment” on?

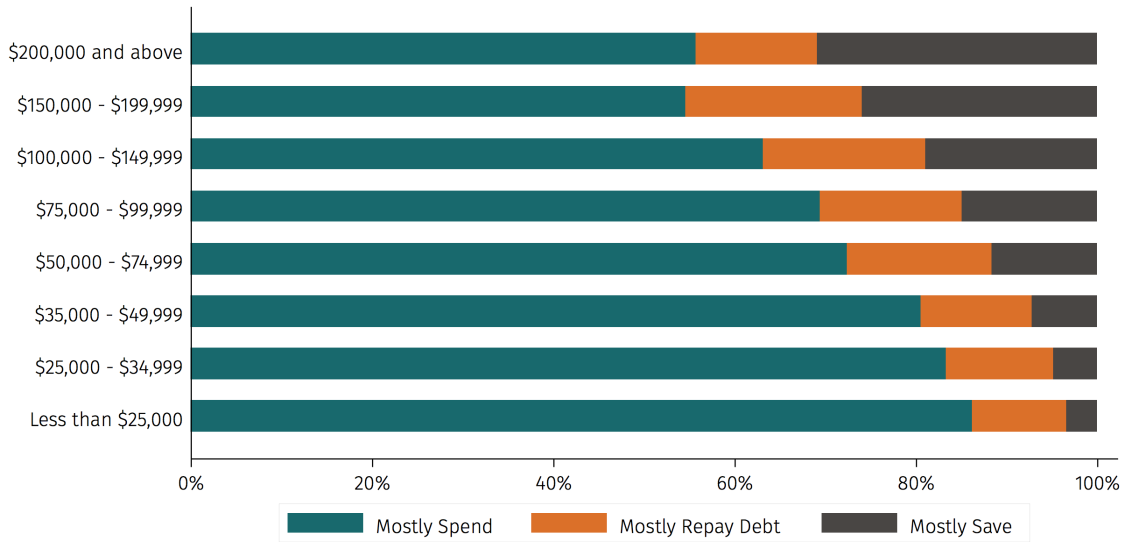
Categories: (1) Food (groceries, eating out, take out), (2) Clothing (clothing, accessories, shoes), (3) Household supplies and personal care products, (4) Household items (TV, electronics, furniture, appliances), (5) Recreational goods (sports and fitness equipment, bicycles, toys, games), (6) Rent, (7) Mortgage (scheduled or monthly), (8) Utilities and telecommunications (natural gas, electricity, cable, internet, cellphone), (9) Vehicle payments (scheduled or monthly), (10) Paying down credit card, student loans, or other debts, (11) Charitable donations or giving to family members, (12) Savings or investments, (13) Other, specify

Households were instructed to select all expenditure categories that applied. Households selected three expenditures categories on average, with 80% of households selecting six or fewer. Approximately 70% of households reported spending some of the EIP on food, making it the most common response by far. Just over 50% of households selected categories 3 (household supplies and personal care products) and 8 (utilities and telecommunications), rounding out the top three responses.

3.4 How Did Households Use Their EIPs?

In this section, I perform a general analysis of how households reported using their Economic Impact Payments, before dividing households by labor status in Section 3.5. In the next section, I show that, consistent with the extant literature, lower income households had a larger spending response than high income households. I then demonstrate households were consistent in their answers between the majority use and expenditure category questions. Overall, almost 75% of households reported that they would use their payments mostly to spend, compared to only 14% using their payment mostly to pay off debt and 11% mostly to add to savings.

Figure 3.1: Economic Impact Payment Usage by Income Group



Notes: Fraction of households in each income group that used the Economic Impact Payment mostly to spend (“pay for expenses”), repay debt (“pay off debt”), or save (“add to savings”).

3.4.1 Usage by Income

Figure 3.1 shows the fraction of each income group that reported using the EIP mostly to spend, mostly repay debt, and mostly save. There is a strong, negative relationship between income and using the EIP mostly to pay for expenses. Almost 86% of low income households earning less than \$25,000 per year report using the EIP mostly to spend, as opposed to around 55% for households earning more than \$200,000 per year. Most of the difference is made up of households switching from mostly spending to mostly saving. Only 3% of low income households report using the EIP mostly to add to savings, compared to almost 30% of high-income households. The fraction of households who used the EIP mostly to repay debt is fairly stable across the income distribution, increasing from approximately 10% for low-income households to 20% for the highest earners.

These patterns remain when controlling for demographic factors. In Table 3.1, I

estimate the linear model

$$EIP\ Usage\ Category_{it} = \alpha_i + \gamma_t Labor\ Status_{git} + \beta X_{it} + u_{it}. \quad (3.1)$$

using ordinary least squares. Each column represents a different dependent variable, $EIP\ Usage\ Category_{it}$, corresponding to whether the respondent selected that they mostly spent, mostly saved, or mostly repaid debt using their Economic Impact Payment. The vector of covariates, X_{it} , includes indicators for income group, gender, hispanic status, race, education, and values for the total number of people in the household and the total number of people in the household under 18-years-old. Exploiting the panel nature of the data (as noted in Section 3.3, each household was surveyed up to three times over 12-week period), I estimate individual and time fixed effects, α_i and γ_t , respectively. Each row of differential effects sums to zero since the respondent must have selected one of the three usage categories.

In Table 3.2, I re-estimate the model for each labor status group and income group, corroborating the visual evidence in Figure 3.2 that there are smaller differences between lower-income employed and unemployed households. The estimates in each row are the difference between employed and unemployed households within a given income group. For example, for low-income households earning less than \$25,000 per year, an unemployed household was 8.6 pp more likely than an employed household to report using the majority of its EIP to pay for expenses. This difference increases to 22% for high-income households earning \$200,000 or more per year.

3.4.2 Matching Majority Use to Expenditure Categories

Table 3.3 cross-tabulates the expenditure categories that households selected in Question 2 with their responses for how they spent the majority of the EIP in Question 1. Each column represents one of the three answers to Question 1 (mostly pay for

expenses, mostly pay off debt, and most add to savings), and each row presents the share of households that selected a given category. Column totals sum to more than 100% because households are able to select multiple categories.

On average, households that reported using the EIP mostly to pay for expenses selected 3.7 categories. Among these households, the three most popular expense categories were food, 83%, household supplies and personal care products, 62%, and utilities and telecommunications, 64%. Around 17% of these households also reported using the EIP to explicitly pay down credit card, student loan, or other debt. Approximately 29% reported paying down their mortgages and 28% reported using the EIP for vehicle payments, which are implicit forms of paying down debt.² Only 6% of these households reported using the EIP for savings or investments.

Households that reported using the EIP mostly to pay off debt selected 2.9 categories on average. Approximately 68% used the EIP to pay down credit card, student loan, or other debt, 20% paid down their mortgages, and 31% made vehicle payments. A large fraction of these households also selected regular spending categories, including food, 44%, household supplies and personal care products, 32%, and utilities and telecommunications, 33%.

Finally, households that used the EIP mostly to add to savings selected 1.8 categories on average, and approximately 71% selected using the EIP for savings or investments. The next most frequent category, food, was selected by 19% of households. Only 10% of households in this group reported explicitly using the EIP to pay down credit card, student loans, or other debts, and just 8% and 6% of households paid down mortgages or made vehicle payments, respectively.

Overall, households' responses to Questions 1 and 2 were largely consistent. Households reporting they used the EIP mostly to pay for expenses selected various spending categories, in addition to explicitly and implicitly repaying debt. The majority

²The HPS does not distinguish between vehicle payments for leased versus financed vehicles.

of households reporting they used the EIP mostly to pay down debt further selected explicitly and implicitly paying down debt, as well as some spending. Households that responded they used the EIP mostly to add to savings overwhelmingly added to savings or investments, with some repayment of debt and other spending.

3.5 EIPs Among Unemployed Households

Economic Impact Payments were distributed to households regardless of individual economic circumstances stemming from the pandemic-induced lockdown. On the one hand, the program's simple eligibility criteria was instrumental in ensuring timely distribution of payments. On the other, critics of the program argue for a smaller and more targeted program with specific eligibility criteria related to the pandemic. Distributing payments to households unaffected by the pandemic, who, critics argue, would use the fiscal transfer to increase savings or pay off debt, unnecessarily adds to the public deficit.

In this section, I contrast between unemployed households, who would have been the focus of a more targeted program, and employed households, who would have been excluded from such a program. Consistent with economic theory and existing studies of fiscal programs, unemployed households had larger spending responses than employed households. However, even employed households had large and economically significant spending responses, quelling fears that these households simply increased their personal wealth.

3.5.1 Usage by Labor Status

Recall that in the entire sample, 75% of households reported using their EIPs mostly to pay for expenses, 14% mostly to repay debt, and 11% mostly to add to savings.

Dividing households by labor status reveals import heterogeneity in EIP usage. Approximately 63% of employed households reported they would mostly spend the EIP, compared to 81% of employed households anticipating unemployment and 84% of unemployed households. Despite differences in spending response between labor status groups, the majority of both employed and unemployed households reported using their Economic Impact Payments mostly to pay for expenses.

This important finding dispels fears that these untargeted payments were used by households remaining gainfully employed solely to increase their personal wealth. Instead, just under 20% of employed households reported they would use the EIP mostly to repay debt, compared to 11% for households that were either unemployed and anticipating unemployment or unemployed. Approximately 19% of employed households reported they would most save the EIP, compared to 9% of employed households anticipating unemployment and 5% of unemployed households.

In Table 3.4, I estimate the regression equation

$$EIP\ Usage\ Category_{it} = \gamma_t + \sum_{g=2}^3 \alpha_g Labor\ Status_{git} + \beta X_{it} + u_{it}. \quad (3.2)$$

using OLS. Each column represents a different dependent variable, $EIP\ Usage\ Category_{it}$, corresponding to whether the respondent selected that they mostly spent, mostly saved, or mostly repaid debt using their Economic Impact Payment. Each $Labor\ Status_{git}$ is an indicator that activates if the household is either anticipating unemployment or unemployed. As noted in Section 3.3, the questions regarding Economic Impact Payments began in week 7, and in total, the estimation includes almost 400,000 (unweighted) observations of households from weeks 7 to 12 that reported receiving Economic Impact Payments.

The vector of covariates, X_{it} , includes indicators for income group, gender, his-

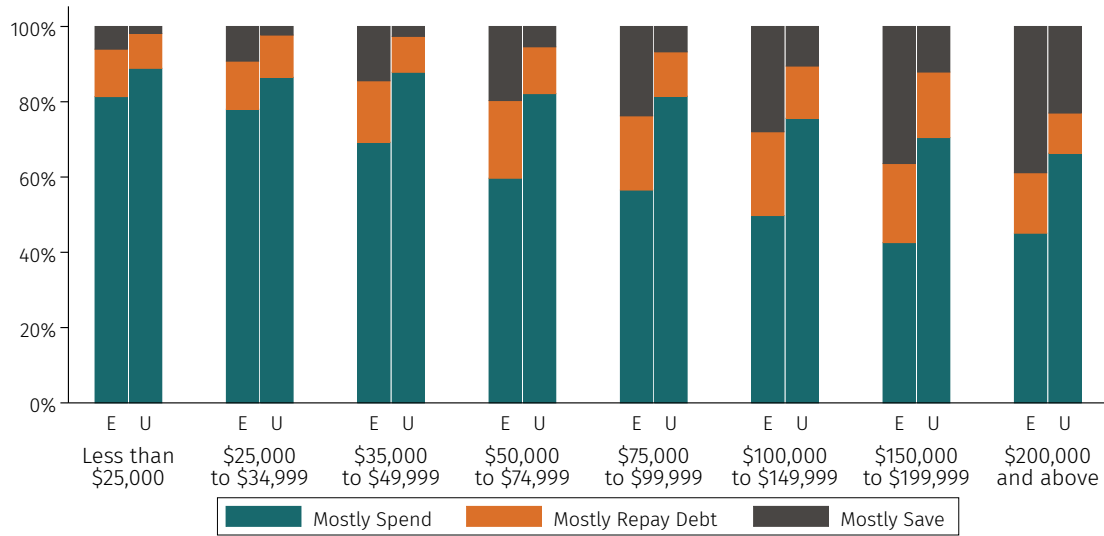
panic status, race, education, and values for the total number of people in the household and the total number of people in the household under 18-years-old. Each row of differential effects sums to zero since the respondent must have selected one of the three usage categories. For example, unemployed households were 19 pp more likely to report using the EIP mostly to pay for expenses, 7 pp less likely to report using the EIP mostly to pay off debt, and 12 pp less likely to report using the EIP mostly to add to savings. The estimated coefficients in the table indicate that even controlling for demographic characteristics, the patterns in the analysis above remain true.

3.5.2 Income as a Determinant of Behavior

The proportion of households reporting unemployment is strictly monotonically decreasing with total household income. Approximately 60% of households with less than \$25,000 in total income reported a loss of labor income, compared to only 47% for households with between \$75,000 and \$99,999 in total income and 33% for households with more than \$200,000 in total income. Across the income distribution, only a small fraction of between 2.5% and 4.5% of households reported currently being employed but anticipating a loss of labor income. For brevity, I combine households that are either employed and anticipating unemployment or unemployed into a single category called “unemployed.”

Figure 3.2 shows the fraction of households in each income and labor status group that used the EIP mostly to spend, repay debt, or save. As in Figure 3.1, there is a strong and negative relationship between income and the fraction of households that used the majority of the EIP to pay for expenses. Within each income group, a larger fraction of unemployed households reported mostly spending their EIP compared to employed households. In Table 3.2 of the Online Appendix, I confirm the patterns discussed in this section using standard regression analyses.

Figure 3.2: EIP Usage by Labor Status and Income Group



Notes: "E" bars represent employed households who reported no income interruption since March 2020 and no anticipation of an interruption. "U" bars represent unemployed households who are either currently unemployed or currently employed and anticipating unemployment soon.

Low-income households reported large spending response regardless of labor status. Almost 89% of unemployed low-income households earning less than \$25,000 per year reported using the EIP mostly to spend, compared to 81% of employed low-income households. As income increases, the difference in spending response between employed and unemployed households begins to widen. For middle-income households earning \$50,000 to \$74,999 per year, 60% of unemployed households used the EIP mostly to spend, compared to 82% of employed households. For high-income households earning \$200,000 or more per year, only 45% of employed households reported using the EIP mostly to spend, compared to 66% of unemployed households. Most of the differences were made up of households with more income switching from mostly spending mostly to saving the EIP. While only 2% of unemployed and 6% of employed low-income households reported using the EIP mostly to save, these figures increased to 23% of unemployed and 39% of employed high-income households. Approximately 13% of employed low-income households used the EIP mostly to repay debt, compared to 16% of employed high-income households.

3.5.3 Categorical Responses

Table 3.5 cross-tabulates the usage categories that households selected in Question 2 with the labor force status (employed, employed but anticipating unemployment, and unemployed). Columns do not sum to one because households are able to select multiple categories.

Spending on Consumer Goods

Categories 1 to 5 in Table 3.5 represent spending on consumer goods. Overall, the majority of both employed and unemployed households reported spending on regular consumption goods. Approximately 60% of employed households reported using the EIP to purchase food, compared to 77% of households anticipating unemployment and 79% of unemployed households. Around 45% of employed households reported spending on household supplies and personal goods, compared to 57% of households anticipating unemployment and 58% of unemployed households. There were also similarities in spending across groups. Just under 20% of all three groups of households reported using the EIP to purchase clothing. Relatively few households in any group reported using the EIP for recreational goods or household items.

Spending on Recurring Expenses

Categories 6 to 9 in Table 3.5 represent regular payments that households likely committed to well before the lockdown began. In these categories, the difference between employed households and households unemployed or anticipating unemployment is stark.

Just under 20% of employed households reported using the EIP to pay rent, while approximately 35% of employed households anticipating unemployment and 39% of

unemployed households reported using the EIP to pay rent. The rates are very similar for mortgage payments. Approximately 19% of employed households reported paying their mortgage with the EIP, while 36% of employed households anticipating unemployment and 30% of unemployed households reported paying their mortgage with the EIP.³

Approximately 41% of employed households used their EIP to pay for utilities and telecommunications, compared to 65% for employed households anticipating unemployment and 63% of unemployed households. Just over 17% of employed households reported using the EIP for a vehicle payment, while 31% of employed households anticipating unemployment and 32% of unemployed households made a vehicle payment using the EIP.

Spending on Increasing Wealth and Charitable Giving

Categories 10 and 12 in Table 3.5 represent repayment of debt and adding to savings, respectively, and category 11 is for charitable donations. Category 13 is a catchall miscellaneous category where respondents were able to write-in their own answers; these were not made available to researchers, but they represent a very small share of total answers.

Employed households did not overwhelmingly direct their Economic Impact Payments towards improving their balance sheets. In fact, all three labor status groups reported similar values for repayment of debt, between 22% and 25%. Only 20% of employed households reported using the EIP to add to savings or invest, relative to 11% of employed households anticipating unemployment and 9% of unemployed households. Just under 8% of employed households made charitable donations using the EIP, compared to 4% of employed households anticipating unemployment and 3%

³In the Online Appendix, I control for home ownership status, which is closely correlated with income and labor status, and find similar differences across labor status groups and EIP usage for rent or mortgage payments.

of unemployed households.

3.6 Measuring Total Spending of EIPs

Evaluating the impact of the CARES Act and Economic Impact Payments requires constructing a measure of total spending out of EIPs, or the aggregate marginal propensity to consume (MPC). However, given that the HPS asks households about how they *mostly* spent their stimulus payments, the survey does not provide a direct estimate of the MPC. As noted by Shapiro and Slemrod (2003), if we assume that “mostly spend” corresponds to an MPC of 0.51 and “mostly repay debt” and “mostly save” correspond to an MPC of 0.49, then regardless of the underlying distribution of responses, the aggregate MPC will be near 0.50. To address this, Shapiro and Slemrod (2003) construct a hypothetical distribution of MPCs centered around the fraction of households that responded “mostly spend” and calculate the aggregate average.

Instead, I use the spending categories selected by the household in Question 4 to calculate an estimate for the aggregate MPC. I label categories 7, “Mortgage (scheduled or monthly),” 9, “Vehicle payments (scheduled or monthly),” and 10, “Paying down credit card, student loans, or other debts,” as “repay debt.” I label category 12, “Savings or investments,” as “save,” and the remaining categories as “consume.” I omit category 13, “Other,” but I verify that since this category represents less than 5% of all responses, its exclusion does not make a material difference in my estimates.

Approximately 13% of households selected either “save” or “repay debt” and no other spending categories, implying an MPC of 0.00. Given the similarities between employed households anticipating unemployment and unemployed households documented in 3.5, I group these two categories of households together and label them as unemployed. Approximately 21% of employed households had an MPC of 0.00, com-

pared to almost 8% of unemployed households. Conversely, 38% of all households did not select either “save” or “repay debt,” implying an MPC of 1.00. Just over 39% of employed households had an MPC of 1.00, similar to the 36% of unemployed households. The remaining 40% of employed households and 56% of unemployed households selected a combination of categories.

3.6.1 Baseline Estimate of Aggregate MPC

In my baseline estimate of the MPC, I assume that if a household selects n categories, it uses the EIP equally across all n categories. For example, if the household uses the EIP to save as well as spend in three categories (such as food, recreational goods, and household items), then I estimate that the household’s MPC is 0.75, MPS is 0.25, and MPRD is 0.00. If the household further reports using the EIP to pay down debt, then the MPC is 0.60, the MPS is 0.20, and the MPRD is 0.20.

The baseline estimated MPC in the entire sample is 0.69, similar to the fraction of households reporting using the EIP mostly to spend, 0.75. The estimated MPS is 0.08 and the MPRD is 0.23, compared to 0.14 and 0.11, the fractions of households reporting they would use the EIP mostly to add to savings and repay debt, respectively. The disparity in estimates arises because of the multiplicity of category selections discussed in Section 3.4. In particular, many households appear to categorize mortgage and vehicle payments as paying expenses, which is consistent with economic theory on spending versus consumption. Subsection 3.6.3 discusses this in more detail and presents an alternate estimate of the MPC.

The baseline MPC for employed households is 0.65, compared to 0.73 for unemployed households. The MPRD is 0.22 for employed households and 0.23 for unemployed households. This difference is driven primarily by differences in the MPS, which is 0.13 for employed households and 0.04 for unemployed households. Employed

households reported using the EIP to add to savings much more than unemployed households, driving up the MPS and therefore lowering the MPC.

3.6.2 Alternate Estimate of MPC

Alternatively, it is likely that households did not equally distribute their EIPs across all of the usage categories they selected. In this estimate, I focus on the MPC and group together the “repay debt” and “save” categories into a single category labelled “increase wealth.” I calculate the MPC assuming that if a household opts to “increase wealth” and selects at least one spending category, then the household uses fraction $p \in [0, 1]$ of the EIP to increase wealth, and the remainder to pay for expenses. Under this specification, the estimated MPC for the households that selected “increase wealth” and at least one other spending category is $1 - p$.

Setting $p = 0.25$, the estimated MPC in the entire sample is 0.74. The MPC for employed households is 0.69, compared to 0.78 for unemployed households. All three estimates are larger than in the baseline estimate, reflecting the fact that the average number of spending categories selected is 2.2. Increasing p to 0.50, the estimated MPC in the entire sample is 0.62, while the MPC is 0.59 for employed households and 0.64 for unemployed households. In an extreme scenario with $p = 90\%$, the aggregate MPC in the entire sample decreases to 0.43. The estimated MPC is 0.43 for employed households and 0.42 for unemployed households.

The alternative estimates illustrate that households had large MPCs even under when assuming that they spent up to 90% of their EIPs on saving or repaying debt.

3.6.3 Relabeling Mortgage and Car Payments as Spending

As discussed in 3.4 and reported in Table 3.3, among households that reported using the EIP mostly to spend, 29% selected paying their mortgage and 28% selected mak-

ing a vehicle payment. This reflects the fact that although making payments against these secured loans reduces a household's debt obligation, it also usually ensures that the household can continue consuming the good used to secure the loan.

In this section, I re-label these two categories as consumption categories, and only category 10, "Paying down credit card, student loans, or other debts," is labelled as "repay debt." As above, I label category 12, "Savings or investments," as "save," and category 13, "Other," is omitted. The remaining categories are labelled as "consume."

Baseline Estimate of MPC The baseline estimated MPC increases to 0.84, reflecting the large fraction of households that reported using the EIP for their mortgage or vehicle payments. The MPRD decreases to 0.09, and the MPS remains 0.08. The MPC increases to 0.75 for employed households and 0.90 for unemployed households. The increase is larger for unemployed households because many more of these households reported using the EIP to make mortgage and vehicle payments.

Alternate Estimate of MPC The alternate estimated MPCs are affected by the relabelling since far fewer households selected the explicit debt repayment category than either the mortgage or vehicle payment categories. With $p = 25\%$, the MPC for the entire sample is 0.84. The MPC is 0.76 for employed households and 0.89 for unemployed households. With $p = 50\%$, the MPC for the entire sample is 0.78. The MPC for employed households is 0.70 and 0.83 for unemployed households. In the extreme case of $p = 90\%$, the MPC for the entire sample is 0.68. The MPC is 0.61 for employed households and 0.73 for unemployed households.

In all three cases, the MPC is much higher than above, because there's a lot less people in the explicit debt repayment category. The MPC is higher and reflects that people used the EIP to make car payments and house payments that they otherwise wouldn't have been able to make.

3.7 Conclusions

The CARES Act was drafted in response to one of the largest economic downturns in US history. As part of the Act, the IRS quickly distributed \$300 billion in Economic Impact Payments directly to all households under a simple income eligibility threshold. I find that almost all households spent or planned to spend a large fraction of their EIPs, and conclude that Economic Impact Payments contributed significantly to stabilizing aggregate spending during the economic downturn associated with COVID-19.

Critics of the Act concede that the direct transfer program's simple design was crucial for the timeliness of payments, but argue for more specific targeting towards households whose income was directly affected by the pandemic-induced lockdown. The analysis in this paper contributes to studying one aspect of this classic trade-off between the timeliness and specificity of government transfer programs. I conclude that since the estimated propensities to consume for employed and unemployed households are similar, a more targeted program would not have yielded a much larger spending response. I find larger differences between households sorted on income, regardless of employment status, suggesting that income may be the more important determinant of EIP usage.

Table 3.1: Regression: EIP Usage and Demographic Factors

	Use EIP mostly to...		
	Pay for expenses	Pay off debt	Add to savings
Income Base Group: Less than \$25,000			
Income Ind.: \$25,000 - \$34,999	-0.020 (0.008)	0.014 (0.007)	0.006 (0.005)
Income Ind.: \$35,000 - \$49,999	-0.043 (0.010)	0.024 (0.009)	0.019 (0.006)
Income Ind.: \$50,000 - \$74,999	-0.069 (0.011)	0.034 (0.010)	0.036 (0.008)
Income Ind.: \$75,000 - \$99,999	-0.088 (0.013)	0.043 (0.011)	0.045 (0.009)
Income Ind.: \$100,000 - \$149,999	-0.112 (0.015)	0.047 (0.012)	0.064 (0.011)
Income Ind.: \$150,000 - \$199,999	-0.134 (0.017)	0.050 (0.014)	0.083 (0.013)
Income Ind.: \$200,000 and above	-0.134 (0.024)	0.023 (0.020)	0.110 (0.019)
Gender Base Group: Male			
Gender Ind.: Female	-0.012 (0.011)	0.006 (0.009)	0.006 (0.009)
Hispanic Base Group: No, not of Hispanic, Latino, or Spanish origin			
Hispanic Ind.: Yes, of Hispanic, Latino, or Spanish origin	-0.009 (0.014)	0.024 (0.012)	-0.015 (0.009)
Race Base Group: White, Alone			
Race Ind.: Black, Alone	0.028 (0.022)	0.008 (0.018)	-0.036 (0.015)
Race Ind.: Asian, Alone	0.004 (0.024)	-0.008 (0.023)	0.004 (0.017)
Race Ind.: Any other race alone, or race in combination	0.010 (0.012)	0.003 (0.010)	-0.013 (0.008)
Education Base Group: No high school			
Educ. Ind.: Some high school	-0.008 (0.026)	0.022 (0.024)	-0.014 (0.016)
Educ. Ind.: High school graduate or equivalent (for example GED)	0.002 (0.027)	0.020 (0.025)	-0.022 (0.017)
Educ. Ind.: Some college, but degree not received or is in progress	-0.041 (0.028)	0.048 (0.026)	-0.007 (0.018)
Educ. Ind.: Associates degree (for example AA, AS)	-0.063 (0.030)	0.064 (0.027)	-0.001 (0.020)
Educ. Ind.: Bachelor's degree (for example BA, BS, AB)	-0.052 (0.030)	0.044 (0.028)	0.008 (0.020)
Educ. Ind.: Graduate degree (for example master's, professional, doctorate)	-0.066 (0.031)	0.047 (0.028)	0.019 (0.021)
Total number of people in household	-0.001 (0.001)	0.001 (0.001)	-0.000 (0.001)
Total number of people under 18-years-old in household	0.019 (0.005)	-0.002 (0.004)	-0.017 (0.003)
Constant	0.825 (0.030)	0.065 (0.027)	0.110 (0.020)
Observations	396,418	396,418	396,418
R^2	0.05	0.01	0.05

Notes: Estimates from regression on self-reported EIP usage and demographic characteristics. Each column represents a linear probability model. For each demographic, the base group is the omitted group.

Table 3.2: Regression: Differences Between EIP Usage by Income and Labor Status

	Use EIP mostly to . . .		
	Pay for expenses	Pay off debt	Add to savings
Less than \$25,000	0.086 (0.004)	-0.035 (0.003)	-0.050 (0.002)
\$25,000 - \$34,999	0.138 (0.004)	-0.052 (0.003)	-0.085 (0.003)
\$35,000 - \$49,999	0.182 (0.004)	-0.073 (0.003)	-0.107 (0.003)
\$50,000 - \$74,999	0.206 (0.003)	-0.074 (0.003)	-0.131 (0.003)
\$75,000 - \$99,999	0.220 (0.004)	-0.076 (0.003)	-0.141 (0.003)
\$100,000 - \$149,999	0.212 (0.004)	-0.066 (0.003)	-0.144 (0.003)
\$150,000 - \$199,999	0.215 (0.006)	-0.049 (0.005)	-0.163 (0.005)
\$200,000 and above	0.222 (0.010)	-0.047 (0.007)	-0.176 (0.009)

Notes: Estimates represent the difference in responses between unemployed and employed households.

Table 3.3: Reported EIP Usage by Expenditure Categories and Majority Usage

		Use EIP mostly to . . .		
		Pay for expenses	Pay off debt	Add to savings
1	Food (groceries, eating out, take out)	0.832	0.444	0.194
2	Clothing (clothing, accessories, shoes)	0.228	0.126	0.061
3	Household supplies and personal care products	0.624	0.316	0.123
4	Household items	0.062	0.063	0.072
5	Recreational goods	0.024	0.028	0.038
6	Rent	0.358	0.195	0.068
7	Mortgage (scheduled or monthly)	0.294	0.203	0.078
8	Utilities and telecommunications	0.639	0.330	0.097
9	Vehicle payments (scheduled or monthly)	0.276	0.308	0.058
10	Paying down credit card, student loans, or other debts	0.172	0.655	0.097
11	Charitable donations or giving to family members	0.037	0.049	0.133
12	Savings or investments	0.056	0.113	0.711
13	Other, specify	0.050	0.068	0.065

Notes: Responses to survey questions regarding majority and categorical usage of Economic Impact Payments. Respondents selected one majority usage category (pay for expenses, pay for debt, or add to savings) and multiple categorical responses. See Section 3.3 for survey instruments.

Table 3.4: Majority Usage of Economic Impact Payments by Labor Status

		Use EIP mostly to . . .		
		Pay for expenses	Pay off debt	Add to savings
Base Group: Employed				
	Anticipating Unemployment	0.141 (0.004)	-0.037 (0.003)	-0.099 (0.003)
	Unemployed	0.189 (0.002)	-0.066 (0.001)	-0.121 (0.001)
Observations		395,695	395,695	395,695
R^2		0.11	0.02	0.09

Notes: Estimates from linear regression with time fixed effects and demographic factors. Observations pooled from weeks 7-12 of Household Pulse Survey. Robust standard errors are clustered at the household level. See Section 3.5.1.

Table 3.5: Reported EIP Usage by Expenditure Categories and Labor Status

	Employed	Anticipating Unemp.	Unemp.
1 Food (groceries, eating out, take out)	0.598	0.766	0.791
2 Clothing (clothing, accessories, shoes)	0.186	0.200	0.203
3 Household supplies and personal care products	0.455	0.572	0.579
4 Household items	0.076	0.055	0.054
5 Recreational goods	0.032	0.011	0.022
6 Rent	0.186	0.345	0.394
7 Mortgage (scheduled or monthly)	0.189	0.357	0.305
8 Utilities and telecommunications	0.407	0.649	0.632
9 Vehicle payments (scheduled or monthly)	0.174	0.313	0.320
10 Paying down credit card, student loans, or other debts	0.240	0.246	0.225
11 Charitable donations or giving to family members	0.075	0.038	0.030
12 Savings or investments	0.198	0.106	0.089
13 Other, specify	0.065	0.047	0.045

Notes: Responses to survey question regarding categorical usage of Economic Impact Payments for each labor status group. See Question 2 of Section 3.3 for survey instrument.

Chapter 4

A Model of the Consumption Response of Households with Bounded Intertemporal Rationality

4.1 Introduction

Modern research in economics studies how households and firms respond to various shocks. How do households respond to unanticipated income shocks? In standard models of consumption and saving, dynamically optimizing households use intertemporal substitution to adjust their lifetime welfare in response to even small shocks. In standard partial equilibrium Permanent Income Hypothesis models, a completely transient \$1 shock to income induces a household to adjust consumption for every remaining period of its life, transforming a small temporary shock to a permanent change in behavior. These models assume that households are keen financial planners who make lifetime plans and adjust them in response to any shocks.

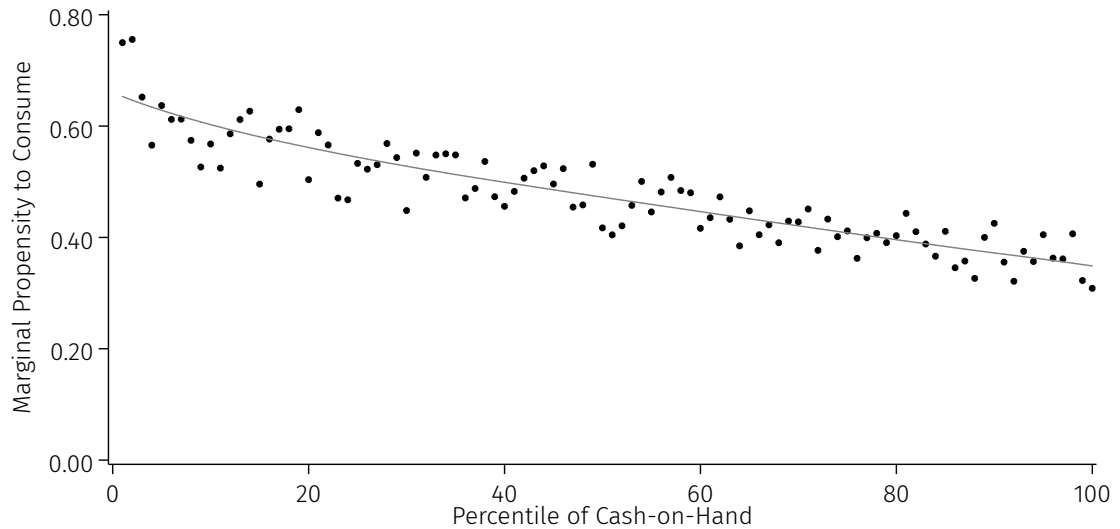
I propose a model in which households respond to income shocks by adjusting their plans over an endogenously selected finite planning horizon. Households choose an optimal planning horizon to trade off benefits of intertemporal consumption smoothing against planning costs increasing in the horizon. I call this bounded intertemporal rationality. The optimal planning horizon depends on the characteristics of the shock relative to the characteristics of the household. Income shocks that are small relative to a household's regular income induce less intertemporal smoothing because the relatively small benefits of consumption smoothing are dominated by planning costs.

Focusing on the Economic Stimulus Act of 2008, I show that households for whom the Economic Stimulus Payment (ESP) represented a smaller fraction of regular income had the largest marginal propensities to consume (MPCs). I then estimate the model and use it as a laboratory to explore alternative fiscal policies that the federal government may have used to stimulate the economy. The main implication for government stimulus programs is that as payment sizes increase relative to income, households optimally choose to smooth them over more periods, maximizing welfare but lowering the immediate stimulative impact of the policy. Fiscal policies that target more households with smaller payments have the largest aggregate spending impact.

The model makes two key contributions to the theoretical literature on the consumption response of households to income shocks. First, the model generates large and realistic MPCs for wealthy and highly liquid households. This is consistent with, for example, the empirical evidence on self-reported MPCs in Jappelli and Pistaferri (2014b), presented in Figure 4.1. The MPC is decreasing in cash-on-hand, starting at 0.75 for the least liquid households and decreasing to 0.30 for the most liquid households. While standard one- and two-asset models also have a decreasing profile, they decrease too much, and the MPC for liquid households, who perfectly smooth shocks over their entire lives, is usually between 0.05 and 0.10. In my model, however, the MPC decreases more slowly with liquid wealth and remains elevated for very liquid households. These households exhibit diminishing returns to consumption smoothing over longer horizons, and therefore opt to plan over finite horizons, generating higher MPCs.

Second, the model matches the empirical finding that households have much larger MPCs out of small income shocks than large income shocks. In Figure 4.2, which plots columns (5) and (6) of Table 4 in Kueng (2018), households are sorted by the relative size of the income shock; in this case, an annual dividend payment from the Alaskan

Figure 4.1: Comparing the Marginal Propensity to Consume for Different Levels of Wealth

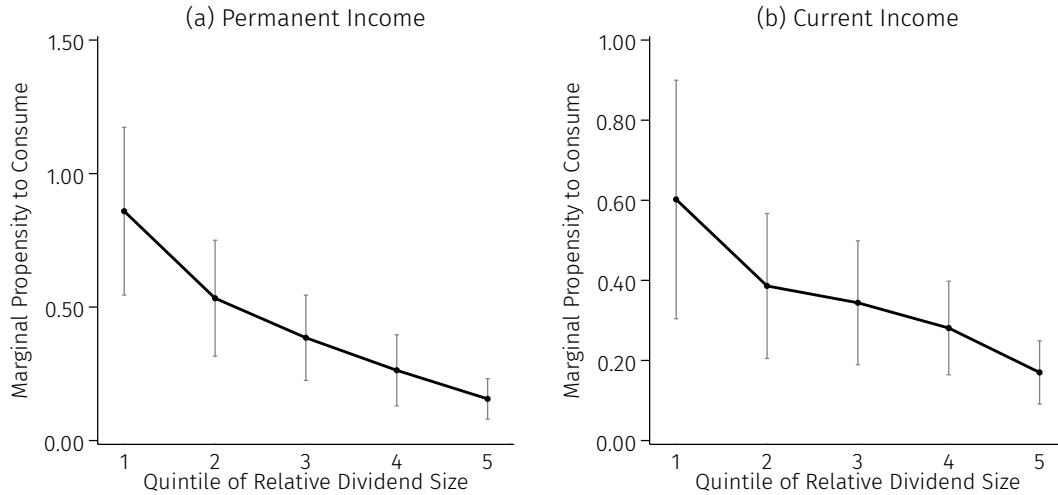


Notes: Marginal propensity to consume is survey response to hypothetical question. Cash-on-hand is the sum of income and liquid wealth. *Source:* 2010 Italian Survey of Household Income and Wealth. Replicates Figure 2 of Jappelli and Pistaferri (2014b).

Fund divided into either permanent or current income. In both cases, the MPC is largest for households receiving the smallest relative size income shocks. In the model, smaller income shocks induce shorter planning horizons and larger MPCs because the benefits of smoothing a small income shock are quickly dominated by planning costs. In standard one- and two-asset models, because of concave consumption functions, the marginal propensity to consume is technically decreasing in the size of the income shock. However, the gradient is fairly small for low-wealth households and near-zero for high-wealth households, and households respond fairly similarly to different sized shocks.

The model consists of two layers. In the outer layer, the household forms long-term plans taking into account typical fluctuations in income, such as seasonal variation in hours worked and temporary spells of unemployment. Each period, the household consumes and saves. In the inner layer of the model, the household is occasionally subject to atypical income shocks, such as an Economic Stimulus Payment, for which

Figure 4.2: Comparing the Marginal Propensity to Consume for Different Shock Sizes



Notes: The estimated marginal propensity to consume out of payments from the Alaska Permanent Fund and corresponding 95% confidence intervals. Households are sorted into quintiles by relative payment size, measured as the payment divided by permanent income in panel (a) and current income in panel (b). *Source:* Columns (5) and (6) of Table 4 in Kueng (2018).

it has no plans. As such, the household reoptimizes and forms short-term consumption and savings plans. The household would optimally choose to smooth consumption over the remainder of its life if there were no planning costs, but the presence of costs induces shorter planning horizons. At the end of the reoptimization horizon, the household returns to using its long run plans, as-if the atypical shock had never occurred.

The outer layer of the model is the standard consumption-savings model and is calibrated using standard values from the literature. As such, the model's stationary distribution of wealth is fairly similar to the distribution of liquid wealth in the 2007 Survey of Consumer Finances. The key driver of the inner layer's dynamics are the planning costs. I estimate them using the Generalized Method of Moments and data on the Economic Stimulus Act of 2008 from the Survey of Consumer Expenditures compiled by Parker, Souleles, Johnson and McClelland (2013b).

On average, Economic Stimulus Payments were equal to 28% of monthly income.

I divide ESP recipients into terciles based on payment amount divided by monthly income. As predicted by the model, households receiving smaller relatively sized payments had the largest consumption responses. Households in the first tercile received an ESP equal to approximately 11% of monthly income and spent all of it within three months of receipt. Households in this group were, on average, both the highest earners and most wealthy. On the other hand, households in the third tercile received an ESP equal to roughly half of monthly income and spent only half of it within three months of receipt. These households had the lowest incomes and least liquid wealth, ruling out the standard borrowing constraint explanation. Using these estimates as targets, I estimate the planning costs and verify their validity using external data from Gelman (Forthcoming) kindly provided by Michael Gelman. The planning costs are non-parametrically estimated but are very closely approximated by an increasing logarithmic function.

The key implication of the model for the design of fiscal stimulus is that smaller payments induce less intertemporal smoothing and higher propensities to consume. This is true for households along the entire income and wealth distribution, and is separate from most existing papers in that the mechanism does not rely on the presence of financial constraints. However, for the same relatively sized shock, low wealth households near their borrowing constraint have higher propensities to consume than high wealth households, which is consistent with existing models and empirical evidence.

The model suggests that stimulative fiscal policy should give smaller payments overall and expanding the upper limits of stimulus eligibility beyond single filers with \$75,000 in annual income. Lower income households are less likely to have high liquid wealth and should receive payments of up to 25% of monthly income, while higher income households should receive payments up to 15% of income. Payments of these amounts trigger little intertemporal substitution and have an immediate

impact on aggregate spending. Since these payments are much smaller than the average payment of 28% of monthly in 2008, the program can be expanded to include additional households and remain cost equivalent.

Section 4.2 reviews the extensive literature studying the consumption response to income shocks. In Section 4.3, I detail the baseline model of bounded intertemporal rationality, and in Section 4.4, I estimate the planning costs that drive bounded intertemporal rationality using data from the Economic Stimulus Act of 2008. Using the estimated model, I discuss the distribution of MPCs in Section 4.5, and some implications for the design of stimulative fiscal policy in Section 4.5.3. Section 4.6 concludes and discusses avenues for future research.

4.2 Related Literature

I contribute to a broad empirical and theoretical literature that studies how households respond to income shocks.

Empirically, there is broad consensus that the MPC is higher for households more likely to be financially constrained, which is usually proxied by low liquid or total wealth. Households unlikely to be financially constrained have lower MPCs but they are not nearly as low as standard models based on the Permanent Income Hypothesis would predict (Olafsson and Pagel, 2018; Gelman, 2019; Fagereng, Holm and Natvik, Forthcoming; Baugh, Ben-David, Park and Parker, Forthcoming). With respect to the Economic Stimulus Act of 2008, Parker et al. (2013b) and Shapiro and Slemrod (2009) demonstrate that households spent sizable fractions of their stimulus payments. They provide some evidence that financially constrained households, i.e, those with less income or liquid assets, had higher MPCs than financially unconstrained households. Parker (2017), Olafsson and Pagel (2018), and Gelman (2019) caution against inferring that low wealth or liquidity imply that borrowing constraints cause large

MPCs. Low liquidity may be a manifestation of preferences or expectations about income growth, which generate high MPCs regardless of financial constraints.

My contribution to this literature is sorting households based on the relative size of the 2008 stimulus payment. Relatedly, Kueng (2018) studies the annual Alaska Permanent Fund dividend payment and shows that the MPC is highest for high income families for whom the payment represents a small fraction of regular income. Summarizing the vast literature on the consumption response to changes in income, Fuchs-Schuendeln and Hassan (2016) conclude that “households tend to behave consistently with the Permanent Income Hypothesis when the stakes are high, that is, when dealing with large or repeated changes in their income,” while “for households that are not constrained, near-rationality is a likely candidate to explain their excess sensitivity to small anticipated income changes.”

Theoretically, standard models in this literature generate realistic aggregate consumption responses by generating large fractions of constrained households with large propensities to consume. Mankiw (2000) exogenously calibrates a fraction of US households as “spenders” with a large propensity to consume. In classic one-asset models of consumption and savings, such as Zeldes (1989), Deaton (1991), and Carroll (1997), borrowing constrained households are those with high marginal propensities to consume. However, the fraction of the population that may be plausibly categorized as borrowing constrained, proxied by low total wealth, is too small; generating the correct aggregate response to income shocks requires a counterfactually large group of low wealth households.

More recently, the two-asset model in Kaplan and Violante (2014) generates a realistic aggregate response using the observed distribution of households that are liquidity constrained despite holding large stocks of illiquid wealth. The key insight of the two-asset model is that even households with high total wealth have high MPCs if they have low liquid wealth. This modeling innovation yields a more realistic ag-

gregate consumption response by plausibly calibrating the fraction of the population that, based on low liquid wealth, can be categorized as borrowing constrained. Kaplan, Violante and Weidner (2014b) focus on liquid wealth and estimate that roughly $1/3$ of the US population can be categorized as constrained and having a large MPC. Of these, $2/3$ have high illiquid wealth, and would not have been classified as constrained in the one-asset model. By accurately capturing these households' large MPCs, the average MPC in two-asset models moves much closer to what is observed in the data.

In both one- and two-asset models, high MPCs are driven by borrowing constraints. As a result, unconstrained households have counterfactually low MPCs. In all three classes of models, whether generated exogenously or endogenously, there exists a dichotomy between “spender” households with high MPCs and “saver” households with low MPCs, whereas in my model, the MPC is elevated for all households. I also focus on both the immediate and cumulative MPCs in response to an income shock, which is important for studying the dynamic effects of policy and distinguishing between models of consumption behavior (Auclert, Rognlie and Straub, 2018).

My model generates higher MPCs without relying on financial constraints. Andreolli and Surico (2021) propose that the large consumption response of unconstrained households can be attributed to non-homothetic preferences over a subset of consumption goods. I contribute to a new strand of literature in macroeconomics that relaxes the assumption of full rationality. I build on the intuition in Cochrane (1989) that households might not be fully rational in the sense of perfect intertemporal substitution, but instead behave according to “near-rational” heuristics that are easier to follow and yield essentially the same lifetime utility. I classify the households in my model as having bounded intertemporal rationality. In Woodford (2018), the agent lives for T periods and makes $k < T$ state-contingent plans in each period of their life. These plans are time inconsistent because in each period the household realizes that there is one more period than it had previously believed, and therefore

reoptimizes. In my model, the household fully understands the length of its life and both the long-term and short-term plans are time consistent.

McDowall (2020) builds a model of mental accounts in which nests the standard one-asset model in one extreme and a hand-to-mouth consumption model at the other, and finds that an intermediate case best explains the consumption response of highly liquid households. Relative to his paper, my emphasis is on finite planning horizons, and my use of mental accounts is an ingredient to separate the types of shocks over which the household has either already formed plans or must reoptimize to form new plans. Ilut and Valchev (2019) build a model in which agents have a limited understanding of the optimal policy function, but incur a cost to improve their understanding at states that are most frequently visited and costlessly extrapolate the policy function at nearby states. This generates steeper consumption policy functions and larger propensities to consume. Relative to their paper, households in my model costlessly and perfectly understand the optimal policy function over a given finite planning horizon, but the optimal planning horizon is chosen subject to planning costs. In response to an income shock, the policy function is steeper for shorter planning horizons because of less intertemporal substitution, generating a larger propensity to consume.

More generally, households decrease intertemporal substitution when they pay limited attention to the future (Gabaix, 2019). For example, with hyperbolic discounting (Laibson, 1997; Laibson, Maxted and Moll, 2020), agents discount the future more so than with standard geometric discounting, generating present bias and larger propensities to consume. In my model, households respond to income shocks by reoptimizing over finite planning horizons. Periods within the planning horizon are discounted using standard geometric discounting and periods beyond the planning horizon are effectively completely discounted (i.e., with a discount factor of zero), which generates larger propensities to consume for shorter planning horizons.

4.3 Model

In this section, I build a partial equilibrium model of consumption and savings with two layers: long-term plans over a deterministic stream of labor income and short-term plans over completely unanticipated income shocks. In Section 4.4, I enrich the outer long-term layer of the model and assume that households face stochastic labor income. Although not crucial for studying how households respond to truly unanticipated income shocks in the short-term, accounting for stochasticity of labor income is important for quantitatively matching the level of (precautionary) saving in the economy. The main innovation in the model is that in response to unanticipated income shocks, the household reoptimizes over a finite planning horizon, the length of which is chosen subject to planning costs.

The short-term reoptimization has two key consequences. First, all households select finite planning horizons because returns to consumption smoothing are decreasing in the reoptimization horizon, while planning costs are increasing. As a result, even households far from their borrowing constraints exhibit large marginal propensities to consume. Second, households benefit less from smoothing smaller income shocks, while planning costs are independent of the size of the shock. As such, agents optimally select shorter planning horizons for smaller shocks, generating less intertemporal substitution and larger MPCs. This is consistent with both the extant literature (see Section 4.2) and new evidence in the next section that households for whom windfall payments from the Economic Stimulus Act of 2008 represented smaller fractions of regular income had larger MPCs and less intertemporal substitution.

4.3.1 Long-Term Plans

Setup

I model a household's working life over $T \leq \infty$ periods. At time zero, the household forms long-term plans over a deterministic stream of income endowments.¹ For example, the household forms long-term plans for anticipated income changes, such as career progression and retirement, or large expenditures, such as annual vacations or childbearing (Campbell and Hercowitz, 2019).

I abstract away from the planning costs associated with long-term plans. As such, I call these plans fully intertemporally rational because the household uses financial planning to intertemporally smooth lifetime consumption and obtain maximal lifetime utility. If the household was required to pay a planning cost to make long-term plans, then the long-term plans would also be subject to bounded intertemporal rationality. Such an environment could be seen as a microfoundation for the spender-saver model in Mankiw (2000). Households that pay the cost to form state-contingent plans are the savers who are PIH households, while households with no intertemporal plans live hand-to-mouth in every single period.

Implementation

The household makes joint consumption and savings plans for each period of its life, denoted by c_t^L and s_t^L , respectively. Financial markets consist of a single bond that costs $(1+r)^{-1}$ per unit and pays one unit in the next period. The household's time preference, λ , is assumed equal to the interest rate, r , and the discount factor is

¹In Section 4.4, I extend the model to the more realistic setting in which households form long-term plans over stochastic labor income. This extension matters quantitatively for generating an empirically plausible distribution of (precautionary) savings, but does not add qualitatively to examining the main mechanism of the model, namely, how households respond to unanticipated income shocks.

given by $\beta = (1 + \lambda)^{-1}$.² The household's total wealth in any period is given by long- and short-term wealth, and the wealth portfolio is denoted by vector $a = \{a^L, a^S\}$. The borrowing limit applies to total wealth, and since the two wealth accounts are transactionally equivalent, can be expressed as $a^L + a^S \geq -\underline{a}$ for some exogenous \underline{a} .

I assume that when forming long-term plans at time zero, the household arranges its finances in its long-term wealth account, a^L . For example, if the household has a typical work-retire income profile, it will save into its long-term wealth account while working, and deplete the account once it retires. When optimizing over the long-term, the household accounts only for long-term wealth, completely ignoring the short-term wealth account. As such, instead of optimizing over the portfolio of wealth, $\{a^L, a^S\}$, it considers only long-term wealth, a^L .

Formally, the household's recursive problem can be written recursively as

$$V_t^L(a^L, y) = \max_{c_t^L(\cdot), s_t^L(\cdot)} u(c_t^L(a^L, y)) + \beta V_{t+1}^L(a^{L'}, y'),$$

with wealth evolving according to saving, $a^{L'} = s_t^L(a^L, y)$. The household is subject to the constraint that in each period, consumption and saving must sum to income and wealth, or:

$$c_t^L(a^L, y) + \frac{s_t^L(a^L, y)}{1 + r} = y + a^L.$$

Long-term wealth, a^L , enters the household's long-term budget constraint, but short-term wealth, a^S , does not. In the last period of life, T , the household chooses zero savings, $s_T^L(a^L, y) = 0$, and consumes all income and wealth, $c_T^L(a^L, y) = y + a^L$.

²Since income is deterministic, this assumption is necessary to ensure that consumption and savings are bounded (Chamberlain and Wilson, 2000). With stochastic income in Section 4.4, this assumption is relaxed.

4.3.2 Short-Term Plans Over Income Shocks

Setup

During its working life, the household consumes and saves according to its long-term plans, which were made contingent upon a deterministic stream of labor income endowments. In some period t , however, the household learns of an income shock path,

$$\Delta = \{\Delta_t, \Delta_{t+1}, \dots, \Delta_{t+N_\Delta-1}\}.$$

The income shock lasts for N_Δ periods (including period t) and is perfectly anticipated once the household initially learns of it. In response, the household reoptimizes and forms short-term plans for $k \geq N_\Delta$ periods. The short-term plans over unanticipated income shocks display bounded intertemporal rationality because the household uses financial planning to intertemporally smooth consumption, but only up to a limit determined by the tradeoff between intertemporal substitution and planning costs.

The dichotomy between long- and short-term plans is generated by two key assumptions: differing mental accounts for long- and short-term wealth, and the planning costs associated with reoptimization.

Mental Accounts When forming short-term plans over the income shock, the household continues to abide by its long-term plans for consumption, and long-term wealth evolves according to the long-term savings plan. The short-term plans aim to smooth consumption over the k -period planning horizon, as opposed to the entire lifetime of the household. To accomplish this, the household makes financial plans that move income between periods in the short-term using a separate but transactionally equivalent mental account for short-term wealth, a_t^S . In other words, when optimizing over the short-term, the household takes as given its plans for long-term wealth, working exclusively with its short-term wealth account.

This assumption is critical for breaking the fungibility between the long-term stream of income and the short-term unanticipated income shocks.³ Otherwise, the household could use its long-term policy functions to interpret the income shocks as exogenous changes to long-term wealth.⁴ This assumption is based on the evidence that households treat income differentially depending on its unexpectedness and source (see, for example, Arkes, Joyner, Pezzo, Nash, Siegel-Jacobs and Stone (1994) and Fogel (1999)). Related to the Economic Stimulus Payments studied in this paper, Epley, Mak and Idson (2006) analyze the framing of tax rebate payments and find that referring to them as “bonuses” increases the propensity to consume, which may be attributed to a change in the way households mentally account for the extra income. Generating this behavior endogenously would entail breaking equivalency between income sources in the household’s budget constraint by, for example, prescribing value to income differently depending on its source valence.

Planning Costs Planning costs play a central role in the household’s response to an irregular income shock and can represent two different types of costs. The first are real costs incurred in changing consumption plans, either directly in terms of adjusting consumption goods (Chetty and Szeidl, 2007) or indirectly in transaction costs (Grossman and Laroque, 1990; Kaplan and Violante, 2014). The second are cognitive costs required in dealing with unexpected changes in income Browning and Collado (2001). The household must exert some cognitive effort, which reduces utility, to process new information and make new choices Reis (2006); Ergin and Sarver (2010), especially with respect to financial planning and budgeting (Ameriks, Caplin and Leahy, 2003).

³Fungibility is “the notion that money has no labels. In the context of the life-cycle theory, the fungibility assumption is what permits all the components of wealth to be collapsed into a single number” (Thaler, 1990, p. 194).

⁴This is how the marginal propensity to consume is usually measured. For more details, see Appendix A.3.

Short-Term Reoptimization

Formally, taking as given the long-term plans for consumption and saving and facing income shock path Δ at time t , the household solves:

$$\max_{k, \{c_\tau^S, s_\tau^S\}_{\tau=t}^{t+k-1}} -\phi_k + \sum_{\tau=t}^{t+k-1} \beta^{\tau-t} u(c_\tau^L + c_\tau^S) + \beta^k V_{t+k}^L,$$

where V_{t+k}^L is the long-term value function of the household at time $t+k$, immediately following the last period of the reoptimization horizon, and subject to two constraints. First, period budget constraints in each period incorporating long-term saving, which is taken as given, and the household's choice of short-term saving. Second, the household is assumed to spend fraction $\theta \in (0, 1]$ of the total income shock within the finite planning horizon:

$$\sum_{\tau=t}^{t+k-1} \frac{c_\tau^S}{(1+r)^\tau} = \theta \sum_{\tau=t}^{t+k-1} \frac{\Delta_\tau}{(1+r)^\tau}.$$

Consistent with the empirical evidence on the short window over which income shocks are spent (Gelman, 2019; Fagereng et al., Forthcoming; Gelman, Forthcoming), I set $\theta = 1$, ensuring that the household expends the entire sequence of income shocks over the finite planning horizon. This is also consistent with the assumption that the planning cost depends only on the k periods over which the reoptimization occurs. Relaxing this assumption implies that despite planning for only k periods (and paying the associated costs), the household's behavior differs from the long-term plan for more than k periods.

The household's problem can be separated into two subproblems: the choice of the optimal planning horizon and, given a reoptimization horizon, the choice of consumption and savings plans.

Optimal Planning Horizon

In this section, I continue assuming that the household is subject to a one-period positive income shock at time t , $\Delta > 0$. The optimal planning horizon depends on both the magnitude of the income shock and household's income and wealth. The household considers each planning horizon $k \in \{0, 1, 2, \dots\}$, beginning with zero, weighing the benefits against the costs. When the costs exceed the benefits, the household stops and returns to the previous k . This ensures the optimal behavior because the cost and benefit functions intersect only once. The household does not form all plans and then selects the optimal one, which would entail paying all of the planning costs *ex ante*.

The household's default behavior, $k = 0$, is to ignore the income shock and pay no planning costs. In this case, the household chooses $k = 0$ with $\phi_0 = 0$. Without re-evaluating value, the household rolls the income shock into its next period long-term wealth: $a^{L'} = s^L(a^L, y) + \Delta$.⁵ Since the household is not reoptimizing, it does not internalize the change in value from changing next period wealth. As such, with default behavior, the household's value is given by the long-term value function, $V_t^L(a^L, y)$. The default behavior is optimal for sufficiently small income shocks because the benefits of reoptimizing for even one period are dominated by the planning costs.

Bounded Intertemporal Rationality When the size of the income shock exceeds a critical value, the household decides to reoptimize and, in addition to new consumption and savings plans, must choose the length of its reoptimization horizon. The optimal planning horizon depends on both the characteristics of the shock and those of the household. I prove that because of increasing planning costs, the optimal planning horizon is increasing in the size of the shock, the household's income, and

⁵I assume that if the income shock is sufficiently negative, the household adjusts wealth up to the borrowing constraint, and then adjusts consumption to account for the difference.

the household's long-term wealth.

Without planning costs, the household benefits from consumption smoothing of small shocks far in the future, and the optimal planning horizon is always the remainder of the household's lifetime. Planning costs dominate smoothing benefits for small shocks far in the future, yielding shorter planning horizons and a more realistic distribution of marginal propensities to consume.

Let $k_t^*(\Delta; a^L, y)$ denote the optimal planning horizon for a household at time t with long-term wealth a^L , income y , and facing an income shock Δ . Proofs to both propositions are in Appendix A.1.

Optimal Planning Horizon and Shock Size. Proposition 1 states that the optimal planning horizon is increasing in the size of the shock.

Proposition 1. *Consider a household at time t with long-term wealth, a^L , and income, y . If $\Delta' > \Delta$, then $k_t^*(\Delta'; a^L, y) \geq k_t^*(\Delta; a^L, y)$.*

The intuition for the proof is straightforward. The benefit of consumption smoothing is increasing in the size of the income shock. If the optimal planning horizon for a small shock is k , then for a larger shock, it will always be at least as beneficial to smooth for that many periods and pay the same planning cost. If the larger shock is sufficiently large, it might even be worth it to extend the planning horizon and pay a further planning cost.

This proposition is simplified by the assumption that planning costs depend only on the length of the planning horizon. If the planning cost also depended on the size of the income shock, then it would obviously be different. The larger the shock, the more the planning cost, but also the more the benefits of smoothing. Would depend on the exact interplay. I focus on the intertemporal substitution aspect, not on the financial literacy or whatever else you would need to get the shock size to matter.

Optimal Planning Horizon and Household Income or Wealth Proposition 2

states that the optimal planning horizon is increasing in the household's income and wealth.

Proposition 2. *Consider a household at time t facing income shock Δ .*

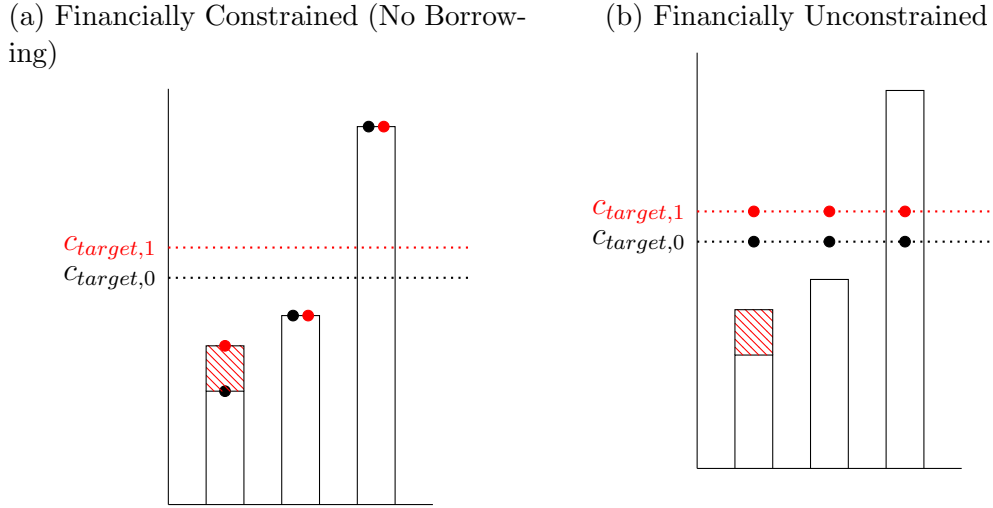
1. *Given a^L , if $y' > y$, then $k_t^*(\Delta; a^L, y') \geq k_t^*(\Delta; a^L, y)$.*
2. *Given y , if $a^{L'} > a^L$, then $k_t^*(\Delta; a^{L'}, y) \geq k_t^*(\Delta; a^L, y)$.*

For a given income shock, the benefits of consumption smoothing are larger for households with more wealth or income. For these households, the desire to smooth consumption forward means that they wish to save most of the income shock in order to increase consumption in future periods. However, for households with less wealth or income, there may be an unfulfilled desire to smooth consumption backward. That is, these households anticipate higher future income and wish to borrow against it to fund increased consumption in the current period, but are unable to do so because of financial (borrowing) constraints. Therefore, in addition to planning costs, these households face an additional motive to choosing shorter planning horizons.

I develop the intuition for this mechanism with a stylized model of consumption smoothing. In Figure 4.3, the vertical bars show the upward-sloping income profile of a household that lives for three periods. I assume that preferences and interest rates are such that the household's consumption target is the horizontal line labelled $c_{target,0}$, which is a function of total lifetime income. Actual consumption is given by the solid markers. In the first two periods, the consumption target is greater than income, and the household aims to smooth consumption in the current period by borrowing from the future.

In panel (a), I assume the household is financially constrained and cannot borrow. As such, in the first two periods, the household sets consumption equal to income, well below the consumption target. In the final period, the household also consumes all

Figure 4.3: Consumption Smoothing in Stylized Model



Notes: Illustrative three-period model of consumption smoothing. Vertical bars depict income, dashed lines represent consumption targets, and markers show actual consumption. Black pattern illustrates initial household behavior and red pattern illustrates new behavior after $\epsilon > 0$ income shock in first period.

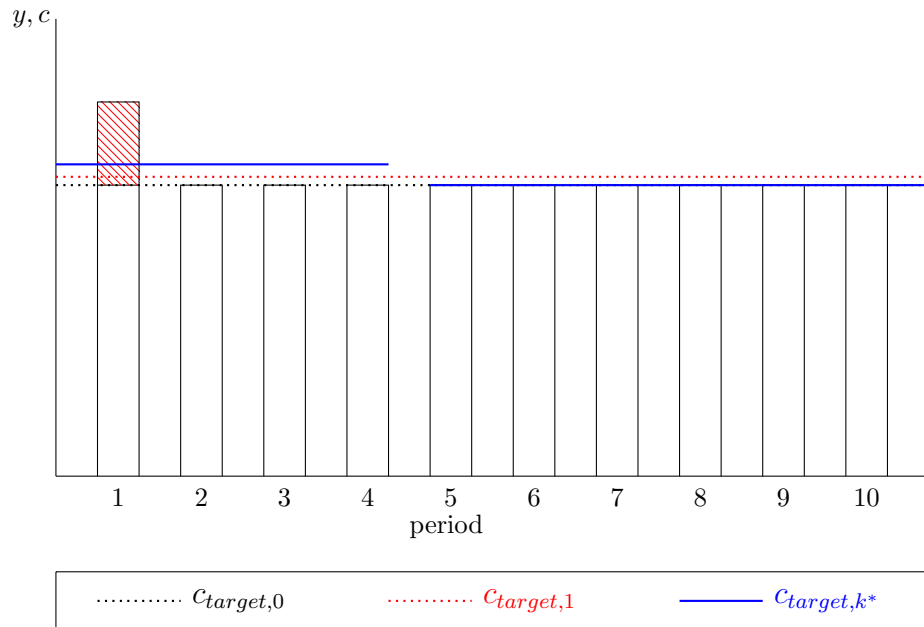
of its income. At the other extreme, in panel (b), I assume the household can borrow without limit. Consumption in each period is equal to the consumption target. In the first two periods, the household borrows from the future to increase consumption above income. As a result, in the final period, consumption is below income. This is the household's optimal lifetime plan for consumption because of its desire to smooth consumption.

Suppose the household receives an unanticipated $\Delta > 0$ income shock. The household reoptimizes to accommodate for the additional income, increasing the consumption target commensurately to $c_{target,1}$. Consider first the constrained household that was not reaching its initial consumption target. This household opts to consume the entire income shock, bringing it closer to the consumption target in the first period. Through the lens of my model, the household optimally selects a one-period planning horizon, even before considering planning costs.

Now consider instead the unconstrained household. Absent planning costs, the marginal propensity to consume is roughly $1/3$ because the household opts to equally

smooth the income shock across every period of its life. In each period, the household again meets the (increased) consumption target. In the first period, because of the income shock, the household borrows less than it previously had. In the second period, the household borrows slightly more, and in the third period, the household consumes slightly more of its income. With planning costs, the household would opt to smooth the income shock over fewer periods, yielding a shorter planning horizon.

Figure 4.4: Consumption Smoothing in Stylized Model



Notes: Illustrative three-period model of consumption smoothing. Vertical bars depict income, dashed lines represent consumption targets, and markers show actual consumption. Black pattern illustrates initial household behavior and red pattern illustrates new behavior after $\epsilon > 0$ income shock in first period.

The intuition for unconstrained households is similar when the household has a flat income profile. To illustrate this, Figure 4.4 plots a household which lives for 10 periods and faces a constant stream of income. The household consumes its endowment in every period and net saving is zero. Suppose again that the household receives an unanticipated $\Delta > 0$ income shock. Absent planning costs, the household smooths the income shock across every period of its life, and the marginal propensity to consume is roughly $1/10$ in each period.

With planning costs, the household chooses a shorter planning horizon. For example, in this figure, the household chooses to reoptimize for four periods, or $k^* = 4$. In the period of the shock and the next three periods, consumption increases by $1/4$ of the income shock. Beginning in the fifth period, consumption returns to its original level, as-if the shock never occurred.

The mechanism in this simple model extends directly to the model with $T \leq \infty$ periods and, in the quantitative extensions in Section 4.4, stochastic income and an occasionally binding borrowing constraint. Constrained households have a desire to smooth consumption by borrowing from the future, but are unable to do so; when subject to a positive income shock, they spend a large fraction of it to immediately increase consumption, generating a large marginal propensity to consume. Unconstrained households have a desire to smooth consumption by saving for the future, but planning costs subtract from the benefits of smoothing deep into the future. The household finds it optimal to front-load consumption of the shock, which generates a larger marginal propensity to consume.

Short-Run Consumption and Savings Plans

As usual, when dealing with recursive finite-horizon problems, I begin with the final period of the finite horizon and work backwards to the first period, which corresponds to the period in which the shock occurred. For planning horizons longer than the income sequence, i.e., $k > N_\Delta$, I define the income shock in each period beyond the end of the income sequence as zero.

I denote the household's **Short-run** policy functions by $c_\tau^S(\{a^L, a^S\}, y^S)$ and $s_\tau^S(\{a^L, a^S\}, y^S)$ for all periods τ in the reoptimization horizon. This notation emphasizes that in contrast to the long-term policy functions, which are defined over (a^L, y) , the short-term plans are formed over both long- and short-run wealth. Long- and short-term consumption are additive, so that utility in any period is given by $u(c_t^L(\cdot) + c_t^S(\cdot))$.

Similarly, total wealth evolves according to $s_t^L(\cdot) + s_t^S(\cdot)$. Taking the long-term plans as given, the household's reoptimization yields the short-term policy functions.

Last Period of Planning Horizon The household reoptimizes at time t for k periods, including period t , so that the final period of the planning horizon is $t+k-1$. Recursively, the household's lifetime value can be expressed as:

$$V_{t+k-1}^S(\{a^L, a^S\}, y) = u(c_{t+k-1}^L(a^L, y) + c_{t+k-1}^S(\{a^L, a^S\}, y)) + \beta V_{t+k}^L(a^{L'}, y'),$$

subject to the budget constraint

$$c_{t+k-1}^L(a^L, y) + c_{t+k-1}^S(\{a^L, a^S\}, y) + \frac{s_{t+k-1}^L(a^L, y)}{1+r} = y + a^S + a^L + \Delta_{t+k-1}.$$

In this period, there is no optimization problem because, by assumption, the household expends all short-term wealth within the finite planning horizon. Thus short-term saving is zero and short-term consumption is whatever remains in the short-term wealth account, plus the income shock (if any) in the final period:

$$c_{t+k-1}^S(\{a^L, a^S\}, y) = a^S + \Delta_{t+k-1}.$$

Long-term wealth in the next period is given by the long-term savings policy function, which depends only on the mental account for long-term wealth:

$$a^{L'} = s_{t+k-1}^L(a^L, y).$$

The household's continuation value is measured using the long-term value function. By assumption, the continuation value is the same as-if there had been no irregular income shock, which the household has already calculated in planning for long-term consumption and saving. Beginning from period $t+k$, the household continues as-if

the income shock had never occurred.

Intermediate Periods of Planning Horizon Between the first and last periods of the planning horizon, i.e., for $\tau = \{t+1, t+2, \dots, t+k-1\}$, the household reoptimizes over both consumption and saving, given income y and mental wealth accounts $\{a^L, a^S\}$. The household chooses policy functions $c_\tau^S(\{a^L, a^S\}, y)$ and $s_\tau^S(\{a^L, a^S\}, y)$ to solve:

$$V_\tau^S(\{a^L, a^S\}, y) = \max_{c_\tau^S(\cdot), s_\tau^S(\cdot)} u(c_\tau^L(a^L, y) + c_\tau^S(\{a^L, a^S\}, y)) + \beta V_{\tau+1}^S(\{a^{L'}, a^{S'}\}, y'),$$

subject to the budget constraint

$$c_\tau^L(\cdot) + c_\tau^S(\cdot) + \frac{s_\tau^S(\cdot) + s_\tau^L(\cdot)}{1+r} = y + a^S + a^L + \Delta_\tau.$$

The household's long-term wealth evolves according to the long-term savings function that incorporates only the mental account for long-term wealth, independently of short-term wealth or savings: $a^{L'} = s_\tau^L(a^L, y)$. The household's decisions for short-term consumption and savings, however, depend on both short- and long-term wealth. Since the entire income shock sequence is known to the household, short-term wealth in the next period is given by short-term savings and the next income shock (which may be zero): $a^{S'} = s_\tau^S(\{a^L, a^S\}, y) + \Delta_{\tau+1}$. As with long-term wealth, short-term wealth is stored in a single bond that costs $(1+r)^{-1}$ per unit and pays one unit in the next period, and the borrowing limit is applied to total bond holdings.

First Period of Planning Horizon At time t , the household's wealth portfolio consists of only long-term wealth, $a_t = \{a_t^L\}$. I model the income shock as being immediately deposited into the household's short-term wealth account, so that the new wealth portfolio is $a_t = \{a_t^L, \Delta_t\}$. reoptimizing over finite horizon k , the household

forms short-term consumption and savings plans over both mental accounts to solve:

$$V_t^S(\{a^L, \Delta_t\}, y) = \max_{c_t^S(\cdot), s_t^S(\cdot)} u(c_t^L(a^L, y) + c_t^S(\{a^L, \Delta_t\}, y)) + \beta V_{t+1}^S(\{a^{L'}, a^{S'}\}, y'),$$

subject to the budget constraint

$$c_t^L(\cdot) + c_t^S(\cdot) + \frac{s_t^S(\cdot) + s_t^L(\cdot)}{1+r} = y + a^L + \Delta_t.$$

As in the intermediate periods, the household's long-term wealth evolves according to its long-term savings plan, independently from the income shock, while the evolution of short-term wealth consists of short-term savings and next period's income shock:

$$a^{L'} = s_t^L(a^L, y), \quad a^{S'} = s_t^S(\{a^L, a^S\}, y) + \Delta_{t+1}.$$

4.3.3 Measuring the Marginal Propensity to Consume

In this section, I assume that the household is subject to a one-period positive income shock at time t , so that $\Delta = \{\Delta\}$, but the analysis extends directly to the multi-period case. I measure the response to the income shock by comparing the long- and short-term policy functions, again in the first period of the planning horizon, the final period, and the intermediate periods.

In the first period, at time t , subtracting the long-term budget constraint from the short-term budget constraint yields

$$c_t^S(\{a^L, a^S\}, y) + \frac{s_t^S(\{a^L, a^S\}, y)}{1+r} = \Delta.$$

The income shock, Δ , is divided between short-term consumption and short-term

saving. Dividing both sides by the shock yields the marginal propensities to consume and save out of the shock, which sum to one:

$$\text{MPC}_{t,0}(\{a_t^L, a_t^S\}, y) + \text{MPS}_{t,0}(\{a_t^L, a_t^S\}, y) = 1.$$

I define $\text{MPC}_{t,s}$ and $\text{MPS}_{t,s}$ as the cumulative marginal propensities at time $t + s$ for a shock that occurs in period t . Similarly, for an intermediate period $\tau = \{t + 1, t + 2, \dots, t + k - 1\}$, subtracting each side of the long-term budget constraint from the short-term budget constraint yields:

$$c_\tau^S(\{a^L, a^S\}, y) + \frac{s_\tau^S(\{a^L, a^S\}, y)}{1 + r} = a^S.$$

In each intermediate period, the household allocates short-term wealth between its short-term consumption and additional short-term saving. Since short-term wealth in each period is the residual saving out of the income shock in the first period, dividing both sides by short-term wealth yields the path of MPCs, $\{\text{MPC}_{t,1}, \text{MPC}_{t,2}, \dots, \text{MPC}_{t,k-1}\}$, that tracks the household's cumulative propensity to consume out of the income shock.

In the final period of the planning horizon, by assumption, short-term savings in the final period are zero and all short-term wealth must be consumed:

$$c_{t+k-1}^S(\{a^L, a^S\}, y) = a^S.$$

By construction, in the final period of the planning horizon, the cumulative MPC is one: $\text{MPC}_{t,k} = 1$. Beginning in the next period, the household will return to its long-term consumption and savings plans, as-if the irregular income shock had never occurred.

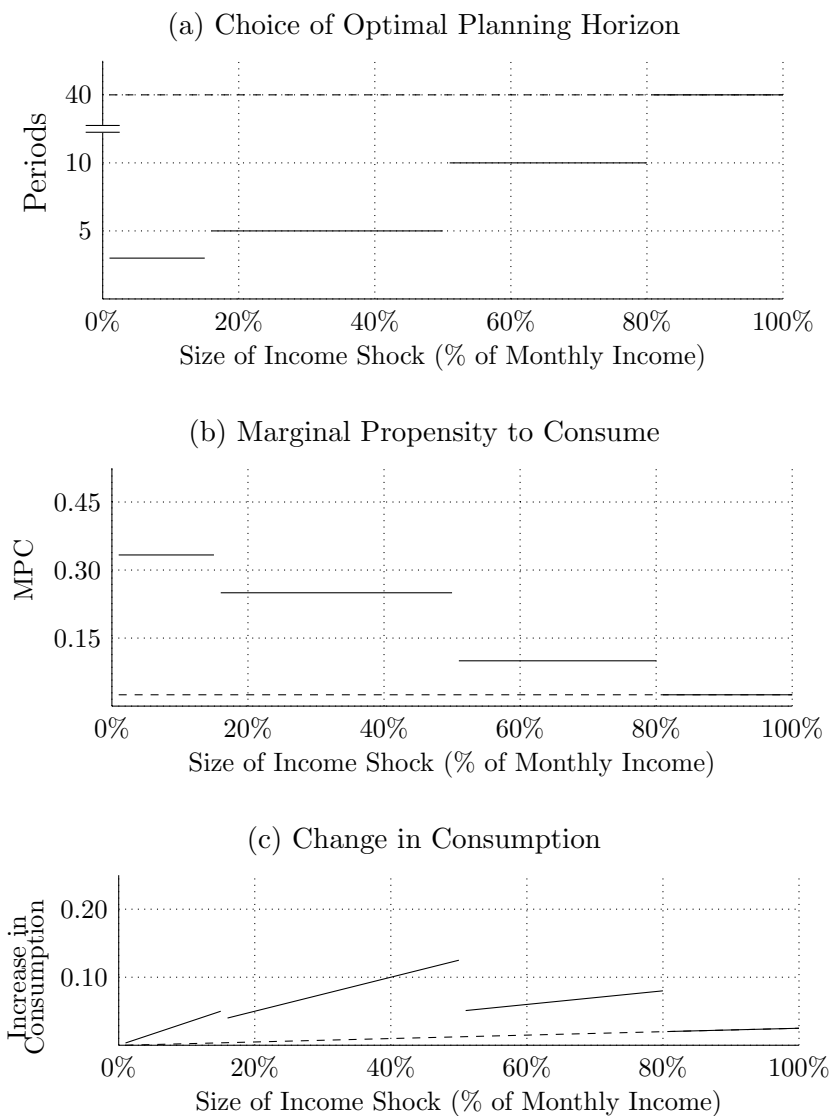
4.3.4 Consumption Response Function

The optimal planning horizon relates directly to the household's consumption out of the income shock. Figure 4.5 illustrates the contemporaneous consumption response of an unconstrained household to a positive income shock which varies in size from 1% to 100% of regular income. In this figure, I assume that the household lives for 40 periods in total, including the first period in which the income shock occurs.

Panel (a) plots the household's optimal planning horizon. In the standard model with no planning costs, illustrated by a dashed line, the household reoptimizes for its entire lifetime regardless of the size of the income shock. In my model, however, the household's optimal planning horizon increases with the size of the income shock. In this example, the household reoptimizes for three periods if the income shock is between 1% and 15% of monthly income, five periods if between 16% and 50%, 10 periods if between 51% and 80%, and for its entire lifetime, 40 periods, if between 81% and 100%. Since larger income shocks provide larger benefits to smoothing, the household is more willing to pay the planning costs, and chooses a longer planning horizon. For sufficiently large shocks, the household finds it optimal to reoptimize over its entire lifetime. As in the standard model with no planning costs, the household internalizes such a large (albeit temporary) income shock as a change in permanent income.

In line with the optimal planning horizon, panel (b) plots the corresponding marginal propensity to consume. In the model with no planning costs, the marginal propensity to consume is roughly $1/40$. For small income shocks over which the household reoptimizes for only three periods, the marginal propensity to consume is significantly larger, but decreases as the planning horizon increases. When the income shock is large enough that the household reoptimizes over its entire lifetime, the marginal propensity to consume is the same as in the model with no planning costs.

Figure 4.5: Illustration of Consumption Response Function



Notes: Illustrative model of unconstrained household that lives for $T = 40$ periods. Solid lines depict behavior of household with bounded intertemporal rationality and partial consumption smoothing. Dashed lines represent behavior of household in standard model with no planning costs and full consumption smoothing.

In the last panel, I multiply the marginal propensity to consume by the size of the shock, plotting the household’s (level) change in consumption under the assumption that regular income is equal to one. The dashed line is the change in consumption in the standard model with no planning costs. The difference between this shallow line and the solid line illustrates the stark difference between the consumption response in the two models. For smaller shocks, the unconstrained household optimally foregoes consumption smoothing to avoid paying the planning costs, generating a steep consumption function. As the size of the income shock increases beyond certain critical values, the optimal planning horizon increases and the consumption response function becomes more shallow. Eventually, when the shock is sufficiently large, the consumption response functions in the two models coincide. The consumption response function is non-monotonic because although the income shock is increasing, when it is divided amongst a longer planning horizon, consumption in the initial period decreases discontinuously.

4.4 Quantitative Model, Calibration, and Estimation

The key parameters I want to estimate are the planning horizon costs, ϕ_k . As laid out in the theoretical section, the model can be divided into two parts: the long-term plan and the short-term plan. I use estimates from the literature for the long-term plan to establish a baseline model comparable with the literature. The short-term dynamics are primarily governed by the planning costs. I use GMM estimation to match the main regression in the previous section. I check the external validity of my estimates by comparing the model with these estimates to those in Gelman (2019).

4.4.1 Quantitative Model Extensions

Prior to estimation, I enrich the model with three additional features that are important quantitatively but do not qualitatively affect the main mechanisms driving bounded intertemporal rationality.

Stochastic Labor Income At time zero, the household forms long-term plans over a stream of income endowments consisting of both deterministic and stochastic components. The deterministic component is similar to above and represents anticipated income changes. The stochastic component represents anticipated but uncertain changes in income, such as end-of-year bonuses or temporary spells of unemployment. This extension generates an empirically plausible distribution of (precautionary) saving in liquid wealth.⁶

Epstein-Zin Preferences I use Epstein-Zin preferences to separate the roles of risk aversion and the elasticity of intertemporal substitution. With the functional forms used to present the model above, risk aversion and the elasticity of intertemporal substitution are inversely related, and using a realistic value for one necessitates an unrealistic value for the other.

Correctly calibrating the degree of risk aversion is important for generating realistic precautionary saving. As noted by Olafsson and Pagel (2018) and Gelman (Forthcoming), and discussed extensively by Aguiar, Bils and Boar (2020), correctly calibrating the elasticity of intertemporal substitution is crucial for discussion of the marginal propensity to consume. Regardless of financial constraints, a preference

⁶Depending on the properties of the income process and the exact borrowing constraint, some fraction of households may be “hard” borrowing constrained, in that $s_t^L(\{a_t^L\}, y_t) = -\underline{a}$. All households will be “soft” borrowing constrained in that their optimal policy functions are affected by the presence of the borrowing constraint. This is true when there exists some sequence of income realizations such that the household becomes hard borrowing constrained; with infinite time and a Markov process with no absorbing states, this occurs almost certainly. This difference may be immaterial for households in the right tail of the wealth distribution, but is relevant for households in the left tail of the distribution who are not hard borrowing constrained but consider they may become so with high probability.

for less intertemporal substitution generates a high propensity to consume and less liquid wealth. If low liquid wealth is used as a proxy for financial constraints, then a researcher may attribute the high propensity to consume to financial constraints, when in fact it is based solely on preferences. By separating risk aversion from the intertemporal elasticity of substitution, the model can generate realistic precautionary savings and marginal propensities to consume.

Differential Saving and Borrowing Rates To further aid in generating a realistic distribution of liquid wealth, I assume that households save and borrow at different rates. Between both mental accounts, if the household is a net borrower, the interest rate is r_{borrow} , and if the household is a net saver, the interest rate is r_{save} .

4.4.2 External Estimates and Calibrations

Income The model is estimated at the monthly frequency and the evolution of income is approximated using a discretized AR(1) process. Gelman (Forthcoming) uses monthly transaction-level data for a long panel of households to separate permanent and temporary fluctuations in income. I use his estimates of:

$$y_{it} = (1 - \rho)\mu_y + \rho y_{i,t-1} + \sigma_y \epsilon_{it},$$

which are $(\rho_y, \mu_y, \sigma_y) = (0.883, 0.096, \sqrt{0.039})$.⁷

Preferences Following Kaplan and Violante (2014), I set the annualized discount factor is 0.941, which is similar to the estimated annualized discount factor of 0.935 in Gelman (Forthcoming). I also set the coefficient of (constant) relative risk aversion to 4 and the elasticity of intertemporal substitution to $1/2$.

⁷For more details on the procedure he uses to reach these estimates, see Section 3.3.3 of Gelman (Forthcoming).

Table 4.1: Summary of Long-Term Model Parameters

Parameter	Description	Value	Source
Regular Income Process			
ρ_y	Persistence	0.096	Gelman (Forthcoming)
μ_y	Unconditional Mean	0.883	Gelman (Forthcoming)
σ_y^2	Variance	0.039	Gelman (Forthcoming)
Preferences			
β	Annualized Time Preference	0.941	Kaplan and Violante (2014)
γ	Risk Aversion	4	Kaplan and Violante (2014)
σ	Elasticity of Intertemporal Substitution	1/2	Kaplan and Violante (2014)
Financial Markets			
r_a	Annualized Saving Rate	2.73%	Federal Reserve Board
r_d	Annualized Borrowing Rate	9.10%	Survey of Consumer Finances (2007)
\underline{a}	Borrowing Limit (\times monthly income)	1.51	Survey of Consumer Finances (2007)

Aguiar et al. (2020) demonstrate that households with high marginal propensities to consume also have high average propensities to consume, implying that their behavior may be driven by preferences in addition to liquidity constraints, and suggest a different calibration for the elasticity of intertemporal substitution. In my baseline specification of the model, I use the same calibration as Kaplan and Violante (2014) to facilitate comparison. In an alternate specification using the calibration in Aguiar et al. (2020), all households indeed have a larger marginal propensity to consume, but the planning mechanism in my model remains crucial for generating a realistic relationship between the propensity to consume and wealth.

Financial Markets Using Table H.15 from the Federal Reserve board, I calculate that the annualized interest rate on a 3-month certificate of deposit in 2007 was 2.73%, and use this as the interest rate for savings. According to the Survey of Consumer Finances, the median interest rate on credit cards was 9.10% and the median credit card borrowing limit was 1.51 times monthly income. I use these as values for the annualized interest rate on borrowing and borrowing limit, respectively.

Table 4.1 summarizes the parameters governing the model's long-term plan layer.

Figure 4.6: Stationary Distribution of Wealth Using Long-Term Plans

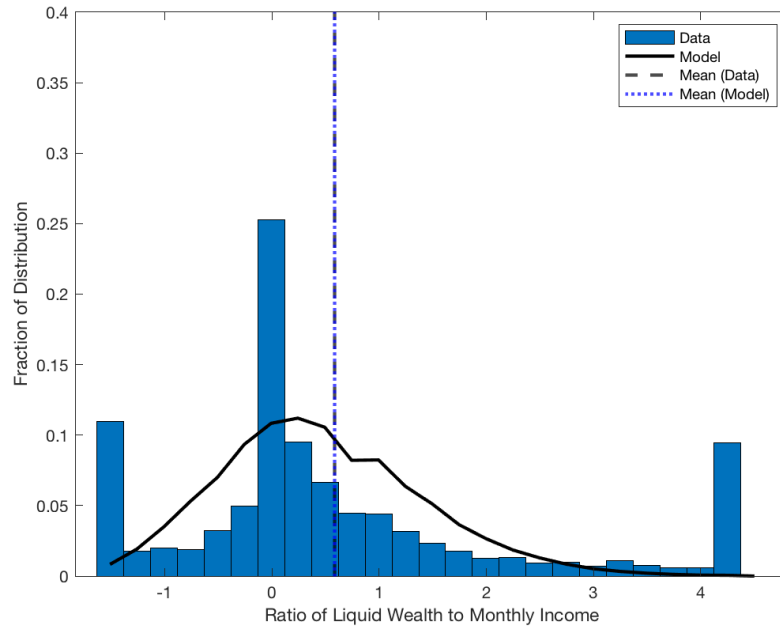


Figure 4.6 plots the stationary distribution of wealth in the long-term model compared to the distribution of liquid wealth from the 2007 Survey of Consumer Finances. Given its parsimony, the model does a fairly good job of fitting the distribution. By construction, the minimal value of wealth in the model is $-1.51 \times$ monthly income, but approximately 10% of households in the Survey of Consumer Finance reported liquid wealth less than this amount. Similarly, the model is unable to capture roughly the top 10% of the liquid wealth distribution. The model also does not attempt to replicate the mass of households who report holding zero wealth. Despite all this, the average level of wealth in the model is approximately $0.59 \times$ monthly income, which is approximately the average level of wealth in the data when the lower and upper 10% of the distribution are excluded.

4.4.3 Estimation of Planning Costs

I estimate the household's planning costs, ϕ_k , using the Generalized Method of Moments and the estimated consumption response to Economic Stimulus Payments in 2008. The planning costs are the key drivers of the households short-term plans in response to an irregular income shock. Recall that the optimal planning horizon depends on the benefits of intertemporal smoothing relative to the planning costs; the benefits to additional intertemporal smoothing are driven by the same parameters (for preferences and financial markets) as the long-term plans.

The Economic Stimulus Act of 2008

The Economic Stimulus Act of 2008 put almost \$100 billion directly into the pockets of households. Economic Stimulus Payments (ESPs) ranged from \$300 to \$600 per adult, depending on income, and additional payments were made to households with dependents. Parker et al. (2013b) use the 2008 wave of the Survey of Consumer Expenditure to estimate that households increased non-durable spending by 12-30 percent of the ESP within three months of receipt. They find that low-income households spent the largest fraction of their ESPs but high-income households spent nearly as much. Reflecting holdings of wealth, they find some relationship between age and homeownership.⁸ Shapiro and Slemrod (2009) use an insert in the University of Michigan's Survey of Consumers to ask households whether they used the majority of their ESP to increase spending, increase saving, or repay debt. Approximately 20% of households responded that they used the majority of the rebate to increase

⁸Lewis, Melcangi and Pilossoph (2019) propose a novel econometric method to study the relationship between household characteristics and the MPC. In their model, instead of *ex ante* grouping households by a given characteristic, they optimally weight households into various groups to maximize model fit. This allows the data to *ex post* reveal underlying patterns between characteristics and the MPC. Their main findings are that households with high-income and/or mortgages have larger MPCs and that a household's MPC and average propensity to consume are related.

spending. High-income households most frequently reported that they would spend the majority of the ESP, but again, the differences between the income groups small.

Overall, evidence from both revealed and reported preferences suggests violations of the standard PIH model. Borrowing constraints may be part of the explanation, but still cannot account for high propensities to consume of households with high income and/or liquid wealth that are traditionally believed to be financially unconstrained. In Appendix A.2, I show that the presence of hand-to-mouth households defined in Kaplan and Violante (2014) and Kaplan et al. (2014b) increases the number of constrained households theoretically and empirically, but, again, cannot account for high propensities to consume for the remaining and presumably unconstrained households.

Sorting Households by Relative Payment Size Payments from the Economic Stimulus Act of 2008 were made to households with joint income of up to \$150,000, almost three times median annual income in the United States.⁹ Given the homogeneity of ESPs, there is large variation in the size of ESPs relative to income. In this section, I present motivating evidence consistent with my model's prediction that smaller relative income shocks induce less intertemporal smoothing and therefore higher MPCs. I construct Relative ESP by dividing the ESP into either monthly income or cash-on-hand, defined as the sum of monthly income and liquid assets.

There is a long history of papers which show the negative relationship between the size of an income shock and the propensity to consume. More recently, Kueng (2018) constructs relative payment size for Alaskan households receiving annual payments from the Alaska Permanent Fund. This section establishes that the same pattern holds for the 2008 ESPs and, presumably, other irregular tax rebates from the government. I therefore interpret them as irregular income shocks in my model, which prescribes distinctly different behavior than if they were regular income shocks.

⁹Median (nominal) income was \$52,397 in the 2007 Survey of Consumer Finances.

Evidence from Survey of Consumer Expenditures. The 2008 wave of the Survey of Consumer Expenditures asked respondents about the ESP. I use the publicly available Parker et al. (2013b) dataset which aggregates responses to the household level. The dataset includes all households in the Survey of Consumer Expenditures that received exactly one ESP. The authors note the data reliability issues with respect to both income and, especially, liquid assets, which roughly half of households in the sample do not report. For more details on how the data is constructed, see Appendix C of Parker et al. (2013b).

I divide households into terciles by relative ESP and present summary statistics in Table 4.2 for the relative ESP, the ESP amount, monthly income, and liquid assets. In the first three columns, relative ESP is defined using monthly income, and in the final three, using cash-on-hand.

Table 4.2: CEX Terciles of ESP to Monthly Inc.

		Mean	Std. Dev.	25 th Perc.	Median	75 th Perc.
T1	Rel. ESP	0.109	0.036	0.084	0.115	0.138
	ESP Amount	803	413	600	600	1,200
	Monthly Inc.	7,862	3,903	4,681	7,507	10,310
	Liquid Assets	14,127	21,409	1,600	5,788	17,000
T2	Rel. ESP	0.218	0.034	0.189	0.212	0.245
	ESP Amount	1,023	495	600	1,200	1,200
	Monthly Inc.	4,778	2,360	2,833	4,583	6,393
	Liquid Assets	11,750	23,393	500	2,706	10,000
T3	Rel. ESP	1.187	10.302	0.334	0.405	0.560
	ESP Amount	1,048	575	600	1,030	1,200
	Monthly Inc.	2,398	1,536	1,250	2,000	3,388
	Liquid Assets	5,652	15,169	5	900	4,200

Notes: Summary statistics for households receiving exactly one ESP and reporting annual income, which is divided by 12 to yield monthly income. See Appendix C of Parker et al. (2013b) for more details on how the sample was constructed.

By construction, the average relative ESP is increasing by tercile, from 11% of monthly income for the first tercile to 43% of monthly income for the third tercile.

Households in the first tercile have the smallest ESPs and most income and liquid assets, followed by households in the second tercile then households in the first tercile. Using income and liquidity as standard proxies for borrowing constraints, households in the first tercile are those least likely to be financially constrained.

Specifically, households in the first tercile received an average ESP of \$785 and had average monthly income of \$7,809, and both average values are close to the medians. The average level of liquid assets for these households was \$13,814, but the distribution is highly skewed, and the median level of liquid assets was \$5,788. Relative to the first tercile, households in the second tercile had, on average, larger ESPs of \$1,017, less monthly income of \$4,869, and less liquid assets of \$11,722. Households in the third tercile of relative ESP had the largest ESP payments of \$1,054, the smallest monthly income of \$2,644, and the smallest level liquid assets of \$5,782. Again, in both the second and third terciles the median level of liquid assets was much less than the average.

The final three columns present summary statistics when relative ESP is calculated using cash-on-hand. The patterns are largely the same. Average ESP is increasing in tercile, average income is decreasing, and liquid assets are decreasing. The primary difference is that the average relative ESP in each group is much smaller than when relative ESP is defined using only income in the denominator.

To estimate the propensity to consume out of the ESP, Parker et al. (2013b) regress changes in consumption on the amount of the ESP:

$$\Delta c_{it} = \alpha + \beta \cdot ESP_{it} + \delta \cdot z_{it} + \gamma_t + u_{it},$$

where Δc_{it} is the measured change in consumption for household i between t and $t-1$, ESP_{it} is the Economic Stimulus Payment at t for household i , z_t contains changes in family demographics, and γ_t is a monthly fixed effect. The coefficient of interest

is β , which measures the propensity to spend out of the ESP in the same month of receipt.

The effect of the stimulus is identified by exploiting the randomized timing of ESP receipts among the non-random sample of households selected to receive the ESPs. Specifically, households received ESPs (either by cheque or direct deposit) based on the last two digits of their Social Security Numbers. To identify the causal impact of the ESP on consumption, I compare consumption at t of households who received the ESP at t against the consumption of households at t who received the ESP at $t' \neq t$.

To measure the differential effect across relative ESP terciles, I interact the ESP amount with the relative ESP tercile:

$$\Delta c_{it} = \alpha + \beta_1 \cdot ESP_{it} + \sum_{j=2}^3 \beta_j \cdot ESP_{it} \times 1\{\text{Tercile } j\}_{it} + \delta \cdot z_{it} + \gamma_t + u_{it}$$

I instrument for the ESP amount (and interactions) using an indicator for households that received a payment and estimate the regression equation using 2SLS. Standard errors are clustered by household. The estimated coefficients are presented in Table 4.3.

Consistent with the model, the estimated marginal propensity to consume is decreasing in the relative ESP tercile for all measures of consumption. For reference, pooling all terciles together and estimating the baseline regression for nondurable consumption from Parker et al. (2013b), the estimated MPC is 0.308. Sorted by relative ESP constructed using monthly income, the implied MPC for the first tercile is 0.347. The implied MPC for the second tercile is 0.210, which is statistically significant at less than the 5% level, but not statistically different than the implied MPC for the first tercile. The implied MPC for the largest tercile is 0.115, which is not statistically different than zero, but is statistically different from the estimated MPC for the third tercile. A similar pattern emerges for both durable and total consumption, although

Table 4.3: Spending Response of Consumption to Economic Stimulus Payments

	(a) Non-Durables		(b) Durables		(c) Total	
	Estimate	Implied MPC	Estimate	Implied MPC	Estimate	Implied MPC
ESP (Base: Tercile 1)		0.347** (0.168)		0.715 (0.537)		1.062* (0.576)
ESP \times Tercile 2	-0.137 (0.138)	0.210* (0.120)	-0.081 (0.423)	0.634 (0.392)	-0.217 (0.456)	0.845** (0.424)
ESP \times Tercile 3	-0.232* (0.136)	0.115 (0.109)	-0.260 (0.424)	0.455 (0.347)	-0.492 (0.454)	0.569 (0.368)
Observations		8,592		8,592		8,592
R^2		0.018		0.005		0.007

Notes: Standard errors in parentheses. *, **, *** denote significance at the 0.10, 0.05, and 0.01 levels under the assumption of a single test. Estimated using two stages least squares and instrumenting for ESP amount with an indicator for ESP receipt. See Parker et al. (2013b) for more details.

the estimates are less precise.

Estimation Using the Generalized Method of Moments

Using the Generalized Method of Moments, I target the estimated propensities to consume in the regressions above. Since the model is monthly and the CEX estimates of consumption are over three-month periods, I target the cumulative MPC over three months in my model. In total, there are six targets, with each estimated propensity to consume corresponding to two parts of the distribution of relative ESPs. The median and maximum relative ESP in the first tercile are 11% and 16% of monthly income, respectively, and both are targeted to yield a cumulative MPC of 0.347. The median and maximum relative ESP in the second tercile are 21% and 28% of monthly income, respectively, and both are targeted to yield a cumulative MPC of 0.210. The median and 75th percentile relative ESP in the third tercile are 40% and 54% of monthly income, respectively, and are targeted to yield a cumulative MPC of 0.115. These targets are summarized in Panel A of Table 4.4.

The household's liquid wealth level in the model is an important determinant of its

MPC and therefore extremely relevant for the estimation procedure. Unfortunately, the 2008 wave of the CEX surveyed households on liquid assets, but did not ask about liquid debt (i.e., unsecured credit card debt). Instead, I use data on liquid wealth from the Survey of Consumer Finances, merged to the CEX using monthly income profiles. See Appendix A.5 for more details.

Table 4.4: Summary of Parameter Values (External Estimates and Calibrations)

(a) GMM Targets

#	Description	Target (Data)	Model
1	3M MPC for $\Delta = 0.11y$ (50 th Percentile of T1)	0.347	0.339
2	3M MPC for $\Delta = 0.16y$ (100 th Percentile of T1)	0.347	0.337
3	3M MPC for $\Delta = 0.21y$ (50 th Percentile of T2)	0.210	0.207
4	3M MPC for $\Delta = 0.28y$ (100 th Percentile of T2)	0.210	0.210
5	3M MPC for $\Delta = 0.40y$ (50 th Percentile of T3)	0.115	0.121
6	3M MPC for $\Delta = 0.56y$ (75 th Percentile of T3)	0.115	0.110

Notes: Targets for estimation using the Generalized Methods of Moments. Distribution of shock sizes, Δ , and three-month marginal propensities to consume (3M MPCs) are estimated from Economic Stimulus Payments in 2008 (see Section 4.4.3).

(b) External Validation

	$\Delta = 0.33y$		$\Delta = 0.45y$		$\Delta = 0.58y$	
	Data	Model	Data	Model	Data	Model
t = 1	0.083	0.077	0.059	0.045	0.038	0.038
t = 2	0.144	0.153	0.110	0.090	0.075	0.074
t = 3	0.173	0.228	0.138	0.133	0.096	0.110

Notes: Out-of-sample test for external validity of the estimated planning costs. Data columns contain estimates from Gelman (Forthcoming) of the one-, two-, and three-month cumulative marginal propensity to consume out of positive income shocks equal to 33%, 45%, and 58% of monthly income, respectively. Model columns contain marginal propensities to consume out of estimated model.

Implementing the Generalized Method of Moments For each target $n \in \{1, 2, \dots, N_{GMM}\}$, I find the planning horizon in the model, k_n^* , that yields the closest cumulative MPC. I then impose a set of conditions such that the value from choosing k_n^* , inclusive of planning costs, is greater than the value from choosing any other $k \neq k_n^*$.

I implement these inequality constraints as equality constraints using the method laid out in Moon and Schorfheide (2009). For each target n , let $V_n(k, \phi_k)$ denote the value from choosing horizon k and paying planning cost ϕ_k . Letting \bar{k} denote the longest horizon considered in the estimation, each target generates $\bar{k} - 1$ inequality constraints, one for each horizon other than k_n^* . That is, for $k \in \{1, 2, \dots, \bar{k}\} \setminus \{k_n^*\}$, the estimation searches for $\phi_{k_n^*}$ and ϕ_k such that

$$V_n(k_n^*, \phi_{k_n^*}) - V_n(k, \phi_k) > 0,$$

Defining $V_n(k^*, k)$ as the difference in value between the targeted planning horizon, k_n^* , and some other planning horizon, k , this condition can be rewritten as

$$V_n(k_n^*, \phi_{k_n^*}) - V_n(k, \phi_k) = \varphi_{n,k},$$

with the parameter restriction $\varphi_{n,k} > 0$ representing the inequality constraint and entering the minimization problem directly.

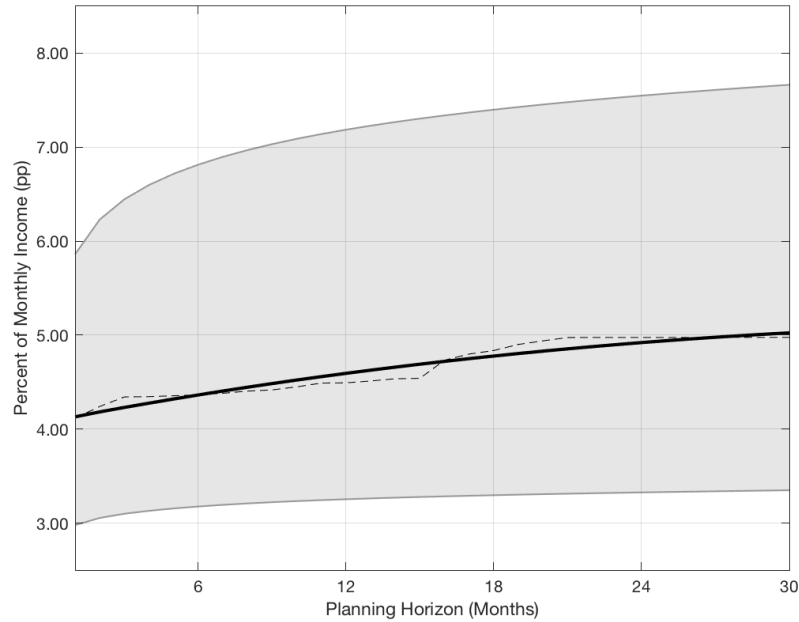
Stacking each of the above restrictions in a vector, the minimization problem can be written as

$$\min_{\Theta} \frac{1}{2} (\mathbf{V}(\mathbf{k}^*) - \boldsymbol{\varphi})' W (\mathbf{V}(\mathbf{k}^*) - \boldsymbol{\varphi}),$$

where Θ contains the \bar{k} elements of the planning costs and $N_{GMM} \times (\bar{k} - 1)$ inequality constraint parameters and subject to the constraint that each element of $\boldsymbol{\varphi}$ is strictly positive. Although these conditions alone generally yield a strictly increasing cost function, I find large computational benefits by imposing that the planning cost is strictly increasing, that is, $\phi_k > \phi_{k-1}$.

Estimated Planning Costs The estimated planning costs are successful in bringing the model in line with the targets, as listed in Panel A of Table 4.4. Figure 4.7 plots the monthly income equivalent of the estimated planning costs. In response to an

Figure 4.7: Estimated Planning Costs as Fraction of Monthly Consumption



Notes: Dashed line plots estimated planning costs and solid line plots quadratic approximation. Shaded area represents confidence interval of estimated planning costs using 95% confidence interval of regressions in Table 4.3 as estimation targets.

unanticipated income shock, the household pays just over 4% of monthly income to select even a one-month planning horizon and spend the entire shock. Planning costs increase slowly to around 4.5% of monthly income for one year and 5% of monthly income for three years. In 2008, median household income in the American Community Survey was \$52,029 (in 2008 dollars). reoptimizing for one month would cost the household \$175, while increasing the planning horizon to one year increases planning costs to \$200. As in Cochrane (1989), only small planning costs are required to push households from perfectly rational to “near rational” behavior.

In Panel B of Table 4.4, I perform an out-of-sample test by comparing the estimated model against external data from Gelman (2019) kindly provided by Michael Gelman. He measures the consumption response of households to their annual tax refunds at a monthly frequency, and I compare the empirical marginal propensity to

consume over each of the first three months to the model counterpart. The model is able to match the external targets fairly well, lending external validity to the estimates using the Economic Stimulus Act of 2008.

4.5 The Distribution of MPCs

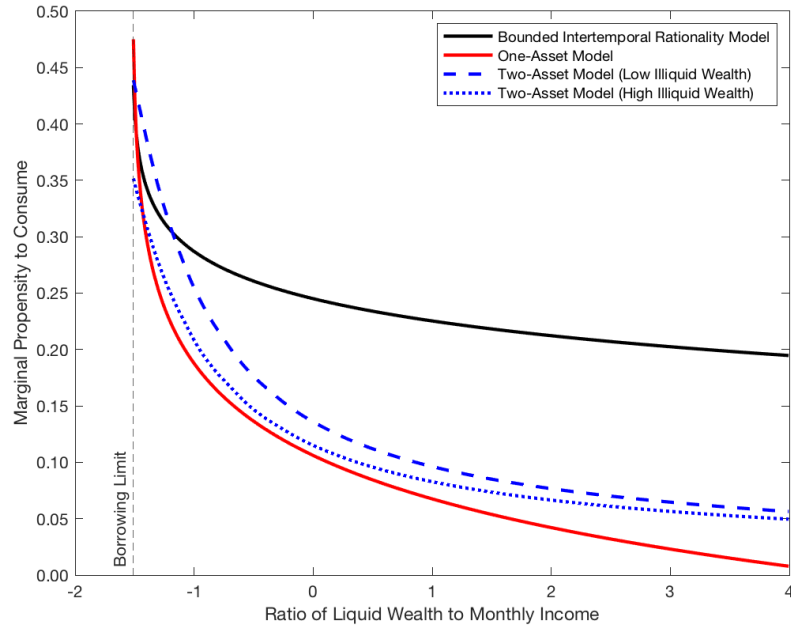
With the estimated planning costs in hand, I construct each household's optimal planning horizon as a function of income, wealth, and the sequence of shocks. I can then calculate the household's consumption response and marginal propensity to consume. In the model, calculating the average MPC out of Economic Stimulus Payments in 2008 yields an estimate very similar to the baseline regression results discussed in Section 4.4.3. This follows directly from calibrating the long-run model to match the stationary distribution of wealth and estimating the short-run planning cost function using the 2008 Economic Stimulus Payments. Instead, I analyze the model's distribution of MPCs across wealth and shock size.

4.5.1 MPC and Liquid Wealth

Figure 4.8 plots the three-month cumulative MPC as a function of liquid wealth for an income shock equal to 28% of monthly income, the average relative size of an Economic Stimulus Payment in 2008. The black line is from the estimated model of bounded intertemporal rationality (BIR) developed in this paper. The red line is the MPC calculated from a one-asset model calibrated the exactly same as the long-term model in Section 4.4.2. The two blue lines are the MPC calculated from the two-asset model developed in Auclert, Bardóczy, Rognlie and Straub (2020). In the two-asset model, the household can freely invest in a liquid asset, or pay a transaction fee each time it adjusts its illiquid asset. The dashed blue line is the MPC for a household

with low illiquid wealth and the dotted blue line for a household with high illiquid wealth.¹⁰

Figure 4.8: Marginal Propensity to Consume and Liquid Wealth

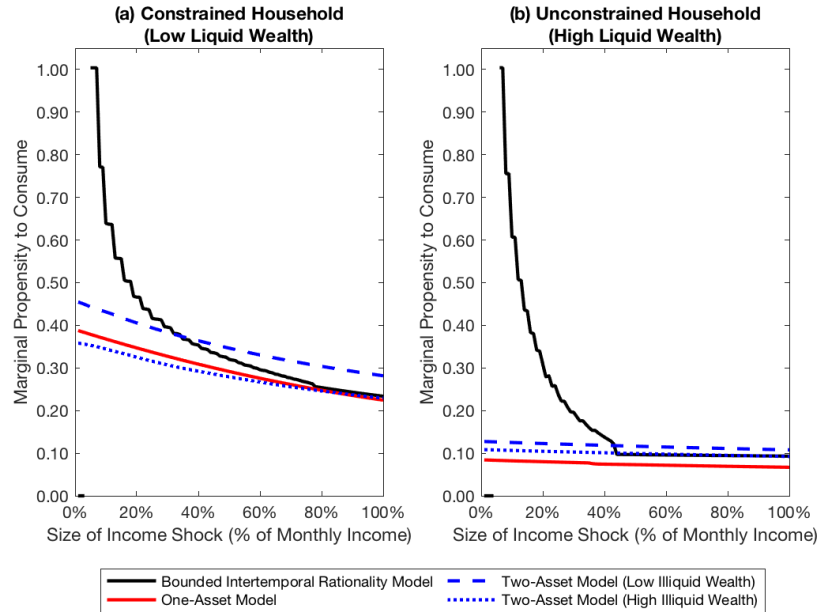


Notes: Marginal propensity to consume out of an income shock equal to 28% of monthly income, the average relative size of an Economic Stimulus Payment in 2008.

In all four cases, the MPC for households with low liquid wealth is high. As discussed in Section 4.3.2, households near the borrowing constraint have an unmet desire to smooth consumption by borrowing from the future. Faced with a positive income shock, they opt to increase consumption in the current period, generating large MPCs. This is true for all four models. As liquid wealth increases, the MPC decreases, but much more quickly in the one- and two-asset models. In these models, unconstrained households smooth the positive income shock over their entire lifetimes, consistent with the Permanent Income Hypothesis. The household saves most of the income shock in order to fund the increased consumption in every future period,

¹⁰Recall that the innovation in the two-asset model is that households with low liquid wealth behave similarly regardless of illiquid wealth. For this reason, the two lines from the two-asset model are similar.

Figure 4.9: Marginal Propensity to Consume for Different Shock Sizes and Wealth Levels



Notes: Marginal propensity to consume out of an income shock ranging from 0% to 100% of monthly income.

generating a small marginal propensity to consume out of the shock.

In the BIR model, the MPC decreases more slowly because wealthier households opt to smooth the income shock over relatively fewer periods. This is due to the combination of diminishing returns to consumption smoothing and increasing costs in the planning horizon. Again consistent with the Permanent Income Hypothesis, the wealthy household wishes to smooth the income shock over future periods, but doing so now incurs the planning costs, and this tradeoff induces shorter planning horizons. As a result, the BIR model generates MPCs for unconstrained households that are still smaller than for constrained households, but much more in line with the empirics; see, for example, the motivating Figure 4.1.

4.5.2 MPC and Shock Size

In Figure 4.9, I vary the size of the income shock between 1% of 100% of monthly income. I compare the MPC of a relatively constrained household in panel (a) to a relatively unconstrained household in panel (b). In both cases, the household opts not to smooth very small income shocks, and the MPC is zero. As the size of the income shock increases, the optimal planning horizon increases, and the MPC decreases.

Constrained households in all three models have large MPCs. In my model, the operative mechanism is bounded intertemporal rationality for small shocks and the financial constraints channel for large shocks. As such, behavior in the three models is distinct for smaller shocks, but behavior of the BIR household resembles that of the other models for larger shocks. Specifically, the constrained BIR household chooses shorter planning horizons for small shocks, generating MPCs between 0.50 and 1.00. In the standard one- and two-asset models, the constrained household's MPC is between 0.40 and 0.50 for small shocks. As the size of the shock increases, the MPC decreases to between 0.25 and 0.35 in all three models. For larger shocks, even the constrained household in the BIR model is driven by its unmet desire for consumption smoothing, and it therefore spends a larger fraction of the income shock.

Unconstrained households in the BIR model have much larger MPCs than households in either one- or two-asset models. In those standard models, the household costlessly smooths any income shock and the MPC is roughly 0.10. In contrast, the BIR household opts to partially smooth income shocks, generating a distinct pattern of MPCs. For income shocks up to 40% of monthly income, the benefits of consumption smoothing are dominated by planning costs, and the household selects shorter planning horizons. As the size of the income shock increases, the household is more willing to reoptimize over additional periods, but the MPC is still larger than in the one- and two-asset models. Eventually, for a sufficiently large shock, the uncon-

strained BIR household opts to pay the planning cost and fully smooth the income shock, and the BIR household's behavior resembles that of the other models.

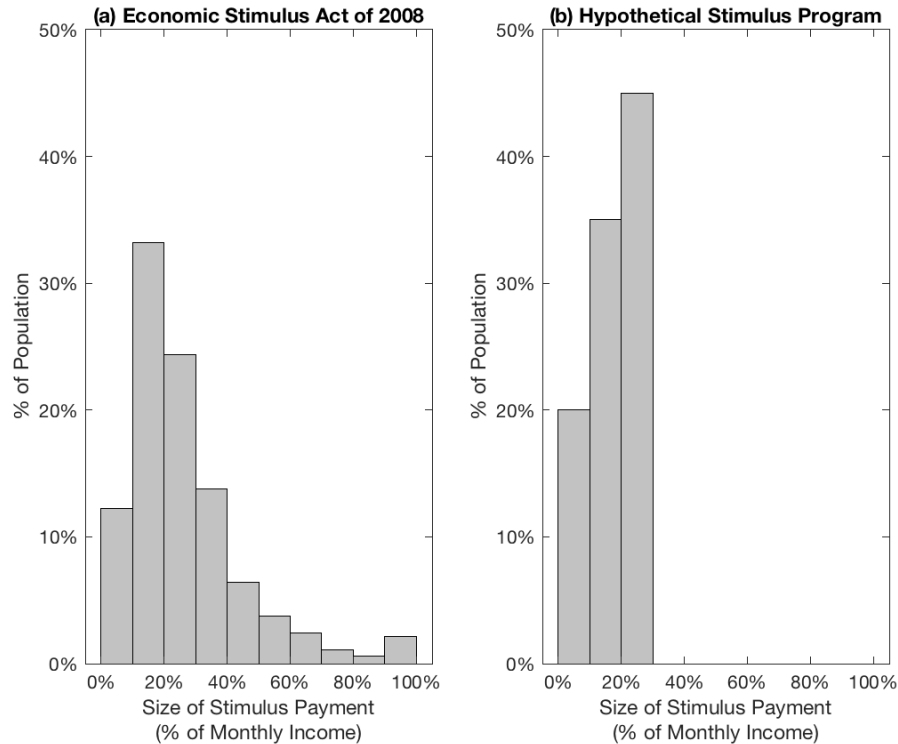
4.5.3 Implications for the Design of Stimulative Fiscal Policy

The relationship between the marginal to propensity to consume and the size of an income shock provides a framework for the design of stimulus programs intended to boost consumption: smaller payments, relative to a household's income, induce less intertemporal smoothing and larger immediate increases in consumption. Panel (a) of Figure 4.10 plots the distribution of relative Economic Stimulus Payments (divided into monthly income) in 2008. As estimated in Section 4.4.3, households in the left tail of the distribution had larger marginal propensities to consume, despite earning more income and holding more liquid wealth.

In panel (b), I outline an alternative stimulus program that distributes smaller relative payments to households. The program has three tiers that partition the population into low-, medium-, and high-income households. High-income households receive payments equal to a small fraction of income, between 5% and 10%. Medium-income households receive intermediately sized payments ranging from 11% to 20% of income, while low-income households receive larger payments ranging from 21% to 30% of monthly income.

As noted extensively by Kaplan et al. (2014b), the correlation between income and liquid wealth is positive but not very strong. Since high-income households are the most likely to be financially unconstrained, my hypothetical program aims to induce limited consumption smoothing in these households by targeting them with smaller payments. Medium- and low-income households are targeted with slightly larger payments because their thresholds for consumption smoothing are larger. A large payment to a low-income household, which is more likely to be financially constrained,

Figure 4.10: Comparison Between Fiscal Stimulus Programs



Notes: In panel (a), the distribution of Economic Stimulus Payments relative to monthly income, from the 2008 wave of the Survey of Consumer Expenditures. In panel (b), the distribution of stimulus payments relative to monthly income for a hypothetical stimulus program.

will generate a consumption response larger than for a similarly sized payment to a medium- or high-income household.

In Kaplan and Violante (2014), the pioneering use of a two-asset model to study stimulative fiscal policy also suggests that smaller payments induce higher propensities to consume. However, the mechanisms in the two models are different, ultimately leading to different policy conclusions. Their ultimate finding is that “the aggregate consumption response is the largest when the policy is phased out around median income” (Kaplan and Violante, 2014, p. 1235), thus excluding half the population from participating in the program. This is because their mechanism works exclusively through the liquidity channel. Despite the presence of high-income households with low liquid wealth and large marginal propensities to consume, lower income house-

holds are more likely to hold low liquid wealth. As such, in a world in which liquid wealth is not observed by the policymaker, the two-asset model suggests targeting low-income households.

In my model and alternative stimulus plan, low-income households are targeted because of the same liquidity channel as in the two-asset model. Medium- and high-income households are targeted with smaller payments because of bounded intertemporal rationality; even if these households do not hold low liquid wealth, the small payments will induce little consumption smoothing and a large marginal propensity to consume. Instead of phasing out the policy completely around median income, the model suggests a more gradual decrease in relative payment size that can extend to more of the high-income population.

4.6 Conclusions

I develop a model of consumption behavior in which households form long-run plans over anticipated fluctuations in income, but reoptimize in response to unanticipated income shocks. My estimated model produces results that are consistent with the motivating figures in the Introduction. Constrained households immediately spend positive income shocks because of an unmet desire to smooth consumption, while even unconstrained households have high marginal propensities to consume because they opt to only partially smooth income shocks. For both types of households, the larger is the shock, the stronger is the incentive for consumption smoothing, and the smaller is the marginal propensity to consume.

I label the households in my model as displaying bounded intertemporal rationality because although they are fully rational, their intertemporal substitution is bounded by the presence of planning costs. Absent these costs, my model collapses to the standard one-asset model with full consumption smoothing for unconstrained

households.

My contribution to the extant literature is a partial equilibrium framework that focuses on income shocks and produces plausible marginal propensities to consume along the entire distribution of wealth. Future work in this area will extend in two directions. First, extending the framework to analyze other shocks, such as to interest rates or borrowing limits. Second, embedding bounded intertemporal rationality into a broader general equilibrium framework to fully examine the effects of fiscal and monetary policy.

Chapter 5

Conclusions

In this dissertation, I provide evidence on how an individual household's consumption response to an unexpected change in income varies with the broader macroeconomic environment, the household's characteristics, and the shock's characteristics.

In the first chapter, I study Economic Stimulus Payments in 2008, which were intended to boost aggregate spending to ward off a recession. Instead, since they were distributed during a credit crunch and while income was stable, they were primarily used to repay debt. In the second chapter, I study Economic Impact Payments distributed in 2020 in light of the COVID-19-induced pandemic. Most households reported primarily using their payments to pay for expenses. While there were some differences in behavior depending on whether the household faced a labor income interruption due to the lockdown, the elasticity of the spending response was much greater with respect to income.

In the final chapter, I build a quantitative model that generates a realistic distribution of consumption responses to income changes. The key mechanism in the model is that in response to unanticipated income shocks, households re-optimize over optimally selected planning horizons. These horizons are selected depending on the characteristics of the household relative to those of the shock. Smaller shocks generate shorter planning horizons and larger propensities to consume, while wealthier households tend to choose longer horizons since they have higher levels of consumption and can afford the benefits of smoothing consumption over more periods.

Appendices

A.1 Proofs

Some definitions. Let $V_t(\Delta, k; a_t^L, y_t)$ denote the lifetime value for a household at time t with long-term wealth a_t^L and income y_t from smoothing shock Δ over k periods. Formally:

$$V_t(\Delta, k; a_t^L, y_t) = \max_{\{\tilde{c}_\tau^S\}_{\tau=t}^{t+k-1}} \sum_{\tau=t}^T \beta^{\tau-t} u(c_\tau^L + \tilde{c}_\tau^S),$$

with the entire shock spent over the k planning periods, i.e.,

1. over the first k periods,

$$\sum_{\tau=t}^{t+k-1} \frac{\tilde{c}_\tau^S}{(1+r)^{t-\tau}} = \Delta,$$

2. for the remaining periods, $\tau > t + k - 1$,

$$\tilde{c}_\tau^S = 0.$$

In this equation, c_τ^L corresponds to the long-run consumption plan that evolves over time according to the initial state variables for long-run wealth and income, (a_t^L, y_t) . As discussed in Section 4.3, long-run wealth evolves according to the long-run savings policy function, $s_\tau^L(\cdot)$, and income evolves exogenously. Both long-run consumption and savings plans are independent of the short-run re-optimization. For

clarity and to focus on the short-run plans, I suppress the notation indicating that in each period, c_τ^L depends on long-run wealth and income in period τ .

Let $c_\tau^S(\Delta, k; a_t^L, y_t)$ denote the optimal short-run consumption at time τ for a household at time t that has long-term wealth a_t^L , income y_t , faces shock Δ , and reoptimizes over k periods. Note that for every period τ , this function is defined over the initial state variables (a_t^L, y_t) , as these will be the focus of the proofs.

Then the expression above can be rewritten as:

$$V_t(\Delta, k; a_t^L, y_t) = \sum_{\tau=t}^{t+k-1} \beta^{\tau-t} u(c_\tau^L + c_\tau^S(\Delta, k; a_t^L, y_t)) + \sum_{\tau=t+k}^T \beta^\tau u(c_\tau^L),$$

Lemma 1. *Fix states. Then:*

$$\frac{\partial V_t(\Delta, k+1; a_t^L, y_t)}{\partial \Delta} > \frac{\partial V_t(\Delta, k; a_t^L, y_t)}{\partial \Delta}.$$

Proof. With respect to Δ , easy:

$$\frac{\partial V_t(\Delta, k; a_t^L, y_t)}{\partial \Delta} = \sum_{\tau=t}^{t+k-1} \beta^{\tau-t} u'(c_\tau^L + c_\tau^S(\Delta, k; a_t^L, y_t)) \cdot \frac{\partial c_\tau^S(\Delta, k; a_t^L, y_t)}{\partial \Delta} > 0.$$

From before, the entire shock is spent inside the planning horizon, and the derivative of this constraint is given by:

$$\sum_{\tau=t}^{t+k-1} \frac{1}{(1+r)^{t-\tau}} \frac{\partial c_\tau^S(\Delta, k; a_t^L, y_t)}{\partial \Delta} = 1.$$

Since by assumption $\beta = (1+r)^{-1}$, this means that the sum above is weighted in each period by the derivative of the short-run consumption function, with weights summing to unity.

When k increases, there is an additional term in the summation and the weights continue summing to unity. By construction, the short-term construction function is decreasing in the number of planning horizons. So the value entering the marginal utility goes down in every term, and since marginal utility is decreasing, each term is larger. Thus the sum is over more terms, and each term is increasing, so the total summation is larger. \square

Lemma 2. *Fix Δ . Then:*

$$\frac{\partial V_t(\Delta, k+1; a_t^L, y_t)}{\partial a_t^L} > \frac{\partial V_t(\Delta, k; a_t^L, y_t)}{\partial a_t^L}.$$

Proof. The derivative with respect to a^L :

$$\begin{aligned} \frac{\partial V_t(\Delta, k; a_t^L, y_t)}{\partial a_t^L} &= \sum_{\tau=t}^T \beta^{\tau-t} u'(c_\tau^L + c_\tau^S(\Delta, k; a_t^L, y_t)) \\ &\quad \times \left(\frac{\partial c_\tau^L}{\partial a_t^L} + \frac{\partial c_\tau^S(\Delta, k; a_t^L, y_t)}{\partial a_t^L} \right) \end{aligned}$$

Note that from $t+k$ to T , all of the S terms are zero. When a^L changes, the marginal value is how utility changes with consumption, $u'(\cdot)$, multiplied by how consumption changes.

Consider the difference between the left- and right-hand side expressions in the inequality. The terms $\tau > t+k$ are equal and net to zero. In $\tau = t+k$, short-run consumption is zero for planning horizon k but positive for planning horizon $k+1$, and the terms in $\tau \in \{t, t+1, \dots, t+k+1\}$ differ since the short-term consumption function is different for the two planning horizons.

As in Lemma 1, the multiplicative term in brackets can be normalized into a weighted average composing of the marginal utility functions. From the constraint

for short-term consumption, we know that:

$$\sum_{\tau=t}^{t+k-1} \frac{1}{(1+r)^{t-\tau}} \frac{\partial c_{\tau}^S(\Delta, k; a_t^L, y_t)}{\partial a_t^L} = 0.$$

This states that when long-term wealth changes, the total change in short-run consumption does not change, since the income shock does not change. As such, for either planning horizon, the sum of the weights does not change, but is re-arranged across the different terms.

Consider the terms of the summation above which differ:

$$\begin{aligned} & \sum_{\tau=t}^{t+k} \beta^{\tau-t} u'(c_{\tau}^L + c_{\tau}^S(\Delta, k+1; a_t^L, y_t)) \times \left(\frac{\partial c_{\tau}^L}{\partial a_t^L} + \frac{\partial c_{\tau}^S(\Delta, k; a_t^L, y_t)}{\partial a_t^L} \right) \\ > \sum_{\tau=t}^{t+k-1} \beta^{\tau-t} u'(c_{\tau}^L + c_{\tau}^S(\Delta, k; a_t^L, y_t)) \times \left(\frac{\partial c_{\tau}^L}{\partial a_t^L} + \frac{\partial c_{\tau}^S(\Delta, k; a_t^L, y_t)}{\partial a_t^L} \right) + \beta^{t+k} u'(c_{t+k}^L + 0) \times \left(\frac{\partial c_{t+k}^L}{\partial a_t^L} + 0 \right) \end{aligned}$$

The terms $\tau > t+k$ do not appear because they are equal. In $\tau \in \{t, t+1, \dots, t+k-1\}$, the terms differ since the short-term consumption function is different for the two planning horizons. In the first line with the longer planning horizon, the summation is to $t+k$, whereas in the second line representing the shorter planning horizon, the summation is to $t+k-1$. I include the term for $t+k$ in the second line for the sake of comparison. In $\tau = t+k$, short-term consumption (and its derivative) are zero for the shorter planning horizon.

Recognizing that these two expressions can be expressed this way as an equal number of terms, then it immediately follows from convexity of the marginal utility function that the first expression is strictly greater than the second.¹

□

¹Convexity of the marginal utility function follows from the presence of incomplete markets and occasionally binding borrowing constraints in the stochastic case and is directly assumed (i.e., prudence) in the deterministic case.

A.1.1 Proof of Proposition 1

Consider three planning horizons of decreasing length, $k_2 > k_1 > k_0$. Let $k_1 \equiv k^*(\Delta)$ denote the optimal planning horizon for the smaller income shock, Δ . To establish the weakly longer planning horizon for the larger shock, I prove that it is at least as long as for the smaller shock, then that it may be larger.

First, I prove that for Δ' , the planning horizon k_1 dominates any $k_0 < k_1$. Given the optimality of k_1 for Δ , we have that

$$V_t(\Delta, k_1; a_t^L, y_t) - \phi_{k_1} > V_t(\Delta, k_0; a_t^L, y_t) - \phi_{k_0},$$

and, re-arranging, that

$$V_t(\Delta, k_1; a_t^L, y_t) - V_t(\Delta, k_0; a_t^L, y_t) > \phi_{k_1} - \phi_{k_0}.$$

This expression states that the marginal value from increasing the planning horizon is more than offset by the marginal increase in planning costs.

Since $k_2 > k_1$, by Lemma 1,

$$V_t(\Delta', k_1; a_t^L, y_t) - V_t(\Delta', k_0; a_t^L, y_t) > V_t(\Delta, k_1; a_t^L, y_t) - V_t(\Delta, k_0; a_t^L, y_t).$$

The marginal value from increasing planning horizons is larger for Δ' than it is for Δ . Combining with the above and re-arranging,

$$V_t(\Delta', k_1; a_t^L, y_t) - V_t(\Delta', k_0; a_t^L, y_t) > \phi_{k_1} - \phi_{k_0}$$

$$V_t(\Delta', k_1; a_t^L, y_t) - \phi_{k_1} > V_t(\Delta', k_0; a_t^L, y_t) - \phi_{k_0},$$

establishing that for Δ' , k_1 is preferred over k_0 . Intuitively, if increasing planning

horizons from k_0 to k_1 is preferred for the smaller shock, then this is also preferred for the larger shock given that the slope of the value function with respect to planning horizons is increasing in the income shock.

Second, I prove that for Δ' , the planning horizon $k_2 > k_1$ may be optimal. This is the case when

$$V_t(\Delta', k_2; a_t^L, y_t) - \phi_{k_2} > V_t(\Delta', k_1; a_t^L, y_t) - \phi_{k_1},$$

which holds if the marginal value from increasing the planning horizon is larger than the marginal cost,

$$V_t(\Delta', k_2; a_t^L, y_t) - V_t(\Delta', k_1; a_t^L, y_t) > \phi_{k_2} - \phi_{k_1}.$$

This expression may obtain given the structure of the value function or planning costs.

A.1.2 Proof of Proposition 2

This proof proceeds similarly to the proof for Proposition 1. Given income y , consider two levels of wealth at time t such that $a_t^{L'} > a_t^L$ and three planning horizons of decreasing length, $k_2 > k_1 > k_0$. Let $k_1 \equiv k_t^*(a_t^L)$ denote the optimal planning horizon for the smaller level of initial wealth, a_t^L . To establish the weakly longer planning horizon for the larger level of initial wealth, I prove that it is at least as long as for the smaller shock, then that it may be larger.

First, I prove that for $a_t^{L'}$, the planning horizon k_1 dominates any $k_0 < k_1$. Given the optimality of k_1 for a_t^L , we have that

$$V_t(\Delta, k_1; a_t^L, y_t) - \phi_{k_1} > V_t(\Delta, k_0; a_t^L, y_t) - \phi_{k_0},$$

and, re-arranging, that

$$V_t(\Delta, k_1; a_L^t, y_t) - V_t(\Delta, k_0; a_L^t, y_t) > \phi_{k_1} - \phi_{k_0}.$$

As above, this expression states the the marginal value of increasing the planning horizon is more than offset by the marginal increase in planning costs. Since $k_2 > k_1$, by Lemma 2,

$$V_t(\Delta, k_1; a_t^{L'}, y) - V_t(\Delta, k_0; a_t^{L'}, y) > V_t(\Delta, k_1; a^L, y) - V_t(\Delta, k_0; a^L, y).$$

The marginal value from increasing planning horizons is larger for $a_t^{L'}$ than it is for a^L . Combining with the above and re-arranging,

$$V_t(\Delta, k_1; a_t^{L'}, y) - V_t(\Delta, k_0; a_t^{L'}, y) > \phi_{k_1} - \phi_{k_0}$$

$$V_t(\Delta, k_1; a_t^{L'}, y) - \phi_{k_1} > V_t(\Delta, k_0; a_t^{L'}, y) - \phi_{k_0}$$

establishing that for $a_t^{L'}$, k_1 is preferred over k_0 . Intuitively, if increasing planning horizons from k_0 to k_1 is preferred for the lower level of wealth, then this is also preferred for the larger level of wealth given that the slope of the value function with respect to planning horizons is increasing in wealth.

Second, I prove that for $a_t^{L'}$, the planning horizon $k_2 > k_1$ may be optimal. This is the case when

$$V_t(\Delta, k_2; a_L^t, y_t) - \phi_{k_2} > V_t(\Delta, k_1; a_L^t, y_t) - \phi_{k_1},$$

which holds if the marginal value from increasing the planning horizon is larger than

the marginal cost,

$$V_t(\Delta, k_2; a_L^t, y_t) - V_t(\Delta, k_1; a_L^t, y_t) > \phi_{k_2} - \phi_{k_1}.$$

This expression may obtain given the structure of the value function or planning costs.

A.2 ESPs to Wealthy Hand-to-Mouth Households

Kaplan and Violante (2014) introduce a new class of constrained households that they call the wealthy hand-to-mouth. They define households as hand-to-mouth using liquid wealth, and define them as poor or wealth using illiquid wealth. Traditionally, empirical analysis in this literature focuses only on total net worth and thus only the poor hand-to-mouth. Instead, Kaplan and Violante show that a large fraction of households that have low liquid wealth but high net worth behave similarly to households with low liquid wealth and low net worth. These households are defined as the wealthy hand-to-mouth.

A key insight to their analysis is that the ratio of liquid wealth to income is the relevant statistic, as opposed to the level of liquid wealth:

$$\text{LWI} = \frac{\text{liquid wealth}}{\text{periodic income}}.$$

For example, a household that earns \$1000 per month and carries \$5000 in liquid wealth has $\text{LWI} = 5$, whereas a household that earns \$10,000 per month and carries \$5000 in liquid wealth has $\text{LWI} = 0.5$.

Kaplan and Violante deem households hand-to-mouth if their LWI ratios fall within one of two intervals. First, if their liquid wealth to income ratio is between

0 and 1, the household is hand-to-mouth because they keep less than one month of income on hand. Second, allowing for a credit limit up to one month of income, households whose liquid wealth to income is less than -1 are also hand-to-mouth.

Table A.1: CEX Regressions with H2M Indicator

	Estimate	Implied MPC
ESP (Base: Tercile 1)		0.186 (0.163)
ESP \times Hand-to-Mouth	0.045 (0.152)	0.231 (0.143)
Observations		3,446
R^2		0.024

In the CEX, I calculate LWI and remove extreme outliers ($LWI > 10$). I then calculate hand-to-mouth status using the two criteria above. To estimate the differential MPC for hand-to-mouth consumers, I estimate the baseline regression and interact the hand-to-mouth indicator with ESP payment. The estimated coefficients are in Table A.1. Although none of the estimated coefficients are statistically significant, the patterns are consistent with existing evidence. The MPC for hand-to-mouth households is 0.231, which is 0.045 percentage points or almost 25% larger than the MPC for non-hand-to-mouth households, 0.186. Again, however, the MPC for non-hand-to-mouth households is much larger than the prediction of near-zero MPCs in standard models.

As a robustness check, I also separate households into terciles based on liquid wealth to income. In Kaplan et al. (2014b), the authors check robustness by changing the criteria used to define LWI (i.e. pay periods, credit limits, etc.), which essentially changes the intervals that define hand-to-mouth status. Dividing households by LWI serves the same purpose. I estimate the baseline regression and interact LWI tercile with ESP payment and the estimated coefficients are in Table A.2. Again consistent

Table A.2: CEX Regressions with LWI Terciles

	Estimate	Implied MPC
ESP (Base: Tercile 1)		0.334* (0.173)
ESP \times Tercile 2	-0.263 (0.178)	0.071 (0.154)
ESP \times Tercile 3	-0.082 (0.191)	0.252 (0.180)
Observations		3,446
R^2		0.024

with existing evidence, I find that households in the lowest tercile are those with the highest MPC. However, the estimated relationship between LWI tercile and MPC is U-shaped, similar to previous findings using this data for the relationship between MPC and wealth. Households in the middle tercile have an MPC of only 0.071, while households in the high tercile have an MPC of 0.252. Overall, it is hard to infer too much from this U-shaped pattern, but it remains the case that the MPC for unconstrained households is too high relative to what standard models would predict.

A.3 Theoretical Construction of the Marginal Propensity to Consume

In standard consumption-savings problems, the marginal propensity to consume out of a temporary income shock is a partial derivative of the consumption function. If the temporary income shock is represented as a distinct state, then the derivative is taken with respect to that state. For example, consider a standard one-asset model in which a household forms state-contingent plans over wealth, a , autoregressive permanent income, ν , and perfectly transient temporary income shocks, ϵ . The marginal

propensity to consume out of temporary income shocks is given by

$$\text{MPC}(a, \nu, \epsilon) = \frac{\partial c(a, \nu, \epsilon)}{\partial \epsilon}.$$

In practice, the statespace in standard models can be reduced by one dimension since the temporary income shock is equivalent to wealth. To see this, note that when the household's problem is written recursively, the consumption policy function is given by

$$c(a, \nu, \epsilon) = \arg \max_c u(c) + \beta E[V(a', \nu', \epsilon') | \nu],$$

with $a' = (1 + r)(\nu + \epsilon + a - c(a, \nu, \epsilon))$. Via the budget constraint, a change in ϵ is equivalent to a change in a . Economically, the perfectly transient income shock is equivalent to the household beginning the period with a different level of wealth. Importantly, a change in the temporary income shock, ϵ , is not equivalent to a change in permanent income, ν , because the latter is autoregressive and enters the conditional expectation.

When the statespace is reduced to wealth and permanent income, the marginal propensity to consume out of a temporary income shock, ϵ , can be written as

$$\lim_{\epsilon \rightarrow 0} \frac{c(a + \epsilon, \nu) - c(a, \nu)}{\epsilon},$$

which is the partial derivative of the consumption function with respect to wealth.

A.4 Discounting of Future Periods

The finite planning horizon model developed in this paper is isomorphic to the standard recursive consumption-saving model with a specific discount rate structure. In

this section, I consider a household that lives for T periods and faces an income shock at time $t = 1$, and I compare the discount rate structure of exponential or quasi-hyperbolic discounting with the finite planning horizon model.

Suppose that, for the same reasons as in the finite planning horizon model, the household in the standard model must reoptimize consumption and savings plans to account for the unexpected change in income at time $t = 1$. The first two rows of Table A.3 show how future periods are discounted with exponential and quasi-hyperbolic discounting.

Table A.3: Discounting Factors in Consumption-Saving Models

	Periods After $t = 1$								
	1	2	...	$k - 1$	k	$k + 1$	...	$T - 1$	T
Standard Discounting	β	β^2	...	β^{k-1}	β^k	β^{k+1}	...	β^{T-1}	β^T
Quasi-Hyperbolic Discounting	β	$\delta\beta^2$	...	$\delta\beta^{k-1}$	$\delta\beta^k$	$\delta\beta^{k+1}$	...	$\delta\beta^{T-1}$	$\delta\beta^T$
Finite k -period Plan	β	β^2	...	β^{k-1}	β^k	0	...	0	0

In the standard model, discount rates are a geometric series with base β . With quasi-hyperbolic discounting, the household discounts between time $t + 1$ and $t + 2$ using $\delta\beta$, but then discounts any two further future periods, i.e., $t + 3$ and $t + 4$,² using only β . This generates present bias since the household discounts the immediate future more than the distant future.

The third row of Table A.3 shows discount rates in the finite horizon model. Faced with an income shock at time $t = 1$, the household determines an optimal k -period planning horizon over which to reoptimize. Within the planning horizon, the household uses standard exponential discounting. Beyond the planning horizon, the household behaves as-if the income shock had never occurred and uses its existing

²More generally, $t + s$ and $t + s + 1$ for any $s \geq 2$. I also deviate from the standard notation in quasi-hyperbolic discounting in order to maintain comparability with the notation in standard discounting. Specifically, I use β for the exponential/geometric discounting and δ for the additional first-period discounting, as opposed to the opposite notation usually employed in this literature (see, for example, Laibson (1997)).

long-term consumption and savings plans. As a result, from the perspective of its reoptimization, it is as-if the household completely disregards all periods beyond k , i.e., discounts them with rate zero.

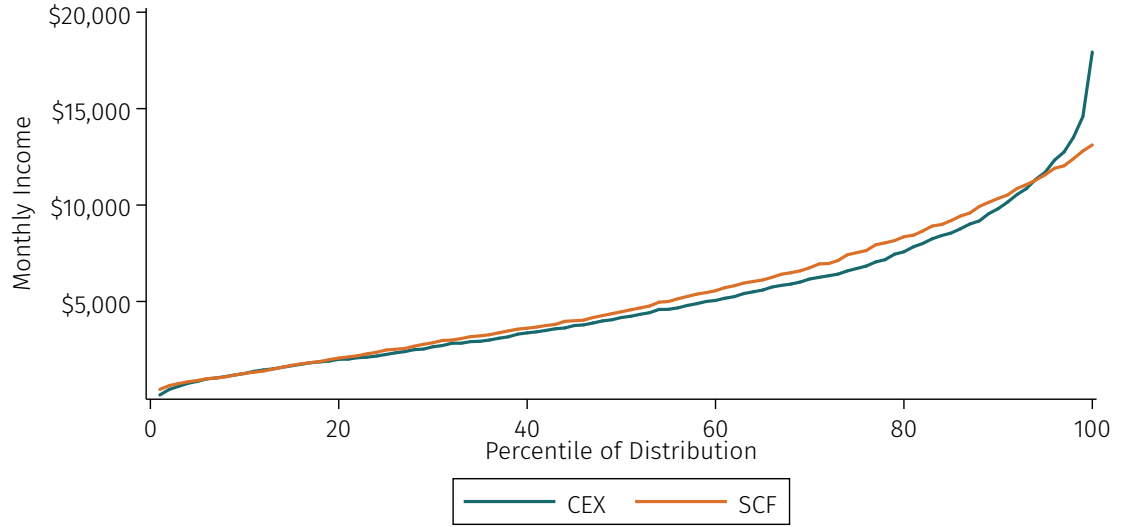
A.5 Constructing Liquid Wealth in the CEX

In the 2008 wave of the Survey of Consumer Expenditures (CEX), approximately half of households did not respond to the optional question on liquid assets, and there is no corresponding question on liquid debt. As such, in this section, I describe the method by which I merge the CEX and Survey of Consumer Finances (SCF), which contains detailed data on both liquid assets and debt.

The SCF collects responses from two groups: a random sample of US households and an additional selected sample of high-wealth households (who, generally, have higher income). In order to make the distributions of household income in the SCF and CEX comparable, I drop the top 6% of observations (see, for example, Heathcote, Perri and Violante (2010) for a broader discussion on comparing household income and wealth across surveys). In Figure A.1, I plot monthly income by percentile in each survey. I evaluated dropping between the top 1 and 10% of households in the SCF and found that 6% minimized the mean squared error between each line in the figure. Notably, household income in each percentile is remarkably similar until around the 95th percentile.

Figure A.2 verifies that liquid assets in each distribution are similar. The solid lines represent the median value of liquid assets in each survey. Unsurprisingly, liquid assets in the CEX display much more variability. In both surveys, liquid assets are increasing in income; this is made clearer by the dashed lines, which are estimated logarithmic regressions of the income percentile on median liquid assets. The lines are almost perfectly overlaid, demonstrating the similarity between liquid assets in

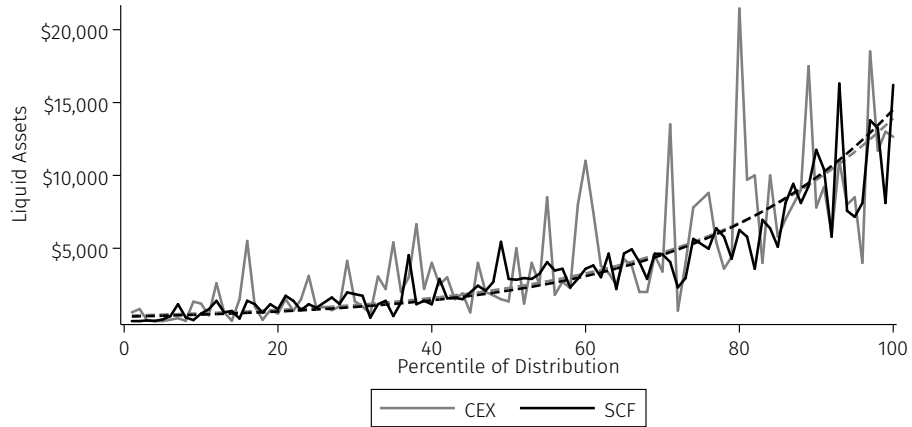
Figure A.1: Monthly Income by Percentile in CEX and SCF



Notes: Top 6% of income distribution in SCF truncated in order to approximate income distribution in CEX. See text for details.

the raw CEX and truncated SCF distributions.

Figure A.2: Liquid Assets by Percentile in CEX and SCF

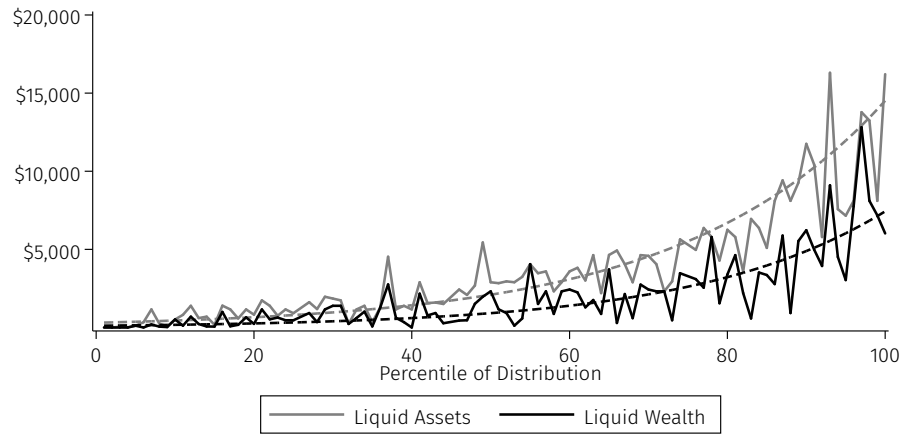


Notes: Top 6% of income distribution in SCF truncated in order to approximate income distribution in CEX. See text for details.

Finally, Figure A.3 plots median liquid assets and liquid wealth by income percentile in the SCF. The difference between the two is liquid debt, which has been documented to be increasing in household income (see, for example, Boutros (2020) and Bornstein and Indarte (2020)). For all households, there is a notable difference between liquid assets and wealth. Altogether, these values of liquid wealth from the

SCF are matched to households in the CEX by percentile of monthly income.

Figure A.3: Liquid Assets and Liquid Wealth by Percentile in SCF



Notes: Top 6% of income distribution in SCF truncated in order to approximate income distribution in CEX. See text for details.

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