The Credit Card Debt Puzzle: New Facts and Theory

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Abstract

Simultaneously holding liquid assets and credit card debt is known as the credit card debt, or co-holding, puzzle. Around 45% of households in the US Panel Study of Income Dynamics (2010-2014) fall into this category. I revisit the puzzle from the perspective of the degree of co-holding and show around 40% of co-holders hold between 2 and 200 times more liquid assets than credit card debt. This new fact has implications for co-holding explanations based on liquidity. I propose an alternative explanation in which consumers value wealth and thus dislike making payments. This explanation has applications to a range of consumer choices, such as Buy Now Pay Later and the credit card premium.

JEL Classifications: D11, D12, D14, G51

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1 Introduction

Simultaneously holding liquid assets and credit card debt is known as the credit card debt, or co-holding, puzzle. Around 45% of households in the Panel Study of Income Dynamics (PSID) (2010-2014) are co-holders.[1] The related literature focuses on various explanations that directly, or indirectly, rely on binding liquidity constraints. I document new facts that suggest liquidity need is not a complete explanation. I find around 40% of co-holders have liquid assets 2 to 200 times greater than their credit card debt (liquid group), meaning, they are very liquid.

This paper first identifies highly liquid co-holders. I use data from the Panel Study of Income Dynamics (PSID). Instead of studying co-holders as one group and comparing this group with non-co-holding groups, as in the literature, I relax the one group assumption. I organise co-holders into two subgroups, according to their liquidity and relative to their credit card debt. Studying the sub groups shows differences between them that suggest the two groups may be co-holding for different reasons. I estimate a regression to pin down the relationship between credit card debt and liquid assets and find liquid assets are substitutes for credit card debt when the household is very liquid, and complements otherwise. Descriptive statistics show the liquid group, are, on average, wealthier, have larger holdings of stocks and bonds, reach a higher educational level, and have somewhat lower mortgages and higher house values than the less liquid group.

Based on these new facts, I develop an alternative model that generates pain of payment and in turn, credit card debt without liquidity need. The explanation assumes consumers have preferences for money (used interchangeably with wealth) and thus dislike making payments. The pain of payment introduces a friction between spending and paying that does not involve liquidity constraints and makes deferring payment attractive. Thus the model describes how the possibility of separating consumption and payment in time affects utility and demand.

The assumption of preferences for wealth, which is at the centre of the model, is not new in economic theory. Early economists, such as David Hume, Adam Smith, John Maynard Keynes and Irving Fisher believed that people valued wealth as an end in itself. Recent literature also assumes wealth has a value in its own right, for example, secular stagnation Michau (2018); Ono (2015), rational bubbles (Michau, Ono, and Schlegl, 2018), and the savings of the rich, (Carroll, 1998).[2] Pain of payment has long

[1] This is consistent with other data sets in the US and Europe.

[2] A model with preferences for wealth is distinct from money-in-utility models, where the purpose of money is to motivate holding cash over another asset with a higher expected return.

been discussed in behavioural research (e.g., Massenot (2021), Loewenstein and Prelec (1998), and Quispe-Torreblanca, Stewart, Gathergood, and Loewenstein (2019). Pain of payment naturally follows from utility from wealth. If wealth is valued as a good, a reduction in wealth (payment) leads to a fall in utility. These ideas are in contrast to standard theory where the value of wealth is for future consumption.

If the consumer faces a delay in payment with no penalty, through, for example, convenience use of a credit card or invoiced expenditure, then, depending on model parameters, the consumer may have higher utility from deferring. This can also lead to higher consumption demand. This outcome is consistent with empirical and experimental evidence from the credit card premium puzzle, (Prelec and Simester, 2001), and emerging evidence from choices with BNPL (DiMaggio, Williams, and Katz, 2022).

In the case where the consumer faces a penalty from deferring payment, preferences for money, result in an optimal choice being to defer, even if there is sufficient liquidity. The amount she chooses to defer is increasing in the rate of time preference and decreasing in the size of the penalty.

The model also addresses the accumulation of household debt. When a consumer has preferences for money, and defers payment *and* consumes more than if she had paid contemporaneously, then she faces an even higher pain of payment in the next period, leading to potentially to more deferral even in the presence of a penalty and liquidity. Because of effects, the consumer may accumulate unnecessary debt (in the sense that they have sufficient liquidity) by putting off paying the card card bill, settling the invoice, making the instalment payment and so on. Accumulating costly debt unnecessarily has welfare implications and thus is relevant for policy.

A growing category of consumer choices, in addition to the credit card debt puzzle, are explained by liquidity constraints, but are observed where liquidity constraints appear not to bind. Examples are the credit card premium, the Buy Now Pay Later (BNPL) premium,[3] and paying late charges on bills (Prelec and Simester (2001), DiMaggio, Williams, and Katz (2022), and Ausubel (1991)). A common feature here is the separation of payment and consumption in time. A challenge in studying payment and consumption separated in time is that no mechanism in the standard life cycle model leads to deferring payment when budget constraints are not binding.

This paper is proposes a general rational choice model for liquid co-holding and other liquidity puzzles. Consumers today increasingly face unsolicited offers to spread pay-

[3]The BNPL premium refers to the emerging evidence that consumers spend more when paying with BNPL compared to other payment methods, even if they appear not to be liquidity constrained.

ments for a purchase, whether they have a liquidity need or not. Why so many accept the offer without an apparent binding constraint (DiMaggio, Williams, and Katz, 2022) is not well understood. Understanding the mechanisms for this, and other, choices may contribute to addressing the welfare trade-offs of consumer credit; welfare improving when it allows smoothing of consumption when constraints bind, versus welfare reducing when overspending leads to unnecessary consumer debt.

The paper is set out as follows: Subsection 1.1 review the literature. Section 2 explains the identification of two sub groups of co-holders and shows how they differ from each other with respect to credit card debt. Section 3 develops a consumer choice model with wealth preferences and shows its implications for optimal choice predictions in several consumer choice settings. Section 4 concludes.

1.1 Related Literature

1.1.1 The credit card debt puzzle

Co-holding was first formally noted by Gross and Souleles (2002); 'over a third of borrowers simultaneously hold more than one months income in liquid assets.' Since then, a number of explanations have been proposed for this violation of the no-arbitrage condition.

Telyukova (2013) suggests much of the puzzle is explained by a precautionary need for cash consumption; because not all goods can be paid for with credit cards, households hold cash for these items and for any unanticipated cash needs. One implication of this theory is that precautionary-liquidity need falls as the proportion of goods that can be paid for with credit cards increases, as it has over the last 30 years. Using data from the Survey of Consumer Finances, 1998 - 2010, Gorbachev and Luengo-Prado (2019), however, find the proportion of co-holders to be stable over time.

Druedahl and Jørgensen (2018) develop a broader precautionary-savings theory, and test it with a structural model. The paper uses credit card debt and liquid-assets data from from the SCF 1998 - 2013 to estimate co-holding and other borrowing behaviour. It assumes households with positive liquid assets can increase their line of credit and accumulate new debt. Increasing the line of credit is driven by household needs to spend or accumulate precautionary savings in the face of dynamic constraints. It does not address co-holding if the household is already holding high levels of liquidity.

Angrisani, Burke, Lusardi, and Mottola (2020) find financial literacy is positively correlated with the ability to absorb shocks and to plan for retirement but finds little correlation with *negative* financial behaviour such as carrying credit card debt. These negative behaviours may be more related to resource constraints or behavioural traits than a lack of understanding. A consumer can thus be financially literate and also engage in negative financial behaviour.

Gathergood and Weber (2014) find co-holders score well on financial literacy tests but also have a high rate of reporting impulsive behaviour and this observation provides some support for the accountant-shopper theory. The accountant-shopper theory describes an intra-household or intra-self dynamic in which a patient *accountant* and a less patient *shopper*. Co-holding arises as the accountant controls consumption, chosen by the shopper. The shopper spends only via a credit card. The accountant controls the spending level of the shopper by not fully paying down the credit card bill. The effectiveness of this strategy is consistent with the finding of Gross and Souleles (2002) that paying the credit card bill leads the shopper to again accumulate debt up to some constant utilisation rate (proportion of line of credit taken as debt). The accountant's saving targets are motivated by income uncertainty and a bequest motive and the asset for satisfying the saving targets is the liquid asset. The theory explains high levels of co-holding, but how the availability of an alternative asset, with higher returns than the liquid asset would affect the level of co-holding is not clear.

Personality types are suggested as an explanation for co-holding. Choi and Laschever (2018) finds personality traits are significant in predicting the likelihood of being a co-holder. The traits work through the two channels of precautionary-liquidity motives and intra-household/intra-self dynamics.

1.1.2 Pain of payment

The alternative explanation for co-holding set out in section 3 abstracts from liquidity need by assuming consumers dislike making a payment. Loewenstein and Prelec (1998) suggest a model that includes a pain of payment as well as pleasure of consumption. The model finds the type of good being purchased influences the optimal payment approach - for example, instalments, pre pay, and pay with debt.

Quispe-Torreblanca, Stewart, Gathergood, and Loewenstein (2019) estimate a model over high frequency credit card data and test whether pain of payment is sensitive to type of purchase. The authors find debt related to durable good purchases is more likely to be paid off than debt associated with non- or semi-durables. The result supports one of the predictions of Loewenstein and Prelec (1998)'s model. The interpretation is that goods that deliver ongoing utility over time have lower associated disutility of payment thus payment is less likely to be deferred.

In a life cycle model, Massenot (2021) replaces opportunity costs (higher consumption today and forgone future consumption) with pain-of-payment costs. The main prediction is that liquid agents consume out of transitory shocks; consistent with empirical evidence but inconsistent with predictions of standard models. **Massenot** points out the role of pain of payment in the case of the credit card premium but does not provide an explicit solution.

1.1.3 Other liquidity puzzles

Two related topics to liquid co-holding are BNPL and the credit card premium.

DiMaggio, Williams, and Katz (2022) finds consumers spend more after adopting BNPL. The increase in spending is persistent and is observed where liquidity constraint appear to bind and, importantly, where they apparently do not.

The credit card premium refers to evidence that consumers spend more when paying for goods with a credit card than with cash. Prelec and Simester (2001) study the credit card premium by measuring willingness to pay in an experimental setting. Participants bid in a second-price auction for sporting event tickets and merchandise. Participants are randomly assigned payment methods of credit card or cash. The median participant is willing to pay a 64 % premium by credit card versus cash. The authors conclude that neither liquidity constraints nor precautionary-liquidity needs can account for the observed outcomes.

2 An Empirical Analysis of the Credit Card Debt Puzzle from the Perspective of Liquidity

I find around 40% of co-holders in the PSID, 2010 - 2014, are highly liquid, which makes their credit card debt inconsistent with liquidity based explanations for co-holding.

In this paper, I first identify co-holders with high liquidity. I use a ratio of credit card debt to liquid assets at the household, time period, level. This approach to characterising co-holding is new and is different from the approach typically used in the literature. Here credit card debt and liquid assets are matched at the variable, not household, level. In my configuration, a ratio greater than 2, means the household has more than twice the level of liquid assets relative to credit card debt. I use the ratio value to group co-holders, the assuming that for a household with a ratio value greater than 2, liquidity does not the explain their borrowing.

2.1 Data

I use data from the US longitudinal biennial household survey, the PSID which follows around 5,000 households (about 18,000 individuals) over time. The 2010 survey added a question on interest-bearing credit card debt. The full question is in appendix A.

In total, 51% of households in the PSID report holding interest bearing credit card debt in at least one period, consistent with other US surveys. For example, $60\% - 62\%$, in the Survey for Consumer Finances, 51%, Census Bureau.

Challenges in studying the credit card debt puzzle that are specific to the PSID structure, such as the two-year gap between surveys and the absence of information on households that have been refused a credit card, are discussed in appendix B.1.

2.2 Definitions of co holding and persistence of co holding

To get some idea of how persistent holding credit card debt is in the PSID, I calculate the number of waves each household reports it (see table 1) and compare this to the findings in other surveys (Later, I look at co-holders in this way too, see table 4). I find the PSID estimates to be conservative in comparison to other surveys used in the literature. In the PSID over 30% of borrowing households, or 15% of all households, report carrying a balance in two or more waves.[4]

The definition of liquid assets takes several forms in the literature. The sum of balances of household checking, savings and money market accounts is widely used. For example, Telyukova (2013), Zinman (2015), Choi and Laschever (2018). Gathergood and Weber (2014) exclude balances from checking accounts but include money market balances. Liquid assets are defined as the sum of the balance of household's checking and savings account. Money market amounts are excluded because in the PSID, money market amounts are combined with savings (separate to savings account balances) and investments. The omission of money market accounts is not a major concern - it leads to a more conservative measure of liquid assets, and this understates the extent of the co holding problem.

[4]The triennial Survey of Consumer Finance reports 36% of households carrying a balance on their credit card, month to month between 2010 - 2013. The Census Bureau's report on the Economic Well-Being of U.S. Households in 2016 finds 28% report mostly carrying a balance over the last year, 20% sometimes and 6% occasionally.

The definition of co-holding also takes several forms in the literature. For example, Telyukova (2013) and Zinman (2015) set a lower bound for co-holding as having debt and liquid assets each greater than $500. For Choi and Laschever (2018), credit card debt must be greater than zero. Gathergood and Weber (2014) use a more demanding criteria; the equivalent of one month's income is subtracted from liquid assets and remaining liquid assets must also be greater than credit card debt. Given the absence of a consensus. I do not take a stand on threasholds but instead define co-holders households with positive credit card debt and positive liquid assets. This may over state co-holding and certainly will include some households with close to trivial levels of credit card debt but the conclusions are robust to stricter definitions.[5] I also define *Savers* as households with zero credit card debt and positive liquid assets and *Borrowers* as households with positive credit card debt and zero liquid assets. These groups follow much of the literature also.

Table 1: The table shows the debt frequency over the three waves of the PSID used in the analysis.

No. Yrs with credit card debt	No of Households in all Time Periods	Percent of Total Sample
0	6190	49
1	2590	20
2	1875	15
3	1920	15

2.3 Ranking of co-holders

I calculate a measure of the degree of co-holding, by household and time period. I divide the liquid assets of household i in time t by the credit card debt of household i in time t. Denote the ratio as $Y_{i,t}|ch = 1$, which I hereafter refer to as $Y_{i,t}$, dropping the conditional notation for simplicity. I then calculate the percentile values of Y's distribution and denote them by Y_p, $p \in [1, 10]$:

$$Y_p = \left[\left[\frac{liquid\ assets}{credit\ card\ debt} \right]_{i,t} \right]_{\mathbf{p}} = percentile\ of\ ratio. \tag{1}$$

Plotting Y_p against the percentiles shows the extent of co-holding across all co-holders.

[5]I loose around one third of the puzzle group if I follow Telyukova (2013), but results hold.

An alternative approach, common in the literature, is to calculate the percentiles of liquid assets and percentiles of credit card debt and to compare the percentile values with each other. For example, the 30th percentile value of liquid assets is $1,000$ and the 30th percentile of credit card debt is 950. Thus the ratio is 1.05, which is equivalent to calculating the ratio as

$$\phi_p = \left[\frac{liquid\ assets_{\mathbf{p}}}{credit\ card\ debt_{\mathbf{p}}}\right] = ratio\ \ of\ \ percentiles, \tag{2}$$

where I again drop the conditional notation of being a co-holder for simplicity. Again, p denotes the percentile $1, ..., 10$.

The p values of ϕ_p provide target moments for structural models to match as well as discussions about the characteristics of co-holders with respect to wealth, income, education, and other characteristics possibly related to co-holding.

The first column of Table 2 shows these ratio values, ϕ_p for percentiles 10 - 90 in the PSID sample. The values range from 0.75 to 2. This finding is consistent with the literature (e.g., Telyukova (2013), Druedahl and Jørgensen (2018)) An interpretation of ϕ_p is that even co-holders in the 90th percentile of liquid assets and the 90th percentile of credit card debt, have less than twice as much liquidity as debt. For the 10th percentile, even if the household did choose to use all its liquid assets to pay its credit card debt, it could not fully do so and it if it did, it would be left with no cash. These values of ϕ_p are robust to other definitions of co-holding. From this perspective, some of the theories presented in the literature are plausible: precautionary liquidity, precautionary savings,and risk aversion. These theories match the moments in column 1, Table 2.

Table 2 compares the percentiles from equations (2) and (1). The comparison highlights that in terms of the extent of the credit card debt puzzle, ϕ_p overstates co-holding at the bottom of the ratio distribution and understates it at the top.

percentiles (p)	ϕ_p	Υ_p
10	0.75	0.08
20	0.98	0.20
30	1.00	0.38
40	1.02	0.67
50	1.06	1.11
60	1.05	1.94
70	1.22	3.33
80	1.45	6.25
90	1.99	16.92

Table 2: A comparison between ϕ and Υ over percentiles

The household-level matching approach is a different way to quantify the extent of the co-holding puzzle. It shows that just under 50% of households have little cash coverage, reinforcing the precautionary-liquidity explanation. But it also reveals households with high levels of cash coverage. Υ_p provides a scale by which the level of co-holding, can be ranked. The distribution of this ratio has a strong right skew and a range of $0.0002 - 2,000!$[6]; that is, at its highest value, the household has liquid assets 2,000 times greater than credit card debt.

The first approach, Υ, reveals a more extreme level of co-holding that is harder to explain with liquidity need. Note also that ϕ_p assumes liquid assets and credit card debt are determined jointly, not independently. It assumes the household with median credit card debt also has median liquid assets.[7] Or

$$Ratio\ of\ percentiles\ p \equiv \phi_p = Percentiles\ p\ of\ ratio. \tag{3}$$

Household i with debt that corresponds to the median value, may have liquid assets in *any* percentile. Taking the approach of equation (2) separates a household with \$500 in liquid assets and \$10,000 in credit card debt from a household with \$500 in liquid assets and \$500 in credit card debt, although from an empirical and theoretical perspective, they are different economic problems.

[6] I drop the 9 observations where the ratio is greater than 2,000 but I keep the lower outliers.

[7] The literature typically focuses on the median values of liquid assets and credit card debt. Telyukova (2013) uses the Survey of Consumer Finances (SCF), 2001 to calibrate the model. Around half of co-holding households have roughly the same amount of credit card debt as liquid assets. Choi and Laschever (2018) finds the median household is holding only a little more liquid asset than credit card debt.

Figure 1 plots ϕ and Υ by percentile.

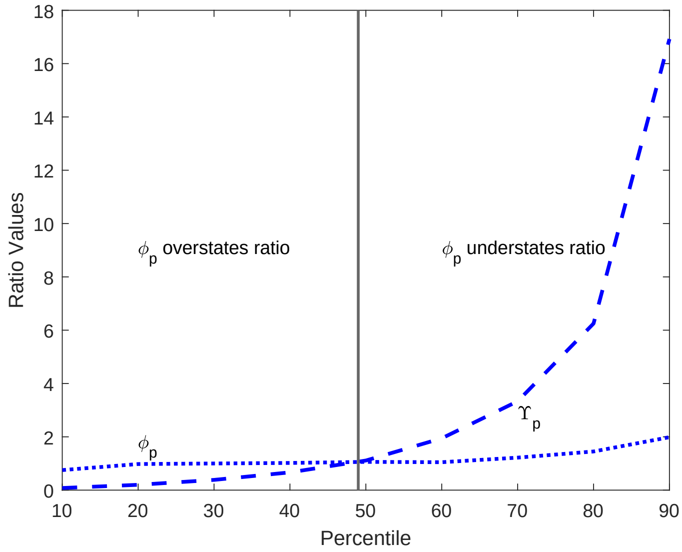

Figure 1: ϕ, dotted line. Υ dashed line by percentile.

Figure 1 plots the values from table 2. Structural models for co-holding aim, and do, match ϕ, but not Υ.

Table 3 gives mean values of liquid assets, credit card debt, and total taxable household income by percentile for the distribution of Υ. For example, the row labelled $\Upsilon_{10} < 1$ gives mean variable values for the households in the bottom percentile of Υ values. In this percentile, Υ takes values less than 1, as shown. In other words, these households have more credit card debt than liquid assets. The exact Υ value for the percentile boundaries are given in Table 2.

Druedahl and Jørgensen (2018) compute a measure equivalent to ϕ with data from SCF and then target its moments with a model. They also compute a liquid-net-worth measure: household-level liquid assets minus credit card debt, scaled by income. This is similar to Υ. Druedahl and Jørgensen (2018) match the range of ϕ_p well, but Υ_p is unmatched away from the median. This finding illustrates, again, how the typical characterisation of the distributions of both liquid assets and credit card debt of co-holding households, may lead to explanations that both overlook and do not explain a non-trivial proportion of co-holders, namely, those with liquid assets many times in excess of credit card debt.[8]

[8]Looking at this scenario another way, subtract the percentile values of liquid assets from the corresponding percentile value of credit card debt, creates a Υ_p distribution. The ϕ_p case gives net wealth values in the range $(-0.06, 0.31)$ and it is not ordered. At the lowest percentile the value is zero and at the median, it is -0.06. In the Υ_p case, the range is $(-1.31, 1.55)$. The success of the structural model matches ϕ_p, but for Υ_p, it does not; the simulated range is $(-.69, 0.49)$. The lowest and highest values

Note also that the accountant-shopper model (Bertaut, Haliassos, and Reiter, 2009) generates co-holding up to the point that the accountant is sufficiently wealthy. From here she will no longer impose a limit on the shopper's spending. Once the accountant has sufficiently high liquid assets, the constraint on the shopper is relaxed, and eventually, reversed. Thus for wealthy households, credit card debt is not generated.

Telyukova (2013) accounts for between 44% and 56% of co-holding households in the SCF 2001. She uses a version of ϕ for model targets. The proportion explained by Telyukova reinforce both the precautionary-liquidity theory and the proposition set out here, namely that liquidity based arguments are less plausible, for around 40% of co-holders.

Centiles of Y	Liquid Assets	Credit Card Debt	Income
$Y_{10} < 1$	540.3	14629.85	49078
$Y_{20} < 1$	1666.8	13147.35	62780
$Y_{30} < 1$	3222.5	11627.02	76453
$Y_{40} < 1$	4323.9	8553.71	74824
$Y_{50} \approx 1$	5748.2	6569.30	80122
$Y_{60} \approx 2$	8904.4	6220.59	81500
$Y_{70} > 2$	12064.8	4839.81	83034
$Y_{80} > 3$	16721.9	3756.45	92005
$Y_{90} > 6$	28253.4	2686.21	83697
$Y_{100} > 15$	87314.2	1460.32	92926

Table 3: Mean values for liquid assets, credit card debt, and total taxable income by values of Y_p, which is $\left[[liquid\ assets \div credit\ card\ debt]_{i,t}\right]_p$. Unscaled, nominal values in USD.

I define co-holders with a value of $Y_{it} \leq 2$ as the cash-poor group. Cash-poor co-holders account for 62% of the total. I define the remaining 38% as cash-rich. Table 4 shows the persistence of co-holding for all co-holders together and by cash-rich and cash-poor groups. Overall, 42% co-hold in all three waves, with a higher proportion of cash-poor co-holding in all three waves.

are understated.

Periods borrowing	All Co-holders	Cash-poor	Cash-rich
	%	%	%
1	27	23	31
2	32	30	34
3	42	46	36

Table 4: Persistence of borrowing by borrowing group.

Finally, I look at the persistence of the cash-rich group in more detail. Cash-rich households that co-hold in all three periods make up 38% of 2010 cash-rich co-holders, 46% of 2012 cash-rich co-holders, and 58% of 2014 cash-rich co-holders. These co-holders have a mean Y value of 34, a minimum value of 2, and a maximum Y of $1,150$.

Based on the findings above, consider columns 2 and 3 in Tables 5, 7, and 8 for demographic, financial, and asset information in appendix B.2. These columns divide co-holders into cash-rich and cash-poor categories. Separating co-holders into the two groups results in a polarization of wealth, income, consumption' and credit card debt. The cash-rich group are closer to the savers and the cash-poor group, closer to the borrowers. Credit card debt is about 3 times higher for the cash poor group than the cash-rich group. Median liquid assets are 6 times higher for the cash-rich. These descriptive statistics show substantial differences in the constraints co-holders may face. Employee savings are a little more commonly held in the cash-rich group, mortgages, less so. A more obvious difference is the proportion of IRAs: 40% cash-rich, and 27% cash-poor. Twenty-four percent of the cash-rich own stocks and bonds which is on a par with the saver group, compared with 12% for the cash-poor.

2.4 Co-holding by cash-rich and cash-poor groups

2.4.1 Amount of debt held by co-holders

This section sets out an estimation strategy to more precisely describe the relationship between credit card debt and liquid assets in cash-rich and cash-poor co-holding households. The purpose of estimating the models is thus not to make causal inferences. Rather, association between the variables can be more tightly estimated with controls than by the raw correlation.

First, I estimate a regression explaining the amount of credit card debt in USD over all co-holders. The dependent variable is log credit card debt, conditional on being a co-holder.

$$ccd_{it}|(CH_{it} = 1) = \alpha_i + \beta_1 \mathbf{X}_{it} + \lambda_t + \gamma' \mathbf{Z}_{it} + \kappa' \mathbf{W}_{it} + u_{it} \tag{4}$$

Estimation is by pooled OLS. The lower case notation denotes log values of the variables. $\mathbf{X}_{it}$ is la_{it} and la^2_{it} - log liquid assets and log liquid assets squared. λ_t controls for time fixed effects.

$\mathbf{Z}_{it}$ is the baseline vector of household-level controls. It includes controls for household composition, marital status, time fixed effects, educational attainment, life-limiting conditions, race, home ownership, being married, and age and age squared.

$\mathbf{W}_{it}$, is a vector of employment controls.[9] There are dummies for unemployment, retirement, being a student, home-maker, and a category for *other*. The excluded category is *employed*. A separate dummy is included for self-employment. I experiment with a version with lags for employment status but do not report or include these, because they were not informative - possibly because the PSID gathers data biennially, so a two-year lag is too long to capture many job changes.[10]

The results of estimating equation (4) suggests a non-linear relationship between credit card debt, conditional on being a co-holder, and liquid assets. Credit card debt is first increasing and then decreasing in liquid assets. To give an idea of the liquid asset value at which the relationship changes sign, plotting the fitted values for liquid assets and fitting it with a non- parametric line shows a turning point around a log liquid asset value (deflated and scaled) of between 7 to 8, around the 75th to 95th percentile of liquid assets. In other words, when a co-holder has relatively high levels of liquid assets, the liquid-asset and credit card debt relationship switches from positive - both liquid assets and credit card debt increasing - to negative, with one increasing and the other decreasing. Full results are set out in the appendix C.1.

To address the non-linearity I estimate equation (4) piecewise, running two regressions - one for the cash-rich and one for the cash-poor. Each has three specifications as follows: define $\mathbf{X}^l_{it}$ as (1) log liquid assets, (2) log liquid assets and log non durable consumption and (3) log liquid assets, log non durable consumption and $\eta^2_{i,t}$, idiosyncratic cash-consumption risk. Full results are in appendix C.1. Squared log liquid assets in-

[9] Between 2008 and 2012, 2.756 billion credit card accounts were closed between 2008 and 2012 making losing a line of credit a real concern. The effect is amplified if a household faces unemployment. So, as well as leading to higher credit card debt from liquidity constraints, unemployment may also be predictive of becoming a co-holder (Druedahl and Jørgensen, 2018).

[10] I also experiment with additional controls suggested in the literature; state level location dummies, dummies if the household head has moved from employment to unemployment, or has retired, since the last wave of the sample. I also try including dummies for having each of the following sort of other (than credit card) debt; student; family; legal; medical. None are significant.

cluded in equation (4), are dropped in the piecewise regression, because the non-linear relationship is captured by the conditioning on cash-rich and cash-poor co-holders.

The two groups of co-holders defined by $Y_{i,t}$ are endogenous to the equation being estimated. To overcome the endogeneity issue I select a proxy of a measure of liquidity well established in the literature: I define a dummy variable for liquid households that is *liquid* if it holds at least the equivalent of one month's income, $Y/12$, in liquid assets. Of the households with a ratio value over 2, 71% have more than one months income in liquid assets. The correlation between being cash-rich and holding at least one months income in liquid assets makes holding at least one months income in liquid assets a reasonable, but not perfect, proxy for being a cash-rich co-holder. Similarly, holding less than one months income in liquid assets is a reasonable proxy for being cash-poor.

I include non durable consumption as a proxy for permanent income. Permanent income is likely related to credit card debt, but because income measurement inevitably includes other components, such as, but not only, transient shocks, also likely to be correlated with credit card debt, I control for the permanent component by using log non-durable consumption (Dynan, Skinner, and Zeldes, 2000). I include the estimated idiosyncratic cash consumption in specification 3 because the precautionary-liquidity theory suggests the scale of cash-consumption uncertainty is explanatory for co-holding.

The piecewise estimations of equation (4) by cash-rich and cash-poor co-holders shows the sign of the the coefficient for liquid assets is both significant and different for the two groups. For the cash-rich co-holders, the coefficient is negative; for the cash-poor, it is positive. The sign of the coefficient is robust to different specifications of the equation, although the significance is sensitive to specification.

$$\underbrace{\frac{\partial ccd|CR=1}{\partial la} < 0,}_{\text{cash-rich}} \qquad \underbrace{\frac{\partial ccd|CP=1}{\partial la} > 0}_{\text{cash-poor}}$$

An interpretation of the different signs is that for the cash-poor co-holders, liquid assets and credit card debt are complements and the household chooses more credit card debt to have more liquid assets. This is directionally consistent with the predictions of theories for co-holding. The household preserves liquid assets at the cost of accumulating credit card debt. For cash-rich co-holders, liquid assets and credit card debt are substitutes; the household's response to less liquid assets is to increase credit card debt.

For both groups, non durable consumption, as a proxy for permanent income, is positively correlated with credit card debt. In part, however, consumption is channelled through liquid assets. For the cash poor group, adding the consumption variable to the equation leads to the coefficient for liquid assets to become smaller (0.0383 to 0.00237) and insignificant. An interpretation of this is that for the cash poor, liquid assets are protected. If consumption goes up, credit card debt does too, to fund the consumption. For the cash rich, including consumption makes the the coefficient on liquid assets significant and more negative (-0.024 to -0.090); an increase in consumption is funded by a decrease in liquid assets and an increase in credit card debt. Both credit card debt and liquid assets are held, with high levels of the latter.

2.4.2 Determinates of co-holding

I now consider the whole sample and estimate a linear probability model where the binary dependent variable, CH_{it}, is equal to 1 if the household is a co-holder, and 0 otherwise. This binary dependent variable approach is used in much of the empirical literature (e.g. Gorbachev and Luengo-Prado (2019), Choi and Laschever (2018)).

I estimate the binary model in several ways. First, I estimate over the entire sample by pooled OLS and by fixed effects using the same structured approach described in subsection 2.4, that is, there are three specifications of $\mathbf{X_{it}}$. Challenges presented by using fixed effects is discussed in appendix C.1.1.

I first pool the data and over the whole sample. Next I take a piecewise approach by estimating over *liquid* households (*liquid*= 1) and *non-liquid* households, (*liquid*= 0). These dummies now identify liquidity rather than cash-rich and cash-poor co-holders, because all households are included, those that are, and are not, co-holders.

I find that for non-liquid households, the probability of being a co-holder increases with liquid assets. The estimated coefficient for liquid assets is positive and significant at the 99% level, in both the pooled and fixed effects approaches. This supports the theories that co-holding is motivated by some sort of constraint, based on precautionary motives, control issues, or smoothing issues.

For liquid households, the coefficient on liquid assets is negative and significant in both the pooled and fixed effects approach. The interpretation is that liquid assets reduce the probability of becoming a co-holder, conditional on having a *liquid* status. Credit card debt and liquid assets are substitutes for the liquid households. The results are robust to the inclusion of the additional variables of non durable consumption and cash consumption risk.

Results from pooled and fixed effect estimation of the linear probability model are directionally similar to each other and to estimation of equation 4. In other words, there is evidence that the estimation approach is not driving the results. In particular, this consistency provides some reassurance that household level effects are not distorting the picture in the pooled case.

2.4.3 Summary of empirical analysis

The results show that the sign of the estimated coefficient for liquid assets takes a different sign depending on the liquidity status of the group whose credit card debt is being conditioned on. For the illiquid co-holders, the coefficient is positive, credit card debt is increased to protect liquid assets. For the liquid co-holders, the relationship is negative, which suggests they are *not* co-holding to preserve liquid assets, but they are still co-holding. These results are stable when estimating the alternative, linear probability model by pooled ols and with fixed effects.

3 A Two-Period Model with Preferences for Money

I develop a two-period model of consumption with preferences for money. In the model, consumers make consumption choices but may face payment that is deferred until a future period. They may, or may not, face a penalty for the deferral.

With standard preferences, deferral of payment with no penalty has no impact on optimal consumption choices unless the consumer is smoothing consumption. In the model with preferences for money, the consumer experiences a *pain of payment* and thus may have a utility gain, or reordering of preferences, when payment is deferred. Including preferences for money means there is an effect from deferring payment that is not motivated from liquidity concerns. This can address the coexistence of high levels of liquidity and high cost credit card debt.

The Consumer lives for two periods and receives exogenous income m_1, m_2 in each. Demand for consumption in the two periods is represented as x_1, x_2.

The total cost of consumption in each period is $x_1 p_1, x_2 p_2$, where p_1, p_2 denotes the prices for period-one and period-two respectively.

The consumer may also borrow and lend any amount of her future or current income to herself over the two periods. Denote this as b. The consumer can choose to borrow all income from the future or lend all current income to the future so that b is in the set $[-m_1, m_2]$. Let the rate/return on b be r^b. In period-1, the consumers stock of wealth is simply her income plus/minus borrowings/lending, plus any initial allocation, which is, for simplicity, set to zero. The need for borrowing/lending in the model is discussed later in this section.

In period-1, it may be that the consumer defers a proportion of payment for the consumption x_1 of $\delta \in [0,1]$, to period-2. The deferral may be exogenous, as in convenience use of a credit card or invoicing, or chosen, as in BNPL, or credit card borrowing.

If $\delta > 0$, the consumer may pay a penalty in period-2. For example, late payment of a bill, or carrying a balance on a credit card. Denote the penalty rate as r^c.

Period-1 stock of wealth is:

$$y_1 = m_1 + b - x_1 p_1 (1 - \delta) \tag{5}$$

In period-2, the consumer pays any outstanding debts from period-1 deferred payment, $\delta x_1 p_1$, or borrowing, b, at the rate r^c and r^b.

Period-2 stock of wealth evolves as

$$\begin{aligned} y_2 &= m_2 - x_2 p_2 - b(1 + r^b) + y_1 - \delta x_1 p_1 (1 + r^c) - && (6) \\ &= m_2 - x_2 p_2 - b(1 + r^b) + m_1 - x_1 p_1 (1 - \delta) + b - \delta x_1 p_1 && (7) \\ &= m_2 + m_1 - x_2 p_2 - x_1 p_1 (1 + \delta r^c) - b r^b && (8) \end{aligned}$$

3.1 The Consumer's Preferences

The consumer gets utility $u(x)$ from consuming x units of a consumption good in period t, and utility $t(y)$ from her stock of wealth y in each period.

The utility function satisfies the usual assumptions: $u_x(x) > 0$ and $u_{xx}(x) < 0$ and $t_y(y) > 0$ and $t_{yy}(y) < 0$. Note that the assumptions on $t(y)$ mean the consumer gets disutility from paying for consumption, with the disutility increasing in consumption; $t_x(y) < 0, t_{xx}(y) > 0$.

The consumer's preferences for money and consumption are additively separable.

Let $V(\mathbf{x}, \mathbf{y})$ denote net lifetime utility where $\mathbf{x} = x_1, x_2$ and $\mathbf{y} = y_1, y_2$.

The consumer's problem is

$$\max_{x_1, x_2, b} V(x, y) = u(x_1) + t(y_1) + \beta \left(u(x_2) + t(y_2) \right), \tag{9}$$

subject to

$$y_1 - m_1 + x_1 p_1 (1-\delta) - y_0 - b = 0$$
$$y_2 - m_2 + x_2 p_2 + r^b b + y_1 + x_1 p_1 (1 + \delta r^c) = 0.$$

$\beta \in (0, 1]$ is a time discount factor.

Maximising utility requires the consumer choose a b, conditional on income, and preferences. For each b there is a corresponding optimal level of consumption so there are multiple intra-period equilibria. One b, however, maximises utility $V(\mathbf{x}, \mathbf{y}$.

To find an expression for maximising $V(\mathbf{x}, \mathbf{y}$, I solve the Lagrangian, $\mathcal{L}$, with respect to x_1, x_2, b,

$$\frac{\partial \mathcal{L}}{\partial x_1} = \frac{\partial u(x_1)}{\partial x_1} + \frac{\partial t(y_1)}{\partial y_1}\frac{dy_1}{dx_1} + \beta \frac{\partial t(y_2)}{\partial y_2}\frac{dy_2}{dx_1} + \lambda_1 p_1 (1-\delta) + \lambda_2 p_1 (1 + \delta r^c) = 0, \quad (10)$$

$$\frac{\partial \mathcal{L}}{\partial x_2} = \beta \left[\frac{\partial u(x_2)}{\partial x_2} + \frac{\partial t(y_2)}{\partial y_2}\frac{dy_2}{dx_2} \right] + \lambda_2 p_2 = 0, \quad (11)$$

$$\frac{\partial \mathcal{L}}{\partial b} = \frac{\partial t(y_1)}{\partial y_1}\frac{dy_1}{db} + \lambda_1 = 0, \quad (12)$$

where λ_1 and λ_2 are the period-1 and period-2 multipliers, respectively.

From equation (10), optimal consumption in period-1 depends on money holdings in period-1 *and* money holdings in period-2. This is because of the $t(\cdot)$ function, preferences for money. The disutility of payment that consumption generates means the consumer may choose not to exhaust her resources on consumption. But whatever x_1 is chosen, the higher it is in period-1, the lower y_1 is at the end of the period. This means y_2 is also lower because it is a function of y_1 (Equation (7)).

First order conditions of equations (10) - (12) gives,

$$u'_{x_1}(x_1) - t'_{x_1}(y_1)(1-\delta)p_1 - \beta t'_{x_1}(y_2)(1+\delta r^c)p_1$$
$$= -(\lambda_1(1-\delta)p_1 + \lambda_2(1+\delta r^c)p_1) \tag{13}$$

$$\beta\left[u'_{x_2}(x_2) - t'_{x_2}(y_2)p_2\right] = -\lambda_2 p_2 \tag{14}$$

$$t'_b(y_1) - \beta r^b t'_b(y_2) + \lambda_2 r^b = \lambda_1 \tag{15}$$

Substituting equation (15) into equation (13) gives

$$u'_{x_1}(x_1) - t'_{x_1}(y_1)(1-\delta)p_1 - \beta t'_{x_1}(y_2)p_1$$
$$= (\lambda_2 p_2(r^b - (1+\delta r^c)) - t'_b(y_1))(1-\delta). \tag{16}$$

And substituting equation (14) into (16) gives the conditions for optimal net lifecycle utility,

$$u'_{x_1}(x_1) + \left[t'_b(y_1)(1-\delta) - t'_{x_1}(y_1)(1-\delta) - \beta t'_{x_1}(y_2)(1+\delta r^c)\right]p_1$$
$$= \beta(u'_{x_2}(x_2) - t'_{x_2}(y_2)p_2)(r^b - (1+\delta r^c))p_2 \tag{17}$$

In the simplest case assume no frictions, $r^c = 0$, $r^b = 0$ and $\delta = 0$. And set $p_1 = p_2 = 1$.

$$u'_{x_1}(x_1) + t'_b(y_1) - t'_{x_1}(y_1) - \beta t'_{x_1}(y_2) = \beta(u'_{x_2}(x_2) - t'_{x_2}(y_2)) \tag{18}$$

At the optimum, the net marginal utility of period-1 *plus* the net gain in marginal utility of borrowing from period-2, equals the marginal utility of period-2.

Put another way, in period-1, the consumer chooses the x_1 where the marginal utility of consumption equals the marginal disutility of paying for this consumption out of y_1 and the additional reduction in period-2 wealth from spending in period-1, and the marginal utility change resulting from the increase in period-1 wealth resulting from b.

In the case where $b > 0$, borrowing from the future, $t'_b(y_1)$ is positive and implies higher period-1 consumption because for the intra period equality to hold, $u'_{x_1}(x_1)$ must be smaller. When $b < 0$, lending to the future, the effect is to lower period-1 consumption choice.

For every unit of borrowing or lending, b, there is an intra-temporal level of consumption that maximises the *intra-period* utility. There is one b^* that maximises net lifetime utility V, for each set of model parameters. I do not solve explicitly for b^*. While b^* can easily be found numerically, for any set of functions, there is not yet a simple analytical solution. Given this, I assume, that that the consumer chooses optimal b^*, and optimal consumption and money levels follow. Evaluating equation (18) at b^*, means

$$\frac{\partial t(y_1)}{\partial y_1}\frac{dy_1}{db}|_{b=b^*} = 0,$$

and equation (18) becomes

$$u'_{x_1}(x_1) - t'_{x_1}(y_1) - \beta t'_{x_1}(y_2) = \beta(u'_{x_2}(x_2) - t'_{x_2}(y_2)) \tag{19}$$

Explanation here.....

Borrowing and lending, b is equivalent to the rearrangement of income over time in the standard textbook model. I set out an explanation of this equivalence:

If the consumer has preferences only for consumption, $u(x)$, as in standard models and $r = 0$, $\beta = 1$ and the consumer's problem is to maximise her lifetime utility:

$$\max_{x_1,x_2,b} u(x_1) + \beta u(x_2) \tag{20}$$

subject to non-negativity constraints $x_1 \geq 0$, $x_2 \geq 0$, $m_1 - p_1x_1 + b \geq 0$ and $m_2 - p_2x_2 - rb + m_1 - p_1x_1 \geq 0$.

The standard terminal condition, $s_2 = m_1 - p_1x_1 + b = 0$, means all money must be spent in the second period, and optimal consumption, $x_1^\star$, $x_2^\star$, is $x_1^\star = x_2^\star = \frac{y_1+y_2}{2}$. If income is different in the two periods, $m_1 \neq m_2$, then $b \neq 0$; the consumer will smooth in order to maximize utility.

All solutions, require all income to be allocated to consumption at some point. For example, that $m_1 - p_1x_1 + b > 0$ and $m_2 - p_2x_2 + m_1 - p_1x_1 > 0$ cannot be a utility-maximising solution, because utility is strictly increasing in x. No mechanism exists for holding money. But when $m_2 > m_1$, or vice versa, the consumer optimally holds some money for smoothing, $b > 0$ or $b < 0$.

If there is a bequest motive, w, then $m_1 + m_2 = p_1x_1 + p_2x_2 + w$, exists where w is saved money at the end of period 2, then $x_1^\star = x_2^\star = \frac{m_1+m_2-w_2}{2}$.

Thus, when the consumer has preferences for consumption, but not money, equation (20), borrowing happens $(b > 0)$, if $m1 < m2$, and lending happens, $(b < 0)$ when

$m_1 > m_2$. Money held at the end of $t = 2$ is 0. By contrast, in equation (9), two-period model with money, borrowing from $t = 2$ can be optimal even when $m_1 = m_2$ and money can optimally be held at the end of $t = 2$.

In the standard case, b is implicit, whereas in the model with money preferences, b is explicit.

When there are preferences for money, for each level of borrowing and lending to or from each period, there is an x_1^* and x_2^* that maximises net utility. So there are multiple intra-period maximums. Every b directly changes y_1 and y_2 and indirectly changes the level of consumption that maximises the intra period utility. Thus for every $y_{b,1} = m_1 + b - x_{b,1}$ there is a corresponding $x_{b,1}^*$ that maximises the intra period function, v_1. And, equally, for every b, there is a unique $x_{b,2}^*$ that maximises v_2.

The friction that determines b^* comes from the opposing effects of b on consumption, and net utility in the two periods. The more the consumer borrows from period-2, the higher is beginning of period-1 stock of money, ω_1. This has two effects. First, in period-1 each unit of $b > 0$ leads to higher money utility, $t(\cdot)$, so the function shifts upwards. This decreases the marginal disutility of payment for every x_1 level of consumption, leading to increased optimal consumption level. Second, higher consumption in period-1 shifts the corresponding period-2 function, $(t(y_2))$, downwards leading to a fall in optimal period-2 consumption by the reverse argument.

With money preferences, the consumer may both borrow and save, that is she chooses $b > 0$ and $y_1 > 0$. Borrowing and saving simultaneously may seem counter intuitive but is consistent with many observed behaviours. For example, consumers who choose to defer payments with BNPL while not being liquidity constrained; consumers who hold a positive balance in one bank account and an an overdraft in another; consumers who simultaneously hold liquid assets and credit card debt, all correspond to this pattern.

The effect of $\delta > 0$, with no penalty, $r^c = 0$

Consumers regularly face deferral of some current period payment. Or consumers may choose to defer some current period payment. δ is the proportion of period-1 payment that is deferred to period-2, where $\delta \in [0, 1]$. An exogenously determined $\delta > 0$ is equivalent to, for example, convenience use of a credit card, an invoiced payment. A chosen $\delta > 0$ is equivalent to an actively chosen use of credit card or BNPL. Consumers can choose to defer even if they have sufficient liquidity to pay contemporaneously.

With standard preferences over consumption, delayed payment without penalty has no impact on demand or utility unless there are returns on the retained amount or smoothing gains. This is not consistent with what is observed in the data where consumers are seen to spend more when paying with, for example, a credit card (Prelec and Simester, 2001), or BNPL, (DiMaggio, Williams, and Katz, 2022), even when they hold no return liquidity. the presence of which makes both arbitrage and smoothing implausible explanations. If, on the other hand, money preferences are included in utility, consumers experience pain of payment and this means delaying payment *per se* has an impact on both utility and demand.

Starting with equation (17), assume that b^* is chosen, that $r^c = 0$, $r^b = 0$ and $y_0 = 0$, prices $p_1, p_2 = 1$. The Euler equation is

$$u'_{x_1}(x_1) - t'_{x_1}(y_1)(1-\delta) - \beta t'_{x_1}(y_2) = \beta(u'_{x_2}(x_2) - t'_{x_2}(y_2)) \tag{21}$$

Solving the period-1 intra-temporal problem,

$$u'_{x_1}(x_1) = t'_{x_1}(y_1)(1-\delta) + \beta t'_{x_1}(y_2)$$

Deferring payment in period-1 has a direct effect and an indirect effect. $t'_{x_1}(y_1)(1-\delta) < t'_{x_1}(y_1)$; the direct effect is that payment disutility for a given x_1 is lower and then $u'_{x_1}(x_1)$ must also be lower, so x_1 higher. This indirect effect is that, if x_1 increases, disutility in period-2 increases. The net effect depends on the strength of the two opposing effects. The period-1 effect means that deferring payment may raise period-1 utility and may raise demand for x_1.

Impatience mutes the second, indirect effect. The higher the level of impatience, the more likely is deferral of payment to lead to higher consumption and higher utilityin period-1.

The effect of $\delta > 0$ with penalty

I next show how a period-2 penalty interacts with a choice to defer payment. Can the consumer find it optimal to choose to defer, when there is a penalty for doing so?

From equation (17), assume $r^c \in (0,1)$, $\beta = \dfrac{1}{1+\gamma}$, $r^b = 0$ and $y_0 = 0$, prices $p_1, p_2 = 1$, the Euler equation is

$$u'_{x_1}(x_1) - t'_{x_1}(y_1)(1-\delta) - \frac{1+\delta r^c}{1+\gamma} t'_{x_1}(y_2) = \frac{1+\delta r^c}{1+\gamma}(u'_{x_2}(x_2) - t'_{x_2}(y_2)) \tag{22}$$

The term $t'_{x_1}(y_1)(1-\delta)$, is payment disutility of spending x_1. As already discussed, payment disutility is decreasing in δ, the more payment is deferred, the lower the disutility. The term $\frac{1+\delta r^c}{1+\gamma} t'_{x_1}(y_2)$ now moves in the other direction, not just because x_1 may be higher, but because the disutility is amplified by the penalty payment. If the agent chooses $\delta = 0$ by paying the entire x_1 in the first period, the negative amplification disappears. If the benefit is higher than this cost, a $\delta > 0$ is chosen such that $(1-\delta) > \frac{1+r^c\delta}{1+\gamma}$. Rearranging this for δ gives

$$\delta < \frac{\gamma}{1+r^c+\gamma}. \tag{23}$$

In order for it to be beneficial to defer payment when there is a penalty, the consumer chooses a δ that satisfies the above condition. The amount deferred is decreasing in the penalty rate and increasing in impatience.

4 Conclusion

This paper revisits the credit card debt puzzle. The households that make up the puzzle can be defined and characterised in many ways. I use a household- level measure of liquid assets and credit card debt and rank households according to how much liquid assets it holds, realative to the amount of credit card debt it carries. The approach reveals a more dispersed picture than is identified by some of the alternative methods in the literature, and may add a new perspective to understanding why existing theories the puzzle, in particular, why co-holding is not predicted for households with high liquidity, despite its pressence in the data. Using the constructed ratio, I show that at the one end, co-holders have liquid assets that are a small fraction of credit card debt, meaning the household cannot pay off the debt with its cash. At the other end, co-holders have liquid assets that are many multiples of credit card debt. These households can pay off the debt and will have cash - often very high levels - left over. Separating co-holders by these criteria and studying their characteristics shows that the co-holders with a liquid asset/credit card debt ratio greater than 2 (defined as cash-rich) are also wealthier, by many measures, than the co-holders with a ratio value less than or equal to 2 (defined as cash-poor). This finding is in contrast to the findings of other studies (Telyukova (2013)) that find co-holders sit between borrowers and savers in terms of wealth. Estimating a piecewise model by a liquidity measure, with a full set of household controls, reveals persistent differences between the two groups with respect to liquid assets and credit card debt, implying co-holding may have systematically different explanations, depending on wealth.

Liquidity need appears to be an incomplete explanation for co-holding. To help explain co-holding, I suggest an alternative idea in which households value wealth, or money, as well as consumption. I show how the additional assumption leads to a pain of payment when consumption and payment are separated in time, and the separation can result in optimally deferring repayment of debt, even if sufficient liquidity is available. The model may also be insightful about other cases where consumption and payment are separated in time. For example, consumers using delayed payment structures such as BNPL. Early work on this shows that spending with BNPL increases consumption, even when liquidity is high (DiMaggio, Williams, and Katz, 2022). Other examples include the credit card premium and late payment of small bills such as parking tickets, such that charges are incurred. This paper is a first attempt at modelling consumer choices when payment and consumption are temporally separated and where liquidity constraints appear not to bind. Further work is needed to formalise the results.

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Appendix

A PSID question about credit card debt

The survey question asked in the PSID on credit card debt:

Aside from the debts that we have already talked about, (like any mortgage on your main home (or/like) vehicle loans,) do (you/you or anyone in your family living there) currently have any credit card or store card debt? Do not count new debt that will be paid off this month..

and

If you added up all credit card and store card debts for all of your family living there, about how much would they amount to right now?

For the sample as a whole, nominal credit card debt has a maximum value of $90,000 and a mean of $2,990. This includes the 49% of the observations where credit card debt is zero. For borrowers only, the nominal mean is $7,382.7.

B Data and Descriptive Statistics

The data are from the US longitudinal biennial household survey, the Panel Study of Income Dynamics (PSID).

In line with the literature, I compare co-holders to borrowers (credit card debt and no liquid assets) and savers (no credit card debt and liquid assets). This establishes that the sample in the PSID has similar characteristics to data used in the literature. I later extend the comparison to sub groups of co-holders; liquid and illiquid co-holders.

Table 5 gives mean and median values for financial variables over these different groups. Values are unscaled and nominal to give a more intuitive and comparative picture - deflation is with 1982 prices. The same information is reported with scaled and deflated values in table 6

For these financial measures, co-holders sit between borrowers and savers in the PSID. For credit card debt, borrowers and co-holders have similar values. Liquid assets are, by definition, zero for the borrowers. The co-holders have mean liquid assets of $\$16,840$, well below that of savers, $\$40,855$. Holdings of stocks and bonds has a similar pattern.

Table 7 gives demographic information for households in each group as a proportion. Savers are a little older than co-holders and borrowers. Savers also have a higher level of education than the other groups. A higher proportion are retired. Borrowers have a higher proportion of married households than the others but are less likely to be home-owners. The proportion of home-owners in the co-holding group is close to that of the saver group. Race is the same for co-holders and savers whereas borrowers have a lower proportion of white respondents.

Table 8 reports financial asset information by group as a proportion of its total. Co-holders have the highest proportion of households with employee savings schemes and mortgages, but the range across groups for both variables is tight; $48 - 67\%$ for employee schemes, $43 - 59\%$ for mortgages. There is a more obvious difference for Independent Retirement Schemes (IRA) - for co-holders and savers, 32 and 37% have IRA's, for borrowers only 12% have an IRA.

Overall, the differences between the groups are small and do not suggest some systematic difference between them that might explain co-holding.

The statistics presented in tables 5, 7, and 8, show that the characteristics of co-holding, saving and borrowing households in the PSID sample are broadly similar to those of co-holders in other work, using US household data. For example, the mean and median values of income and assets of borrowers are similar between borrowers, co holders, and savers in Telyukova (2013), Druedahl and Jørgensen (2018), and Choi and Laschever (2018).

B.1 Data challenges for credit card debt in the PSID

The PSID survey takes place every two years. Thus, a household which reports credit card borrowing for repeated waves may be habitually borrowing, or may be unlucky in the timing of the interview. Timing may also be an issue, borrowing is more likely at certain times of the year and at certain points in a month. Timing of the interview is not reported. Other literature in the credit card debt puzzle field face similar problems. Some surveys are cross sectional, for example, so only observe a household once, or for one year.

Another limitation of the PSID credit card debt question is that it asks whether the household has credit card debt, not whether it *has* a credit card. A response of *no* to the credit card debt question has two potential meanings. The household has a credit card and no debt, or the household does not have a credit card and therefore is not able to carry debt. The focus of this paper is on households with credit card debt and high levels of liquid assets. These households are compared with households with credit card debt and low levels of liquid assets and household with positive liquid assets and no credit card debt. This group could include households who would like to hold credit card debt but are not able to get a credit card.

To get some idea of how likely it is that liquid co-holders have been misallocated to the savers group I refer to the 2013 Federal Reserve Survey for household Well being. Around 16% of respondents in the survey report being denied credit at least once in the year. The figure includes those who received offers of credit lower than requested, as well as outright refusals. But excludes the 12% of respondents who did not submit an application but would like to have access to credit. Reasons are fear of refusal or fear of debt. The rate of denial is higher when income is less than $\$40,00$. The average income of the liquid co-holders group in the PSID is around $\$87,000$ with a median of $\$71,000$. Thus the likelihood of households with high liquidity and unrealised credit card debt being mis-allocated to the saver group because they have been denied credit should be fairly small.

B.2 Tables of Descriptive Statistics

Table 5: Income and Assets, *USD* Unscaled, Nominal Values. Column 2 is all co-holders, as one group. Column 3 and 4 separate co-holders according to Y_{it}. Column 1 and 5 are comparison groups for co-holders; borrowers and savers.

	Borrowers Mean (Median)	All Co-Holders Mean (Median)	CP Mean (Median)	CR Mean (Median)	Savers Mean (Median)
Wealth	74,532	205,766	124,438	340,474	433,079
	(7,550)	(52,950)	(29,000)	(127,000)	(107,000)
Income	52,696	77,556	71,536	87,528	78,686
	(40,000)	(65,063)	(62,651)	(71,000)	(50,500)
Consumption (nd)	31,975	39,701	38,555	41,598	38,423
	(28,480)	(35,852)	(35,037)	(37,030)	(32,253)
Credit Card Debt	7,621	7,357	9,907	3,133	0
	(4,900)	(4,000)	(7,000)	(1,800)	(0)
Subjective House Value	94,063	158,157	143,383	182,629	176,405
	(37,500)	(125,000)	(115,000)	(150,000)	(120,000)
Mortgage Remaining	53,996	88,541	89,344	87,214	62,940
	(0)	(54,000)	(59,376)	(45,000)	(0)
Liquid Assets	0	16,840	4,206	37,766	40,855
	(0)	(4,500)	(2,500)	(15,000)	(10,000)
Stocks and Bonds	3,834	19,330	7,215	39,397	68,250
	(0)	(0)	(0)	(0)	(0)
Observations	678	5488	3422	2066	6811

Table 6: Information in Table 5, restated as deflated using 1982 prices and scaled to adjust for household composition. See section B.3 in this appendix for details on scaling and deflation.

	All CH		CP		CR		Savers	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Wealth	50,172	12,044	28,201	6,253	86,563	28,603	110,922	25,058
Income	17,619	14,773	15,874	13,959	20,510	16,102	18,219	12,411
NDC	8,310	7,380	7,890	7,117	9,006	7,826	8,450	7,175
CC Debt	1,711	955	2,287	1,529	755	405	0	0
Liquid Assets	4,249	1,019	958	539	9,699	3,593	10,693	2,304
House Value	36,115	27,733	31,747	24,417	43,350	33,369	43,513	26,532
Mort Remaining	18,975	11,464	18,868	12,193	19,150	10,167	13,988	0

Table 7: Age of respondent and demographic characteristics by group as a proportion of its total. Column 2 is all co-holders, as one group. Column 3 and 4 separate co-holders according to v_{it}. Column 1 and 5 are comparison groups for co-holders; borrowers and savers.

	Borrowers	Co-Holders	CP	CR	Savers
	-	-	-	-	-
Age of Respondent	43.03	45.31	44.26	47.05	47.06
% Highest: Grade School	0.29	0.23	0.24	0.21	0.23
% Highest: Some College	0.34	0.32	0.33	0.31	0.25
% Highest: College or Higher	0.26	0.41	0.38	0.45	0.45
% White	0.78	0.91	0.91	0.92	0.91
% Retired	0.13	0.13	0.11	0.15	0.22
% Homeowner	0.55	0.69	0.67	0.73	0.65
% Married	1.93	1.65	1.68	1.59	1.72
Observations	678	5488	3422	2066	6811

Table 8: Financial asset information by group as a proportion of its total. Column 2 is all co-holders, as one group. Column 3 and 4 separate co-holders according to v_{it}. Column 1 and 5 are comparison groups for co-holders; borrowers and savers.

	Borrowers	All Co-Holders	CP	CR	Savers
	-	-	-	-	-
% Have Employee Savings	0.48	0.67	0.65	0.70	0.54
% Have Retirement Account	0.12	0.32	0.27	0.40	0.37
% Have Mortgage	0.45	0.59	0.60	0.58	0.43
% Owns Stocks and Bonds	0.05	0.16	0.12	0.24	0.24
Observations	678	5488	3422	2066	6811

B.3 Variable construction

The sample includes households with heads aged 20 - 80. I include households with single heads. Obvious outliers are dropped. The final sample has 12,597 observations, 5,641 households. I use data from three biennial waves, 2011 - 2015 (labelled 2010-2014).

Scaling and deflation

To account for price changes, certain variables are deflated. Category specific price indexes are used where possible, and CPI where no index is available.

For some of the analysis it is important to account for household composition to interpret findings for an individual agent. Variables are scaled using the OECD approach $scale = 1 + 0.7(n-1) + 0.5k$ where n is the number of adults in the household and k the number of children. Later, for estimations with log values, a further restriction is imposed for scaling with dummies for household composition by including dummies for the number of children and adults. Define scale as $S_{i,t} = \sum w_i N_i$, some weight w applied to household size and composition. Then the equation has the form $\ln ndc_{i,t} - ln(scale)_{i,t} = \sum \alpha_i N_i$. Or $\ln C_{i,t} = \gamma ln(\sum w_i N_i)_{i,t} + \sum \alpha_i N_i$. The hypothesis that $\gamma = 1$ is not rejected so imposing the scaling on the dependent variable is acceptable. This equation brings out the different way that the number in each category influences log consumption; linearly through the dummies and logarithmically through the scaling.

It is also necessary is to account for price changes. Values are deflated by category specific price indexes where possible, and by CPI where no index is available.

Savings Plans

Respondents in the PSID are asked if they, or anyone in their household, has money in an IRA. A dummy identifies these households;

$$IRA = \begin{cases} 1 & \text{if IRA} \\ 0 & \text{if no IRA} \end{cases}$$

Questions about employee savings plans are asked with respect to the head and spouse of household. I collect information on 401k savings plans with respect to the current job and previous jobs (head only for this question). For individuals employed in the civil service, or by and organisation without a 401k plan, individuals are asked about Keogh and Thrift plans.

$$\text{emp} = \begin{cases} 1 & \text{if household have at least one employee savings plan} \\ 0 & \text{if household have none of the employee savings plans} \end{cases}$$

where an employee savings plan includes any of the above definitions and where an individual is said to have and employee savings plan if either the head or spouse have such a plan from a current or previous job.

Table B.3 shows the proportion of households with an IRA or an employment savings scheme.

	Percent of Households
Employment Scheme	55
IRA	34
All Savers	65
Observations	12571

Table 9: Proportions of households with IRA and Employee savings schemes.

Income

I use *taxable income* for the head and spouse. This is a composite; the sum of the head's asset income (dividends, interest, rental income and asset income from farm business), the head and spouses asset and labour income.

C Consumption and Y_{it}

To investigate the co-holding from the perspective of Y further, I plot per household period, log non durable consumption against Y to show how liquid assets, credit card debt and consumption (as a proxy for permanent income) relate to each other. Each dot is a household in a time period. For a given level of consumption, there is a wide range of Y values. The horizontal line defines the $Y_{p=70} = 3.3$, the household has 3.3 times more liquid asset than credit card debt. The plot shows that these households are in the middle and higher middle consumption households and not the high spenders.

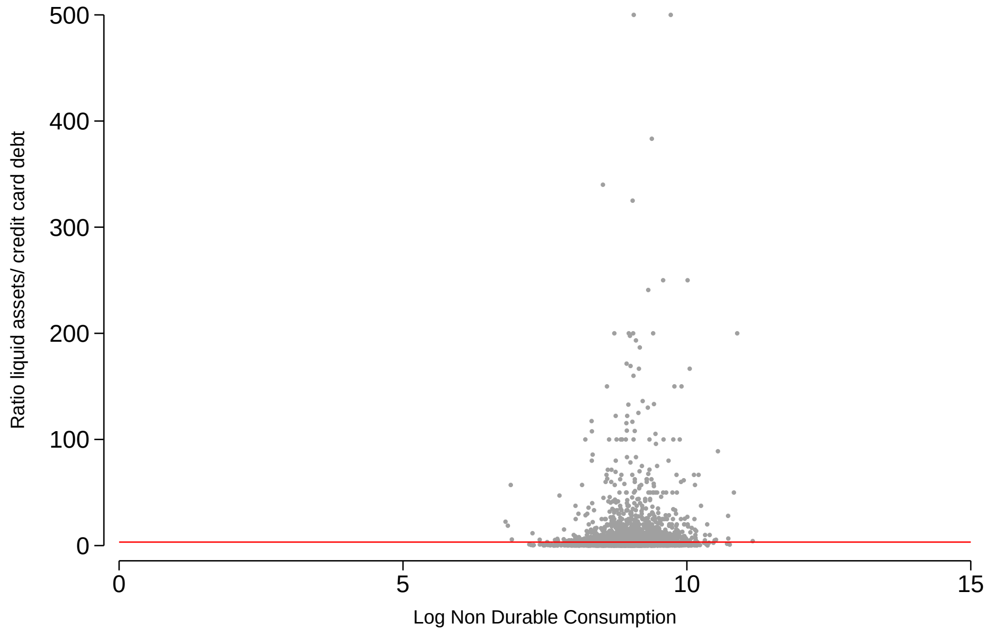

Figure 2: $Y_{i,t}$ plotted against log non durable consumption, x axis. The red line is $Y_{p=70} = 3.3$

C.1 Regression results for equation 4.

	Cash Poor			Cash Rich		
	(1)	(2)	(3)	(1)	(2)	(3)
Age	0.0654***	0.0604***	0.0622***	0.0712***	0.0606***	0.0684***
	(0.0146)	(0.0145)	(0.0167)	(0.0165)	(0.0165)	(0.0193)
Age^2	-0.0572***	-0.0534***	-0.0552**	-0.0685***	-0.0580***	-0.0665***
	(0.0162)	(0.0160)	(0.0181)	(0.0174)	(0.0173)	(0.0198)
Adults	-0.210***	-0.180***	-0.244***	-0.181**	-0.132*	-0.184**
	(0.0445)	(0.0446)	(0.0481)	(0.0618)	(0.0601)	(0.0662)
Children	-0.189***	-0.143***	-0.198***	-0.0633	-0.00608	-0.0554
	(0.0259)	(0.0269)	(0.0275)	(0.0350)	(0.0352)	(0.0374)
White	0.188	0.172	0.227*	0.0935	0.0656	0.0992
	(0.0973)	(0.0950)	(0.105)	(0.126)	(0.124)	(0.134)
unemployed	-0.0735	0.0391	-0.0496	0.443**	0.508***	0.503**
	(0.126)	(0.128)	(0.141)	(0.153)	(0.153)	(0.161)
Retired	-0.228	-0.160	-0.233	-0.111	-0.0605	-0.113
	(0.119)	(0.119)	(0.123)	(0.121)	(0.119)	(0.125)
Student	0.0361	0.101	-0.0716	-0.181	-0.128	-0.204
	(0.228)	(0.238)	(0.233)	(0.228)	(0.210)	(0.207)
Homemaker	-0.161	-0.200	-0.197	-0.262	-0.332	-0.290
	(0.204)	(0.194)	(0.236)	(0.252)	(0.244)	(0.279)
Other	-0.0845	0.130	-0.0523	0.462	0.321	0.194
	(0.526)	(0.517)	(0.495)	(0.516)	(0.589)	(0.530)
Not Hm Owner	-0.343***	-0.287***	-0.390***	-0.106	-0.0257	-0.0624
	(0.0628)	(0.0625)	(0.0692)	(0.0821)	(0.0808)	(0.0929)
Self Emplyd	0.173*	0.139	0.192*	0.246**	0.190*	0.257**
	(0.0760)	(0.0754)	(0.0806)	(0.0946)	(0.0913)	(0.0992)
Limiting Disblty	-0.0533	-0.0279	-0.0725	0.0181	0.0371	0.0286
	(0.0845)	(0.0843)	(0.0899)	(0.0886)	(0.0881)	(0.0963)
Marital Status	-0.0490	-0.0374	-0.0524	-0.0173	-0.00623	-0.00919
	(0.0291)	(0.0287)	(0.0319)	(0.0366)	(0.0357)	(0.0398)
2012	-0.0790	-0.0748	-0.0667	0.0725	0.0850	0.0841
	(0.0461)	(0.0458)	(0.0484)	(0.0557)	(0.0553)	(0.0589)
2014	-0.0461	-0.0365	-0.0368	0.267***	0.291***	0.275***
	(0.0478)	(0.0475)	(0.0505)	(0.0599)	(0.0590)	(0.0632)
Grade School	0.185	0.139	0.171	0.0959	0.0608	0.103
	(0.115)	(0.116)	(0.124)	(0.211)	(0.207)	(0.242)
Some College	0.223*	0.159	0.199	0.314	0.225	0.306
	(0.111)	(0.111)	(0.119)	(0.209)	(0.204)	(0.240)
College or Higher	0.566***	0.437***	0.558***	0.392	0.230	0.388
	(0.112)	(0.114)	(0.119)	(0.208)	(0.203)	(0.238)
Ln LA	0.0383*	0.00237	0.0324	-0.0240	-0.0896**	-0.0118
	(0.0191)	(0.0229)	(0.0201)	(0.0296)	(0.0301)	(0.0314)
Log NDC		0.384***			0.534***	
		(0.0843)			(0.0682)	
$\eta_{i,t}$			0.0291			-0.308
			(0.0156)			(0.172)
Constant	5.251***	2.145**	5.459***	5.085***	1.030	5.056***
	(0.368)	(0.742)	(0.417)	(0.473)	(0.686)	(0.551)
Observations	3352	3352	2949	2116	2116	1892

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

C.1.1 Additional discussion and results for sub section 2.4.2, determinates of co-holding,

The linear probability model that is estimated is

$$P(CH_{it} = 1) = \alpha + \beta' \mathbf{X}^{l}_{it} + \delta \mathbf{J}_{it} + \lambda_t + \gamma' \mathbf{Z}_{it} + \kappa' \mathbf{W}_{it} + u_{it} \tag{24}$$

Where $u_{it} = \epsilon_{it} + e_i$ and in the fixed effects estimation we control for covariance between e_i and the other variables. I estimate over the three specifications of vector $\mathbf{X}_{it}$. $P(CH_{it} = 1)$ is the probability of being a co-holder. As before, I experiment with various controls. In this case, including employment controls and other debt categories improve model fit and are thus included in $\mathbf{Z}_{it}$. Specifically, dummies if the household head has moved from employment to unemployment, or separately, has retired, since the last wave of the sample. Also, a dummy that equals 1 if the household has student or family or legal or medical debt. This is vector $\mathbf{J}_{it}$.

The pooled model ignores unobserved household level effects. To get some idea for the strength of these effects, I estimate the model by fixed effects. The cost of this approach is that since there are only three time periods, there may not be much to estimate once time invariant means are subtracted, and also, it excludes households with credit card debt in every or no periods: the most persistent co-holders. For cash poor co-holders this is 46% of the observations. For cash rich, 42%. Results should be interpreted with this in mind. It is nonetheless useful to compare results of the pooled and fixed effects approach.

Regression results for whole sample, Pooled and FE estimation of equation 24. Dependent variable, $P(CH = 1)$

	Pooled	FE
Age	0.0103***	0.0484***
	(0.00213)	(0.0136)
Age^2	-0.00882***	-0.0185**
	(0.00228)	(0.00649)
Adults	0.00491	0.0173
	(0.00803)	(0.0113)
Children	0.00622	0.00982
	(0.00430)	(0.00855)
White	0.0367**	-0.240
	(0.0131)	(0.229)
Retired	-0.103***	-0.0423
	(0.0172)	(0.0235)
Student	-0.0840***	-0.0358
	(0.0250)	(0.0317)
Not Hm Owner	-0.0931***	-0.0255
	(0.0120)	(0.0177)
Self Emplyd	-0.0467***	-0.0211
	(0.0140)	(0.0182)
Limiting Disblty	0.0420**	0.0256
	(0.0129)	(0.0149)
2012	-0.0332***	-0.0951***
	(0.00676)	(0.0264)
2014	-0.0618***	-0.187***
	(0.00750)	(0.0527)
No Mort, Hm Owner	-0.208***	-0.0226
	(0.0146)	(0.0208)
Hv Stdnt Dbt	0.143***	0.0398**
	(0.0113)	(0.0153)
Hv Med Dbt	0.0711***	0.0147
	(0.0131)	(0.0145)
Hv Fam Ln	0.0849**	-0.0139
	(0.0291)	(0.0311)
Ln LA	0.0322***	0.0397***
	(0.00132)	(0.00197)
Constant	-0.0932	-1.384*
	(0.0512)	(0.594)
Observations	15111	15111

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regression results for OLS estimation of equation 24. Dependent variable, $P(CH = 1)$

	Liquid = 0			Liquid = 1		
	Bsln	+ ndc	+ Var Csh	Bsln	+ ndc	+ Var Csh
Age	0.00366	0.00363	0.00106	0.0187***	0.0178***	0.0186***
	(0.00241)	(0.00241)	(0.00287)	(0.00336)	(0.00334)	(0.00379)
Age^2	-0.00257	-0.00257	-0.000253	-0.0154***	-0.0146***	-0.0152***
	(0.00266)	(0.00266)	(0.00308)	(0.00345)	(0.00343)	(0.00381)
Adults	-0.00300	-0.00238	-0.00510	0.00620	0.00945	0.00178
	(0.00854)	(0.00854)	(0.00953)	(0.0141)	(0.0140)	(0.0151)
Children	0.00826*	0.00913*	0.00679	-0.00837	-0.00258	-0.0106
	(0.00416)	(0.00421)	(0.00464)	(0.00852)	(0.00863)	(0.00910)
White	0.0373**	0.0371**	0.0334*	-0.0522	-0.0544	-0.0553
	(0.0117)	(0.0117)	(0.0131)	(0.0320)	(0.0318)	(0.0339)
Retired	-0.0409*	-0.0390*	-0.0474*	-0.114***	-0.110***	-0.124***
	(0.0197)	(0.0198)	(0.0214)	(0.0254)	(0.0254)	(0.0263)
Student	-0.0243	-0.0201	-0.0140	-0.0557	-0.0404	-0.0523
	(0.0228)	(0.0233)	(0.0280)	(0.0601)	(0.0578)	(0.0627)
Not Hm Owner	-0.0818***	-0.0799***	-0.0961***	-0.0500**	-0.0362	-0.0499*
	(0.0130)	(0.0133)	(0.0142)	(0.0194)	(0.0197)	(0.0210)
Self Emplyd	-0.0382*	-0.0384*	-0.0375*	-0.0196	-0.0250	-0.0265
	(0.0160)	(0.0160)	(0.0178)	(0.0204)	(0.0203)	(0.0213)
Limiting Disblty	0.0142	0.0151	0.0184	0.0577**	0.0601**	0.0553*
	(0.0142)	(0.0142)	(0.0157)	(0.0210)	(0.0210)	(0.0221)
2012	-0.00770	-0.00718	-0.00776	-0.0689***	-0.0672***	-0.0671***
	(0.00886)	(0.00888)	(0.00972)	(0.0118)	(0.0118)	(0.0123)
2014	-0.0233*	-0.0229*	-0.0225*	-0.118***	-0.116***	-0.114***
	(0.00955)	(0.00956)	(0.0105)	(0.0125)	(0.0125)	(0.0132)
Grade School	0.0288*	0.0275	0.0330*	0.102*	0.0982*	0.108*
	(0.0142)	(0.0143)	(0.0163)	(0.0398)	(0.0396)	(0.0430)
Some College	0.0584***	0.0564***	0.0590***	0.129**	0.121**	0.129**
	(0.0152)	(0.0154)	(0.0170)	(0.0395)	(0.0394)	(0.0426)
College or Higher	0.00525	0.00180	0.00240	0.0582	0.0411	0.0573
	(0.0175)	(0.0179)	(0.0194)	(0.0385)	(0.0387)	(0.0416)
No Mort, Hm Owner	-0.129***	-0.128***	-0.136***	-0.137***	-0.131***	-0.139***
	(0.0186)	(0.0187)	(0.0201)	(0.0188)	(0.0189)	(0.0196)
Hv Stdnt Dbt	0.0927***	0.0924***	0.0875***	0.125***	0.122***	0.126***
	(0.0121)	(0.0121)	(0.0135)	(0.0189)	(0.0189)	(0.0210)
Hv Med Dbt	0.0241	0.0241	0.0366*	0.111***	0.110**	0.138***
	(0.0131)	(0.0131)	(0.0145)	(0.0336)	(0.0335)	(0.0359)
hvfamln	0.0967***	0.0958***	0.107***	-0.0382	-0.0413	-0.110
	(0.0286)	(0.0286)	(0.0318)	(0.0547)	(0.0549)	(0.0632)
Ln LA	0.0781***	0.0778***	0.0795***	-0.0541***	-0.0612***	-0.0557***
	(0.00163)	(0.00161)	(0.00177)	(0.00568)	(0.00584)	(0.00609)
Log NDC		0.00679			0.0513***	
		(0.00607)			(0.0121)	
$\eta_{i,t}$			0.00339			-0.0215***
			(0.00250)			(0.00630)
Constant	-0.0492	-0.107	0.0252	0.360***	-0.0205	0.389***
	(0.0542)	(0.0775)	(0.0657)	(0.0988)	(0.134)	(0.112)
Observations	8923	8923	7492	6188	6188	5474

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regression results for FE estimation of equation 24. Dependent variable, $P(CH = 1)$

	Liquid = 0			Liquid = 1		
	Bsln	+ ndc	+ Var Csh	Bsln	+ ndc	+ Var Csh
Age	0.0144	0.0146	0.0255	0.0630**	0.0624*	0.0668*
	(0.0178)	(0.0178)	(0.0199)	(0.0244)	(0.0244)	(0.0266)
Age^2	-0.0101	-0.0104	-0.00450	-0.0186	-0.0179	-0.0197
	(0.00946)	(0.00945)	(0.0107)	(0.0105)	(0.0106)	(0.0119)
Adults	0.0186	0.0181	0.0179	0.0115	0.0142	-0.0108
	(0.0141)	(0.0142)	(0.0156)	(0.0234)	(0.0242)	(0.0253)
Children	0.0106	0.0100	0.00687	-0.0210	-0.0186	-0.0180
	(0.0100)	(0.0101)	(0.0115)	(0.0192)	(0.0198)	(0.0218)
White	0.625***	0.624***	0	-0.416	-0.414	0
	(0.0621)	(0.0624)	(.)	(0.314)	(0.309)	(.)
Retired	-0.000530	-0.000978	0.0186	-0.0381	-0.0378	-0.0385
	(0.0334)	(0.0336)	(0.0365)	(0.0363)	(0.0363)	(0.0381)
Student	0.00667	0.00609	0.00758	-0.179*	-0.179*	-0.187*
	(0.0355)	(0.0358)	(0.0421)	(0.0776)	(0.0777)	(0.0868)
Not Hm Owner	-0.00979	-0.0103	0.00566	-0.0427	-0.0411	-0.0416
	(0.0232)	(0.0233)	(0.0255)	(0.0335)	(0.0339)	(0.0377)
Self Emplyd	-0.00248	-0.00253	-0.00908	-0.0277	-0.0269	-0.0137
	(0.0236)	(0.0236)	(0.0268)	(0.0315)	(0.0316)	(0.0321)
Limiting Disblty	0.0167	0.0167	0.0237	0.0280	0.0274	0.0374
	(0.0192)	(0.0192)	(0.0217)	(0.0269)	(0.0269)	(0.0282)
2012	-0.0181	-0.0184	-0.0523	-0.157***	-0.157***	-0.162**
	(0.0345)	(0.0345)	(0.0388)	(0.0464)	(0.0464)	(0.0509)
2014	-0.0370	-0.0373	-0.114	-0.295**	-0.295**	-0.300**
	(0.0687)	(0.0688)	(0.0776)	(0.0925)	(0.0924)	(0.101)
No Mort, Hm Owner	-0.0134	-0.0136	0.0119	0.0161	0.0163	0.0195
	(0.0296)	(0.0296)	(0.0315)	(0.0337)	(0.0337)	(0.0359)
Hv Stdnt Dbt	0.0435*	0.0435*	0.0298	-0.0317	-0.0332	-0.0367
	(0.0185)	(0.0185)	(0.0209)	(0.0306)	(0.0305)	(0.0347)
Hv Med Dbt	-0.00607	-0.00599	0.00535	0.00890	0.00852	-0.00269
	(0.0160)	(0.0160)	(0.0176)	(0.0429)	(0.0429)	(0.0458)
hvfamln	0.00906	0.00924	0.0224	-0.0466	-0.0475	-0.0161
	(0.0367)	(0.0368)	(0.0419)	(0.0684)	(0.0685)	(0.0734)
Ln LA	0.0681***	0.0682***	0.0697***	-0.0294***	-0.0295***	-0.0332***
	(0.00292)	(0.00292)	(0.00321)	(0.00866)	(0.00867)	(0.00928)
Log NDC		-0.00337			0.0111	
		(0.00926)			(0.0225)	
$\eta_{i,t}$			0.00213			-0.00493
			(0.00264)			(0.00758)
Constant	-0.849	-0.822	-0.931	-1.475	-1.570	-2.008
	(0.685)	(0.689)	(0.799)	(1.105)	(1.120)	(1.216)
Observations	8923	8923	7492	6188	6188	5474

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

C.2 Introduction to preferences for money

Assume we have a consumer who gets utility $u(x)$ from consuming x units of the consumption good and utility $t(y)$ from holding amount y of money. The utility function satisfies the usual assumptions: $u_x(x) > 0$ and $u_{xx}(x) < 0$ and $t_y(y) > 0$ and $t_{yy}(y) < 0$. The assumptions on $t(y)$ mean the consumer gets disutility from parting with money, and the disutility is increasing in spending on the consumption good.

Assume the consumer's preferences for money and the consumption good are additively separable. Net utility is $v(x, y) = u(x) + t(y)$.

The consumer maximises utility with respect to consumption but conditional on preferences for money. This example is a single variate unconstrained static consumer choice problem. The consumer chooses x to maximise utility. Because y is a function of x, optimising with respect to x gives optimal y also. Let p denote the price of the consumption good, and $m > 0$, denote the consumer's disposable income (referred to as income henceforth). Where income and price are exogenous. The consumer's maximisation problem can be stated as

$$\max_{x} u(x) + \alpha t(y). \tag{25}$$

The consumer chooses the x where $v_x(x, y) = 0$. Utility from consuming the next unit of the good is equal to the disutility of spending the next dollar.

C.2.1 Example with log utility

Let net utility function take the form:

$$v(x, y) = ln(x) + \alpha ln(y),$$

where $\alpha \geq 0$ is the weight the consumer puts on money preferences. In the log functional form, this is interpreted as the consumer's elasticity of money. If $\alpha = 0$ the consumer does not have preferences for money. Thus, the model is a nested version of the standard and we are back to the standard model for consumption in which consumers have preferences over consumption alone. At the maximum,

$$x^{\star}(m, p, \alpha) = \frac{(m))}{(\alpha + p)} \tag{26}$$

Expression 26 has a natural interpretation. Optimal level of consumption is increasing in disposable income, m, decreasing in price of consumption, and in preferences of money , α, which can be interpreted here as elasticity of money. Comparative statics give:

$$\frac{\partial x^{\star}}{\partial m} > 0 \ , \ \frac{\partial x^{\star}}{\partial p} < 0 \ , \ \frac{\partial x^{\star}}{\partial \alpha} < 0$$

This is graphically shown in Figure 3, in the right hand column. μ is the wedge driven between optimal consumption and m. The extent of the wedge for any given m is determined by the consumers relative preferences for consumption and money. The grey shaded area is the region outside the budget set. If the consumer had higher income, she would be better off consuming at $x^{\star}$.

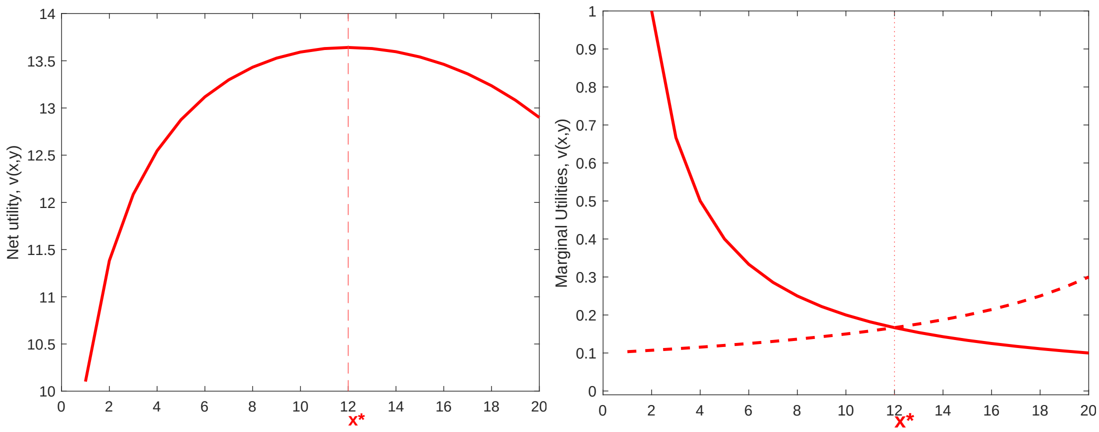

Figure 3: The horizontal axis plots x. The left panel plots net utility as consumption increases. The right panel plots the marginal utility of consumption (solid line) and the marginal disutility of payment (dashed line)