Household Need for Liquidity and the Credit Card Debt Puzzle: Online Appendix

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Appendix A Data

A.1 Sample Selection

I use the 2001 wave of the SCF, and the Q2 2000 - Q1 2001 of the CEX, to capture all households who were interviewed in 2001. In both surveys, I restrict the sample to people of ages between 25 and 64. I drop low-income outliers below a threshold of $200 per month, and also those who are incomplete income reporters in either survey. Further, I drop those who fail to report valid asset and credit card debt information (if a CEX household has no such information in its fifth interview, then I drop it for all the quarters in which it is present). This leaves me with 2,878 households in the SCF, and 2,743 households in the CEX, with 2,164 of them present for the entire 12 months of the survey.

A.2 Household Assets and Subdivision of Population into Subgroups

I select the subgroups with the intention of matching their characteristics as closely as possible in the two data sets. In the SCF, liquid asset holdings are measured in detail, as are credit card debt data. The SCF asks the following questions about credit card balances that I use here:

- "After the last payment [on your credit card accounts], roughly what was the balance still owed on these accounts?"
- "How often do you pay off your credit card balance in full?" Answer choices are: Always or almost always, Sometimes, Almost never.

From the first question, I can clearly distinguish revolving balance from the new purchases that appear before the bill is paid. I use the second question to select only habitual credit card debtors to be in the puzzle group, that is, those who answer “Sometimes” or “Almost never”; of all households who report to have positive credit card debt at the time of the interview, 77% are in this group.

Liquid assets are defined as all household checking and savings account balances, and I also include brokerage accounts, because in the CEX there is no way to separate them out. Credit cards that I consider are bank-type and store credit cards, that is, those that allow to revolve debt.

In the CEX, credit card balance information is collected in the second and fifth interviews, and in the fifth interview, households are also asked the amount they paid in the last year in finance charges on credit cards (distinct from late fees). The relevant questions in the CEX are:

- “On the first of this month, what was the balance on your credit card account(s)?”
- “What was the amount paid in finance charges on all credit card accounts over the last 12 months?”

As is clear from the first question, it is harder to distinguish revolving debt from new purchases in the CEX, but I can do so using the finance charge question. In the CEX, credit cards are defined similarly to the SCF, as store and bank-type cards that allow debt to be revolved. Selecting a threshold of $500 for revolving debt, and assuming it is revolved for a year, I take all households who paid an average of 14% APR on this balance as credit card revolvers. (The 14% interest rate is the SCF-reported interest rate paid on average on credit cards, shown in the text). Again, liquid assets are savings, checking and brokerage accounts.

In both surveys, those who report credit card debt above $500 and liquid assets below $500 (and those who are habitual debtors in the SCF, or paid positive finance charges in the CEX) are then put in the subgroup “debtors”. The remaining subgroup - those with little non-habitual debt or no credit card debt - are “savers”.

A.3 Separating Consumption Goods into Groups by Payment Method; ABA Survey of Consumer Payment Preferences

In looking at household consumption in the CEX, it was necessary to separate consumption into goods that people have to pay for with liquid instruments (cash, check, debit card) and goods that can be paid by either credit or liquidity. I separate household expenditures in the CEX into "cash-only goods", "cash-or-credit goods", education and durables. I separate out education and durables because expenditures for these goods occur rarely, while consumption is continuous but not measured through expenditure alone (see Krueger and Perri, 2003). Thus, studying volatility of expenditure on these goods is uninformative. This is true of cash-or-credit goods to some extent also, since they include many semi-durable items, such as clothing; it is important that the point of this exercise is not to compare volatilities across good groups.

To accomplish the separation, I relied on the 2004 Survey of Consumer Payment Preferences conducted by the American Bankers Association and Dove Consulting. This survey is not representative of all U.S. households, but is the only up-to-date survey that studies consumer payment methods. The sample that it does study consists of people with access to internet, so arguably, these are households who have the broadest payment options, and thus it should give a fairly accurate idea of payment methods used for most common good groups. In the survey, consumers are asked how they pay for certain types of goods and services, as well as at certain types of stores. Tables A.3.1 and A.3.2 present a summary of all results from the survey that pertain to consumer choice of payment methods. The questions were all phrased in the same way: "When you make purchases at [type of store], which method of payment do you use most often?", and "When you pay for [type of bill], which payment method do you use most often?"

The resulting categories are presented in table A.3.3.

Appendix B An Example Model of Measurement Error

Suppose that expenses on a generic good in the CEX have the following expenditure structure: for good i, household j at time t, true consumption satisfies

$$c_{ijt} = x_{ijt} + \sum_{k=1}^{K} z_{ijt,k}, \tag{1}$$

Table A.3.1: ABA Survey: Most Used Payment Method by Bill Type

Bill type	Check, cash, direct debit	Debit Card	Credit Card
Rent or mortgage	99.4	0.3	0.4
Loan or lease	98.2	1.0	0.8
Insurance	96.2	1.2	2.6
Child care, tuition	91.8	2.2	6.0
Utilities	95.0	2.5	2.5
Charity contributions	96.0	1.3	2.7
Memberships, subscriptions	85.2	3.1	11.7

Table A.3.2: ABA Survey: Most Used Payment Method by Store

Store	Cash or check	Debit Card	Credit Card
Grocery store	45.4	35.7	18.9
Gas station/convenience store	34.1	26.8	39.1
Department store	27.6	26.4	46.0
Discount store/warehouse club	43.4	27.2	29.4
Drug store	47.3	29.7	23.0
Restaurants	42.3	23.4	34.3
Fast food	85.6	7.8	6.6
Transit system	81.4	8.6	10.0

Table A.3.3: Goods Categories for CEX Analysis

Good group	Components
Cash-only goods (paid by check, debit, cash)	Rent, mortgage, utilities, property taxes, insurance, household operations/repairs/maintenance, child care, public transportation, health insurance, cash contributions; food in and out, alcohol, tobacco.
Cash-or-credit goods	Apparel, entertainment, gasoline, medical services, medical equipment, prescription drugs, reading, personal care, membership fees, funeral expenses, legal fees, auto insurance, auto repairs, other vehicle expenses.
Durables	Households furnishings and major appliances, vehicle purchases
Education	Tuition and fee expenses, textbook purchases

where x_{ijt} represents a regular expense (like a weekly grocery trip, monthly utility payment, monthly transit pass, a shoe purchase), and $z_{ijt,k}$ are incidental expenses, possibly irregular, or very frequent, of any magnitude (i.e. a sandwich purchase, a taxi ride, purchase of new running shoes). Let $x_{ijt} \sim N(\mu_x^{ij}, \sigma_x^{ij})$,[1] and $z \sim U[0, \lambda^i \sigma_x^{ij}]$. For certain goods, like utilities, we'd expect $K = 0$, for most others, $K > 0$. For this formulation we have the mean and variance of true consumption at the household level, assuming independence of individual expenses and a long enough time horizon, as

$$\mu_C^{ij} = \mu_x^{ij} + K\frac{\lambda^i \sigma_x^{ij}}{2} \tag{2}$$

$$(\sigma_C^{ij})^2 = (\sigma_x^{ij})^2 + K\frac{(\lambda^{ij}\sigma_x^{ij})^2}{12}. \tag{3}$$

Now suppose that there are two types of measurement error. First, households may forget the exact size of their regular purchase X. This error $\varepsilon_{ijt} \sim iid(0, \sigma_\varepsilon^i)$ is the classical measurement error. Second, the memory error is a function of the size of the expense, and is given by $R(z_{ijt,k})$. This function captures that households are more likely to forget small expenses than large ones, and is given by

$$R(z_{ijt,k}) = \begin{cases} \gamma_h > \frac{1}{2} & \text{if } z_{ijt,k} \geq \frac{\lambda\sigma_x^{ijt}}{2} \\ \gamma_l < \frac{1}{2} & \text{if } z_{ijt,k} < \frac{\lambda\sigma_x^{ijt}}{2} \\ 0 & \text{otherwise} \end{cases} \tag{4}$$

Assume for simplicity that $\gamma_h = 1$ and $\gamma_l = 0$, so households remember all incidental expenses higher than the mean of the uniform distribution, and forget all such expenses smaller than the mean. With this error structure, suppose that measured consumption looks as follows:

$$\tilde{C}_{ijt} = (X_{ijt} + \varepsilon_{ijt}) + \sum_{k=1}^{K} R(z_{ijt,k}) z_{ijt,k} = (X_{ijt} + \varepsilon_{ijt}) + \sum_{k=1}^{K/2} \tilde{z}_{ijt,k}, \tag{5}$$

where $\tilde{z}_{ijt,k} \sim U[\frac{\lambda\sigma_x^{ijt}}{2}, \lambda\sigma_x^{ijt}]$.[2] Under the assumption of a long enough time horizon for a given household, the mean of measured consumption is given by

$$\mu_{\tilde{C}}^{ij} = \mu_x^{ij} + \frac{K}{2}\frac{3\lambda^i\sigma_x^{ij}}{4} < \mu_C^{ij}. \tag{6}$$

[1] The assumption of normality on the level of consumption is unusual, and would be more standard on the log of consumption. Here, I make this assumption purely for algebraic convenience, supposing the parameters of the distribution such that the probability of a negative event is negligible.

[2] Obviously, the model could also incorporate classical error on the reporting of incidental expenses z_{ijt}. Here I omit this for simplicity, but the spirit of the argument would still go through.

Notice that for a good that has no incidental expenses, like a monthly utility payment, $K = 0$, so the mean of measured consumption will equal the mean of true consumption, but for any good that has incidental expenses, mean measured consumption will be lower than mean true consumption. Thus, if only classical error were present, we would expect CEX/PCE ratios of 1 for all goods; if memory error is also present, at least for goods with incidental purchases, we would expect the CEX/PCE ratios below 1, which is consistent with what we see in the data.

What about the variances? For measured consumption, we get

$$(\sigma^{ij}_{\tilde{C}})^2 = (\sigma^{ij}_x)^2 + (\sigma^i_\varepsilon)^2 + \frac{K}{2}\frac{(\lambda^{ij}\sigma^{ij}_x)^2}{48}. \tag{7}$$

For a good that has no incidental expenses, like utilities, classical error would exaggerate household-level variance since $K = 0$. The size of the distortion would depend on the variance of the error. However, if most goods in the CEX feature incidental payments, then it is quite clear that the memory error would reduce the variance of these incidental payments, and possibly undo the exaggeration of variance of measured consumption created by the classical error. It is not hard to derive the values of the parameters of this model under which measured volatility of consumption would be *lower* than true volatility. In this example,

$$(\sigma^{ij}_{\tilde{C}})^2 < (\sigma^{ij}_C)^2 \text{ whenever } (\sigma^i_\varepsilon)^2 < \frac{7}{96}K(\lambda^{ij}\sigma^{ij}_x)^2. \tag{8}$$

To tie this model back to the discussion of expense emergencies, first, those kinds of events are not well-represented by a uniform distribution like that on z_{ijt} here. One way to model this would be with a third component in (1) described by a Poisson distribution, for example. If we assumed that those events are remembered accurately, it would not change any of the discussion above: memory error would affect more minor expenses, classical error could affect those as well as the regular expenses X, but the combination of the memory and classical error would still understate the measured mean consumption, and may understate the measured variance, relative to the true consumption moments, depending on the parameters of the two errors. In any case, if we apply this model, with or without Poisson events, to the cash-good category as a whole, we might expect that what is left in the uniform distribution of z_{ijt} are relatively large or unusual expenses, while all the small food expenses are forgotten; in that case, both K and λ would be large, and the above condition (8) would be more likely to be satisfied.

Second, since I map volatility of log-consumption to the model, rather than of consumption level, the relevant statistic to examine is not absolute variance of consumption, but rather the coefficient of variation – i.e. standard deviation relative to the mean. For memory error to reduce the coefficient of variation when both the mean and variance of consumption fall, it needs to be relatively large enough so that the reduction in the mean is smaller than the reduction in the standard deviation, or

$$\sqrt{\frac{(\sigma_x^{ij})^2 + (\sigma_\varepsilon^i)^2 + K\frac{(\lambda^{ij}\sigma_x^{ij})^2}{96}}{(\sigma_x^{ij})^2 + K\frac{(\lambda^{ij}\sigma_x^{ij})^2}{12}}} < \frac{\mu_x^{ij} + \frac{K}{2}\frac{3\lambda^i\sigma_x^{ij}}{4}}{\mu_x^{ij} + \frac{K}{2}\lambda^i\sigma_x^{ij}} \tag{9}$$

It is also relevant that in calibrating the model, I target the share of liquid consumption in total household consumption rather than the absolute level. What is the impact of memory error on this share? Under the assumptions of this example, memory error affects small incidental expenses more than large incidental ones. It can be argued that more of the goods that are in the credit good category – medical expenses, durable purchases, auto repairs and the like – are likely to require larger expenses and thus, it is possible that on average a household is more likely to forget a cash expense than it is a credit expense. This is also true because credit good purchases are summarized in monthly statements, unlike cash goods. By this argument, it is possible that memory error can lead to understatement of the *share* of liquid consumption in the total, which would then bias the model towards underpredicting precautionary money balances relative to the data.