Household Expense Shocks and Consumption Smoothing—Evidence from Automobile Expenses

Bilal Islah*

January 2024

Abstract

This paper studies the consumption consequences of household automobile expense shocks. According the to Federal Reserve's Report on the Economic Well-Being of U.S. Households in 2018, 40% of adults would not be able to cover a sudden $400 emergency out of their own savings. By making use of high-frequency household transaction level banking data, I document the size and frequency of large out-of-pocket automobile expenses, which occur every two years and cost $800 on average. I estimate the consumption-smoothing costs to households and show that households that I identify as low in liquid wealth, which represent 10% of my sample and are likely an underestimate of the share of the population, struggle to finance these expenses directly. I document that these households reduce consumption while simultaneously carry credit card balances that are similar in magnitude to the overall total out-of-pocket expense shock itself for a period of up to 6 months after the initial event. Furthermore, I suggest that the observed consumption-smoothing response to automobile expense shocks is unlikely to be generated by the standard benchmark consumption-smoothing model without several augmentations. In particular, low liquid wealth households undersave relative to levels of risk aversion and discount rates typically assumed in the literature, while also carrying credit card balances close to their borrowing constraint. As a result, low liquid wealth households fail to self-insure against an important category of household expense shocks. I then conduct policy exercises that suggest there are welfare benefits that result from policy that either directly reduces transportation risk, such as via increased access to public transportation, or by increasing access to credit for this group.

*University Mohammed VI Polytechnic. E-mail: bilal.islah@um6p.ma

1 Introduction

What are the household finance consequences of automobile ownership? The average American household owns 1.9 automobiles and spends about $4900 annually just to operate these vehicles (between gas, insurance, maintenance and repair expenses)[1]. About 85% of Americans commute to work by automobile[2] and compared to cities worldwide the United States is an outlier[3]. An automobile in the vast majority of American cities is not solely a consumption good but is also an investment good, as it is often the only viable means of daily transportation to work. With relatively little supply of lower cost[4] transportation alternatives across many cities, American households choose to invest in automobiles as an asset that allows them to get to work. I ask how do high rates of automobile asset ownership interact with the risky nature of automobile ownership.

Specifically, I make the link between household ability to self-insure against shocks and risky asset ownership. I note that automobiles are the primary asset of the bottom 30% of households in the United States[5]. Furthermore, they are also a significant source of expense shocks. The household finance literature has documented the financial difficulties that Americans have with sudden expense shocks, for example, we know from the annual FED survey of well-being[6] that over 40% of Americans would lack the liquid savings to repay a sudden $400 within a month of the shock. I show that automobile repair shocks occur at

[1] The first statistic on automobile ownership is from the United States Department of Transportation's Bureau of Transportation and the second on household expenditures is from a 2016 report by the United States Bureau of Labor Statistics

[2] The 2018 American Community Survey shows that 85% of Americans commute to work by car. This number includes car commutes with more than one occupant. For single person car commutes, the number is 76%.

[3] A 2017 OECD report on International Transport looked at mobility by mode share in all cities worldwide with population greater than 300 000. North America is the only region where greater than 80% of trips are by automobile. The next closest region in the report is the OECD Pacific region at roughly 60% (Australia & New Zealand). Note the 80% number is pulled down by Canadian cities which all exhibit higher public transit usage than comparably sized US cities.

[4] In the transportation literature, transportation cost includes both the dollar cost to operate/access and the time-travel cost.

[5] see figure 1

[6] The survey notes: 'When faced with a hypothetical expense of $400, 61 percent of adults in 2018 say they would cover it, using cash, savings, or a credit card paid off at the next statement (referred to, altogether, as "cash or its equivalent")'

similar magnitudes and at a similar frequency. I find that large out-of-pocket automobile repairs occur roughly once every two years on average and cost close to $800 per expense. Taking into account that for the bottom tercile of wealth the importance of owning an automobile stems from the need to have transportation access to work, it is important to point out that this need to owning an automobile is also a major source of expense shocks that this group is exposed to and would struggle to finance. This raises essential questions about the extent of financial tools available to cover this type of risk and about urban policy that can reduce the set of households whose automobile ownership in urban areas is a daily necessity.

To empirically document the consumption-smoothing risk between automobile ownership and households of low financial wealth empirically, I make use of proprietary high frequency banking data to study household consumption and savings responses to these shocks. The dataset allows detailed analysis of transaction level checking account and credit card data which enables me to, first, document the extent to which households are faced with auto repair expenses. I note that out-of-pocket automobile repair expenses occur as frequently as similarly matched out-of-pocket medical expenses for the most constrained group[7]. Secondly, I note considerable heterogeneity in the frequency of auto repair expenses, even conditional on automobile ownership, both for low liquid wealth households, as they drive on average 20-40% less than the average household, and for households who live in urban areas with significant usage of alternative transportation, as proxied by cities where public transit usage is more common.

I then use the ability to observe auto repair expense transactions in the data to document the cost of household ablility to finance these expenses. Specifically, I measure household consumption and borrowing responses to the auto repair expense by implementing event-study regressions both at the short-run and long-run horizons. Notably, I find that households low in liquid wealth face the largest effects in responding to the shock, both in the short-run

[7] I specifically isolate to expenses in the that are greater than $200, but I note that this is in line with the type of expense shock that is documented by the FED well-being survey.

and the long-run. I find that the primary method of responding to these expenses is via a combination of savings and access to credit, which by virtue of being low in liquid wealth, these households lack the ability to do so. Overall, households with sufficient liquid wealth are able to completely cover the auto repair expenses, with no financial consequence other than needing to draw down liquid wealth by the amount of the expense. On the other hand, low liquid wealth households must engage in various methods to deal with the expense. Specifically, I find that in the same month, low liquid wealth households immediately reduce non-auto related consumption and finance the remainder on available credit. Furthermore, in the longer-run horizon of 6-months I find that low liquid wealth households reduce their consumption by roughly 50% of the auto expense amount and also incur additional credit card balances together totaling the amount of the auto repair expense. Thus, the overall cost of exposure to out-of-pocket auto repair expenses is much higher than just the amount of the expense itself, as it causes drops to consumption to particularly high marginal utility over consumption individuals, and furthermore, reduces their available borrowing capacity all while incurring high cost of credit financing charges.

These findings point to the inability to easily financially cope against transportation expense shocks for households of low liquid wealth. In particular, the uniqueness of auto expense shocks, allows evaluation of interesting policy alternatives. Specifically, auto related expenses seem to be immediately binding shocks, as the daily transportation and mobility is a necessity in gaining access to labor income in the vast majority of the United States. Thus, either the availability of insurance or additional credit access that is specifically targeted to automobile repair expenses is indirectly an insurance on labor income. In order to test these policy alternatives I construct a structural model of households who make consumption and savings decisions while also endogenously make decisions over automobile expenses. In this model, unemployment risk from emergency automobile expenses drives household behavior to make endogenous maintenance or emergency automobile expenses. By matching to empirical moments of consumption, savings and the reduced from event-study consumption response to automobile expenses, I can then evaluate the impact of both insurance and credit expansion on household behavior. In particular, to what extent would households take up an insurance policy that covers emergency expenses, and to what extent does additional credit availability mitigate the consumption consequences of emergency expense risk.

Furthermore, heterogeneity in exposure to auto expense shocks are also related to urban policy. Cities like New York and San Francisco, that have built out public transportation systems, implicitly insure households as the need for making these expenses becomes less binding. Whether households opt out of owning an automobile completely, drive less than the average American and incur these expenses less frequently, or simply decide to defer making these expenses at the time of a shock given the availability of alternative transportation, low liquid wealth households can avoid these expense shocks as a consequence of the urban form of these cities. That being said, the vast majority of American cities do not even have modest public transit usage, and sometimes completely lack any public transit service in some areas or during certain times of the day. Thus, as an alternative to directly insuring against auto related expense shocks and in addition to the vast list of other reasons[8] policymakers have the ability to expand public transit services in a way that can deliver significant welfare gains to low liquid wealth households. I include the evaluation of a low risk emeregency risk scenario in the structural model analysis, as a benchmark alternative to the insurance and credit expansion policies.

1.1 Related Literature

My paper contributes to several areas of the literature. Firstly, a large literature in labor economics on spatial mismatch documents how households trade-off residential choice, commuting costs and employment opportunities. We know from recent work such as in Andersson, Haltiwanger, Kutzbach, Pollakowski & Weinberg (2018) that low income households spend longer periods of time in unemployment the further they are away from large employ-

[8]Environmental, agglomeration, congestion, housing costs, commuting time costs, etc

ment clusters. Baum (2009) also shows that non-college educated single mothers are more likely to find employment opportunities when they have access to a vehicle. Together these two papers emphasize that lower income households are especially dependent on automobile access to find employment opportunities and specifically this is tied to the existing urban geography of cities. For example, Bento, Cropper, Mobarak and Vinha (2006) show that cities with greater automobile commuting mode shares also have greater distances between household residential and employment pairs. This suggests that policy choices that prioritize automobiles as the primary form of urban transport increases the risk borne by individuals of low wealth to self-insure transportation access against loss of income.

Furthermore, a vast literature in household finance has studied household consumption responses to shocks and more specifically to income shocks. A series of papers have studied household consumption sensitivity to idiosyncratic income shocks that can be interpreted as natural experiments such as changes to tax refunds. Poterba (1988) finds a 20% increase in consumption per dollar of tax refund, while Souleles (1999) finds an increase in consumption of about 18% per dollar of tax refund is able to document that it is largely reflected in durable spending. More recent work such as in Olaffson & Pagel (2018) have made use of similar high frequency banking data to analyze the daily response to income shocks. Olaffson & Pagel (2018) find that low liquid households are very sensitive to the arrival date of their paycheck even if liquidity constraints do not necessarily bind and households do indeed have some liquid savings. A key difference is I am focused on the sensitivity of households with low liquid wealth to expense shocks as opposed to generally timing consumption with income shocks.

In addition, closely related in spirit to this paper is an important theoretical literature that has focused on explaining precautionary savings motives with respect to uncertain medical expenses. Hubbard, Skinner & Zeldes (1995), and Palumbo (1999) make the important observations that end-of-life uncertainty in medical expenditures can help explain elevated savings levels in old age, as well as explain the value of medicaid insurance programs in preserving consumption levels for low wealth individuals. Furthermore, more recent work of De Nardi, French & Jones (2016) also estimate a structural model of medical expense uncertainty using both consumption and savings data as well as data on the frequency and type of medical expenses to calculate the household valuation of Medicaid programs. Similarly, to medical expense uncertainty, underinsurance in auto repair expenses can also drive precautionary savings motives for low liquid wealth households whose primary asset is an automobile. For example, Jorring (2020) explicitly models state variable uncertainty behaviorally. Built on Gabaix (2016) who provides micro foundation for behavioral inattention to the evolution of state variables, Jorring (2016) reconciles empirical consumption drops to predictable future changes in expenses. I propose an alternative explanation to reconcile consumption drops and low household savings. Similar to the literature in development economics, which has documented the existence of present-bias among households, as in Bauer (2012), I find that a model in which households discount future consumption heavily as well as face binding constraints is necessary in matching the observation of both a low savings rate and consumption drops in response to an expense event. Finally, similar to the point that public transportation can serve as implicit insurance, Mahoney (2015) shows that bankruptcy can distort individual insurance coverage in the context of medical expenses. Specifically, Mahoney (2015) shows that individuals with low wealth at risk from bankruptcy are less likely to have medical insurance and make lower out-of-pocket medical expenses.

2 Data and Measurement of Household Automobile Expenditures

I make use of a proprietary United States banking and credit card dataset that includes individual-level transactions from both checking accounts and credit card accounts held at an individual's bank. This dataset includes a cross-section of a large number of American banks. This means, also, that an individual need not hold all their accounts at one bank to be observable in the dataset. For example, if an individual has a checking account account with bank A and a credit card account at bank B, I can observe both the credit card transactions and checking account transictions for the same individual, as they are identified in the dataset with a unique identifier.

In particular, transactions include date, amount, location (if they are made at a physical location), and a category classification made by the data provider. With these categories, I can identify both transactions that are in-flows (credits) and out-flows (debits) to checking accounts, and hence, for example, I can separate between individual labor income and consumption. Furthermore, in addition to a broad set of categories such as groceries, restaurants, medical, travel, gas, etc, I can also identify transactions that are automobile related. Finally, I can approximately identify household residential locations based on the observed physical locations of frequent grocery transactions.

I filter the dataset to include only individuals for which I observe regularity in their monthly transactions. That means for each individual I observe consistent bi-weekly labor income in-flows to their checking accounts. In addition, I require that I can also match individual accounts via payments that flow from checking accounts to credit card accounts in the dataset. That is, whenever I observe a credit card payment from a checking account, I make sure that the corresponding credit card account exists in the dataset, otherwise if no such account exists I exclude that individual. All together this results in an initial panel dataset for which I observe roughly 23000 individuals and their daily transactions for at least 2 years in the period between January 1st, 2012 and May 30, 2016.

To briefly discuss the representativeness of individuals I observe in the dataset, I compare income and spending amounts to the Bureau of Labor Statistics Consumer Expenditure Survey (CEX) in the year 2014. Immediately, from table 1, it is noticeable that individuals in the lowest decile of income are missing. This is not surprising as we know from the annual FED report on well-being[9] that the lowest decile of income has the largest share of unbanked

[9]The report notes: 'Six percent of adults do not have a checking, savings, or money market account (often referred to as the "unbanked"). In addition, 16 percent of adults are "underbanked": they have a

or underbanked individuals. The average annual income in the lowest three deciles of income in the CEX data is approximately \$5700, \$15000 and \$23000. Thus, the data I use likely misses Americans in the bottom quintile of income. That said, comparing the mean income between the 20th-30th percentile of income in the CEX data, the mean is approximately \$22000, which roughly matches up to the mean income in the lowest decile of the sample. Likewise, with consumption, the mean expenditure in the CEX data between the 20th-30th percentile of income is roughly \$31000 which also matches up to the mean consumption of the lowest decile in the sample. Furthermore, the dataset also does not match up as well with the highest deciles of income from the CEX data. This is because the CEX data is at the household level, in the CEX data the mean number of earners increases with household income, from 0.5 in the lowest decile, to 2.0 in the highest decile with an average of 1.3 earners for all households. Whereas with the dataset I have access to, it is harder to tie together accounts for multiple earners, thus I do not attempt to not link accounts for multiple earners and instead assume a single earner, though this may pose a problem for the consumption measurement from joint accounts. This may bias downward household income relative to household consumption that I observe in the data.

In addition, the sample roughly comprises of individuals living in urban or suburban areas. Specifically, I made an attempt to identify only individuals living in United States census defined metropolitan statistical areas in order to narrow the focus on urban automobile choices and expenses. Overall, the proportion of individuals living in the United States Northeast and the United States West roughly match the actual population distribution in those areas, but the United States South is overrepresented relative to the United States Midwest in the data[10]

Furthermore, important to this paper is identifying households that are low in liquid wealth. In order to do that ideally, I would observe checking account balances and then

bank account but also used an alternative financial service product. One percent of those with incomes over \$40,000 are unbanked, versus 14 percent of those with incomes under that threshold'

[10]The definition of each region follows definitions used by the United States Census.

label those in the sample based on households with very low checking account balances. That said, I do not observe checking account balances. To overcome that I instead construct a measure to identify cumulative changes to checking account balances. I look at a rolling 12-months of in-flows and out-flows to checking accounts to calculate the change in overall savings in that period. More specifically, I require that if for every month of the last 12 months that the difference between consumption and labor income is consistently within a fixed interval in each month, and hence not deviating to far from 0 in a 12-month period[11] then the household is likely low in savings accumulation and more likely to be low in overall liquid wealth. Overall, roughly 10% of the sample fits this definition of low liquid wealth, and furthermore, if I exclude households with above median income or above median consumption and also exclude households that transfer large deposits into their checking account this number becomes roughly 40% of the filtered sample.

Finally, in order to identify regions with high rates of alternative transportation at a granular geographic level, I complement the transaction dataset with data from the American Community Survey (ACS). The ACS data includes mean commuting mode shares by transportation type at the ZIP code level. In particular, I use this as a proxy to identify areas of low alternative commuting cost, specifically I assume this suggests the extent that households in a specific geography perceive the costliness of not commuting by car to get to work.

2.1 Automobile Expenses

Given the large number of Americans who typically depend on their automobiles to get to work, it is conceivable that large automobile expenses are financial shocks that may prevent the operability of one's car and that, without a costly replacement, this event is a potential

[11]I use a threshold of +/- 40% of monthly income and discuss sensitivity to this threshold in a later section. The reason for the lower bound is to eliminate households who save a large portion of their labor income, and the reason for the upper bound is to eliminate households who are able to draw from their intial wealth to fund consumption. Finally, I also require households not to have non-labor income deposits of greater than $5000 more than once and no non-labor income deposit greater than $15000 at all within the 12-month period.

loss of labor income due to the impediment in daily access in getting to work. In order to identify automobile expenses that seemingly fit this criterion, I identify transactions that appear to be major automobile repairs and which to also to a certain extent appear to be unpredictable. To do so, I first filter for transactions labeled as automotive by the data provider and then furthermore filter out transactions that take place at dealerships or are labeled tire or oil shops. The assumption being that dealership transactions may include a broader range of more routine and maintenance type of services such as oil changes, or they may be transactions that are partially covered by warranties. Finally, I also rule out transactions that I observe that involve insurance providers, in order to isolate only on completely out-of-pocket automobile repair expenses. This leaves me with a set of automobile expenses that I can observe in the data take place only at physical merchants which are specialized automobile repair shops such as body shops or mechanics.

While this does not completely rule out the potential ability to predict or delay the timing of an automobile expense, I show evidence in a later section that household behavior is not consistent with changes in the form of consumption and savings responses that would indicate that possibility. Furthermore, I argue that my results are conservative to the true cost of an immediate automobile expense shock for low liquid wealth households, as the dataset misses out on the bottom two deciles of labor income, and I also condition on households having access to credit cards.

2.1.1 Summary Statistics

In table 3, I note that within the sample, conditional on being an automobile user[12], auto repair expenses that are greater than \$200 occur roughly once every 11 months and for those greater than \$400, once every 19 months. Annually, this corresponds to close to \$800 on auto repair spending for transactions greater than \$200. This number compares to the BLS mean

[12] I identify car users based on observing frequent monthly gas expenses. If in the last 12-months, at least 10-months included gas expenses above \$30 (the amount was chosen to exclude miscellaneous gas store items.)

auto repair expense at the median income level of roughly $710, which likely also includes routine maintenance that I specifically exclude.

The mean frequency of automobile repairs hides considerable amounts of heterogeneity across geographies and by financial wealth. Individuals living in urban areas where less than 50% of households commute to work by automobile, face this risk less often, approximately once every 34 months. This is directly correlated with less automobile usage, automobile owners living in cities with high public transit have lower mean annual gas expenditures ($1620 compared to $2260 annually). Furthermore, low liquid wealth wealth households face making costly auto repairs less often than the full sample households as they make expenses greater than $200 once every 19 months and those over $400 once every 40 months. This is possibly because low liquid wealth households may select only to make the most essential of automobile repairs, whereas the full sample of households may be able to identify such repairs more routinely. It is also the case that low wealth liquid households drive less than the full sample of households, roughly based on annual gas expenditures, they drive about 20% of what a similar household does annually and up to 40% less than the full sample. Furthermore, we know that from the medical insurance literature, that underinsured individuals are more likely to time discretionary medical services when they have greater medical insurance coverage as documented in Diamond, Dickstein, McQuade, and Persson (2019). This suggests, that underinsurance in the form of low liquid savings would reduce the likelihood of automobile repair expenses except for those that are essential. Finally, when conditioning on a household who lives in a low car commute urban area and is also a low liquid wealth household, they essentially do not face this risk even if they own a car. Empirically, I find that they make this expense roughly once every 94 months.

As an important comparison, I also identify out-of-pocket medical expenses within the sample. I look at all transactions labeled as medical expenditures that are above $200 and $400, exactly the same as the automobile repair expenses. Notably, out-of-pocket medical expenses occur at a similar frequency and magnitude to out-of-pocket automobile repair expenses for the group that is low in liquid wealth and for the below median income sample. This emphasizes the importance of documenting the existence of automobile expense risk, as we know from the medical insurance literature, out-of-pocket medical expenses can have detrimental consequences on financial wealth[13]. For the low liquid wealth group, out-of-pocket medical expenses occur roughly once every 17 months and annually total $280, similar to auto repair expenses. On the other hand, unlike automobile expenditures, geographic variation is far less correlated with supply of alternative transportation. Thus, highlighting that automobile expenditures have an additional source of potential policy implications that are not simply related to providing financial liquidity and insurance.

3 Reduced Form Evidence

3.1 Event-Study

I use the observation of auto repair events in the data and the high-frequency nature of the dataset to document which actions households take at various time horizons to respond to the auto repair event. Specifically, I am able to observe how households react in terms of consumption and usage of credit through credit cards. To document each of these, I look at the monthly as well as the 6-month horizon to capture the full event response.

$$y_{it} = \beta * \text{auto repair event}_{it} + \alpha_i + \alpha_t + \epsilon_{it} \tag{1}$$

$$y_{it} = \sum_{j=-m}^{n} \gamma_j + \alpha_i + \alpha_t + \epsilon_{it} \tag{2}$$

[13]For example, Mahoney (2015) shows that underinsured and low wealth individuals undergo bankruptcy as an implicit form of insurance for out-of-pocket medical expenses

In table 4, I look at the 1-month household response to an auto repair event that is greater than \$400. For households for whom I've identified as being low in liquid wealth, the average auto repair event expense is about $\sim 31\%$ of monthly income and the response at a 1-month horizon is a reduction in non-auto related consumption by roughly $\sim 9.5\%$ of monthly income and an increase in credit card balances of $\sim 11\%$ [14].

Similarly, I also plot the coefficients to the event-study regression in figure 3. The 1-month response, while representing the largest single-month response to both consumption and credit card balances, represents only about 50% of the total reduction in consumption and about 75% of the total increase to credit card balances over the overall 6-month period. At the end of the 6-month period the measureable impact begins to taper off.

In table 4, using a panel dataset that is aggregated at a 6-month time period rather than monthly, I provide estimates that capture the full household response[15] At the 6-month horizon, for households low in liquid wealth, the average consumption response is a reduction in non-auto related consumption by roughly ~17% of 1-month's income and and increase in credit card balances over the full period of ~19%.[16] This suggests that close to almost half the auto repair expense is financed through foregone consumption, and the remaining amount likely accumulates interest at credit card rates.

The event-study plots in figure 3 also show event-study coefficients for the sample of households that are below median income but not low in liquid wealth. This sample appears to be unaffected in consumption terms from auto repair events. Although credit card usage is similar to the low liquid group at the time of the event, the figure also clearly shows the non low liquid wealth group is able to repay any added credit card balance with 2-3 periods.

[14] With the average income for this group being roughly \$2200, this accounts to an average $\sim$ \$680 auto repair expense with a simultaneous $\sim$ \$210 reduction in consumption and an increase in credit card balances by $\sim$ \$240.

[15] The sample size here is reduced, as in order to capture at least 2 6-month periods, one before and one after the auto-repair event, which have to be centered such that the auto repair event occurs at the first month of the 6-month period, some individuals are dropped as even if they are in the sample for 2 years, there are not enough full 6 month periods before and after the event for them.

[16] This represents a total dollar amount of ~\$360 in consumption and ~\$400 in new credit credit card balances. The total of the two closely matching the average auto repair expense for this group.

3.2 Matched Difference-in-Differences

In addition to the event-study results, I also include a matched difference-in-differences analysis. Given the panel nature of the dataset, it is possible to cconstruct a control group of individuals with similar characteristics as those who face an automobile repair expense.

I construct a control panel of individuals using propensity score matching to identify a one-to-one match for each individual in the low liquid wealth panel who face an automobile repair event. In particular, I match individuals on labor income, consumption, borrowing limit and rolling checking account flow at 6 months prior to the treatment individuals automobile repair expense event. I also absolutely require that a matched control individual did not face an automobile repair expense in the matched t_{-6} to t_{12} period. The propensity score matching uses the observation of a automobile repair event as the y variable (auto repair event$_{it}$).

$$\begin{aligned} y_{it} = \delta * \text{treat}_{it} + \gamma * \text{auto repair event}_{it} + \\ \beta * \text{auto repair event} \times \text{treat}_{it} + \sigma_i + \alpha_t + \epsilon_{it} \end{aligned} \tag{3}$$

In table 5, I report the results of the matched difference-in-differences analysis. Crucially, the estimates of consumption and credit card balance are very similar to the event-study results. Whereas the event-study only includes the effect of the treatment on the treated, the matched difference-in-differences allows a comparison of parallel trends with a control group of individuals who are also part of the low liquid wealth group. The consumption response at a 1-month horizon is by roughly $\sim 9.3\%$ of monthly income and an increase in credit card balances of $\sim 13\%$.

3.3 Robustness & Discussion

The estimates from the previous regression analyses merit discussion as to whether they can plausibly be interpreted as causal. As the aforementioned auto repair expense events arise from transaction data, the observation itself is an endogenous choice to make an auto expense. A couple of important features related to the construction of the set of events labelled as auto repair expenses suggest that it may not be a cause for concern. Firstly, I filter out all transactions that include either the insurance category label or in the text description include the names of a large set of US insurance companies. In addition, I filter out transactions, by text analysis, that occur at dealerships, tire repair shops and oil change locations, as these are likely to include a greater proportion of maintenance rather than purely emergency events. Thus, largely leaving a set of transactions that occur at mechanics and garages. As a test, I also include a separate event-study regression that only includes transactions I identify as coming from dealerships, tire shops and oil change locations. Figure 4 plots the event-study coefficients for each location and transaction type. Interestingly, for the low liquid wealth group, there is only modest changes in the size of the consumption and credit card balance responses, possibly suggesting even transactions that occur at these locations are likely to skew toward emergency versus maintenance expenses and hence have a binding necessity to make the expense.

Furthermore, an argument can be made that if these events are the result of endogenous timing, then there would be observable pre-trends in consumption and credit-card balances in the months prior to the auto repair expense event. In figure 5, I include a linear pre-trend coefficient and find no evidence of any directional change in the months prior. In a consumption-smoothing framework, if prior knowledge of an expense that would occur a few periods ahead and the household was low in liquid wealth, the optimal response would be to smooth any drop in consumption and increase in credit usage over the periods that precede the event. I find no evidence of this behavior, suggesting either any possible timing of the expense to be limited to within a 1-month horizon, or no effect from prior knowledge.

In addition, I also show that there is no evidence of any significant pre-trend in changes to gas or labor income in the months prior to an automobile repair expense. In figure 6, I plot the event-study coefficients of both gas and labor income, which appear to remain similar to in the pre and post period. If there was evidence of behavior that suggested timing or a prolonged gap between the observation of the repair event and the expense, either a decrease in gas expenses prior to the automobile repair expense or a visible impact on labor income would be plausible.

In table 6, I report results that allow for discussion on sensitivity to the choice of the low liquid wealth threshold in the data. I chose the threshold to capture a large enough subset of the sample, but also such that it excludes households that have greater flexibility to draw from savings or alternatively can accumulate significant savings out of their income. Table 6, shows that increasing the threshold while restricting the sample to the same below median income group results in a decreased impact on consumption in response to an automobile repair event. The threshold of 40% that I used is robust to a tigher threshold of 30%, but the sample size is decreased at that level. Increasing the threshold to 75% of monthly income results in a smaller but significant consumption response going from about 9.3% of monthly income to 5% of monthly income. In addition,, this also includes a larger percentage of the below median income sample at roughly $\sim$ 50%. Removing the threshold completely includes the entire below median income sample but results in an even smaller consumption response that is not statistically significant.

Finally, I suggest that the reduced form results I find are conservative to the true cost of an immediate automobile expense shock for the most constrained group of low liquid wealth households, as the dataset misses out on the bottom two deciles of labor income, and I also only can observe households that have some access to credit card borrowing capacity.

4 Structural Model

4.1 Motivation

The empirical results highlight that the sensitivity of consumption and the inability to repay credit card balances are mainly borne by low liquid wealth households. This observed behavior is suggestive of binding liquid wealth constraints and potentially behavioral reasons that reduce precautionary savings motives. In order to motivate the structural model that follows, I present additional suggestive empirical evidence of binding wealth constraints and credit limitations.

In table 7, I split the low liquid wealth sample into 4 groups. I partition by the median in savings accumulated over the 12 month period prior to 6 months before an automobile repair event and by the median borrowing limit observed in the data for each individual. That is, any given individual in the low liquid wealth sample can be in the below median savings and below median borrowing limit group, the below median savings and above median borrowing limit, above median savings and below median borrowing limit, and finally the above median savings and above median borrowing limit group. For each group, I report the average savings and average borrowing limit normalized by monthly income. For example, the below median savings and below median borrowing limit has an average 12 month accumulated savings of ~ -2.5 and an average borrowing limit of ~ 0.7 of monthly income. The average consumption response for this group to an automobile repair expense is a $\sim 11.5\%$ decrease of consumption in monthly income terms Columns 3 and 4 of table 7, show that the groups that are both above median in accumulated savings and are also above median in borrowing capacity have a decreasing consumption response of $\sim 8\%$ and $\sim 5.5\%$ respectively.

Given the heterogeneity in consumption sensitivity to a sudden automobile repair expense, I make use of a consumption-savings model that allows for both binding credit constraints and for the level of liquid wealth in savings to be an important state variable. Thus, in order to further study this heterogeneity in this setting, and to be able to quantify the welfare consequences of policy responses that either relax financial constraints or reduce risk exposure, I make use of the following model.

4.2 Household Consumption Model

Firstly, I take the standard household consumption-savings buffer-stock model a la Carroll (1995) with risky income. In addition to households being faced with permanent and transitory income shocks, I make a simple addition by adding transitory auto expense shock risk. That is, I initially assume households have no control on when to make auto expense repairs, thus they face idiosyncratic expense shocks, e, with a probability of π_e. The purpose of this is to initially stay as closely within the standard precautionary savings model where the only addition is the idiosyncratic risk households face from auto repair expenses. Note that, for now, I don't assume households have the ability to either defer or endogenously time auto expenses.

$$\max \mathbb{E}_t \sum_{n=0}^{T-t} \beta^n \frac{c_{t+n}^{(1-\rho)}}{1-\rho}$$

$$m_{t+1} = (m_t - c_t)R + y_{t+1} - e_{t+1}$$

$$m_t - c_t = a_t \geq \underline{\mathrm{a}}$$

In this model, households enter every period with cash-on-hand m_{t+1} where m_{t+1} is the result of the return on last period's choice in savings a_t adjusted by constant return R and in addition they receive risky income y_{t+1}. Furthermore, each period there is a realization of the auto repair expense e_{t+1} which can lower cash-on-hand in that period. Households then decide the optimal choice of consumption c_t as a function of state variable m_t for every period t in solving their dynamic program. Note, as in the standard buffer-stock model, there is only one state variable m_t as other state variables can be normalized by permanent income.

Figure 7 plots the optimal consumption policy function to this model. From the figure, we can observe that when credit constraints are binding, low liquid wealth households are unable to save at all and that their consumption is very sensitive to their cash-on-hand. This means that any shock to liquid wealth would induce a one-for-one change to consumption.

4.3 Model Estimation

In order to estimate the model, I take a two-step simulated method of moments approach. That is, I first calibrate exogenous model parameters to the data in the first step, and then estimate parameters generated via simulated model moments to match to empirical moments. In the first step, I calibrate the empirical expense distribution, (π_e, μ_e, σ_e), as well as the size of the income shocks (μ_y, σ_y). In particular, in the second step I estimate preference parameters β, ρ.

Prior to engaging in estimation of such a model, I firstly discuss the outcomes of a calibration exercise with the aforementioned model. First, I calibrate the empirical expense distribution, (π_e, μ_e, σ_e), as well as the size of the income shocks (μ_y, σ_y) to match the empirical moments in the data. I also calibrate the initial wealth distribution to match the empirical wealth of the low liquid wealth group in the data[17].

To simultaneously match both savings behavior and the consumption responses to auto expense events, two important feaures are necessary. The first affects the precautionary savings behavior generated by the model. A large amount of present-focus and an increase in risk-tolerance is necessary to match savings behavior by this group of households. Present-focus here means a particular high time discount rate parameter. I calibrate a model that can match savings behavior and the consumption response for the low liquid wealth group. The first row of table 8 shows the average sample consumption, sample savings out of labor income and the average estimated consumption response to an automobile repair expense.

[17] I use the previous 12-months of accumulated savings to estimate the wealth of households in the data

In table 8, I show that calibrated parameters $\hat{\beta} = .4, \hat{\rho} = 1.1$ can best match the sample $\bar{c}, \Delta\bar{m}, \Delta\bar{c}_e$. Furthermore, the last two columns of table 8 show that the buffer stock level, which is the level of wealth m such that $E_t[m_{t+1}|m_t] = m_t$, is also close to 0. That is, under these parameters, households hold very little in savings and hence, when faced with an automobile repair expense would need to draw from available credit.

Rows 3 and 4 show the average consumption and savings levels for households with parameters $\hat{\beta} = .9, \hat{\rho} = 1.5$ with calibrated wealth (m) in the range between ($[-2, 4]$). At this level of wealth, households would expect to consume far less than the sample equivalents. Furthermore, the expected drop in consumption in response to an automobile repair event would be negligible. Households would also reach an expected buffer stock level of wealth of around $\sim$ 28 months of labor income. That is, with levels of time-discounting that is less present-focused, the result of a large consumption drop would be unexpected and surprising. Furthermore, row 4 of table 8 suggests this is not driven by the knowledge of automobile repair risk itself. Shutting down the risk in the model results in very little change in consumption-savings behavior. Hence, suggesting that awareness is unlikely to play a role, at least from the perspective of accumulating buffer stock savings due to labor income risk. It is plausible though that labor income risk itself is misperceived. Though that would need to be tested in a separate context to automobile repair expenses.

Furthermore, in figure 9, I show the result of calibrating the model to the most constrained and least constrained groups as in table 7. The main difference arises from a difference in the calibrated borrowing limit of 0.7 and 1.7 respectively. The model can not only match the t_0 consumption response for both groups but also the full path of consumption responses in the months following. The greater borrowing capacity in the model means that a greater portion of households are not on the portion of their optimal consumption that is bound by credit constraints and where changes in wealth result in a greater change in consumption and thus, a greater ability to make use of credit to preserve consumption as is similar in the data.

Therefore, when interacting low savings behavior stemming from present-focus and including binding credit constraints can one simultaneously match empirical savings behavior and jointly match the consumption response to an auto expense event. Low savings behavior would not be enough, as on its own could be compatible with a higher level of averagge accumulated wealth, but that would fail to explain such a large consumption response to a sudden expense shock.

5 Welfare & Policy Discussion

I discuss the welfare consequences of a few possible policy interventions that can apply to households that have low liquid wealth stemming from present-focus, that face credit constraints, and are subject to emergency expense shocks. In these circumstances, we can either reduce the risk directly or provide financial accommodations to mitigate the consequences of such risk. The first policy intervention is simply to lower the frequency of automobile expenses. In real world terms, automobile expenses are a function of automobile usage, and the age of the vehicle. As shown in the data, areas with higher density or that have public transportation systems are correlated with less driving and hence lower frequency of gas expenses. An intervention that results in improved public transportation can both reduce the frequency of automobile expense events as well as offer temporary relief by allowing deferral of the timing of making an automobile expense. Hence, one exercise is to compute the welfare benefit from a reduction in auto expense frequency that matches the frequency of regions that are high in public transportation usage.

Two other policy interventions that rely on financial tools are the availability of credit and the existence of insurance. In the first case, we know that simply providing the same amount of borrowing capacity that the the above median split of the low liquid wealth category has to the below median split category will reduce the size of the consumption responses to automobile expense events in the latter group. The benefit of this exercise is that it computes the value of a counterfactual that at least some of the low liquid wealth group already faces.

Finally, another policy alternative is to compute the welfare benefit of holding insurance in which the household pays a monthly cost to avoid having to make the auto expense at the time of the event. The closest real world example of this are some existing insurance products that are sold in addition to automobile insurance to cover non-accident repairs.

5.1 Augmented Model

In order to conduct the previously mentioned policy exercises, I augment the model to allow for a richer representation of automobile expense events in the model. I now model automobile expense events as belonging to a two categories: maintenance and emergency repairs. The purpose of this is to allow households to endogenously make decisions over automobile expense spending. In addition to allowing for two type of expenses, I also allow for the household to choose to defer automobile expenses. In order for deferral to make sense in this context, I model the motivation for deferral to diverge depending on the expense type. In the case of a maintenance expense, deferral trades off being in a state of lower emergency expense frequency for present consumption. Whereas in the case of an emergency expense, deferral trades off unemployment for present consumption. In this way, I can better model the cases when a low liquid household is likely to defer and not defer an automobile expense. In the case of an emergency expense, a deferral means the household chooses not to fix an emergency expense and thus losing transportation access to work and hence being in a state of unemployment. In the case of a maintenance expense, deferral means labor income access is continued, but the household remains in a high state of emergency expense risk rather than in a low one.

Both features are important as I empirically find evidence of a greater reduction in the frequency of maintenance expenses rather than the frequency of emergency expenses for the most constrained group. This suggests, the likelihood of deferring an automobile expense is related to the immediate consequence of not making the expense.

Thus, I model that in each period, a household receives risky income y_t and the realization of an auto expense event $e_t \in (\text{maintenance}, \text{emergency}, \text{normal})$. In normal states, no auto expense event occurs, the household chooses (c_t, a_t), consumption and savings, subject to a borrowing constraint $-\underline{\text{a}} \leq a_t$, where $\underline{\text{a}} \geq 0$, such that:

$$V(m_t, e_t) = \max \mathbb{E}_t \sum_{n=0}^{T-t} \beta^n \frac{c_{t+n}^{(1-\rho)}}{1-\rho}$$

is optimized. Furthermore, household cash-on-hand, m_t, evolves each period as:

$$m_t = Ra_{t-1} + y_t$$

In the event of an emergency expense, the household has the choice to pay the expense $(\tilde{e}_e)$ in the same period, or face unemployment. In this case, paying the expense means $m_t = c_t + a_t + \tilde{e}_e$. Whereas unemployment means an immediate shock to permanent income of p_{ue}, a constant unemployment insurance payment of $y_t = y_{ue}$ in each period and a probability, π_{ue}, of transitioning out of unemployment back to a normal state in each period.

In the event of a maintenance expense, the household has the chance to pay the expense $(\tilde{e}_m)$ in the same period, or not. In this case, paying the expense means $m_t = c_t + a_t + \tilde{e}_m$, no chance of an emergency or maintenance shock in the next period, and a probability, π_m of transition back to a normal state in each period, otherwise remaining in a state of no emergency/maintenance shock. Not paying the expense means returning to a normal state in the next period.

An important feature of the model is the transition probability, π_m, out of a low emergency risk state to a high emergency risk state. One way to calibrate this parameter would be to use vehicle manufacturer statistics related to maintenance and the likelihood of facing an emergency repair event. Given the data available, I instead label automobile repair expenses that occur at dealerships, tire and oil shops to be in the maintenance category, and automobile repair expenses at garages and mechanics to be emergency expenses. While not a perfect separation in these two types of expenses, I do observe heterogeneity in the sample for the most borrowing constrained group and the less borrowing constrained along these expenses. Table 9 shows that the most borrowing constrained group has a 0.4% monthly probability of making a maintenance expense as opposed to 1.6% for the less constrained group. The total monthly probability for all automobile repair expenses is similar for both groups at 6.4% and 6.5% respectively. Hence, I estimate the transition probability π_m that can match this observed heterogeneity.

Figure 10 plots the value functions for making an maintenance expense when faced with a maintenance repair event. A transition probability of $\pi_m = .98$ for remaining in the same low emergency repair state is necessary to induce heterogeneity in maintenance spending based on credit constraints when households have present-focus. At a lower level, such as $\pi_m = .95$, households would not make any maintenance expenses for all levels of wealth.

Figure 11 plots the optimal consumption policy functions of the most borrowing constrained and least accumulated savings group in contrast to the least borrowing constrained and most accumulated savings group as in table 7. I separately estimate time-discount and risk aversion parameters for both groups. In order to reconcile the levels of consumption and savings given labor income risk and emergency expense risk, an annualized time-discount rate parameter of $\hat{\beta} = .302, \hat{\rho} = 1.12$ and $\hat{\beta} = .694, \hat{\rho} = 1.232$ is necessary to match consumption and savings moments of both groups respectively. In addition, I can match the consumption volatility, savings volatility, and consumption response to emergency expenses. The consumption response in the model is largely matched dueto a larger portion of the most borrowing constrained group being closer to their binding borrowing constraint. Finally, as previously discussed, in table 5, a maintenance transition probability of $\hat{\pi}_m = .971$ is necessary to match the maintenance spending across both groups in the data.

5.1.1 Discussion

Figure 12 plots the value functions of the various policy interventions. Interestingly, the credit policy intervention[18] and lower risk scenarios have the clearest benefit compared to the base case. Surprisingly, the insurance case actually hardly performs any better than the base case, this is likely driven by the extreme present-focus driving household behavior, where a monthly consumption cost is far greater than the benefit of having emergency expenses covered by the insurer.[19] Interestingly, there is a range of wealth where the household would value expanded credit even more than the the world without risk. This is where the household is very close to their borrowing constraint. At this level, the expanded borrowing constraint results in a greater benefit than even removing the risk completely. The point where these two intersect are where additional credit capacity provides little benefit as the household is further away from their credit constraint, and so a lower risk environment is preferable.

Table 10 shows the model moments of each policy intervention. Both the credit expansion and insurance scenarios result in a lower consumption response to an emergency expense. In particular, the expanded availability of credit leads to a roughly 33% reduction in the magnitude of consumption drops because of an emergency expense. The insurance scenario results in almost a complete elimination of the consumption drop, but this is because by design the insurance scenario means that apart from a 33% deductible (equivalent to 10% of monthly income), the emergency expense is payed off by the insurer.

An additional important consequence is the change in maintenance spending under the two interventions. For the credit capacity expansion, maintenance spending remains very similar to the base case (roughly maintenance spending occurs in both cases once cash-on-hand is greater than 1.7 times monthly income). On the other hand, under the insurance

[18]The size of the credit expansion also matters here, I implemented a 50% of monthly income increase in credit capacity. This is less than the difference between the borrowing limit difference between the high and low borrowing constraint groups.

[19]This is of course sensitive to the size of the consumption cost, which is modeled here at 1.1% of monthly income, the perfect competition expected cost of insurance. A lower consumption cost may make this option better relative to the base case, but this would be a subsidized insurance scenario. Of course a monthly cost of 0 is the same as the world without expense risk.

intervention, maintenance spending never occurs. Thus, while eliminating the loss from consumption drops, the insurance scenario results in moral hazard, in that it incentivizes households to avoid preventative maintenance expenditures, even though insurance is priced at cost and includes a deductible amount.

In order to compute the welfare benefit to the household under different policy interventions, I compare the present day wealth that the household would require to match the level of their value function to a world with the policy intervention.

$$V_1(m_1 + \lambda(m_1)) = V_2(m_1)$$

Here V_1 is the value function in the world without the policy intervention, and V_2 is the world with the policy intervention. I also average over $\int \lambda(m_1)$dm given the wealth distribution in the sample for the most constrained group.

Table 11 shows the average compensating variation under each policy intervention. Given how a large fraction of the sample is close to their borrowing constraint, the average benefit under the credit policy intervention is greater than the average benefit of removing automobile expense risk entirely by roughly a 50% difference (.34 monthly income versus .19 of monthly income). In addition, the welfare benefit under a world with at cost insurance would result in a negligible welfare change (close to -0.01 of monthly income). This is also true for insurance contracts with even greater coverage, such as including maintenance expenses and removing a deductible. While the insurance scenario eliminates the consumption drop, the trade off between a monthly consumption premium and the reduction in emergency expense risk is poorly valued by present-focused households. The welfare gains are essentially none, relative to the case of credit expansion, which while not eliminating the consumption drop, is far more greatly valued by borrowing constrained households.

6 Conclusion

As a body of literature has shown, the bottom 30-40% of the wealth distribution in the United States is exposed to emergency financial shocks. I make the case that notable among them is automobile repair events. Given the extent Americans rely on automobiles to commute to work, an important factor in shaping urban policy should take into account the necessity and riskiness of such financial decisions. In this context, public transportation infrastructure that elimantes the immediate need to make an emergency automobile repair can provide an insurance benefit against these shocks whereas an alternative such as private market insurance may lead to failure in takeup due to behavior consistent with present-focus. I also find that relaxing borrowing constraints in relation to spending on automobile repairs can also reduce the consumption cost of automobile expense risk.

By documenting the frequency and magnitude of out-of-pocket automobile expenses, I have shown evidence that this risk is both a frequent risk that many low-liquid wealth households must face and has considerably negative financial consequences by disrupting household consumption. Furthermore, unique to transportation is that urban areas with lower cost transportation implicitly insure households against both the need to expose a large fraction of wealth to automobiles and the need to finance automobile related operating expenses. Overall, this adds an important insurance benefit to policy that governments should consider when computing the benefits of investing in public transit infrastructure as an alternative to more complicated targeted financial insurance or by subsidizing access to credit. Especially given that public transit infrastructure investment decisions are often made on cost-benefit analysis that does not fully consider the expense risk generated by automobile transportation to the user. This suggests a possible significant underestimate of the welfare gain from public transit infrastructure from households who are likely to be highly sensitive to the availability of public transit infrastructure.

References

Andersson, F., J. Haltiwanger, M. Kutzbach, H. Pollakowski, and D. Weinberg. (2018). “Job Displacement and the Duration of Joblessness: The Role of Spatial Mismatch”. The Review of Economics and Statistics, 100(2), 203-218.

Bauer, M., J. Chytilova, and J. Morduch. (2012). “Behavioral Foundations of Microcredit: Experimental and Survey Evidence from Rural India”. American Economic Review, 102(2), 1118-1139.

Baum, C., (2009), “The effects of vehicle ownership on employment”. Journal of Urban Economics, 66(3), 151-163.

Bento, A., M. Cropper, A. Mobarak, and K. Vinha. (2005). “The Effects of Urban Spatial Structure on Travel Demand in the United States”. The Review of Economics and Statistics, 87(3), 466-478

Bureau of Labor Statistics, U.S. Department of Labor. (2017). “The Economics Daily, Consumer spending on vehicles averaged $8,427 in 2016”.

Campbell, J. (2006). ”Household Finance” Journal of Finance, 61(4), 1553-1604.

Carroll, C. (1997). “Buffer-Stock Saving and the Life Cycle/Permanent Income Hypothesis”. The Quarterly Journal of Economics. 112(1),1–55

De Nardi, M., E. French, and J. Jones. (2016). ”Medicaid Insurance in Old Age.” American Economic Review, 106(11), 3480-3520.

Diamond, R., M. Dickstein, T. McQuade, and P. Persson (2019). “Take-Up, Drop-Out, and Spending in ACA Marketplaces”. Working Paper.

Dobkin, C., Finkelstein, A., Kluender, R., and M. Notowidigdo. (2018). “The Economic Consequences of Hospital Admissions” American Economic Review, 108(2), 308–352.

Gabaix, X. (2016). “Behavorial Macroeconomics Via Sparse Dynamic Programming”. Working Paper

Hubbard, R., Skinner, J., and Zeldes, S. (1995). “Precautionary Saving and Social Insurance”. Journal of Political Economy, 103(2), 360-399.

Jørring, A. (2020). “The Costs of Financial Mistakes: Evidence from U.S. Consumers”. Working Paper.

Laibson, D. (1997) “Golden Eggs and Hyperbolic Discounting” Quarterly Journal of Economics, 112(2), 443–477.

Low, H., Meghir, C., and Pistaferri, L. (2010). "Wage Risk and Employment Risk over the Life Cycle" American Economic Review, 100(4), 1432-1467.

Mahoney, N. (2015). "Bankruptcy as Implicit Health Insurance." American Economic Review, 105(2), 710-46.

OECD (2017), "Car share in cities by region: As a percentage of all trips, Baseline, Robust Governance (ROG) and Integrated Land-Use and Transport Planning (LUT) scenarios", Sectoral outlook, OECD Publishing, https://doi.org/10.1787/9789282108000-graph56-en.

Olaffson, A., M. Pagel. (2018). "The Liquid Hand-to-Mouth: Evidence from Personal Finance Management Software". Working Paper.

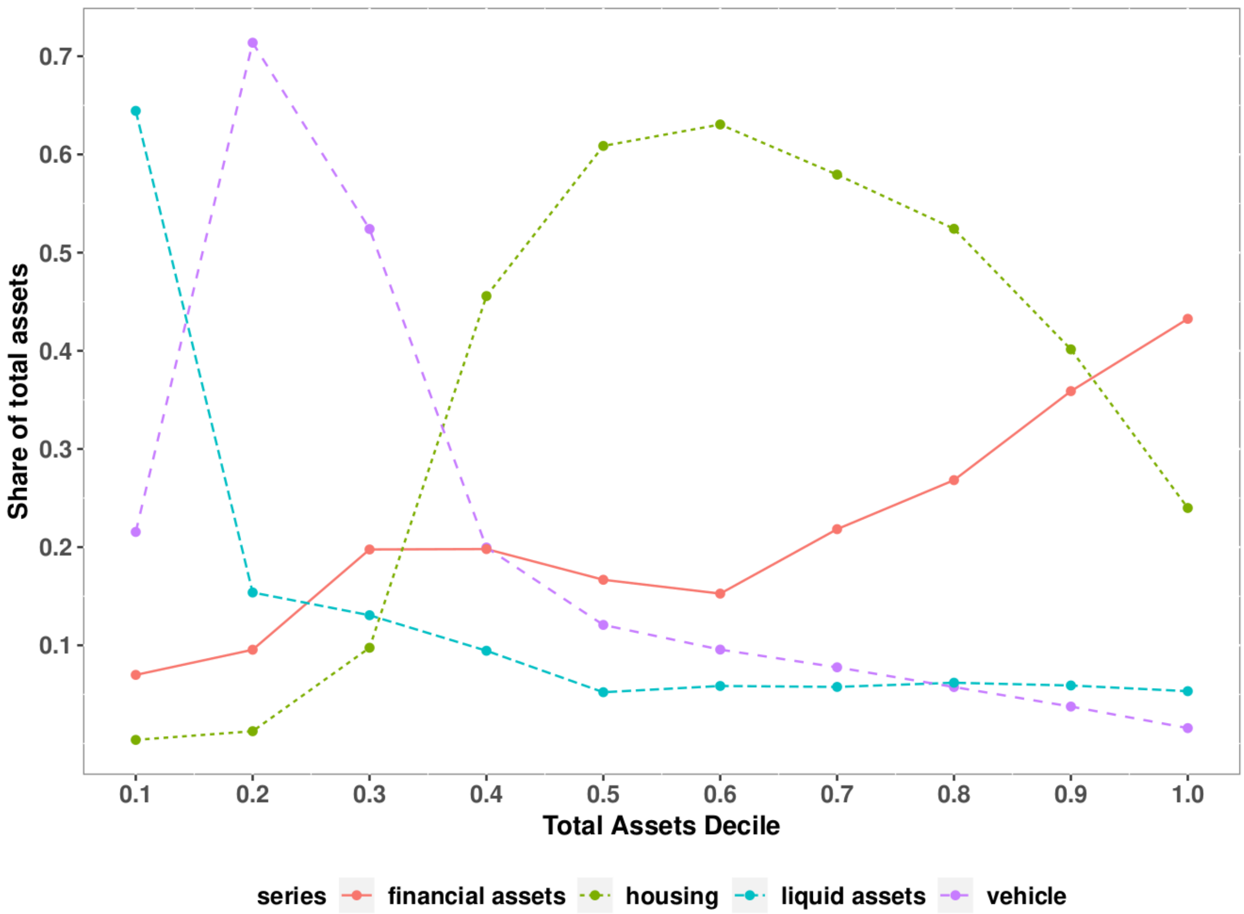
Palumbo, M. (1999). "Uncertain Medical Expenses and Precautionary Saving Near the End of the Life Cycle". The Review of Economic Studies, 66(2), 395–421.

Poterba, J. (1988). "Are Consumers Forward Looking? Evidence from Fiscal Experiments". The American Economic Review, 78(2), 413-418.

Souleles, N. (1999). "The Response of Household Consumption to Income Tax Refunds." American Economic Review, 89(4), 947-958.

7 Tables & Figures

Figure 1: **Household Wealth Composition by Decile**



This figure plots the mean share of wealth by asset category across the wealth distribution based on data from the 2016 Survey of Consumer Finances.

Table 1: **Annual Summary Statistics**

Category	*Sample Mean Within Decile:* 10th	30th	50th	70th	90th
Labor Income	19065	37321	51305	68494	98289
Consumption	34889	43168	51127	62295	82207
	BLS Mean Within Decile: 10th	30th	50th	70th	90th
Labor Income	5675	22757	41177	67239	116404
Consumption	22488	31317	41728	54797	82911

Table 2: **Geographic Representation**

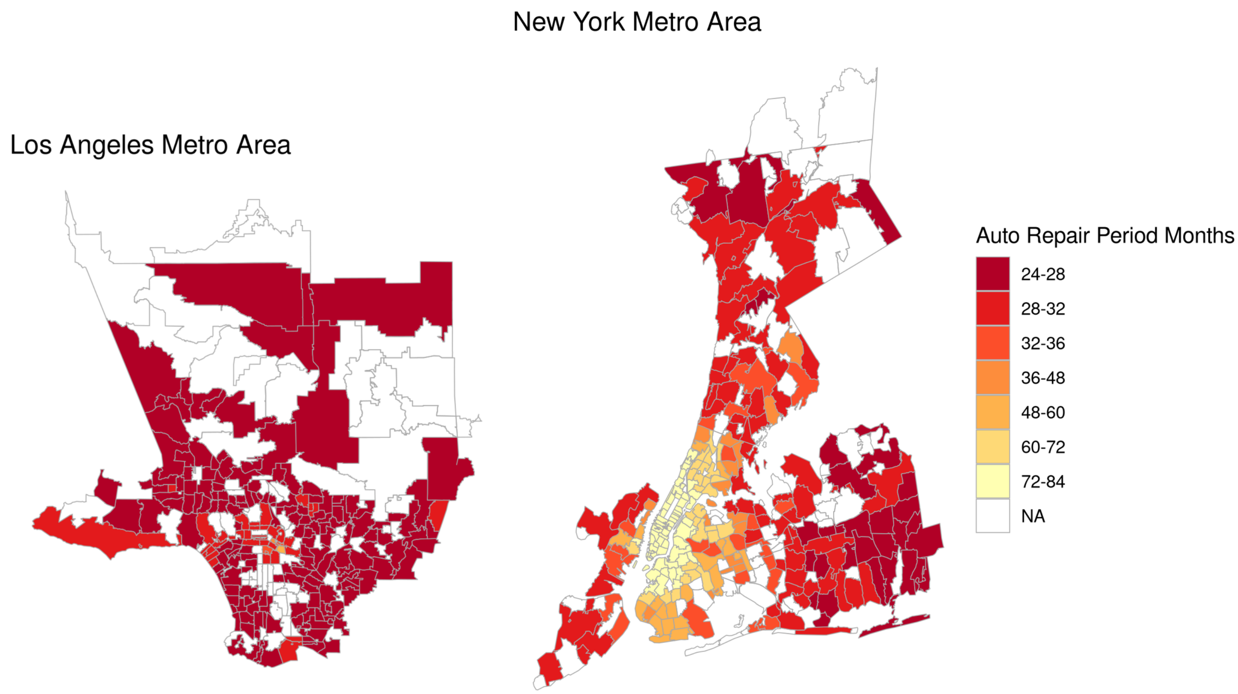
Region	*Percentage:* Sample	Actual
Northeast	0.161	0.171
Midwest	0.104	0.208
South	0.493	0.383
West	0.242	0.239

Table 3: **Monthly Summary Statistics**

	Full Sample	Below Median	Low Liquid Wealth
Labor Income	5461.8	3107.1	2165.1
	(8.332)	(3.965)	(4.26)
Consumption	5225.7	2629.6	1916.5
	(10.5)	(3.942)	(4.685)
Borrowing Limit	7655.6	3623.1	2547.2
	(7.144)	(5.577)	(7.877)
Auto Expense	66.92	36.3	25.15
	(0.5994)	(0.4816)	(0.6223)
1(Auto Expense≥200)	0.0902	0.0640	0.0523
	(0.0003)	(0.0005)	(0.001)
1(Auto Expense≥400)	0.0520	0.03328	0.0243
	(0.0002)	(0.0004)	(0.0006)
Gas Expense	170.1	116.8	98.59
	(0.232)	(0.321)	(0.4611)
Medical Expense	83.88	35.97	23.01
	(0.452)	(0.417)	(0.568)
1(Medical Expense≥200)	0.1527	0.0826	0.0602
	(0.0004)	(0.0006)	(0.0011)
1(Medical Expense≥400)	0.06305	0.0261	0.0155
	(0.0002)	(0.0003)	(0.0005)
N	23121	6190	2553
NT	800420	174838	48544

Sample means for three cuts of the data. The first is the fully matched labor income and credit card account dataset. The second only includes individuals of below median income and consumption, the third is only the low liquid wealth group.

Figure 2: **Automobile Repair Expense Frequency in New York & Los Angeles**



This figure plots the geographic heterogeneity in automobile expense frequencies in two cities, New York City and Los Angeles. The unconditional likelihood of an automobile expenses is both a function of differences in car ownership rates and in differences in vehicle miles traveled. Los Angeles exhibits a relatively uniform automobile expense risk, whereas New York City has a considerable degree of heterogeneity between the inner boroughs and surrounding suburbs.

Table 4: **Event-Study Estimates**

Dependent Variables:	Consumption	Credit Card Balance	Auto Repair Expense
Model:	(1)	(2)	(3)
Variables			
1-Month	-0.0949***	0.1113***	0.3125***
	(0.0102)	(0.0141)	(0.007)
Model:	(4)	(5)	(6)
Variables			
6-Month	-0.1711	0.1929**	0.3480***
	(0.1052)	(0.0834)	(0.0240)
Fixed-Effects			
Individual	Yes	Yes	Yes
Month	Yes	Yes	Yes
Year	Yes	Yes	Yes
Matched Control	No	No	No

Sample includes only below median income and low liquid wealth individuals. The mean monthly income is ≈ \$2200.

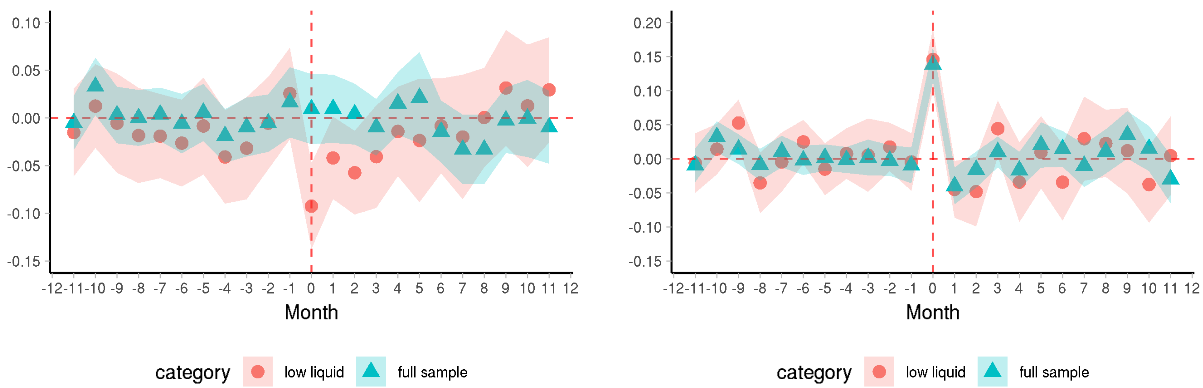
- Models (1),(2),(3) report the β coefficient of consumption, credit card balances, and auto repair expenses all normalized by monthly income at the 1-month time horizon.
- Models (4),(5),(6) report the β coefficient of consumption, credit card balances, and auto repair expenses all normalized by monthly income at the 6-month time horizon.

Table 5: **Matched Difference-in-Difference Estimates**

Dependent Variables:	Consumption	Credit Card Balance	Auto Repair Expense
Model:	(1)	(2)	(3)
Variables			
1-Month	-0.0928***	0.129***	0.3158***
	(0.0111)	(0.0143)	(0.008)
Fixed-Effects			
Individual	Yes	Yes	Yes
Month	Yes	Yes	Yes
Year	Yes	Yes	Yes
Matched Control	Yes	Yes	Yes

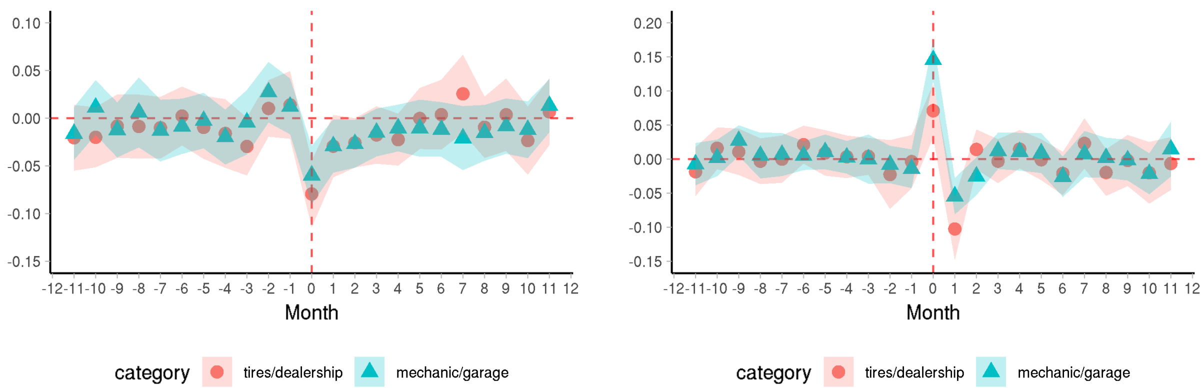
Sample includes only below median income and low liquid wealth individuals. The mean monthly income is $\approx$ \$2200.

Figure 3: **Consumption & Credit Card Balance Event-Study Plot**



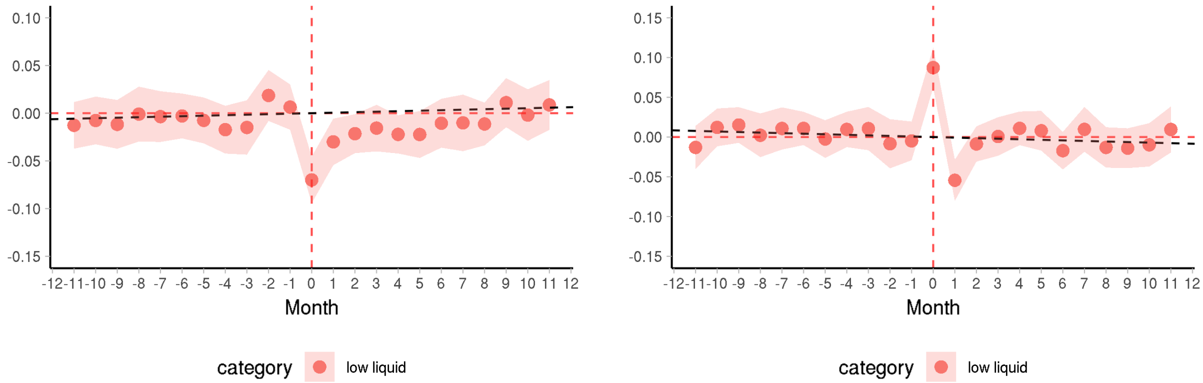
This figure plots monthly consumption and credit card balances changes normalized by monthly income from the event-study regressions centered at the month where the automobile repair event occurs.

Figure 4: **Consumption & Credit Card Balance Event-Study by Repair Type**



The main consumption result appears to be robust to splitting the type of automobile expense among dealership/tireshop locations vs mechanic/garage locations. In the former group, one might expect that the type of automobile expenses to be more predictable (tire replacements, oil changes), yet, neither category shows any sign of pre-trends. For credit card balances, dealership/tire events appear to be repayed immediately within 1-month as opposed to mechanic/garage repairs, which see larger initial balances that are carried for a longer period.

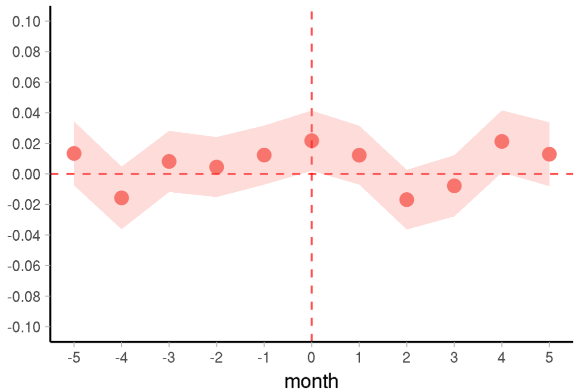
Figure 5: **Consumption & Credit Card Balance Event-Study with Linear Trend**

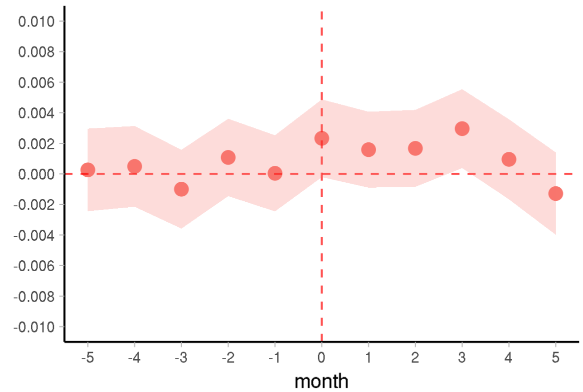


$$y_{it} = \delta j + \sum_{j=0}^{12} \beta_j \text{auto repair event}_{it} + \alpha_i + \alpha_t + \epsilon_{it}$$

- Similar to Dobkin (2018), I include a linear time trend regressor in the pre-period (δ). Both the linear time-trend and the event-study coefficents are plotted in the figure.
- The event-study coefficients after the event occurs show a clear break with the almost non-existent linear time trend.

Figure 6: **Labor Income & Gas Expense Event-Study Plot**





Event-study coefficients for labor income (left) and gas expenses (right) for the low liquid wealth group around the automobile repair event. Both are normalized by permanent monthly income. Neither labor income nor gas expenses see a significant change prior to the automobile repair event. Labor income does not appear to adjust at all, whereas gas expenses see a small percent increase post the automobile repair event.

Table 6: **Consumption Response & Low Liquid Wealth Threshold**

Dependent Variables:	Consumption			
Model:	(1)	(2)	(3)	(4)
Variables				
1-Month	-0.0843***	-0.0928***	-0.0498***	-0.0151
	(0.0202)	(0.0111)	(0.0107)	(0.0094)
Fixed-Effects				
individual	Yes	Yes	Yes	Yes
month	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes
matched control	Yes	Yes	Yes	Yes
$y - c$ Threshold	≤ 0.3	≤ 0.4	$\leq .75$	–
% of Below Median Income Sample	11%	28%	51%	100%
% of Full Sample	5%	10%	20%	50%

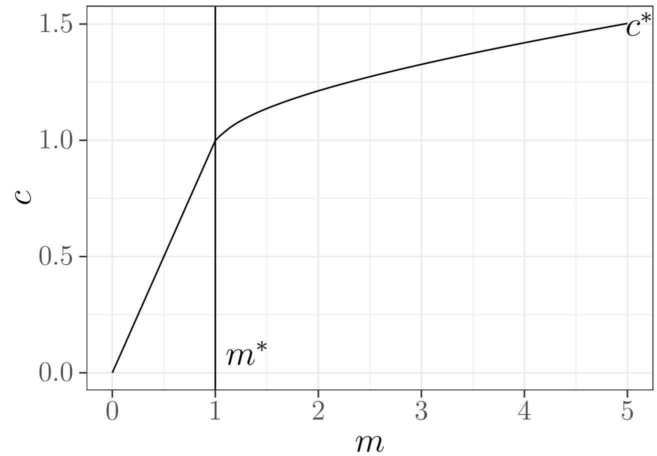
This table shows the consumption response in the same month as an automobile repair expense using different thresholds to determine liquid wealth. From left-to-right the threshold of $|y_t - c_t| < K$ is increasing, where K represents the thereshold normalized in monthly labor income terms. The idea is that the greater the ability to regularly consume either greater than labor income or to consume far less than labor income, the greater likelihood of either liquid wealth reserves or savings ability. Hence, a greater ability to minimize disruptions to consumption at the time of an automobile repair expense.

Table 7: **Consumption Estimates, Borrowing Constraints & Recent Savings**

	Non-savers		Savers	
	Low BC	High BC	Low BC	High BC
Model:	(1)	(2)	(3)	(4)
Dependent Variables:	Mean Checking Account Flow			
Variables				
Matched t_{-6}	-2.49	-3.38	-0.0709	-0.0922
	(0.172)	(0.183)	(0.082)	(0.1199)
Dependent Variables:	Mean Borrowing Limit			
Variables				
Matched t_{-6}	0.6946	1.883	0.7239	1.701
	(0.0221)	(0.059)	(0.021)	(0.0534)
Dependent Variables:	Consumption			
Variables				
1-Month	-0.115***	-0.121***	-0.0804***	-0.0558*
	(0.0235)	(0.0176)	(0.0172)	(0.0192)
Fixed-Effects				
Individual	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Matched Control	Yes	Yes	Yes	Yes

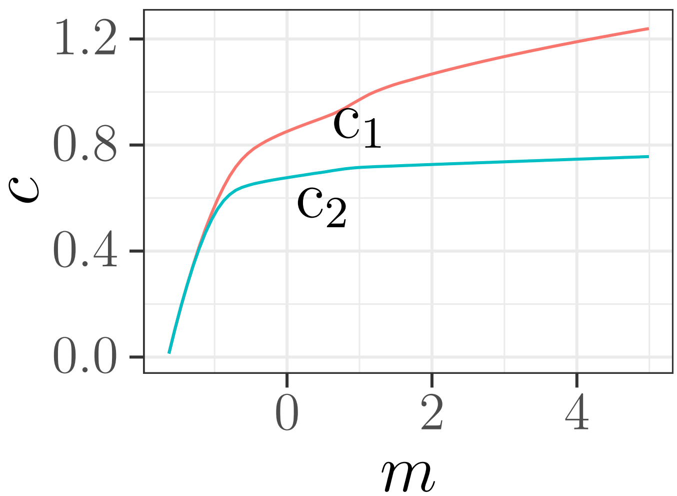
This table shows heterogeneity in the consumption response for the low liquid wealth group. The low liquid wealth groups is split by median borrowing limit and by median savings accumulation. The first column represents individuals who are both below median borrowing limit, as shown in row 2, and below savings accumulation, as shown in row 1. As borrowing limits increase and savings accumulation are increased, the average consumption response to an automobile repair expense decreases. This heterogeneity serves as motivation for the structural model, in particular, in allowing the ability to calibrate different borrowing constraints and allowing for time-discount preferences to match to observed consumption and savings levels.

Figure 7: **Optimal Consumption & Cash-on-hand Plot**



This figure plots the optimal consumption function of the household consumption model with exogenous expense risk as a function of cash-on-hand. m^* is the buffer-stock level, where $E[m_{t+1}|m_t] = m_t$

Figure 8: **Consumption & Cash-on-hand Plot**



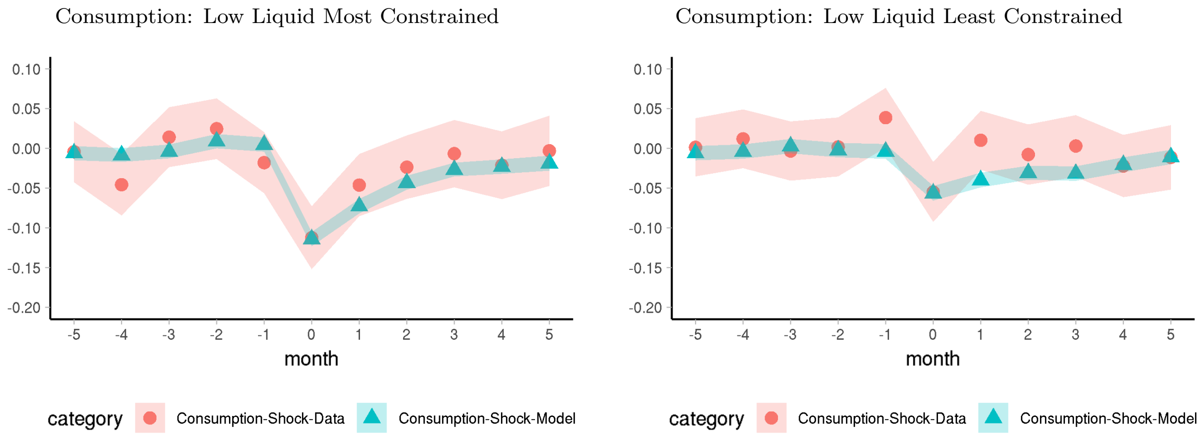
This figure plots the optimal consumption function as a function of cash-on-hand for the calibrated models (1) and (2) as in table 8.

Table 8: **Structural Model Moments**

	$\bar{c}$	$\Delta \bar{m}$	$\Delta \bar{c}_e$	m^*	$c(m^*)$
Sample	0.995	-.033	-0.096	–	–
Model (1): $\beta = 0.4, \rho = 1.1$	1.032	-.031	-0.097	-0.113	0.948
Model (2): $\beta = 0.9, \rho = 1.5$	0.731	0.268	-0.004	27.72	0.966
Model (3): $\beta = 0.9, \rho = 1.5, \pi_e = 0$	0.752	0.247	–	27.01	0.981

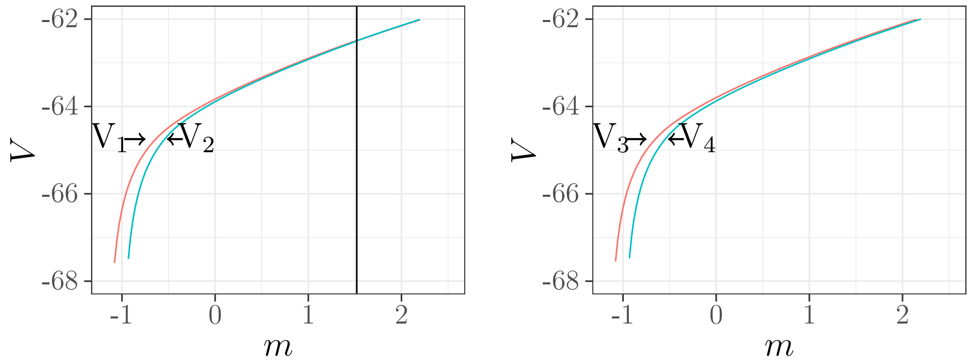
This table includes the sample mean consumption, savings and consumption responses normalized by monthly income in row 1. Rows 2,3 and 4 include model generated moment analogues, in addition to the buffer-stock level of cash-on-hand and the optimal consumption at the buffer-stock level. Model (3) contrasts with model (2) in that it shuts of automobile expense risk. Importantly, in order to jointly match the observed consumption-savings levels and the consumption response to an automobile repair expense, it is necessary to have time-discount preferences that induce low buffer-stock savings levels. Otherwise, the household would likely have sufficient cash-on-hand to avoid a large consumption response.

Figure 9: **Consumption Response Model & Sample Plot**



For both the most and least borrowing constrained groups, the model can not only match the t_0 consumption response but also the entire path of consumption. In both cases, household borrowing was calibrated to match the sample averages of each group.

Figure 10: **Value Function & Maintenance Spending Threshold Plot**

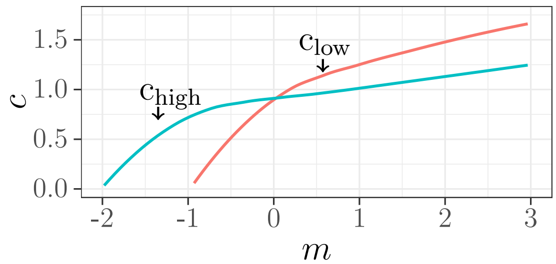


Comparison of minimum wealth thresholds for maintenance spending under different transition probabilities. Present-focus heavily skews households to avoid maintenance spending, similar to the disincentive to save, households valuation of the return on maintenance spending decreases with present-focus.

- When a maintenance shock occurs, V_1 is the value function of an individual who chooses to never spend on maintenance, and V_2 always makes a maintenance expense and holds belief $\pi_m^s = .98$. V_3 and V_4 are the analogous value functions with $\pi_m^s = .95$.
  - $V_1 > V_2$ for $m \in (-1.15, 1.5)$
  - $V_3 > V_4$ for all m.

- Estimated parameters $\hat{\beta}_1 = 0.302, \hat{\beta}_2 = 0.694, \hat{\rho}_1 = 1.120, \hat{\rho}_2 = 1.232, \hat{\pi}^s_m = .971$ to fit $(\bar{c}, \sigma_c, \Delta\bar{m}, \sigma_m, \sigma_{\Delta m}, \Delta\bar{c}_e, \bar{\pi}_m, \bar{\pi}_e)$.
- Calibrated parameters $-\underline{a}^{low} = 1, -\underline{a}^{high} = 2$

Figure 11: **Consumption & Cash-on-hand Plot**



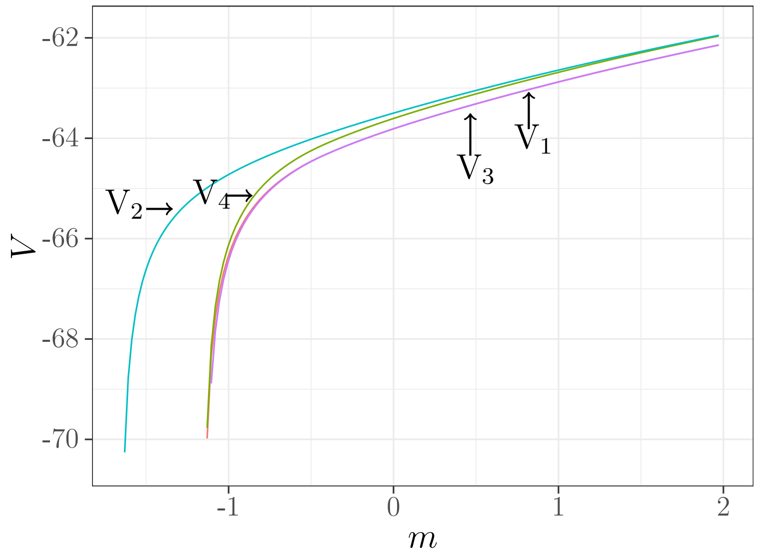
Plot of the optimal consumption to cash-on-hand for the low borrowing limit and high borrowing limit low liquid wealth groups. High borrowing limit corresponds to the least borrowing constrained and above median savings accumulated group in table 7. A time discount paramter that suggest a greater present-focus is necessary to match consumption for the most constrained group.

Table 9: **Augmented structural model moments, for the low and high borrowing cost groups.**

Low BC	$\bar{c}$	σ_c	$\Delta\bar{m}$	$\sigma_{\Delta m}$	$\Delta\bar{c}_e$	$\bar{\pi}_m$	$\bar{\pi}_e$
Sample	1.095	0.332	-0.097	0.381	-0.115	0.004	0.060
Model	1.019	0.389	-0.054	0.374	-0.099	0.000	0.050
High BC	$\bar{c}$	σ_c	$\Delta\bar{m}$	$\sigma_{\Delta m}$	$\Delta\bar{c}_e$	$\bar{\pi}_m$	$\bar{\pi}_e$
Sample	0.938	0.339	0.061	0.391	-0.056	0.016	0.049
Model	0.944	0.334	0.019	0.347	-0.036	0.018	0.046

The model can match consumption, savings, consumption response, and maintenance spending for both groups. Binding credit constraints and a greater degree of present-focus is consistent with a larger consumption drop and lower wealth accumulation.

Figure 12: **Value Function & Policy Alternatives Plot**



This figure plots the value function of the various policy interventions. With the insurance option performing the most poorly, and the credit expansion and lower frequency of risk options introducing the greatest welfare benefit.

- Comparing policy interventions
  - V_1: Base case with expense risk
  - V_2: Credit capacity expansion
  - V_3: Insurance option
  - V_4: No expense risk

Table 10: **Structural Model Moments & Policy Alternatives**

	$\bar{c}$	$\Delta\bar{m}$	$\Delta\bar{c}_e$	$\bar{\pi}_m$	$\bar{\pi}_e$
Sample	1.095	-0.097	-0.115	0.004	0.060
Base Case Low BC	1.019	-0.074	-0.099	0.000	0.050
Credit Expansion	1.034	-0.069	-0.065	0.001	0.051
Insurance	1.018	-0.054	-0.006	0.000	0.050

Model moments under each policy intervention for the most borrowing constraint group.

Table 11: **Welfare Computation & Policy Intervention**

	Policy Intervention				
	Credit	Insurance Emergency Only	Insurance Emergency & Maintenance	Insurance Emergency & Maintenance No Deductible	No Risk
Compensating Variation	0.342 ($752)	-.009 (-$20)	-0.033 (-$66)	-0.044 (-$97)	0.188 ($414)

Average compensating variation for the most borrowing constrained group under each policy intervention. The low dollar amounts partially reflect the high time-discount ($\hat{\beta} = .302$) for this group. The credit expansion scenario provides the greatest welfare improvement relative to even the no risk scenario. The various insurance interventions offer no welfare improvement to the household.