The Liquid Hand-to-Mouth: Evidence from Personal Finance Management Software

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Abstract

We use a very accurate panel of all individual spending, income, balances, and credit limits from a financial aggregation app, and we document significant spending responses to the arrival of both regular and irregular income. These payday responses are clean, robust, and homogeneous for all income and spending categories throughout the income distribution. Spending responses to income are typically explained by households' capital structures. Households that hold little or no liquid wealth have to consume hand-to-mouth. However, we find that few individuals hold little or no liquidity, and we report that liquidity holdings are much larger than predicted by state-of-the-art models that explain spending responses with liquidity constraints due to illiquid savings. Given that present liquidity constraints do not bind, we analyze whether individuals hold cash cushions to cope with future liquidity constraints. To that end, we analyze cash-holding responses to income payments inspired by the corporate finance literature. However, we find that individuals' cash responses are consistent with standard models without illiquid savings, and neither present nor future liquidity constraints being frequently binding. Because these models are inconsistent with payday responses, we feel that the evidence therefore suggest the existence of "liquid hand-to-mouth" households that spend heuristically.

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1 Introduction

Standard economic theory states that consumption should not respond to the timing of predictable changes in disposable income.[1] However, a number of empirical studies report that consumption responds to disposable income or that it is "excessively sensitive" to income.[2] This excess sensitivity and the mechanisms behind it are important for understanding the effectiveness of short-term stimulus payments among other policy prescriptions. Recent advances in the literature explain excess sensitivity with households' capital structures. In the presence of illiquid savings, many households consume hand-to-mouth because they hold little or no liquid wealth (Kaplan et al., 2014; Kaplan and Violante, 2014b; Laibson et al., 2015). Using very accurate data on spending, income, balances, and credit limits, this paper shows that (1) spending is excessively sensitive to income payments for at least half the population; (2) less than 3 percent of individuals have less than one day of spending left in liquidity before receiving their paychecks; and (3) liquidity holdings are at least three times greater than predicted by the state-of-the-art economic models. Because current liquidity constraints are not binding, we then analyze whether cash-holding responses indicate the presence of insufficient cash cushions and future liquidity constraints–inspired by the cash-flow sensitivity of cash work in the corporate finance literature (Almeida et al., 2004). However, we find that individuals' cash-holding responses do not indicate the presence of insufficient cash cushions or future liquidity constraints.

Our findings thus suggest that many households consume hand-to-mouth despite not being liquidity constrained in the present or the future. This is important because the policy implications for liquidity constraints are the opposite of the policy implications for low resources: the former suggest credit-market inefficiencies and that credit should be expanded, whereas the latter may suggest that individuals overconsume and credit should be restricted. Campbell and

[1] This is true for both the standard consumption-savings model (Friedman, 1957; Hall, 1978) and the more recent "buffer-stock" versions (Deaton, 1991; Carroll, 1997).

[2] Examples of micro evidence on excess sensitivity are Parker (1999), Souleles (1999), Shapiro and Slemrod (2003a), Shapiro and Slemrod (2003b), Shapiro and Slemrod (2009), Johnson et al. (2006), Parker et al. (2013), and Broda and Parker (2014), as surveyed in Jappelli and Pistaferri (2010) and Fuchs-Schundeln and Hassan (2015). Macro evidence is provided by Campbell and Mankiw (1989) and Campbell and Mankiw (1990) in response to the seminal paper by Flavin (1981).

Mankiw (1989) are the first to assume that a fraction of income goes to hand-to-mouth consumers (who consume part of their disposable income each period), whereas the remainder goes to consumers who optimize intertemporally. Several papers have since studied the implications of including hand-to-mouth consumers on monetary and fiscal policy in macroeconomic models. However, Kaplan and Violante (2014b) argue that measurements of hand-to-mouth behavior that use balance sheets are misleading because they focus on poor hand-to-mouth households and overlook "wealthy hand-to-mouth" households, which hold sizable amounts of wealth in illiquid assets despite having very little to no liquid wealth. In addition to the poor and wealthy hand-to-mouth, this paper suggests that another class of households exists, the liquid hand-to-mouth, who indeed consume heuristically rather than optimizing intertemporally.

In contrast to the standard economic model, though in line with previous studies, we start by documenting significant spending responses on paydays of both regular and irregular income. These payday responses are clean, robust, and homogeneous for all income and spending categories throughout the income distribution. Such hand-to-mouth behavior is predominantly explained by liquidity constraints. However, we find that almost all households spend when income becomes available–independent of whether or not they are liquidity constrained. Our measures of liquidity constraints include income, balances, credit limits, and the presence or absence of household spending on (discretionary) goods and services immediately before and on payday. However, we conclude that the fraction of constrained households is too small to quantitatively generate the degree of excess sensitivity documented empirically, and we also find that liquidity holdings are too large to generate high marginal propensities to consume out of fiscal stimulus payments in the models of Kaplan and Violante (2014b) and Laibson et al. (2015).

These findings could be explained by our measure of liquidity constraints not capturing whether or not households actually feel liquidity constrained. More specifically, the measurement of liquidity constraints via balances and credit limits is not applicable if households hold cash or credit cushions either to cope with unforeseen expenses or to save for foreseen expenses. Such insufficient cash cushions and potentially binding future liquidity constraints may explain

payday responses even when present liquidity constraints are not binding. To address this conjecture, we show large spending responses by individuals who recently received a large exogenous wealth shock due to a court ruling. Additionally, we examine cash-holding responses to income payments for different measures of liquidity constraints; inspired by Almeida et al. (2004)–a highly-cited paper in the corporate finance literature that proposes to look at cash rather than investment sensitivities to cash inflows. If individuals are worried about binding liquidity constraints in the future and hold insufficient cash cushions, they have a high propensity to hold on to the cash upon receiving income payments. We thus compare the empirical patterns of individuals' cash-holding responses with the predictions of three models: (1) a standard model in which individuals hold their lifetime savings in cash, such that the marginal propensity to hold on to cash is simply the reverse of the marginal propensity to consume; (2) a model with liquid and illiquid savings in which individuals optimally hold little or no cash; and (3) a model with liquid and illiquid savings in which future liquidity constraints bind frequently. The third model predicts a decreasing relationship between cash-holding responses and liquidity, thus capturing insufficient cash cushions. In other words, a "soft" liquidity constraint is binding even though "hard" liquidity constraints are not. However, we find that individuals' cash-holding responses to income payments correspond to the first standard model, which cannot explain high marginal propensities to consume. Thus, we conclude that neither current nor future liquidity constraints (or hard and soft liquidity constraints) seem to explain payday responses. In our minds, the prevalence of payday responses in the population points toward a different theoretical explanation. We theorize that households consume heuristically and feel they have a license to spend upon receiving their income.

We follow Gelman et al. (2014), Baker (2013), Kuchler (2015), and Kueng (2015) in using data from a financial aggregation and service application (app), which overcomes the accuracy, scope, and frequency limitations of the existing data sources of consumption and income. Gelman et al. (2014) were the first to advance the measurement of income and spending with this high-frequency app data, which is derived from the actual transactions and account balances of individuals. Gelman et al. (2014) find that there is a spending response to the arrival of

anticipated income providing evidence of excess sensitivity. However, the authors find that this excess sensitivity of spending largely results from the coincident timing of regular income and regular spending, while the remaining excess sensitivity is concentrated among individuals who are likely to be liquidity constrained. The authors consider total spending, nonrecurring spending, and spending on fast food and coffee shops in response to the arrival of regular paychecks or Social Security payments. Because our data comes from Iceland, it is particularly well suited for drawing a more precise picture of both regular and irregular income and many spending categories for three reasons. (1) The income and spending data is pre-categorized (and Iceland is a small country, which makes accurate categorization easy); (2) the app is marketed through banks and supplied for their customers (thus covering a fairly representative sample of the population); and (3) the data is basically free of the one remaining shortcoming of app data–the absence of cash transactions (in Iceland, consumers almost exclusively use electronic means of payment). Thus, our data is exceptionally thorough with respect to capturing all spending, even compared with data sets of the same type.

We apply the identification strategy from Gelman et al. (2014) to our income and spending panel data to document payday responses, but, unlike Gelman et al. (2014), we do not conclude that excess sensitivity is limited to liquidity-constrained individuals or non-coffee-shop spending. First, we observe much cleaner and more homogeneous spending responses than do Gelman et al. (2014) for all income levels and every income and spending category. When we split the sample into ten income deciles, we observe a monotonic decrease in the initial spending response from 70 percent to 40 percent above the average daily spending. However, we fail to observe payday responses of less than 40 percent, even when splitting the sample in many other ways. We analyze heterogeneity by running regressions at the individual level and find that only 20 percent of the population displays payday responses between zero and 20 percent, while at least 50 percent of the population displays payday responses of more than 20 percent. Second, we observe robust spending responses for consumers who are not liquidity constrained according to our measures. To ensure that we do not pick up the coincident timing of consumption commitments and income (as explained in Gelman et al. (2014)), we generally limit

our spending measures to non-recurring spending (i.e., spending for which individuals have to swipe their cards). We also examine immediate consumption categories (such as restaurants), discretionary categories (such as alcohol), and unlikely-to-coordinate-on categories (such as groceries). Additionally, we perform our analyses on individuals whose income schedules do not coincide with typical patterns, and we examine irregular and exogenous income categories (such as tax rebates) to confirm our previous findings.[3] Additionally, we examine the internal versus external margins of spending and sort individuals according to different proxies for financial sophistication–such as holding savings and overdrafts simultaneously.

A natural question arises regarding the economic importance of understanding these payday responses. After all, the calculations of Browning and Crossle (2001) show that the utility loss from setting consumption equal to income (instead of smoothing it perfectly) is second order in a plausibly parameterized life-cycle buffer stock model. Cochrane (1989) and Krusell and Smith (1996) perform similar calculations in a representative agent environment. However, we think that payday effects are important for six reasons. First, we document payday responses that are so clean and homogeneous throughout a population holding substantial liquidity that they appear to point toward a shortcoming in the way that we currently model economic behavior in a life-cycle consumption context. Individuals seemingly do not intertemporally optimize but instead use heuristics to decide how much to consume and save. In this paper, we remain agnostic about which environmental or preference-related theories drive hand-to-mouth behavior, and we assume that this behavior may be caused by any cognitive, computational, or time limits of the household and that it may simply be a rule of thumb. However, we believe that our results call attention to an important issue: the lack of rigorous, portable, and generally-applicable models of such behavior. An early example of such a theory is Campbell and Mankiw (1989), who simply assume that a fraction of income goes to hand-to-mouth

[3]We have the following regular income categories: child support, benefits, child benefits, interest income, invalidity benefits, parental leave, pension income, housing benefits, rental benefits, rental income, salaries, student loans, and unemployment benefits. In addition, we have the following irregular income categories: damages, grants, other income, insurance claims, investment transactions, reimbursements, tax rebates, and travel allowances. The spending categories are groceries, fuel, alcohol, ready-made food, home improvements, transportation, clothing and accessories, sports and activities, and pharmacies. We can observe expenditures on alcohol that is not purchased in bars or restaurants because a state-owned company, the State Alcohol and Tobacco Company, has a monopoly on the sale of alcohol in Iceland.

consumers who consume part of their disposable income each period. Beyond this approach, the only existing theory that rationalizes our findings is modeled in Delikouras and Korniotis (2014), who assume that individuals' marginal utilities of consumption increase upon the arrival of income because they feel they have a license to spend. Second, for countercyclical fiscal policy, it is important not only to know the rate at which fiscal stimulus payments are consumed by households but also to understand the mechanisms behind the effectiveness of tax rebates as short-term stimuli for aggregate consumption. A collective body of evidence has convincingly concluded that households spend between 20 and 40 percent of rebates on nondurables in the quarter that they are received. Kaplan and Violante (2014b) offer a quantitative study of these episodes within a structural, dynamic, and forward-looking model. In line with Kaplan and Violante (2014b), we find that hand-to-mouth behavior is pervasive across all income classes. However, unlike Kaplan and Violante (2014b), we find that very few hand-to-mouth consumers are liquidity constrained as measured by their liquid wealth. Additionally, we do not find the patterns in cash responses that are predicted by a model with illiquid savings and insufficient cash cushions or future liquidity constraints. To figure out whether or not individuals are liquidity constrained as opposed to just having low resources is of huge importance: after all, liquidity constraints call for policy measures that expand credit versus low resources may be caused by overconsumption problems in which case credit should be restricted. Finally, we confirm the finding of Parker (2014) that liquidity appears to be a very persistent household trait rather than the product of swings due to transitory income shocks, as predicted in the Kaplan and Violante (2014b) model. Third, the analysis of individuals' cash holdings is important, as cash holdings have high opportunity costs if individuals are to invest their cash in the stock market. We assess whether individuals hold cash cushions to cope with future liquidity constraints; however, we find that neither present nor future liquidity constraints appear to matter, which implies that individuals forgo a considerable amount of return on their wealth by holding cash. Thus, this evidence suggests that the need for cash cushions does not bring about non-participation in the stock market. Fourth, the increase in spending on paydays could explain the finding of Andersson et al. (2015) that excess mortality increases on payday for activity-related reasons.

Fifth, payday responses are potentially important because a monthly cycle in household expenditures could trigger a price-discriminating response by firms. Hastings and Washington (2010) use scanner data from the US and find that supermarkets have a procyclical pricing strategy. Prices are high at the beginning of the month and low at the end. Sixth, we recommend caution regarding some policy prescriptions put forward in the existing literature. Parsons and van Wesep (2013), for example, argue that paychecks could be distributed more often to improve consumption smoothing and welfare. However, our results suggest that frequent disbursement may lead to higher overall consumption, as partially found by Aguila et al. (2015).

2 Literature Review and Theoretical Background

Other empirical papers that examine expected temporary payments to test the permanent income hypothesis include Shapiro and Slemrod (1995), who conduct a phone survey in which 43 percent of the respondents report mostly spending a perfectly temporary income shock due to a reduction in tax withholding. The authors conclude that such spending is driven by a proportion of people who follow a simple rule to spend their current paychecks rather than by liquidity constraints. Shapiro and Slemrod (2003a) use a similar survey to investigate the effect of the income tax rebate of 2001 and find that 22 percent report that they would mostly spend it–thus supporting the existence of hand-to-mouth consumers. Parker (1999) examines whether or not spending changes when take-home pay increases in the months after wage earners hit the earnings ceiling for Social Security payroll taxes and concludes that hand-to-mouth behavior explains the correlation between consumption and take-home pay rather than liquidity constraints. However, these studies on the share of hand-to-mouth consumers are based on surveys that make "following the money" of consumers difficult because respondents may have little incentive to answer the questions accurately, may not understand the wording of the questions, or may behave differently in practice and forget their reported behavior. Moreover, such measurement error or noise in the data generated by surveys that simply ask about past purchases can increase with the length of the recall period (de Nicola and Giné, 2014). Additionally, sur-

veys can produce biased (rather than merely noisy) data if respondents have justification bias, concerns about surveyors sharing the information, or stigma about their consumption habits (Karlan and Zinman, 2008).

Previous work on payday effects has restricted its attention to subpopulations. These papers document that expenditures and the caloric intake of poor households increase on payday (e.g., Stephens, fthc; Huffman and Barenstein, 2005; Shapiro, 2005). More specifically, Stephens (fthc) and Mastrobuoni and Weinberg (2009) find that both consumption expenditures and consumption are higher in the week after Social Security checks are distributed than in the week before. Mastrobuoni and Weinberg (2009) propose hyperbolic discounting as an explanation for households with few or no assets. Shapiro (2005) also rejects the exponential discounting model by showing that food stamp recipients consume 10 to 15 percent fewer calories the week before food stamps are disbursed. Stephens and Unayama (2011) exploit an exogenous change in the frequency of pension payments in Japan holding total pension income constant. Public pension benefits were paid out every three months before the change and once every two months after. They find that, after the change, elderly households are better able to smooth consumption expenditures. However, Vellekoop (2013) shows that more frequent disbursements of checks could back-fire, as the payment of consumption commitments plays a role for disposable liquidity. Additionally, there exists evidence of intra-monthly cycles in financial crimes (Foley, 2011) and mortality (Evans and Moore, 2012). With respect to behavior and cognitive function around paydays, Carvalho et al. (fthc) fail to find before-after payday differences in risk-taking, the quality of decision-making, the performance in cognitive function tasks, or in heuristic judgments. Our results also suggest more present bias on paydays when individuals are less constrained rather than before paydays.

As noted by Kaplan and Violante (2014b), wealthy individuals may engage in hand-to-mouth behavior due to illiquid wealth. Recent theoretical examples of models with liquid and illiquid assets are Angeletos et al. (2001), Laibson et al. (2003), Flavin and Nakagawa (2008), Chetty and Szeidl (2007), Alvarez et al. (2012), Huntley and Michelangeli (2014), and Kaplan and Violante (2014a). Angeletos et al. (2001) and Laibson et al. (2003) show that

households with hyperbolic-discounting preferences optimally decide to lock their wealth in the illiquid asset in order to cope with self-control problems. Such self-control problems are also generated in the models by Bucciol (2012) and Pagel (2013). Kaplan and Violante (2014a) do not need to assume that households have hyperbolic-discounting preferences and still generate a high marginal propensity to consume out of transitory shocks in a two-asset environment. Moreover, Flavin and Nakagawa (2008) define a utility function over two consumption goods– one representing non-durable consumption and one representing housing (that is characterized by adjustment costs). As the utility function depends non-separably on the two goods, non-durable consumption is excessively sensitive. A similar utility function is assumed by Chetty and Szeidl (2007); however, this function is separable in the two goods, which implies that consumption is excessively sensitive with respect to the durable good only.

In a one-asset environment, Koszegi and Rabin (2009) show that, in an environment with little to no uncertainty, agents with reference-dependent preferences may consume entire windfall gains. Moreover, Reis (2006) assumes that agents face costs when processing information and thus optimally decide to update their consumption plans sporadically, resulting in excessively smooth consumption that is shown to matter in the aggregate by Gabaix and Laibson (2002). Additionally, Tutoni (2010) assumes that consumers are rationally inattentive, and Attanasio and Pavoni (2011) show that excessively smooth consumption results from incomplete consumption insurance due to a moral hazard problem. Moreover, recent papers test the permanent income hypothesis using data from the labor market. Card et al. (2006) estimate the excess sensitivity of job search behavior to cash-on-hand, and Basten et al. (2014) examine the effect of severance payments on non-employment duration. Finally, Dupas et al. (2015) find that bicycle taxi drivers in Western Kenya work more in response to cash needs.

3 Data and summary statistics

3.1 Data

This paper exploits new data from Iceland generated by Meniga, a financial aggregation software provider to European banks and financial institutions. Meniga has become Europe's leading private financial management (PFM) provider. Meniga's account aggregation platform allows bank customers to manage all their bank accounts and credit cards across multiple banks in one place by aggregating data from various sources (internal and external). Meniga's financial feed documents consumers' budgets in a social media style. Categorized transactions are combined with automated and custom advice, notifications, messages, merchant-funded offers, and various insights into and interpretations of the users' finances. Figure 1 displays screenshots of the app's user interface. The first screenshot shows the background characteristics that the user provides; the second one shows transactions; the third one shows bank account information; and the fourth one shows accounts that can be added.

In October 2014, the Icelandic population was 331,310, and one-fourth of Icelandic households were using the Meniga app. Because the app is marketed through banks and automatically supplied to customers using online banking, the sample of Icelandic users is fairly representative. Each day, the application automatically records all bank and credit card transactions (including descriptions as well as balances), overdraft limits, and credit limits. We use the entire de-identified population of active users in Iceland and the data derived from their records from 2011 to 2015. We perform the analysis on normalized and aggregated user-level data for different income and spending categories. Additionally, the app collects demographic information such as age, gender, marital status, and postal code. Moreover, we can infer employment status, real estate ownership, and the presence of young children in the household from the data. Presumably, the user population is not perfectly representative of the Icelandic population, but it is a large and heterogeneous sample that includes many users of different ages, education levels, and geographic locations.

3.2 Summary statistics

Table 1 displays summary statistics of the Icelandic users, including not only income and spending in US dollars but also some demographic statistics. We can see that the average user is 40 years old, 15 percent of the users are pensioners, 50 percent are female, 20 percent have children, and 8 percent are unemployed. For comparison, Statistics Iceland reports that the average age in Iceland is 37 years, 12 percent of Icelanders are pensioners, 48 percent are female, 33 percent have children, and 6 percent are unemployed. Thus, our demographic statistics are remarkably similar to those for the overall Icelandic population. This comparability is reassuring, as one concern with app data use is that the user population is more likely than the overall population to be young, well situated, male, and tech savvy. The representative national household expenditure survey conducted by Statistics Iceland also reports income and spending statistics. In Table 1, parentheses indicate when spending categories do not match perfectly with the data. We can see that the income and spending figures are remarkably similar for the categories that match well. Figures 2 to 4 show the distribution of regular, salary, and irregular income payments over the course of a month. Approximately 85 percent of the individuals in the sample are paid on a monthly basis, whereas the remainder are paid on a more frequent basis. This variation allows us to also consider individuals who are paid on unusual schedules. Additionally, the irregular payments are distributed rather evenly over the course of the month.

4 Analysis

In this study, we estimate payday effects by running the following regression

$$x_{it} = \sum_{k=-7}^{7} \beta_k I_i(Paid_{t+k}) + \delta_{dow} + \phi_{wom} + \psi_{my} + \eta_i + \epsilon_{it} \tag{1}$$

where x_{it} is the ratio of spending by individual i to his or her average daily spending on date t, δ_{dow} is a day-of-the-week fixed effect, ϕ_{wom} is a week-of-the-month fixed effect, ψ_{my} is a month-by-year fixed effect, η_i is an individual fixed effect, and $I_i(Paid_{t+k})$ is an indicator that

is equal to 1 if i receives a payment at time $t + k$ and that is equal to 0 otherwise. The β_k coefficients thus measure the fraction by which individual spending deviates from the average daily spending in the days surrounding the receipt of a payment. We use indicator variables for income payments to alleviate potential endogeneity concerns at the income level. The day-of-the-week dummies capture within-week patterns for both income and spending. Standard errors are clustered at the individual level. We will initially differentiate between the arrival of regular and irregular income and separate households into ten income deciles. We can also include day-of-the-month fixed effects because there is considerable additional variation on which day individuals are paid due to weekends and holidays.

4.1 Regular income payments

Figure 5 displays the spending responses to regular income payments of households in ten different income deciles, as measured by their regular salaries. Both poor and rich households clearly respond to the receipt of their income, with the poorest households spending 70 percent more than they would on an average day and the richest households spending 40 percent more. Even for the richest households, we observe a surprisingly high consumption response. Table 2 presents all regression results for four income quartiles and four types of spending. While grocery and fuel spending can be regarded as necessary, ready-made food (such as restaurants) and alcohol spending can be regarded as discretionary. Moreover, Figures A.1 and A.2 separately display the spending responses to income for necessary categories and discretionary categories. Individuals are equally inclined to spend on necessary and discretionary goods and services upon receiving their income. There is no change in permanent income on paydays and there is no new information because paydays are perfectly predictable. While a buffer stock model can potentially explain sensitivity to surprising large payments or changes in permanent income, it cannot explain sensitivity to regular paydays. To the extent that paydays are predictable, these payday responses are inconsistent with standard models of consumption and savings. Although we focus on irregular spending and control for day-of-the-week fixed effects, this spending response to regular income might stem from the coincident timing of reg-

ular income and irregular spending. Therefore, we will now examine irregular income. As a quick reminder, regular income categories include child support, benefits, child benefits, interest income, invalidity benefits, parental leave, pensions, housing benefits, rental benefits, rental income, salaries, student loans, and unemployment benefits. The irregular income categories include damages, grants, other income, insurance claims, investment transactions, reimbursements, tax rebates, and travel allowances.

4.2 Irregular income arrival

Figure 6 displays the spending responses to irregular income payments of households in ten different income deciles, which are measured by their regular salaries. Again we observe both poor and rich households responding to the receipt of their income, and poor households' spending responses are somewhat more pronounced. Again, even for rich households, the spending response on payday is large and significant, at approximately 40 percent. Thus, we do not observe that the bulk of the spending responses to income or the excess sensitivity of consumption is due to poor households or the coincident timing of regular income and spending, as proposed in Gelman et al. (2014). More generally, the payday responses appear to be considerably cleaner and more homogeneous than those documented in Gelman et al. (2014).[4]

4.3 Heterogeneity

We are interested in the question of whether the payday responses are prevalent for a large fraction of the population or are being driven by a small fraction of the population. To do so, we run a regression for each individual in four income and salary quartiles and display their individual payday coefficients in Figure 7. Approximately 22 percent of the individuals have a payday coefficient equal to zero. There are some negative coefficients but a greater number of positive coefficients, which results in an average coefficient of approximately 0.6 for the lowest

[4]To understand why our payday responses appear to be cleaner, we reran the regressions using only 300 consecutive days in 2012 and 2013, as Gelman et al. (2014) use, but we find very similar responses. We thus conclude that our categorization and measurement of spending and income make a difference.

quartile and 0.4 for the highest quartile. Therefore, at least half of the population, rather than a small fraction of the population, displays substantial payday responses.

4.4 Internal versus external margin of spending

We are interested in the question of whether payday responses are an internal or external phenomenon in the sense of individuals spending more when they go shopping or making an additional shopping trip. In Table 3, we display the results of regressions that estimate how much more likely individuals are to buy in different categories, such as groceries, fuel, and restaurants, on their payday. For instance, individuals are 11 percent more likely to go on any shopping trip on paydays. In a second set of regressions, we then compare how much they spend if they shop on a payday relative to any other day. Individuals spend 21 dollars more on all shopping trips on their paydays. Because individuals spend, on average, 50 dollars every day on non-recurring consumption and approximately 80 dollars on paydays, this 21 dollar increase corresponds to approximately 80 percent of the increase in spending on paydays (30 dollars). Thus, individuals are more likely to go shopping and, if they go shopping, they spend more than they would on a shopping day when they do not get paid.

4.5 Financial sophistication

We observe a number of potential proxies for financial sophistication: age, pensions, employment, benefits payments, number of log-ins, voluntary reductions of overdraft limits, banking fees paid, payday loans, simultaneous savings and overdraft debt, large checking account balances that do not pay interest, and whether individuals link their spouse. We first examine simultaneous savings and overdraft debt, which can be considered a mistake because overdrafts cost more interest than savings yield. Figure 8 shows the spending responses of individuals sorted according to how much interest is lost by holding overdrafts and savings simultaneously. Individuals who lose less have less pronounced spending responses than those who lose more. The reason for this result is that wealthier individuals have savings and overdrafts simultane-

ously. Second, we look at individuals with large balances in their checking accounts, which can be considered a mistake because checking accounts do not pay interest (which is approximately 4 percent in Iceland over the sample period). Figure 9 shows the spending responses of individuals sorted according to whether or not they hold more than one month of average spending in their checking account. Individuals who lose less interest have more pronounced spending responses than those who lose more. Again, the reason for this result is that wealthier individuals have larger balances in their checking accounts. We also sort individuals according to a summary measure of how much they lose in banking fees, interest, and payday loans in Figure A.3, which shows a similar pattern.

4.6 Robustness

We fail to find any income or spending category for which the payday responses are absent or less pronounced. Because irregular income responses may be unanticipated, payday responses are not necessarily inconsistent with the standard model. Nevertheless, confirming the existence of payday responses for irregular income rules out many alternative explanations for payday responses to regular income, such as naturally recurring spending and income or coordination stories that would not be picked up by day-of-the-week fixed effects. Overall, the day-of-week fixed effects pick up the bulk of variation and seem most important. Beyond the day-of-the-week fixed effects, the week-of-the-month fixed effects control for some mechanical effects due to fixed expense cycles at the beginning of each month. Additionally, we perform a number of robustness checks. First, we take a closer look at the characteristics of the individuals in the lowest income decile because their spending responses appear to be slightly different from the other income deciles. However, we do not observe unusual characteristics. The mean income of individuals in the lowest income decile is approximately 750 dollars and their mean age is 34 years, while the second decile's mean income and age are approximately 1,000 dollars and 34 years, respectively. Second, we examine the responses for the ready-made-food category because such spending is instantly consumed. Third, we examine only individuals who are paid on unusual days. In doing so, we also ensure that we observe payday responses for all

categories and not simply categories that are likely to be consumed alongside coworkers who are paid on the same unusual paydays (such as restaurants and alcohol). Fourth, we include day-of-the-month fixed effects on top of day-of-the-week and year-month fixed effects. Fifth, we examine only tax rebates and exogenous wealth shocks (described below) to control for potential endogeneity of income (Figure 10). Sixth, we examine individuals who have linked their spouse to ensure that the responses are not driven by intra-household bargaining. Seventh, any price-discriminatory response of firms does not explain the magnitude of the observed effects (Hastings and Washington (2010)) and does not apply to individuals with unusual paydays or irregular income. Seventh, we sort individuals according to how often they log into the app to ensure that app usage is unrelated to payday responses. Figure A.4 shows the payday responses for individuals who are sorted into sextiles according to their log-in frequency. Log-in frequency does not seem to be associated with a pattern in payday responses. If anything, the individuals who log in most frequently have less pronounced payday responses than the individuals who log in the least. Overall, we conclude that spending responses to income payments constitute a very robust phenomenon, which is cleanly estimated and prevalent throughout the population. Given the robustness of these payday responses, we think that attempting to better understand what is driving them is a valuable exercise.

We doubt that any of our results are amplified by the Icelandic financial crisis or otherwise country-specific. First, we can restrict the sample to just 2015 and obtain the same payday responses. Moreover, Iceland recovered very quickly and experienced high GDP growth and low unemployment during our sample period. Moreover, we find quantitatively similar payday responses (around 50 percent for the average household) to Gelman et al. (2014), who use US data of the same kind. Relative to Gelman et al. (2014), it just appears as if our payday responses are more clean and less noisy because of the absence of cash transactions and the increased accuracy of the categorization system.

Using large exogenous wealth shocks, we can also estimate the marginal propensity to consume in response to fiscal stimulus payments of our sample population. The shocks that we use originate from a debt relief ruling that resulted in large repayments from banks to

thousands of Icelandic households holding foreign-indexed debt. In this natural experiment, Icelandic lenders had to pay out as much as $4.3 billion, i.e., one-third of the economy's GDP, after a court found that some foreign loans were illegal. These foreign loans were the largest single loan category of the banks, with a value of approximately $7.2 billion (Bloomberg, July 7 2010). After the financial crisis, the Icelandic Supreme Court ruled on June 16 2010 that loans indexed to foreign currency rates were illegal in three cases involving private car loans and a corporate property loan. This decision meant that borrowers with such loans were only obliged to repay the principal in Icelandic krona, making the lenders liable for currency losses of approximately $28 billion in debt because the krona's value against the Japanese yen and Swiss franc declined by one-third since September 2008. Iceland's 2008 financial crisis was exacerbated by banks that borrowed in Japanese yen or Swiss francs to take advantage of lower interest rates and then repackaged the loans in krona before passing them on to clients. This exchange-rate indexation of loans meant that the total amounts owed in Icelandic krona varied according to its exchange rate against the currencies in which the loans were issued. Such loans had been aggressively promoted by Icelandic banks in previous years and left many diligent car and home owners with debts greater than the original amount–despite paying their bills every month. After the debt-relief ruling, banks had to repay their customers, which we consider to be exogenous wealth shocks. We obtain marginal propensities to consume that are perfectly in line with existing papers, such as Agarwal and Qian (2014), who analyze Singaporean consumers' responses to a fiscal stimulus announcement and payout, and Kueng (2015), who uses payments originating from the Alaska Permanent Fund. Other studies examining fiscal stimulus payments are Johnson et al. (2006), Parker et al. (2013), Parker (2014), and Jappelli and Pistaferri (2014), as surveyed by Jappelli and Pistaferri (2010).

4.7 Examining liquidity constraints

Thus far, our results suggest that hand-to-mouth behavior is prevalent across all income groups, which casts doubt on liquidity constraints as the only explanation for such behavior. To further establish that liquidity-constrained households are not alone in exhibiting spending responses,

we now examine different measures of liquidity constraints: cash holdings in checking and savings accounts, cash holdings in checking and savings accounts plus credit card balances plus credit limits and overdraft limits, credit utilization, and spending on (discretionary) goods and services immediately before income payments. All liquidity measures are normalized by each individual's average consumption. Figures 11, 12, and A.5 compare the spending responses to regular and irregular income for three tertiles of our standard measures of liquidity: cash, cash and credit lines, and credit utilization. Figures A.6 and A.7 compare the spending responses to regular and irregular income for three tertiles of our new measures of liquidity: whether individuals spend on (discretionary) goods and services prior to income payments. Overall, we see that households exhibit spending responses, even in the highest tertile of all liquidity measures.

Furthermore, we examine the distribution of cash holdings (checking and savings accounts balances plus credit card balances) and liquidity (overdraft and credit limits plus checking and savings accounts balances plus credit card balances) before paydays in Figure 13. We see that cash holdings fall discontinuously at zero when overdrafts start to cost interest and that approximately 10 percent of individuals hold fewer than ten days of cash in their checking and savings accounts. Moreover, approximately 10 percent of individuals hold fewer than ten consumption days of liquidity. In turn, Figure 14 provides a breakdown by 1 to 10 days of spending for cash and liquidity for individuals who hold less than 10 days of cash or liquidity, respectively. Here, we see that less than 3 percent of individuals hold less than one day of spending in liquidity and that less than 3 percent hold less than one day of spending in cash. Thus, according to our measures, the fraction of liquidity-constrained individuals is quantitatively too small to explain the observed spending responses to income. Thus, we conclude that liquidity constraints in the literal sense are unlikely to explain payday responses.

Additionally, Table 4 displays summary statistics for the three tertiles of liquidity in consumption days. We can see that even the most liquidity-constrained households hold considerable liquidity of approximately 38 days of spending, while the least liquidity-constrained tertile of individuals holds approximately 546 days of spending in liquidity. When we com-

pare these numbers to the state-of-the-art model developed by Kaplan and Violante (2014b) to explain high marginal propensities to consume out of tax rebates, we see a discrepancy between the theoretical predictions and the empirical evidence on the amount of liquid assets that individuals hold. Figure 16 shows the life-cycle profiles of liquidity normalized by quarterly consumption for five quintiles of the distribution of agents in the model of Kaplan and Violante (2014b). We see that the liquid asset holdings of the bottom three quintiles are basically zero for all the simulated agents' lives. The top two quintiles of agents hold, on average, approximately 4 quarters of consumption in liquidity. By contrast, empirically, the most liquid tertile of individuals holds, on average, 6.1 quarters of consumption in liquidity, while the middle and least liquid tertiles hold 1.37 and 0.41 quarters of consumption in liquidity, respectively–all of which far exceeds the predictions of the model when using the parametrization in Kaplan and Violante (2014b).[5] Moreover, if the Kaplan and Violante (2014b) model is forced to generate the amount of liquidity that we observe in the data, the fixed costs of illiquid assets must be very low, which implies that individuals can easily adjust their illiquid asset holdings, which reduces their marginal propensity to consume out of fiscal stimulus payments.

Overall, the literature examining liquidity constraints is very mixed. Shapiro and Slemrod (2009) document that poor households–which are arguably more likely to be liquidity constrained–did not spend most of the 2008 tax rebate as the fiscal stimulus package intended. Contrary to policy-makers' expectations, these households ultimately used the funds to pay off debt, which corresponds with cash hoarding to relieve current and future liquidity constraints. In contrast, Shapiro and Slemrod (1995) find that those expecting their financial conditions to be worse in the next year were more likely to spend the 1992 change in tax withholding. With respect to current financial conditions, the authors cannot document a stable relationship with the propensity to spend. Moreover, the authors find that households that typically received a refund were more likely to spend the extra take-home pay; although this finding is consistent with theories of inertia, lack of foresight, or failure to optimize, it is not aligned with liquidity

[5]We doubt that large liquidity holdings are due to the Icelandic financial crisis or otherwise country-specific. The economy has been booming in the sample period and many households have large amounts of roll-over debt (inefficient financial markets should restrict borrowing). Moreover, Iceland is characterized by well-functioning health-care, social-security, and unemployment-insurance systems.

constraints. Overall, the authors conclude that liquidity constraints do not motivate the spending behavior of the 43 percent of households that report that the timing of tax payments will affect their consumption. Souleles (1999) examines the responses in non-durable and durable consumption and documents the advantages of using tax refunds to document excess sensitivity in consumption. While the author finds that constrained households are more likely to spend their tax refunds on non-durable consumption, the picture is reversed for durable consumption. Thus, liquidity-unconstrained households are not overwithholding to force themselves to save up enough for durable consumption goods because they could easily undo any forced saving by drawing down their liquid assets.

According to our measures, the fraction of liquidity-constrained individuals is quantitatively too small to explain the observed spending responses to income. Nevertheless, many individuals hold roll-over debt–the lowest tertile holds an average of 38 days of their average spending in debt. Liquidity constraints are not the same thing as low resources. These results suggest that liquidity constraints are not straightforward to document empirically. While some households are liquidity constrained in the literal sense–that is, they live from paycheck to paycheck and have no savings–many other households may hold a cash cushion for either unforeseen adverse expenditure shocks or foreseen expenses. However, they may still be liquidity constrained inasmuch as they would consume or invest more if they could borrow more cheaply because they expect higher income in the future. Abstracting from cash cushions, the theoretical literature has explicitly considered wealthy households to be liquidity constrained when they lock their wealth in illiquid assets (Laibson et al., 2003; Kaplan and Violante, 2014b). However, empirically, we find that almost all households hold large amounts of cash, though few hit a liquidity constraint of no savings before their paychecks. Because Kaplan and Violante (2014b) use Survey of Consumer Finances data, the authors do not observe liquidity holdings before paychecks but only average liquidity holdings. They classify individuals as hand-to-mouth consumers when their average liquid wealth is less than half of their earnings, which they find to be the case for 30 percent of the US population. For comparison, using their definition, we find that 58 percent of households are hand-to-mouth in our population. How-

ever, because individuals have sufficient liquidity at the end of their pay cycles, this finding cannot explain payday responses to income. To the extent that payday responses are driven by the same mechanism as responses to fiscal stimulus payments, we thus raise an important question: How can we define liquidity-constrained individuals and identify them empirically?

Individuals who choose to hold a significant amount of liquidity could ”feel” liquidity constrained because they hold an insufficient cash cushion. A potential approach to assess whether payday responses are driven by these individuals is the following: Individuals who have just received a large exogenous wealth shock should not exhibit payday responses, as they are exogenously more liquid. In Figure 15, we thus show that individuals exhibit substantial payday responses even in the months after which they received a large exogenous wealth shock from a court ruling (explained in Subsection 4.6). Therefore, endogenous liquidity holdings due to insufficient cash cushions seemingly do not explain payday responses. Nevertheless, to examine the question further, we now look at cash-holding responses to income payments.

4.8 Examining cash-holding responses to income payments

Given the difficulties of measuring liquidity constraints in the presence of cash cushions, we are interested in a different method that considers the potential existence of cash cushions. To this end, inspired by the corporate finance literature, we think about a measure of liquidity constraints derived from individuals' demands for liquidity. The methodology follows that used in the influential paper by Almeida et al. (2004). In this paper, the authors develop a new test measuring the effect of financial constraints on corporate policies. This effect of financial constraints is captured by a firm's propensity to save cash out of cash inflows. The authors hypothesize that constrained firms should have a positive cash-flow sensitivity of cash but that unconstrained firms' cash savings should not be systematically related to cash flows. In the household context, we empirically assess households' propensities to increase cash cushions after cash inflows and the ways in which this propensity is related to liquidity. If a household feels liquidity constrained (even if its hard liquidity constraint is not binding), it will try to increase its cash cushion after cash inflows.

In corporate finance, analyses of the effects of financial constraints on firm behavior and the manner in which firms implement financial management have a long tradition. The paper by Almeida et al. (2004) states that firms want to have a liquid balance sheet to undertake valuable projects when they arise. However, if a firm has unrestricted access to external capital–that is, if a firm is financially unconstrained–there is no need to safeguard against future investment needs; thus, corporate liquidity becomes irrelevant. In contrast, when a firm faces financing frictions, liquidity management is a key issue for corporate policy. Thus, there exists a link between financial constraints and corporate liquidity demand, which has been ignored by the prior literature focusing on corporate investment demand. In their seminal paper, Fazzari et al. (1988) propose that, when firms face financing constraints, investment spending will vary with the availability of internal funds, rather than just with the availability of positive net present value projects. Accordingly, the authors examine the influence of financing frictions on corporate investment by comparing the empirical sensitivity of investment to cash flow across groups of firms that are sorted according to a proxy for financial constraints. Follow-up research, however, has identified several problems with that strategy regarding the theoretical and empirical robustness of the implications. Moreover, if cash flows contain valuable information about a firm's investment opportunities, the cross-sectional patterns reported by Fazzari et al. (1988) can be consistent with a model with no financing frictions. Almeida et al. (2004) then advance the literature by examining the empirical cash-flow sensitivities of cash rather than the cash-flow sensitivities of investment. In a household context, the study by Fazzari et al. (1988) may correspond with the analysis of household spending or investment in response to cash inflows. Households may spend or invest more in response to cash inflows because they are currently liquidity constrained. However, we find that individuals hold too much cash relative to the predictions of state-of-the-art economic models. In turn, we want to examine whether individuals' payday responses stem from a concern about future liquidity constraints, which would be reflected in a high marginal propensity to hold on to cash.

To formalize these ideas, Figure 17 shows the marginal propensities to hold on to cash implied by three different simple models. First, we consider a standard consumption-savings

model without illiquid savings. In this model, the marginal propensity to hold on to cash (MPCash) equals one minus the marginal propensity to consume (MPCons), i.e., MPCash = 1-MPCons, as the agent holds his entire life-time wealth in cash. Because the MPCons in this model is always decreasing in income or liquidity, the MPCash will always be increasing. Furthermore, the MPCash is higher when the agent's horizon increases, as he consumes only a small amount of his income and saves most of it. Second, we consider a consumption-savings model in which the agent can save in a liquid or an illiquid asset that pays slightly higher interest. In such a model, the MPCash may be either increasing or decreasing in liquidity or income because the MPCash equals one minus the MPCons minus the marginal propensity to invest in the illiquid asset (MPIlliInv), i.e., MPCash = 1-MPCons-MPIlliInv. While the MPCons is always decreasing in liquidity, the MPIlliInv is increasing, which implies that the MPCash is either increasing or decreasing. However, the MPCash is always small as in the model of Kaplan and Violante (2014b) because agents have little reason to hold cash. To obtain the result from the corporate finance literature–an MPCash that is decreasing in liquidity–one needs to introduce more frequently binding future liquidity constraints. One way to increase the importance of future liquidity constraints is to assume that the agent receives news about income shocks in the future but that he or she will not be able to consume that income immediately. In such a situation, the MPCash becomes decreasing in liquidity or income for reasonable parameter combinations, as predicted in the corporate finance models.

Figure 18 displays individuals' cash-holding responses to regular and irregular income payments for three tertiles of liquidity. We can see that less liquidity-constrained individuals have more pronounced cash-holding responses than more liquidity-constrained individuals. Moreover, cash responses are larger than spending responses. Both of these findings are predicted by a standard consumption-savings model. Thus, we conclude that cash responses do not seem to indicate the presence of illiquid savings (which could be interpreted as durable consumption in a high-frequency consumption framework), future liquidity constraints, or insufficient cash cushions. Even for deciles, all of the pictures show an increasing relationship between the propensity to hold on to cash and liquidity constraints as well as a very high propensity to

hold on to cash–much higher than the propensity to consume. We again use indicator variables for income payments to alleviate potential endogeneity concerns, but we can also estimate the MPCash directly and obtain the same relationship with liquidity. These findings are thus consistent with the standard consumption-savings model without illiquid savings. However, this model is not consistent with a high marginal propensity to consume out of transitory income shocks. We thus conclude that neither current nor future liquidity constraints can account for the observed payday responses to income payments.

Individuals can reduce overdraft limits relatively easily, while any credit limit increases have to be approved by the bank. Thus, we want to ensure that the increasing cash responses are not driven by changes in overdraft limits that are initiated by individuals on paydays. Examining changes in overdraft limits around paydays yields very interesting results. Figure A.8 shows that individuals with less liquidity tend to reduce their overdraft limits around paydays, while individuals with high liquidity do not engage in such behavior. In itself, this is evidence against liquidity constraints being a problem in our sample and points toward the existence of overconsumption problems. After all, standard economic theory predicts that individuals should never reduce their limits, as borrowing opportunities are always weakly welfare increasing. However, we clearly see that individuals tend to reduce their limits after paydays. A potential explanation for this tendency is that individuals want to restrict their future selves from borrowing or that they want to reduce their mental borrowing accounts. To ensure that the documented increasing payday liquidity responses do not stem from low-liquidity individuals' tendencies to reduce their limits after paydays, we also examine individuals' balances–that is, their checking and savings account balance minus their credit balance–in Figure A.9. We again observe high and increasing responses that are consistent with a model without illiquid savings or future binding liquidity constraints.

5 Conclusion

We use data from a financial account app in Iceland, which is characterized by outstanding accuracy and comprehensiveness due to Icelanders' nearly exclusive use of electronic payments, to evaluate whether spending or consumption results from an intertemporal optimization problem and is thus independent of income. Contradicting this theoretical prediction but in line with previous studies, we find significant spending responses to the receipt of regular and irregular income on paydays. However, in contrast to previous studies, we argue that hand-to-mouth behavior is not limited to liquidity-constrained households, as we show that non-liquidity-constrained households exhibit hand-to-mouth behavior through three measures of liquidity constraints: balances and credit limits, spending on discretionary goods and services, and spending immediately before income payments. Overall, less than 3 percent of individuals have less than one day of average spending left in liquidity before their paydays. Moreover, individuals' average cash holdings seem to be much larger than predicted by state-of-the-art economic models that explain high marginal propensities to consume out of transitory income shocks via illiquid savings. Because individuals may either hold cash cushions or save for foreseen expenses, we also examine cash-holding responses to income payments, inspired by the corporate finance literature. We notice that a model with liquid and illiquid savings and future liquidity constraints makes a joint prediction about the marginal propensity to consume and the marginal propensity to hold on to cash: both are decreasing in liquidity. We test this joint prediction in our data, however we do not find evidence for it. Because the cash-holding responses are most consistent with the standard consumption-savings problem without illiquid savings or future binding liquidity constraints, we argue that the evidence is not consistent with either present or future liquidity constraints. Instead, our findings are consistent with consumers feeling that they have a license to spend upon receiving their income, as modeled in Delikouras and Korniotis (2014). To figure out whether or not individuals with liquidity cushions but roll-over debt are liquidity constrained is of great importance: after all, liquidity constraints are not the same thing as low resources. For policy purposes, liquidity constraints call for expanding

credit, while low resources due to overconsumption problems call for restricting credit. The latter measure is also supported by our finding that low-liquidity households tend to voluntarily reduce their overdraft limits around paydays.

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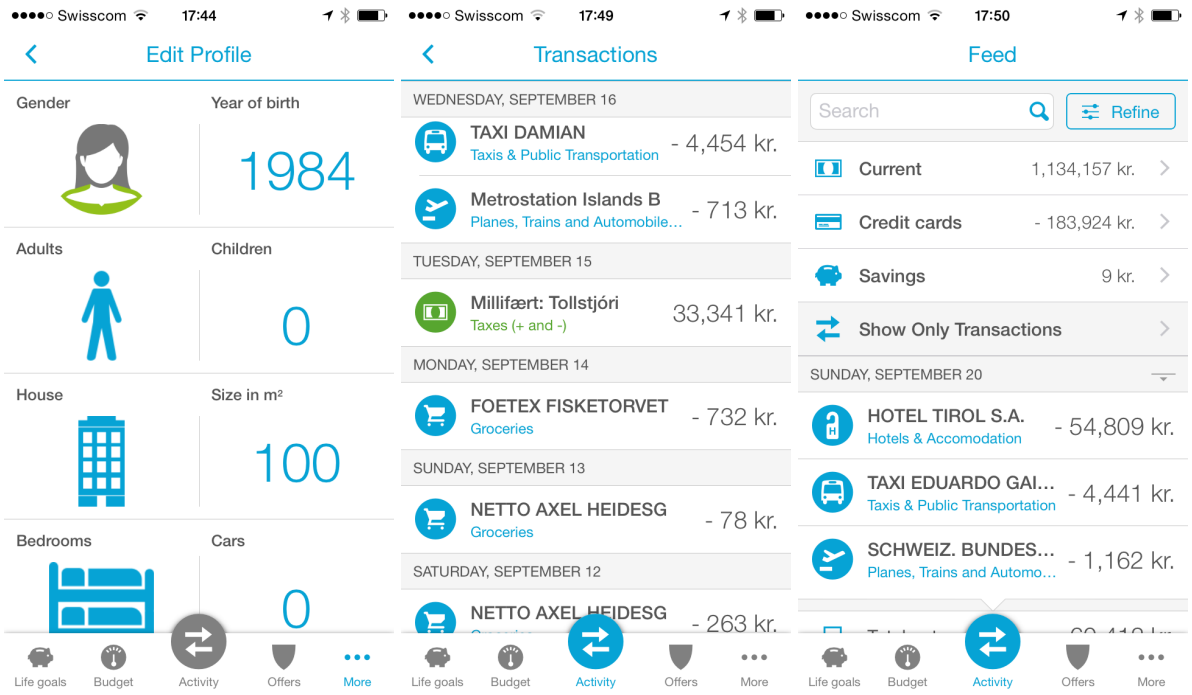
Figures and tables



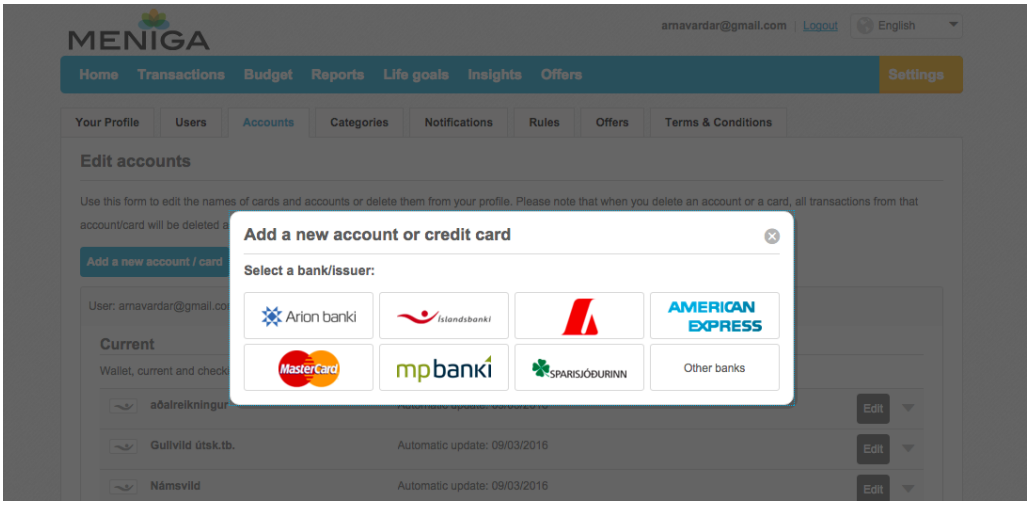


Figure 1: The Financial Aggregation App: Screenshots

Table 1: Summary Statistics

	Mean	Standard Deviation	Statistics Iceland
Monthly total income	3,256	3,531	3,606
Monthly salary	2,701	2,993	2,570
Monthly spending:			
Total	1315.1	1224.3	
Groceries	468.29	389.29	490
Fuel	235.88	258.77	(359)
Alcohol	61.75	121.43	85
Ready Made Food	170.19	172.64	(252)
Home Improvement	150.16	464.94	(229)
Transportations	58.33	700.06	66
Clothing and Accessories	86.62	181.27	96
Sports and Activities	44.29	148.41	(36)
Pharmacies	39.62	62.08	42
Age	40.6	11.5	37.2
Female	0.45	0.50	0.48
Unemployed	0.08	0.27	0.06
Parent	0.23	0.42	0.33
Pensioner	0.15	0.36	0.12

Note: All numbers are in US dollars. Parentheses indicate that data categories do not match perfectly.

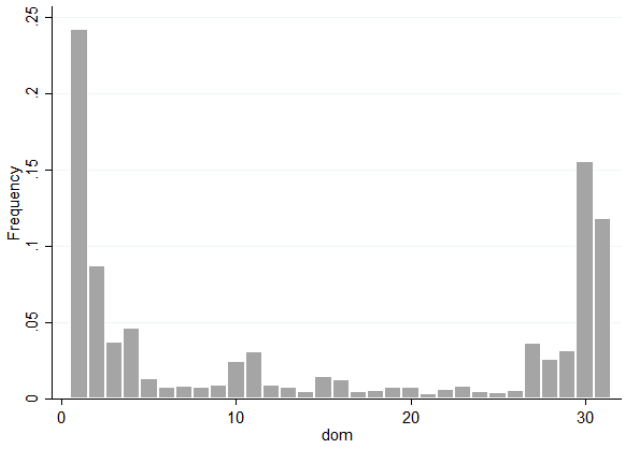


Figure 2: The Distribution of Regular Income Arrival over the Month

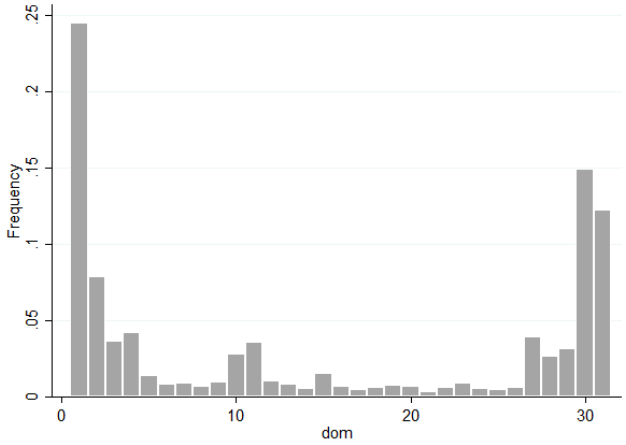


Figure 3: The Distribution of Paycheck Arrival over the Month

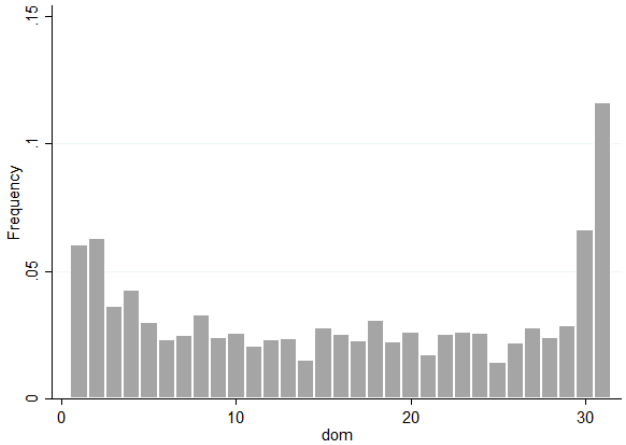
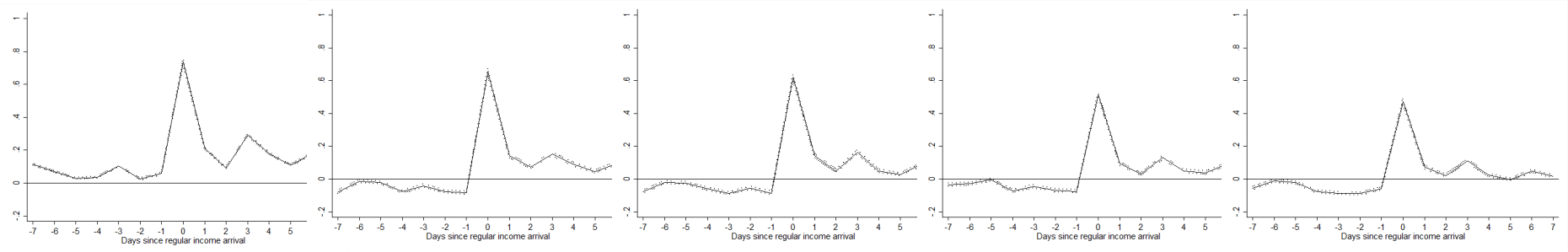
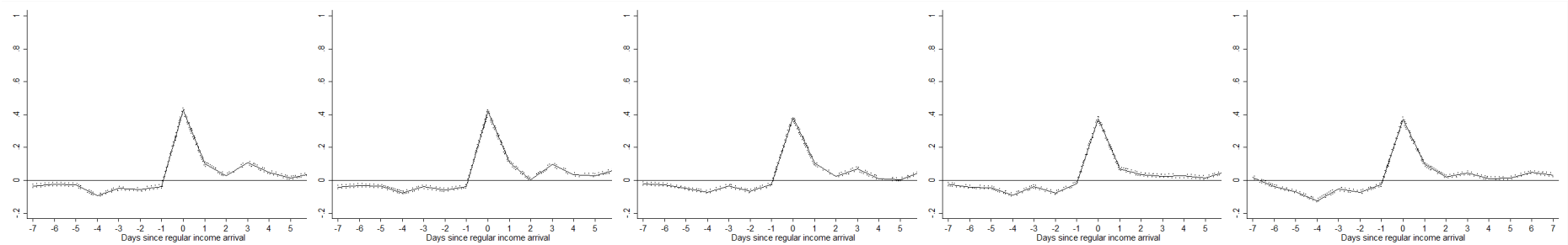


Figure 4: The Distribution of Irregular Income Arrival over the Month

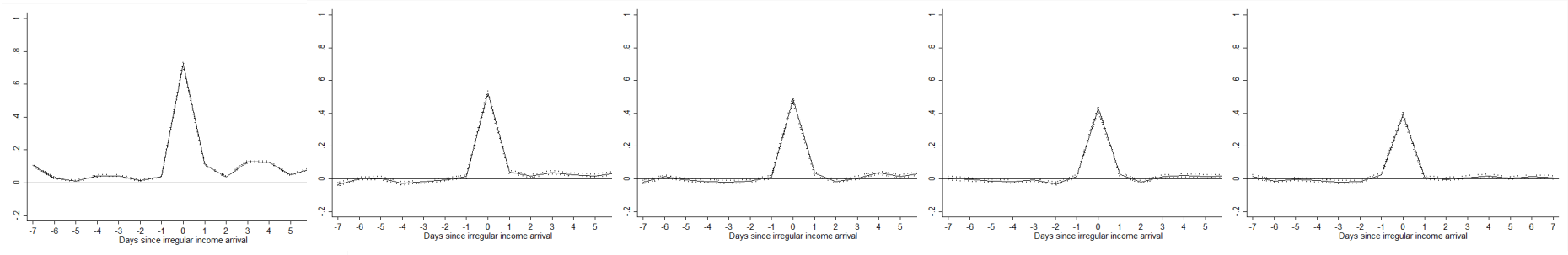


Salary Group 1 Salary Group 2 Salary Group 3 Salary Group 4 Salary Group 5

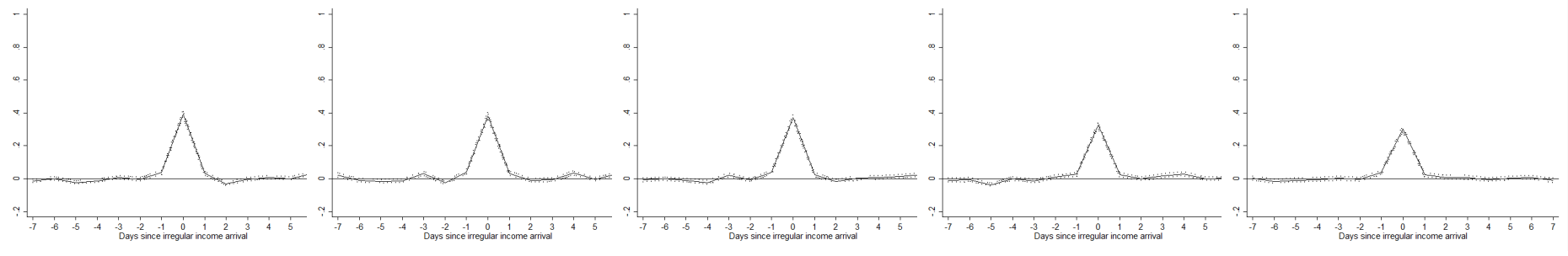


Salary Group 6 Salary Group 7 Salary Group 8 Salary Group 9 Salary Group 10

Figure 5: The Effects of Regular Income on Spending



Salary Group 1 | Salary Group 2 | Salary Group 3 | Salary Group 4 | Salary Group 5



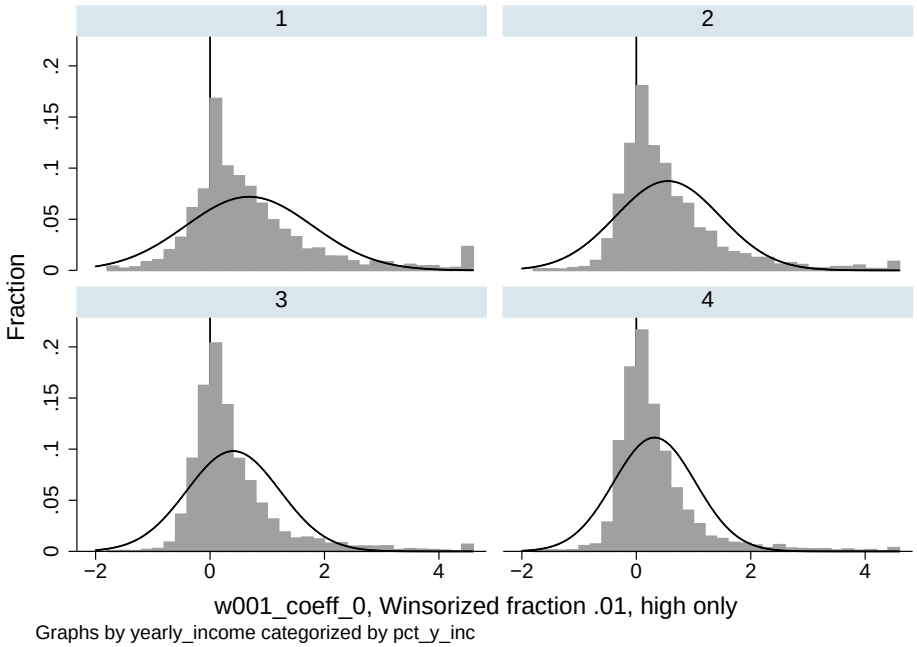
Salary Group 6 | Salary Group 7 | Salary Group 8 | Salary Group 9 | Salary Group 10

Figure 6: The Effects of Irregular Income on Spending

Table 2: The Impact of payments on household spending by income quartiles

	(1) Total Spending	(2) Groceries	(3) Fuel	(4) RMF	(5) Alcohol
Panel A: 1st salary quartile					
$I(Payment_{it} > 0)$	0.800***	0.679***	0.756***	0.560***	0.875***
	(0.0088)	(0.0085)	(0.0124)	(0.0084)	(0.0162)
$I(Regularpayment_{it} > 0)$	0.880***	0.768***	0.880***	0.599***	0.992***
	(0.0135)	(0.0126)	(0.0195)	(0.0120)	(0.0243)
$I(Irregularpayment_{it} > 0)$	0.727***	0.595***	0.653***	0.507***	0.814***
	(0.0099)	(0.0097)	(0.0132)	(0.0100)	(0.0201)
$I(Salary_{it} > 0)$	0.815***	0.722***	0.825***	0.548***	0.862***
	(0.0151)	(0.0147)	(0.0231)	(0.0140)	(0.0307)
Panel B: 2nd salary quartile					
$I(Payment_{it} > 0)$	0.529***	0.434***	0.508***	0.318***	0.627***
	(0.0099)	(0.0091)	(0.0168)	(0.0094)	(0.0205)
$I(Regularpayment_{it} > 0)$	0.590***	0.516***	0.649***	0.332***	0.750***
	(0.0142)	(0.0130)	(0.0269)	(0.0123)	(0.0282)
$I(Irregularpayment_{it} > 0)$	0.464***	0.348***	0.377***	0.287***	0.533***
	(0.0110)	(0.0099)	(0.0159)	(0.0117)	(0.0265)
$I(Salary_{it} > 0)$	0.560***	0.457***	0.654***	0.283***	0.678***
	(0.0134)	(0.0121)	(0.0261)	(0.0128)	(0.0309)
Panel C: 3rd salary quartile					
$I(Payment_{it} > 0)$	0.430***	0.314***	0.429***	0.241***	0.522***
	(0.0104)	(0.0087)	(0.0176)	(0.0090)	(0.0202)
$I(Regularpayment_{it} > 0)$	0.436***	0.358***	0.544***	0.248***	0.572***
	(0.0136)	(0.0119)	(0.0272)	(0.0120)	(0.0275)
$I(Irregularpayment_{it} > 0)$	0.418***	0.260***	0.339***	0.225***	0.474***
	(0.0130)	(0.0101)	(0.0182)	(0.0121)	(0.0270)
$I(Salary_{it} > 0)$	0.448***	0.364***	0.529***	0.210***	0.580***
	(0.0116)	(0.0104)	(0.0234)	(0.0114)	(0.0287)
Panel D: 4th salary quartile					
$I(Payment_{it} > 0)$	0.350***	0.230***	0.418***	0.155***	0.430***
	(0.0111)	(0.0092)	(0.0229)	(0.0096)	(0.0219)
$I(Regularpayment_{it} > 0)$	0.343***	0.245***	0.530***	0.139***	0.467***
	(0.0148)	(0.0121)	(0.0356)	(0.0127)	(0.0294)
$I(Irregularpayment_{it} > 0)$	0.348***	0.208***	0.294***	0.160***	0.372***
	(0.0152)	(0.0112)	(0.0206)	(0.0130)	(0.0301)
$I(Salary_{it} > 0)$	0.405***	0.318***	0.513***	0.184***	0.690***
	(0.0106)	(0.0097)	(0.0231)	(0.0105)	(0.0259)

Standard errors are clustered at the individual level and are within parentheses. Each entry is a separate regression. The salary arrival responses are estimated by salary quartiles while the response to any payments, regular payments, and irregular payments are estimated by total income quartiles. variable. The outcome is the fraction by which individual spending in each category deviates from average daily spending in the day of income arrival.



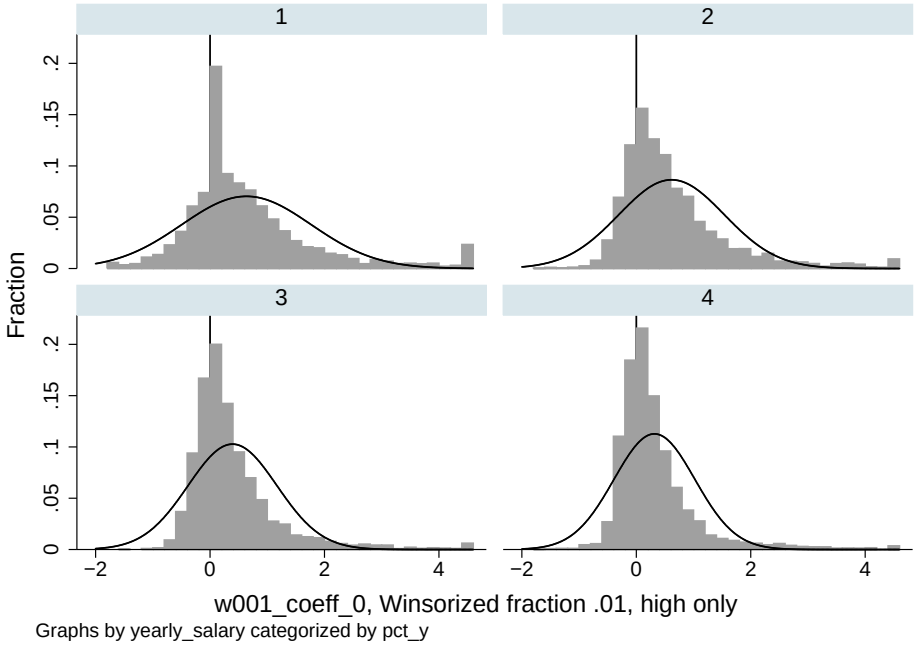


Figure 7: The Distribution of Payday Coefficients for Individuals by Income and Salary Quartiles

Table 3: Internal and External Margins of Spending Reaction

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Spending:	Any	Groceries	Fuel	Alcohol	Ready Made Food	Home Improvements	Home Security	Vehicles	Clothing and Accessories	Sports and Activities	Pharmacies
Panel A: External margin											
Payment	0.121***	0.082***	0.052***	0.021***	0.058***	0.020***	0.001***	0.015***	0.010***	0.009***	0.015***
	(0.0009)	(0.0007)	(0.0006)	(0.0003)	(0.0006)	(0.0003)	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0003)
Regular	0.107***	0.075***	0.047***	0.023***	0.050***	0.017***	0.002***	0.015***	0.010***	0.009***	0.015***
	(0.0009)	(0.0008)	(0.0007)	(0.0004)	(0.0007)	(0.0003)	(0.0002)	(0.0003)	(0.0002)	(0.0003)	(0.0003)
Irregular	0.122***	0.081***	0.053***	0.018***	0.059***	0.021***	0.001***	0.014***	0.010***	0.008***	0.014***
	(0.0012)	(0.0009)	(0.0008)	(0.0004)	(0.0009)	(0.0003)	(0.0001)	(0.0003)	(0.0002)	(0.0002)	(0.0003)
Salary	0.103***	0.069***	0.046***	0.024***	0.049***	0.015***	0.002***	0.015***	0.009***	0.008***	0.013***
	(0.0010)	(0.0009)	(0.0008)	(0.0004)	(0.0007)	(0.0003)	(0.0002)	(0.0003)	(0.0002)	(0.0003)	(0.0003)
Panel B: Internal margin											
Payment	20.2	6.0	9.0	4.4	1.6	15.2	2.1	50.7	4.5	7.9	1.6
	(0.4)	(0.1)	(0.3)	(0.2)	(0.1)	(0.9)	(1.9)	(4.8)	(0.5)	(0.7)	(0.1)
Regular	19.2***	7.6***	11.8***	3.8***	1.6***	6.7***	3.4***	20.3***	4.3***	3.5***	1.8***
payment	(0.5)	(0.1)	(0.5)	(0.2)	(0.1)	(1.0)	(3.4)	(5.1)	(0.6)	(0.8)	(0.1)
Irregular	20.2 ***	4.3***	6.3***	4.8***	1.6***	19.7***	0.1***	70.8***	3.9 ***	10.8***	1.4***
payment	(0.6)	(0.1)	(0.3)	(0.3)	(0.1)	(1.2)	(0.5)	(7.0)	(0.6)	(0.9)	(0.1)
Salary	18.0***	6.9***	12.2***	3.9***	1.5***	7.2***	4.1***	13.8***	4.2***	3.7***	1.4***
check	(0.5)	(0.2)	(0.5)	(0.2)	(0.1)	(1.1)	(3.9)	(5.0)	(0.6)	(0.9)	(0.1)

Standard errors are clustered at the individual level and are within parentheses. Each entry is a separate regression. Panel A shows the effect on the probability of buying the goods under consideration on payday. Panel B compares the expenditure on shopping days when consumers do and do not get paid.

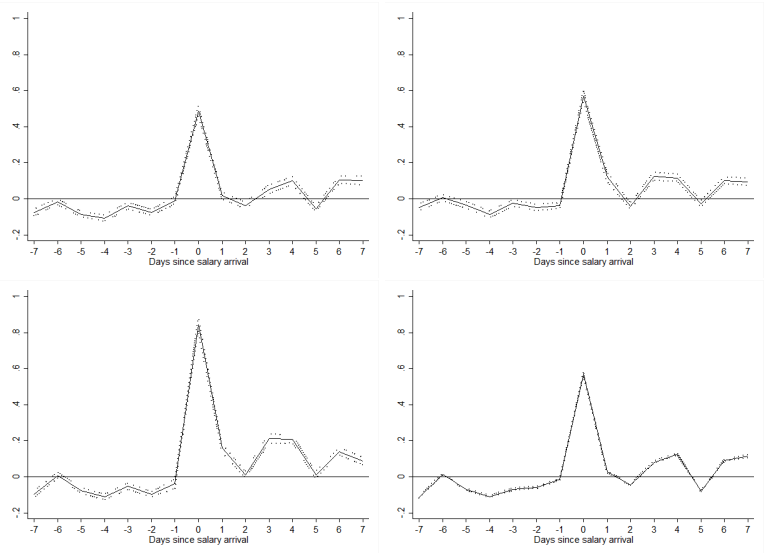


Figure 8: The Effects of Regular Income Arrival on Spending by Amount Lost due to Holding Overdrafts and Savings Simultaneously

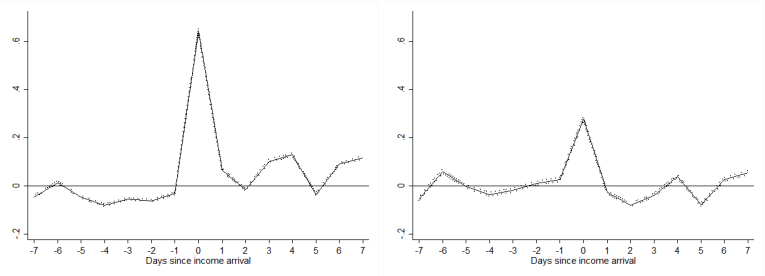


Figure 9: The Effects of Regular Income Arrival on Spending by Individuals who Hold on Average Less or More than one Month of Spending in Their Current Account

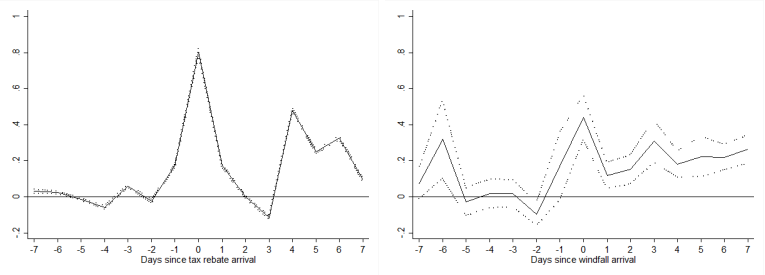
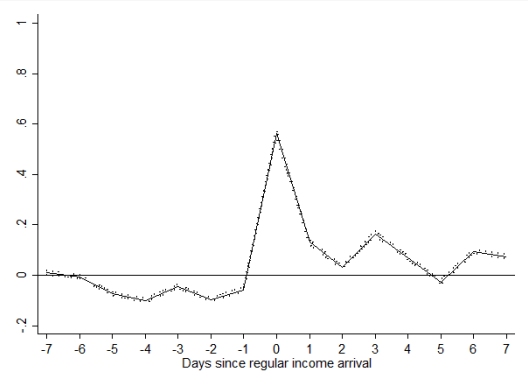
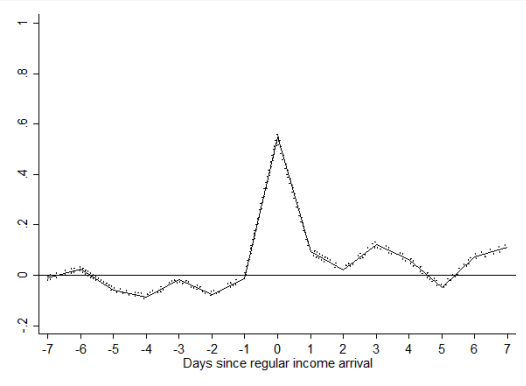


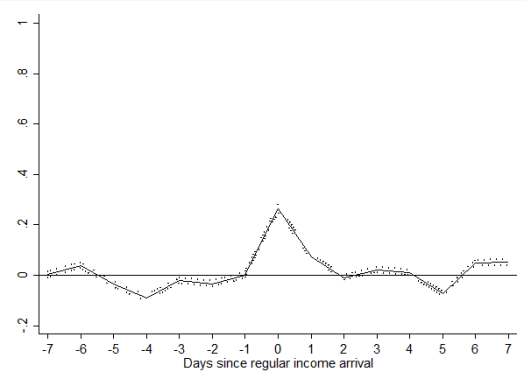
Figure 10: The Effects of Exogenous Income Arrival (Tax Rebates and Wealth Shocks) on Spending



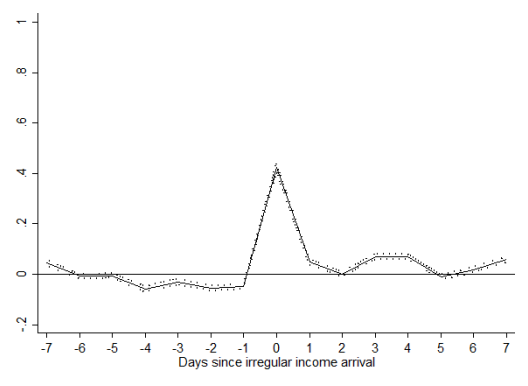
Regular Income Liquidity Group 1



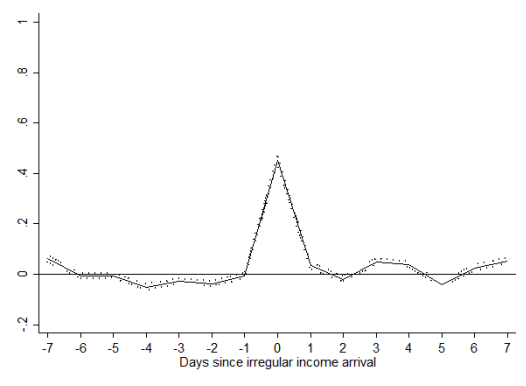
Regular Income Liquidity Group 2



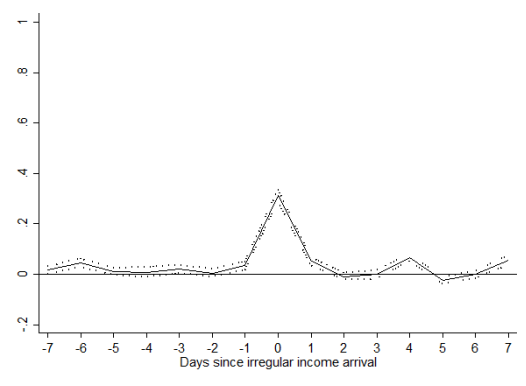
Regular Income Liquidity Group 3



Irregular Income Liquidity Group 1

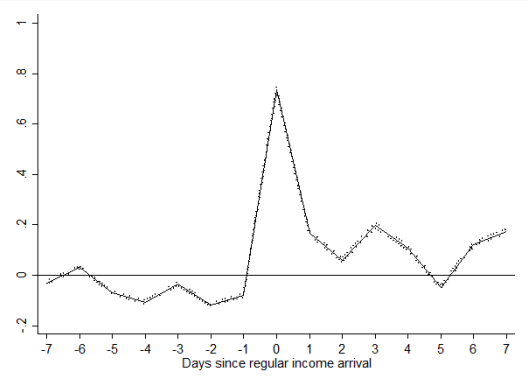


Irregular Income Liquidity Group 2

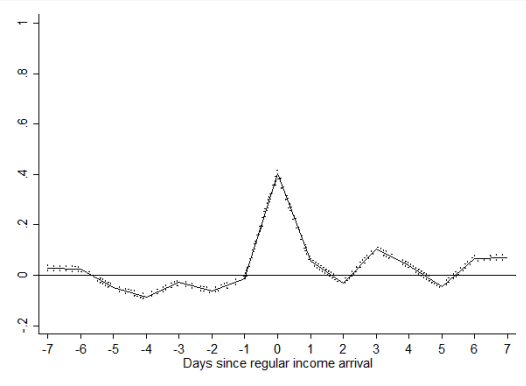


Irregular Income Liquidity Group 3

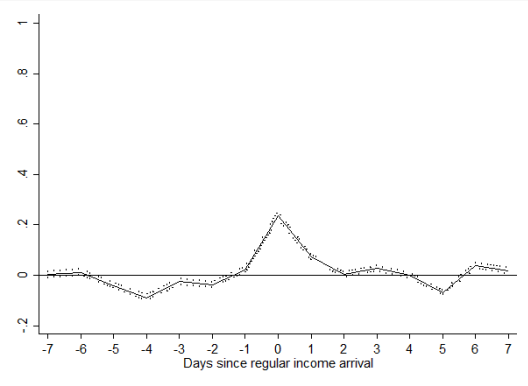
Figure 11: The Effects of Irregular and Regular Income on Spending by Cash (measured by the median number of consumption days held in cash)



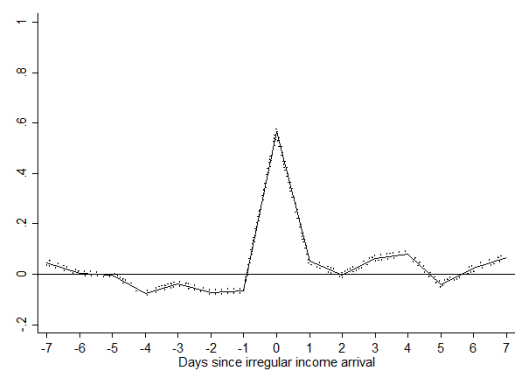
Regular Income Liquidity Group 1



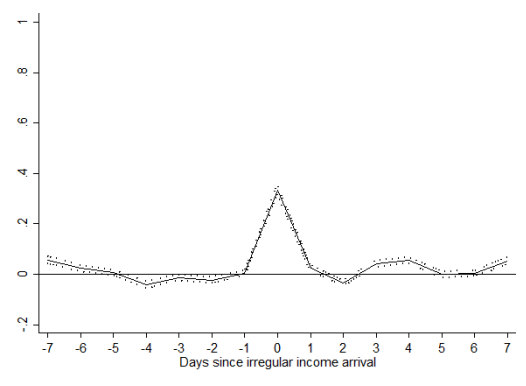
Regular Income Liquidicity Group 2



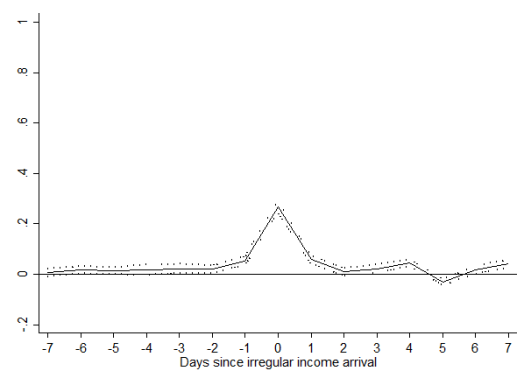
Regular Income Liquidity Group 3



Irregular Income Liquidity Group 1

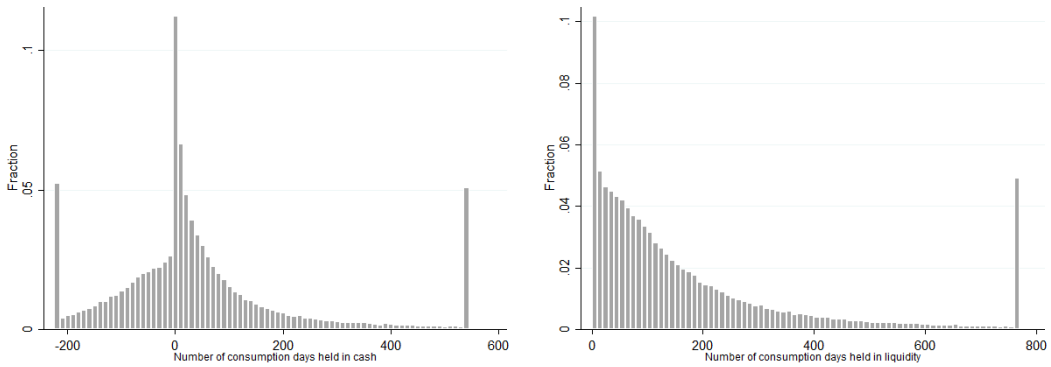


Irregular Income Liquidity Group 2



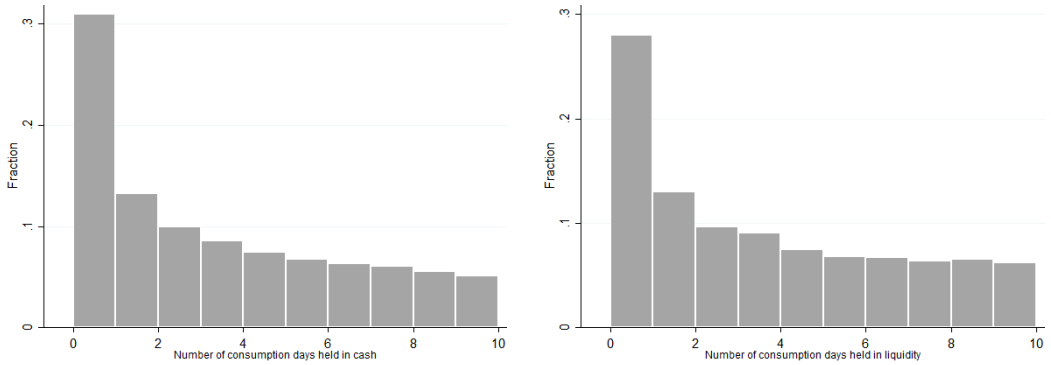
Irregular Income Liquidity Group 3

Figure 12: The Effects of Irregular and Regular Income on Spending by Liquidity (measured by the median number of consumption days held in cash or lines of credit)



Cash holdings in 10 consumption days Liquidity in 10 consumption days

Figure 13: The Distribution of Cash Holdings and Liquidity before Paydays



Cash holdings in consumption days Liquidity in consumption days

Figure 14: The Distribution of Cash Holdings and Liquidity before Paydays for Individuals Holding less than ten Days of Spending

Table 4: Summary Statistics by Tertiles of Liquidity in Consumption Days

	(1)	(2)	(3)
monthly income	362,714	496,280	599,862
age	36	41	45
spouse	0.16	0.21	0.20
savings account balance	20,463	77,424	1,122,701
checking account balance	-220,787	-149,808	331,403
credit-card balance	-132,311	-216,989	-222,292
checking account limit	311,311	433,727	440,056
credit-card limit	241,061	626,274	1,027,097
cash	-200,323	-72,385	1,454,103
liquidity	219,738	770,627	2,698,963
credit utilization	0.52	0.35	0.26
checking account utilization	0.37	0.30	0.14
payday loan	41	4	0
gender	0.53	0.46	0.39
average daily spending	5,558	6,291	5,731
number of days held in cash	-38	-14	214
number of days held in liquidity	38	123	546

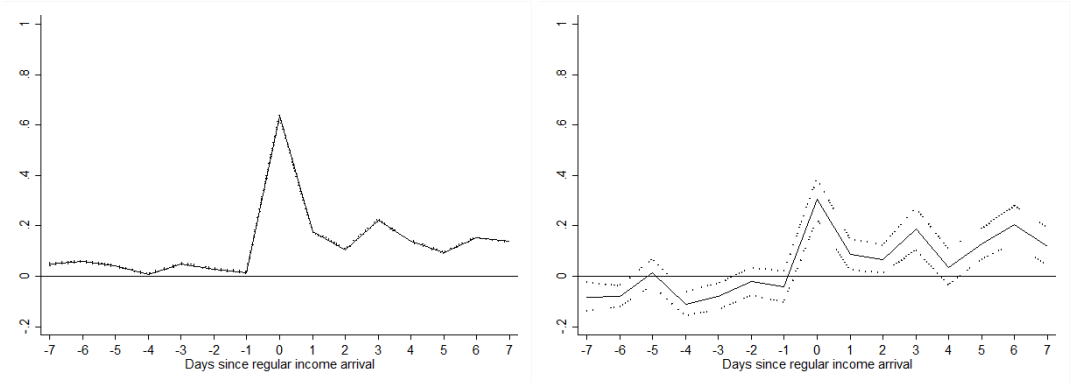


Figure 15: The Effects of Regular Income Arrival on Spending by Individuals who Did not or Did Receive a Large Exogenous Wealth Shock in that Month

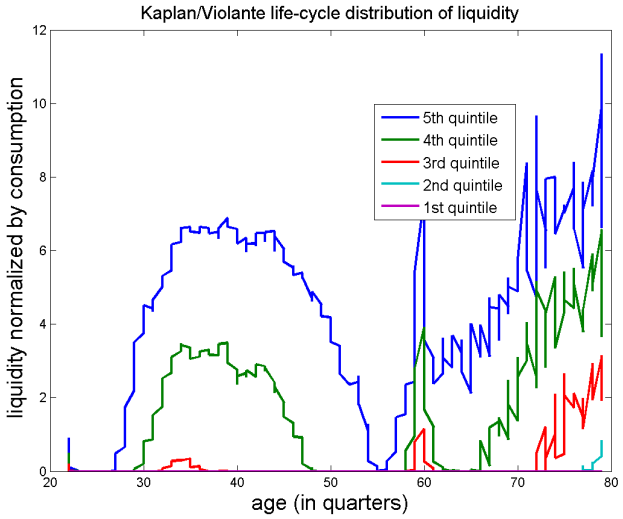


Figure 16: Life-Cycle Profiles of Liquid Asset in Consumption (quarterly) as predicted by the model in Kaplan and Violante (2014b)

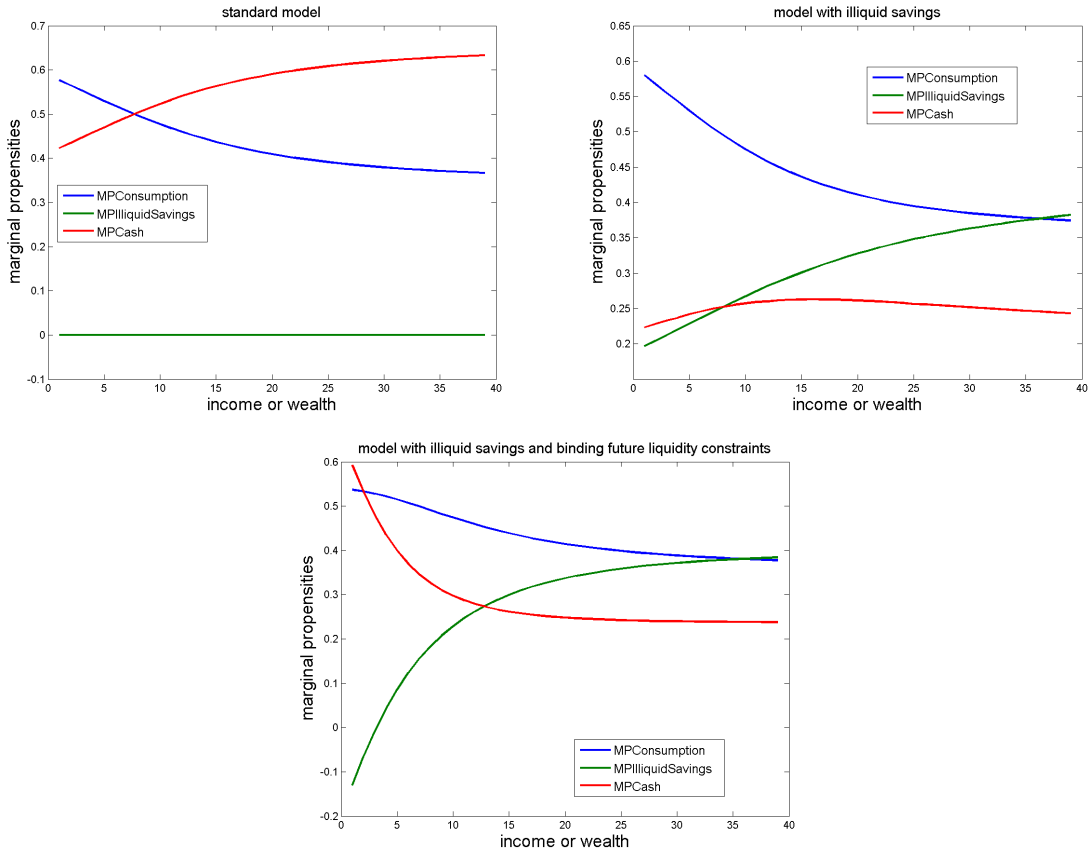
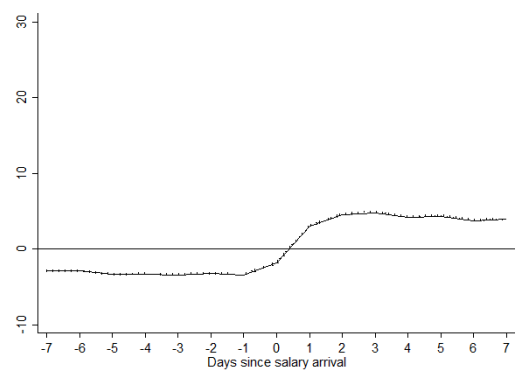
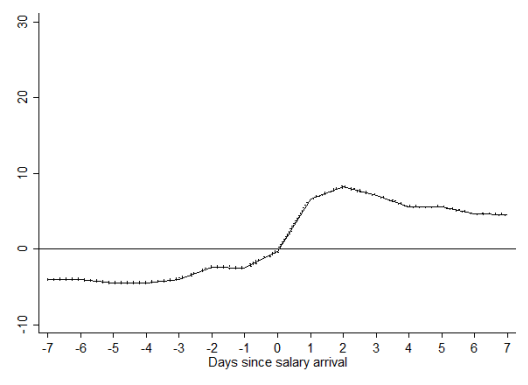


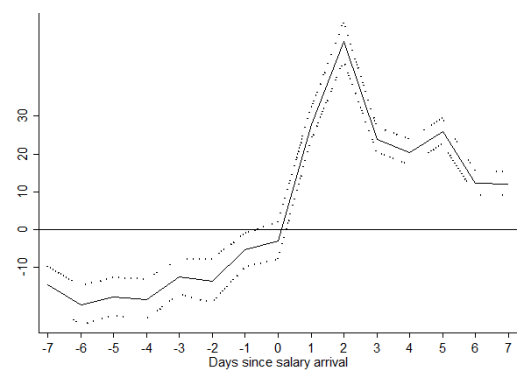
Figure 17: Marginal Propensities to Consume, Save Illiquidly, and Hold on to Cash as implied by Models with and without Illiquid Savings and Future Binding Liquidity Constraints



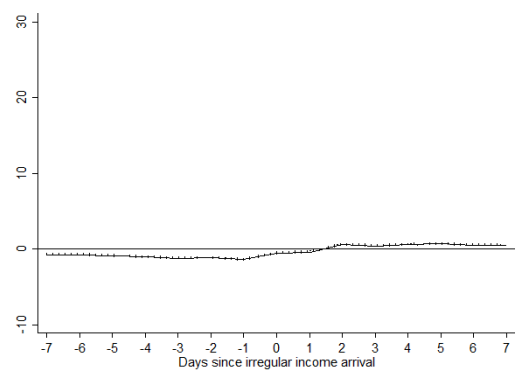
Regular Income Low Liquidity



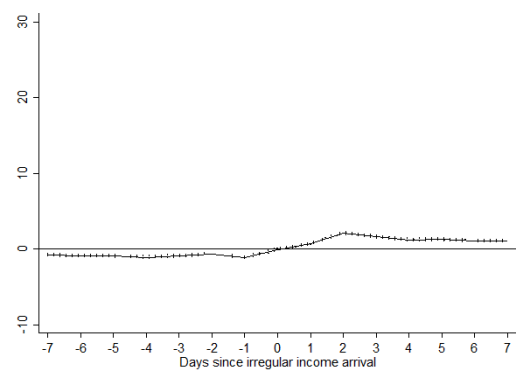
Regular Income Medium Liquidity



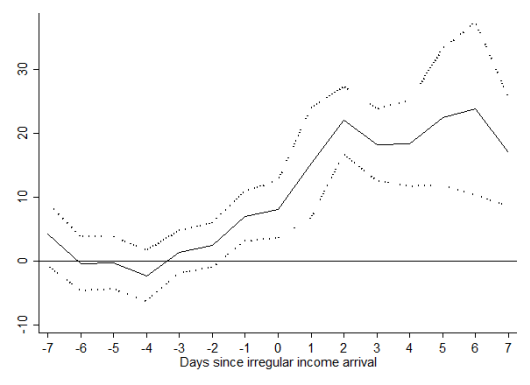
Regular Income High Liquidity



Irregular Income Low Liquidity



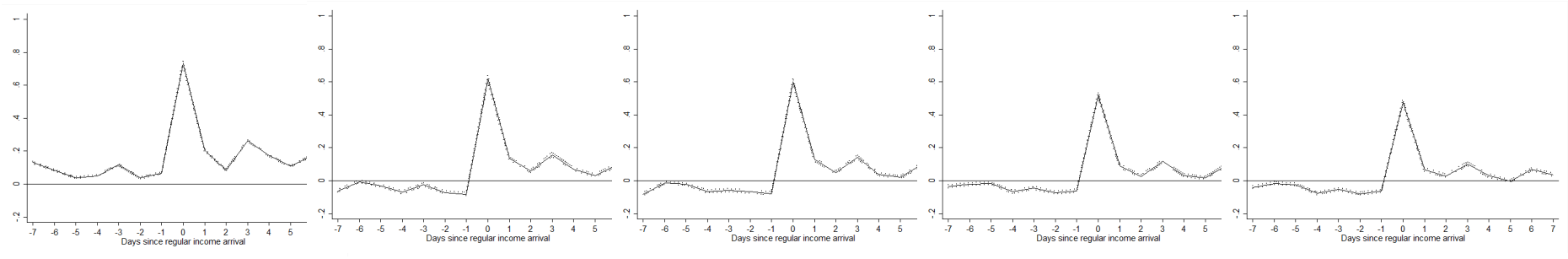
Irregular Income Medium Liquidity



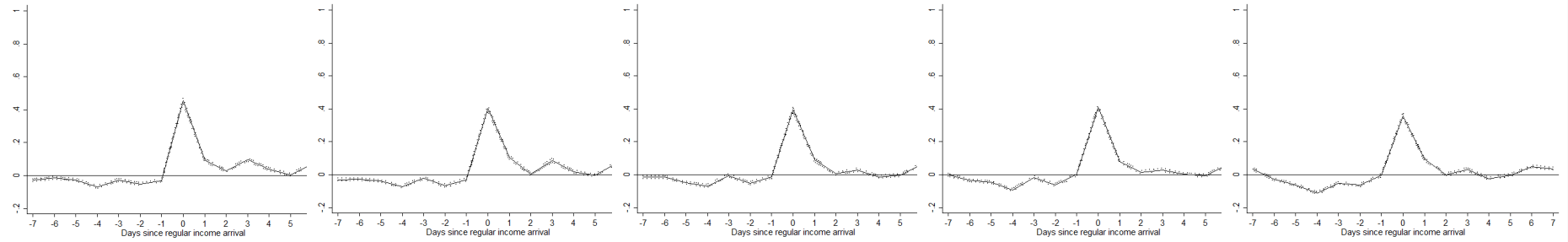
Irregular Income High Liquidity

Figure 18: The Effects of Regular and Irregular Income Arrival on Liquidity by Tertiles of Consumption Days From Current Liquidity

Appendix

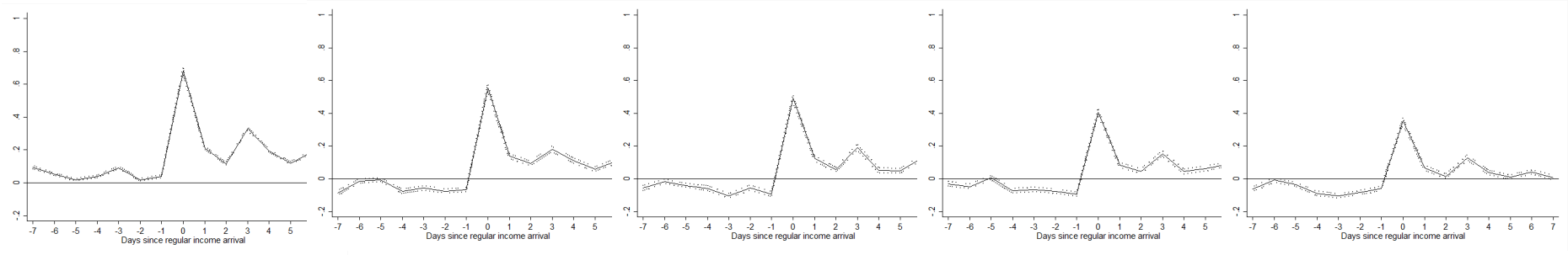


Salary Group 1 | Salary Group 2 | Salary Group 3 | Salary Group 4 | Salary Group 5

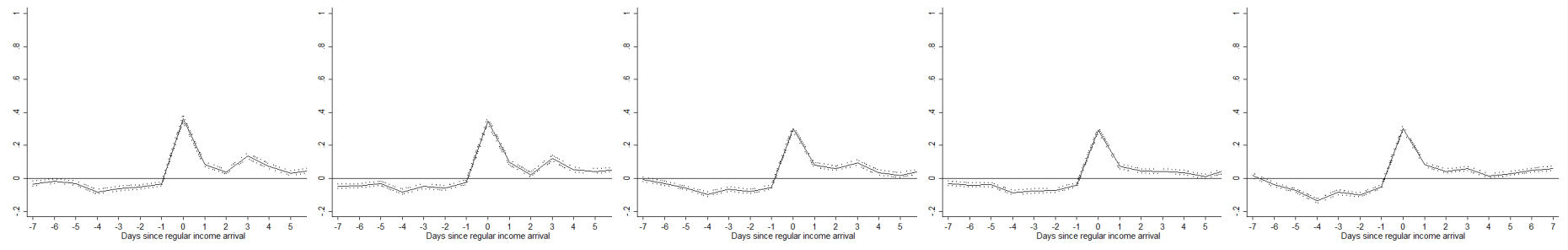


Salary Group 6 | Salary Group 7 | Salary Group 8 | Salary Group 9 | Salary Group 10

Figure A.1: The Effects of Paycheck Arrival on Necessary Spending

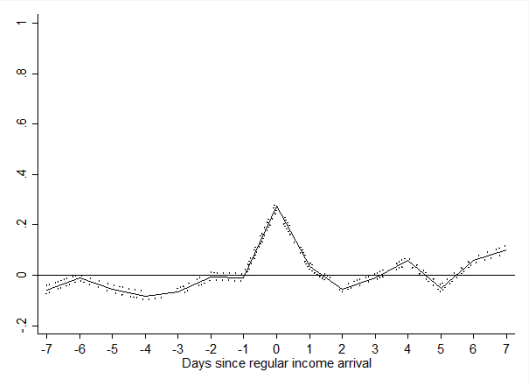


Salary Group 1 | Salary Group 2 | Salary Group 3 | Salary Group 4 | Salary Group 5

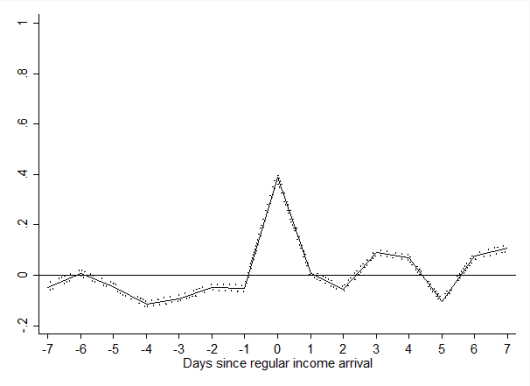


Salary Group 6 | Salary Group 7 | Salary Group 8 | Salary Group 9 | Salary Group 10

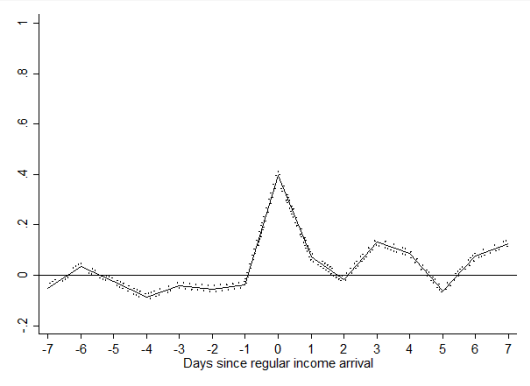
Figure A.2: The Effects of Paycheck Arrival on Discretionary Spending



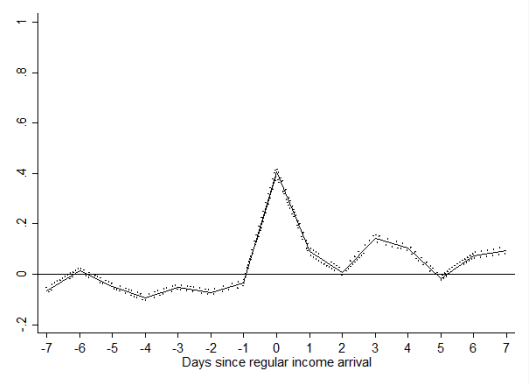
Financial Sophistication Group 1



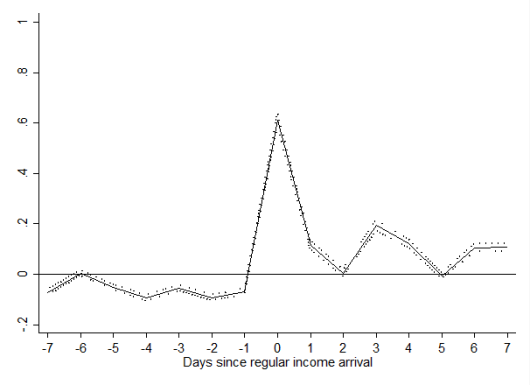
Financial Sophistication Group 2



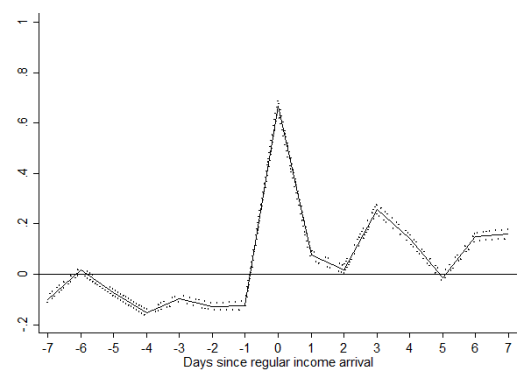
Financial Sophistication Group 3



Financial Sophistication Group 4

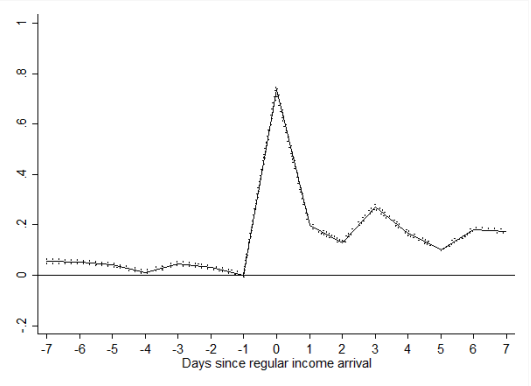


Financial Sophistication Group 5

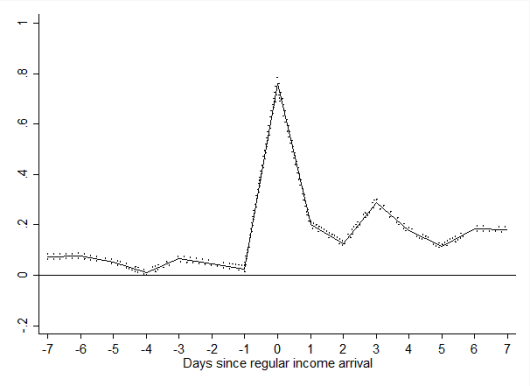


Financial Sophistication Group 6

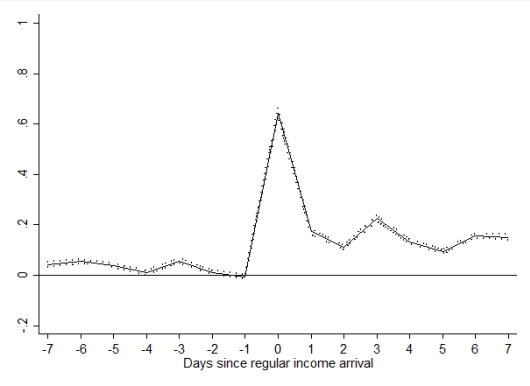
Figure A.3: The Effects of Regular Income Arrival on Spending by Individuals Costs in Banking Fees, Interest, and Payday Loans



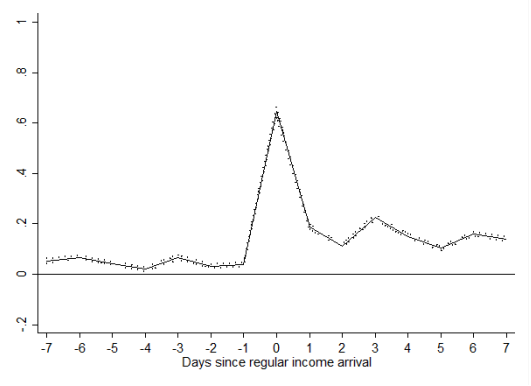
Log-in Group 1



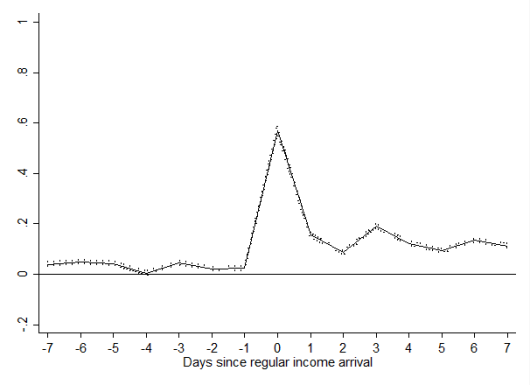
Log-in Group 2



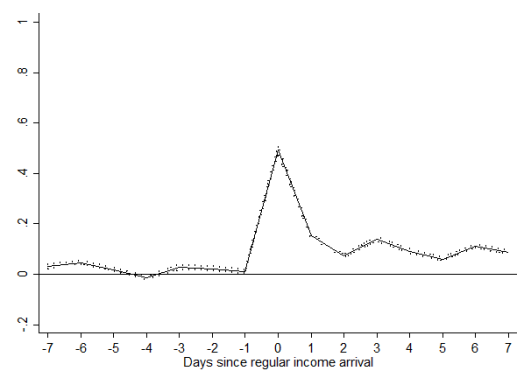
Log-in Group 3



Log-in Group 4

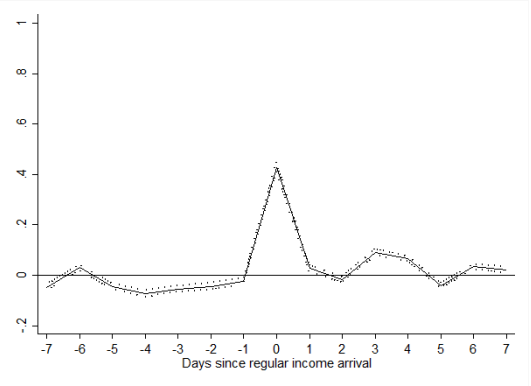


Log-in Group 5

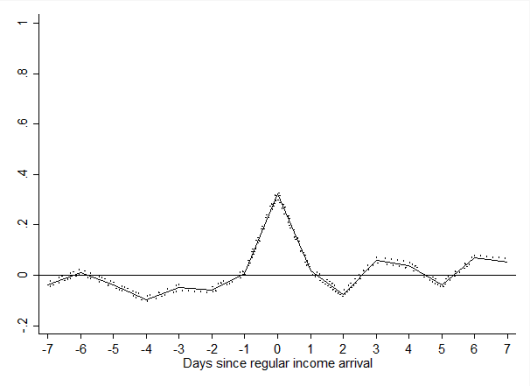


Log-in Group 6

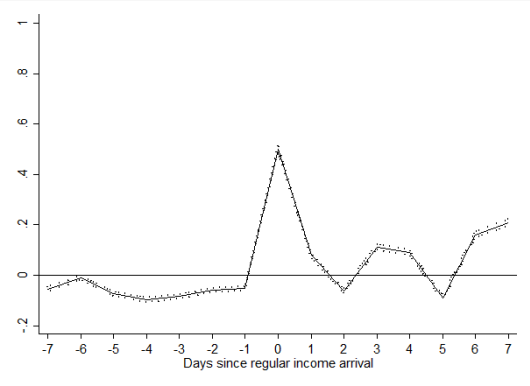
Figure A.4: The Effects of Regular Income Arrival on Spending by Frequency of Log-in



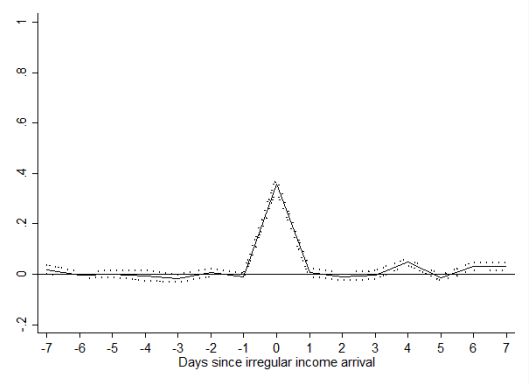
Regular Income Credit Utilization 1



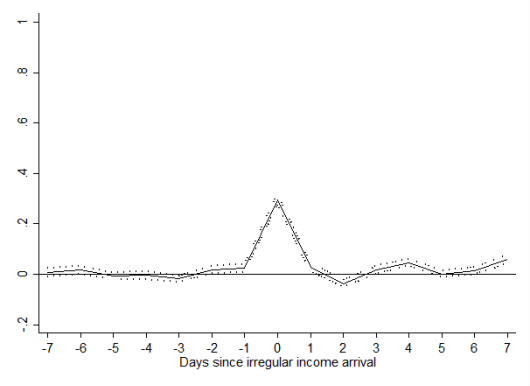
Regular Income Credit Utilization 2



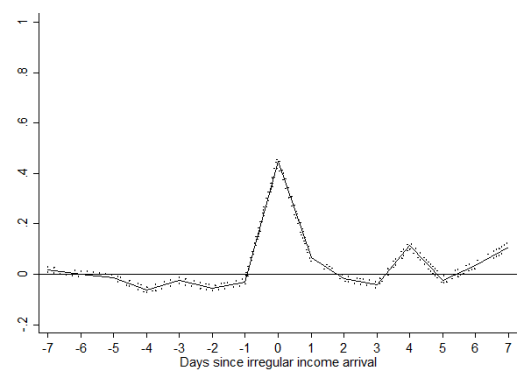
Regular Income Credit Utilization 3



Irregular Income Credit Utilization 1

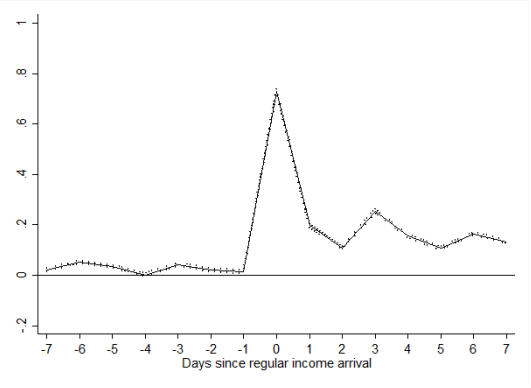


Irregular Income Credit Utilization 2

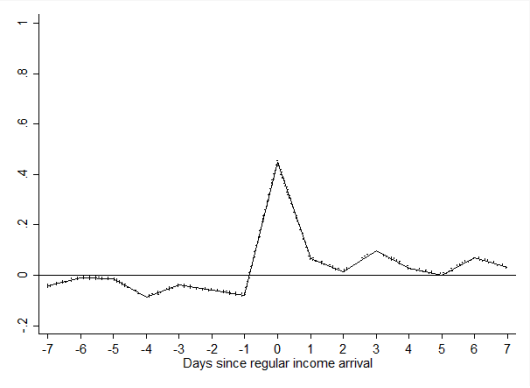


Irregular Income Credit Utilization 3

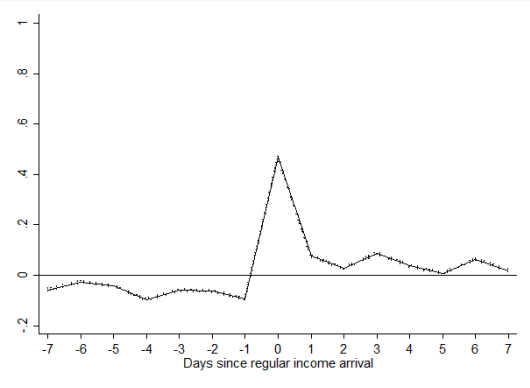
Figure A.5: The Effects of Irregular and Regular Income on Spending by Tertiles of Credit Utilization



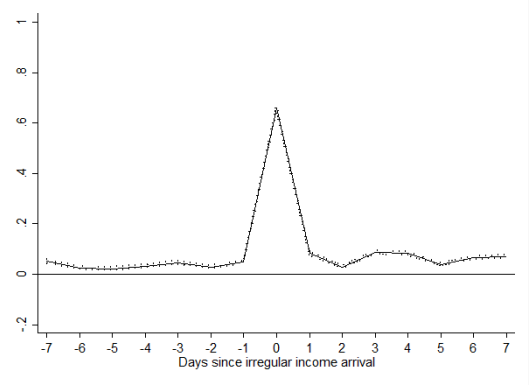
Regular Income Liquidity Group 1



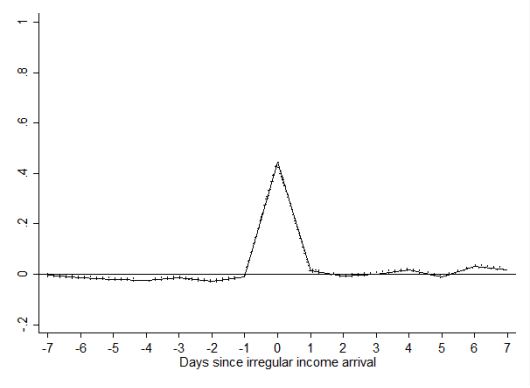
Regular Income Liquidicity Group 2



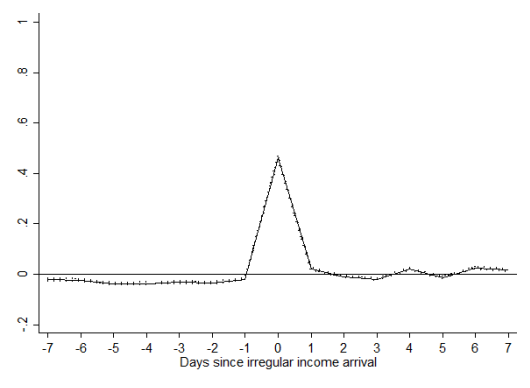
Regular Income Liquidity Group 3



Irregular Income Liquidity Group 1

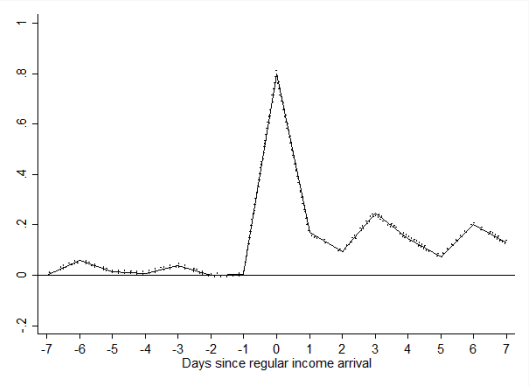


Irregular Income Liquidity Group 2

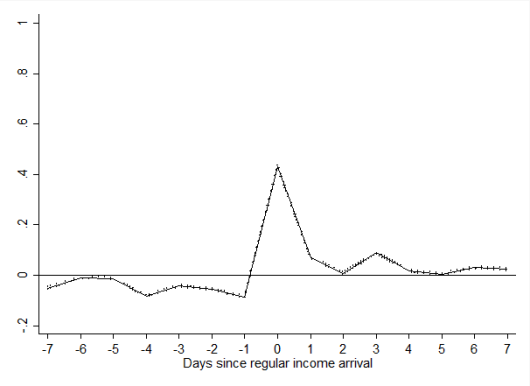


Irregular Income Liquidity Group 3

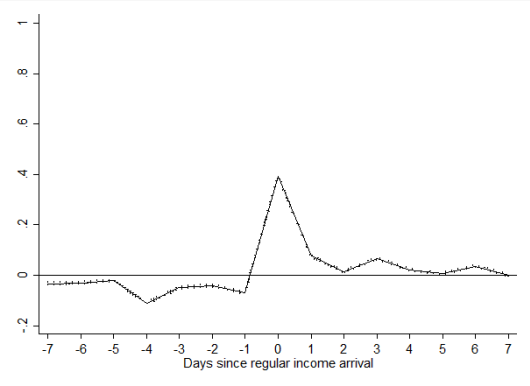
Figure A.6: The Effects of Irregular and Regular Income on Spending by Liquidity (measured by how much people spend as compared to to average day in the last 4 days prior to income arrival)



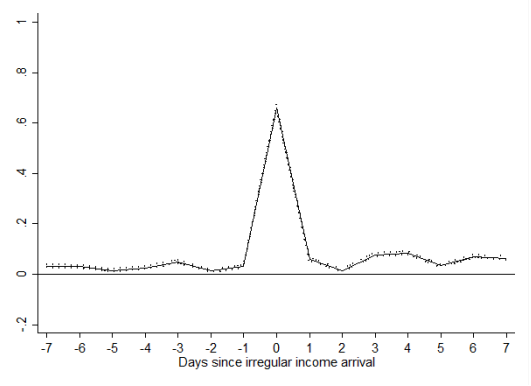
Regular Income Liquidity Group 1



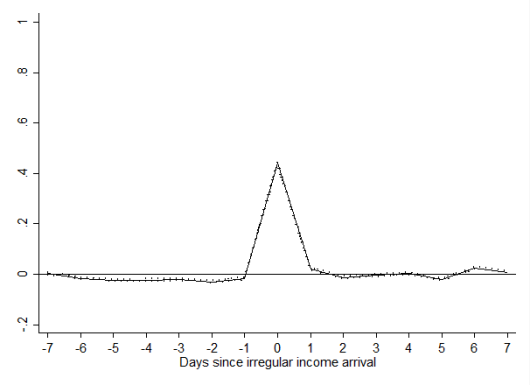
Regular Income Liquidicity Group 2



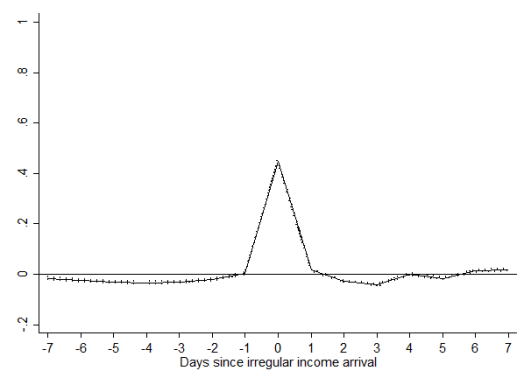
Regular Income Liquidity Group 3



Irregular Income Liquidity Group 1

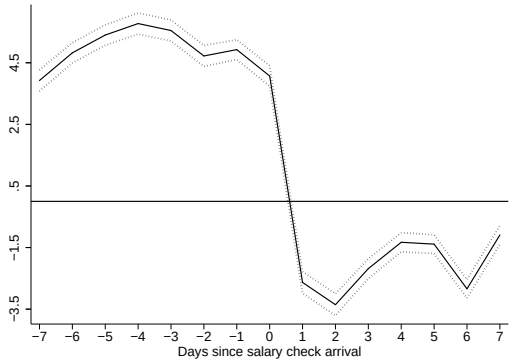


Irregular Income Liquidity Group 2

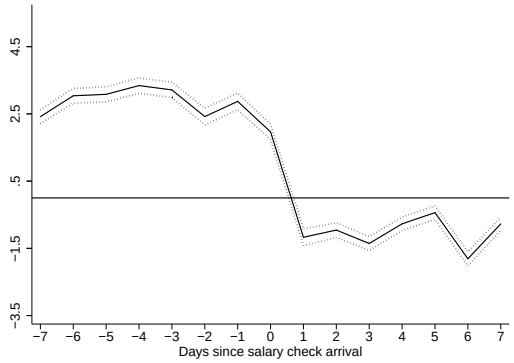


Irregular Income Liquidity Group 3

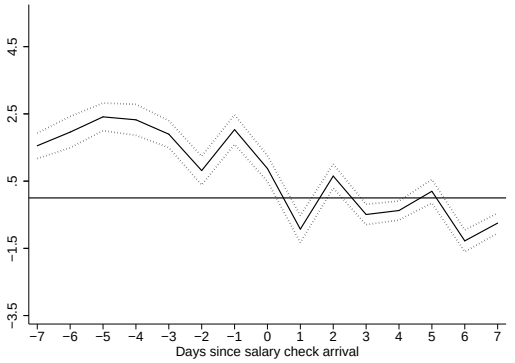
Figure A.7: The Effects of Irregular and Regular Income on Spending by Liquidity (measured by how much people spend on discretionary goods and services as compared to to average day in the last 4 days prior to income arrival)



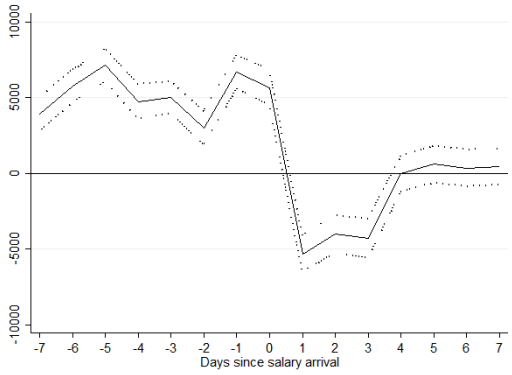
Regular Income Low Liquidity



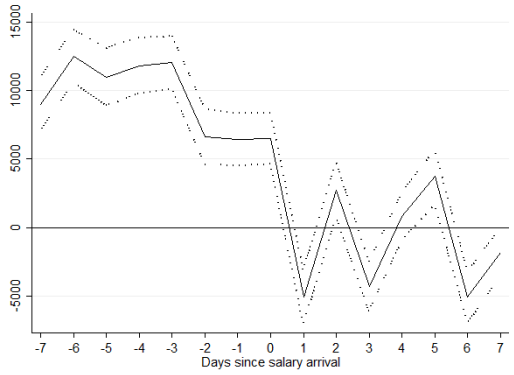
Regular Income Medium Liquidity



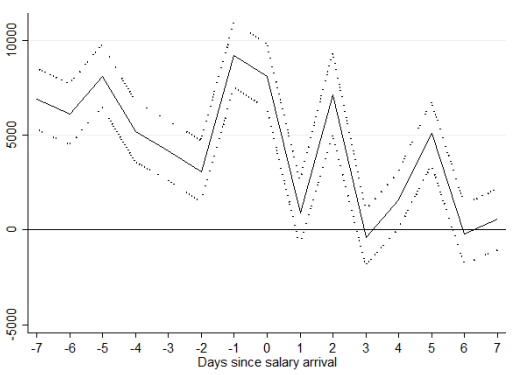
Regular Income High Liquidity



Irregular Income Low Liquidity

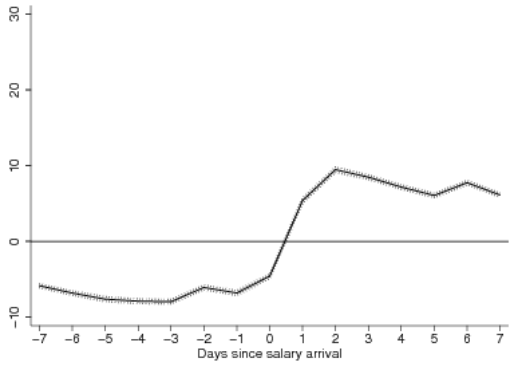


Irregular Income Medium Liquidity

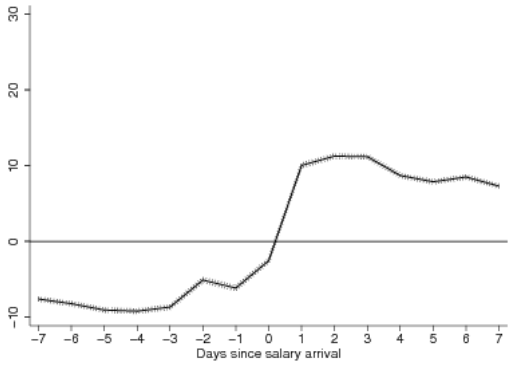


Irregular Income High Liquidity

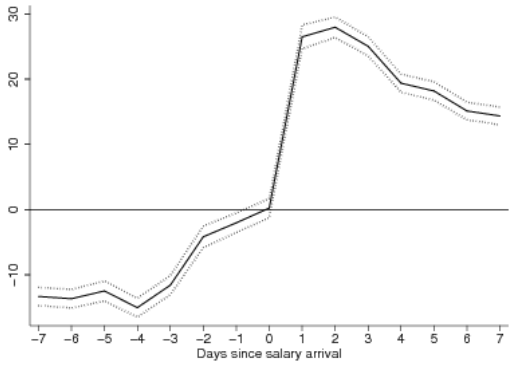
Figure A.8: The Effects of Regular and Irregular Payments on Overdraft Limits by Tertiles of Consumption Days From Current Liquidity



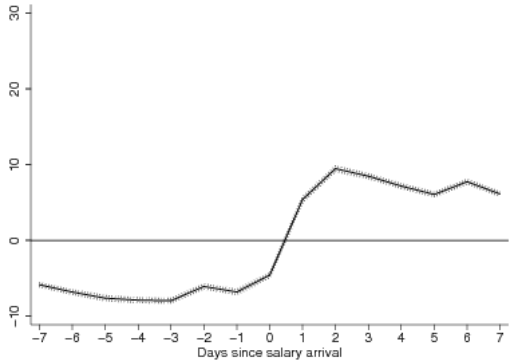
Regular Income Low Liquidity



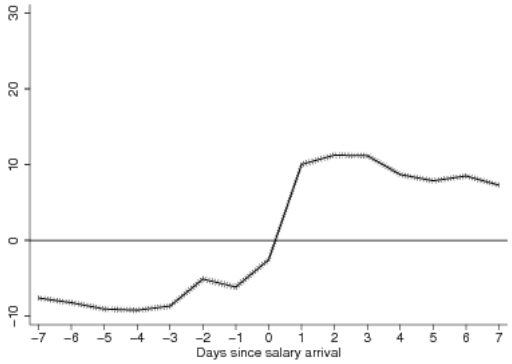
Regular Income Medium Liquidity



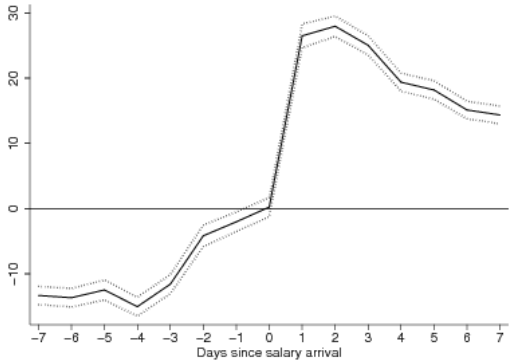
Regular Income High Liquidity



Salary Low Liquidity



Salary Medium Liquidity



Salary High Liquidity

Figure A.9: The Effects of Regular Income and Salary Arrival on Cash minus Credit Balances by Tertiles of Consumption Days From Current Liquidity