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Discussion Paper No. 2022-18

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May 2022

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CeDEx Discussion Paper Series
ISSN 1749 - 3293


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# The Co-holding Puzzle: New Evidence from Transaction-Level Data

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May 3, 2022

**Abstract**

Using detailed and highly disaggregated data on household finances, we examine the tendency of consumers to "co-hold" savings and debt simultaneously. The disaggregated nature of the data allows us to calculate co-holding at daily frequency. We find that co-holding is rare and mostly occurs in short spells within the month, but is a persistent behavior among a subset of consumers. For this group, we find evidence in support of explanations for co-holding based upon functional mental accounting in which agents hold spending and saving accounts, while we find less support for rational explanations.

*Keywords*: co-holding; credit card puzzle; consumer credit; household finance
*JEL Codes*: D12; D14; D15; G51

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This project has received funding from the Danish Council for Independent Research, under grant agreement no 6165-00020. Andrea Marogg provided excellent research assistance. We are indebted to Meniga for providing and helping with the data.

# 1 Introduction

Individuals commonly exhibit financial behaviors that appear inconsistent with models of rational, or even quasi-rational, behavior. These include, e.g., failing to refinance a mortgage to a much cheaper interest rate even when a better deal is available to the household, paying down debt on a lower interest rate credit card while forgoing the opportunity to pay down debt on a higher interest rate credit card, and choosing a dominated option from a menu of health insurance plans (see Andersen et al., 2020; Bhargava et al., 2017 and Gathergood et al., 2019). Understanding the prevalence and causes of suboptimal behavior is important for developing realistic models of consumer behavior and for contributing to debates surrounding the role of policy in improving outcomes.

In this paper we use unique and highly detailed daily data containing information on spending, deposit accounts, and overdrafts to study one of the starkest violations of simple arbitrage on household balance sheets: holding low-yield, liquid savings while simultaneously holding high-cost unsecured credit on revolving credit lines. This tendency is known as the "co-holding" puzzle (or "credit card debt" puzzle when referring specifically to credit cards as the revolving credit product), whereby individuals apparently violate simple arbitrage by holding low yield liquid savings which could be used to pay down higher-cost debt, thereby eliminating excess debt interest charges with no change to net liquidity.

A series of studies, beginning with Morrison (1998) and Gross and Souleles (2002), show in cross-section data that a significant fraction of individuals hold low-yield liquid savings and higher-cost revolving credit card debt simultaneously. Co-holding liquid assets and revolving credit card debt is particularly puzzling because, unlike other credit products, there is no apparent friction in the terms and conditions of the products which would explain this behavior.[1] Explanations offered in the literature appeal to the need to access cash (Telyukova and Wright, 2008, Telyukova, 2013), precautionary behavior in light of the risk of credit limit chase-down (Druedahl and Jørgensen, 2018, Gorbachev and Luengo-Prado, 2019), cognitive ability (Choi and Laschever, 2018) and holding-out credit balances as a means of self-control either for the

[1] This may not be the case with other credit products, such an instalment loans, where it may not be possible to pre-pay the loan, or where consumers may be unable to re-access the line of credit (and hence reduce their total liquidity by pre-paying the loan).

individual or for members of the household unit (Bertaut et al., 2009; Gathergood and Weber, 2014; Vihriala, 2019).

We study co-holding in a unique context which offers exceptionally detailed daily-level information on deposit balances, overdrafts, and transactions provided by a financial aggregator. This allows us to accurately measure co-holding based upon objective data on financial balances, and to take measurements at the daily level. The co-holding puzzle is normally analyzed empirically using self-reported survey data on savings balances and credit card balances at a point in time because in many institutional settings these represent the most common liquid assets and liquid debt, and few non-survey measures of co-holding are available. With the availability of objective daily-level data, we are able to measure co-holding precisely and examine multiple dimensions of co-holding, including the duration of co-holding spells and frequency of spells within and across individuals over time, allowing us to examine the persistence of this behavior and sources of heterogeneity. We can also link the onset of co-holding to spending patterns. In these richer data we can therefore test between a wide variety of competing explanations for co-holding, which has not been feasible using standard data sources.[2]

We also focus on an institutional setting in which the most common means of revolving unsecured borrowing is via bank overdraft (the Icelandic consumer credit market). In contrast with most consumer credit markets, where credit cards are the most common revolving credit product, the most common form of revolving consumer credit in Iceland is high-cost overdraft lines (with an average Annualized Percentage Rate of around 12%). At the same time, deposit balances earn near-zero interest. As in most consumer credit markets, overdraft lines are simply negative deposit account balances. However, in contrast to most other consumer credit markets, it is quite common that an individual holds more than one deposit account and can therefore run a deposit account balance and an overdraft line simultaneously. With both accounts being

[2] Survey-based measures of deposit account balances and credit card debt may suffer from measurement error (in particular, survey measures tend to underestimate revolving credit card debt, on which see Zinman, 2009). Surveys also typically offer only low-frequency data (e.g., yearly), capturing balances only at the interview date. From these data it is not possible to calculate the persistence of co-holding at the individual level at frequencies lower than a year, though as we show this an important element for understanding the nature and costs of co-holding. Furthermore, even with access to credit report data, it is not currently possible to separate revolving from transacting balances, and an accurate measure of rolled-over consumer debt can therefore not be obtained from such data.

fully liquid, individuals can transact from either account and individuals can adjust balances at any point in time. Co-holding in this setting is therefore a particularly stark violation of simple arbitrage, given the ease with which balances can be adjusted.

This focus on overdraft borrowing, in contrast with credit card borrowing, has a number of advantages. In our setting the cost of co-holding is incurred with certainty from the point in time in which balances are held simultaneously (in contrast with credit card co-holding, which is financially *beneficial* during the zero-interest float period). Overdrafts also do not offer additional benefits such as frequent flyer miles, or cashback on spending, which might confound the calculation of excess interest due to co-holding. While credit cards are commonly used for transaction purposes in Iceland, they are rarely used as a revolving credit instrument. In our data, 98% of credit card statements show zero revolving balance. We further show that patterns of credit card usage do not explain the co-holding behaviors we observe in the sample.[3]

Our data source is Iceland's most commonly used financial aggregator app, Meniga, which is used by approximately 20% of the Icelandic population. The app's user base is broadly representative of the Icelandic population, partly due to the app being marketed by all of the country's large retail banks. The data set provides to us a daily view of an individual's transaction-line expenditure and income as well as balance records. These data allow us to measure co-holding at daily frequency. Using the spending data, we are also able to normalize co-holding by individual expenditure, thereby quantifying co-holding in (approximate) consumption terms. Quantifying co-holding in terms of days of spending provides an economically meaningful measure of the cost of co-holding to the individual, which also allows us to measure co-holding that is not undone by immediate spending needs.[4]

Our first contribution is to present new results on the measurement of co-holding at the daily level and relate these to the findings from previous studies which use more aggregated data. Analyzing co-holding at the individual × day level, we find that co-holding occurs on 15%

[3] It is important to emphasize though that credit card use is very common in Iceland, and consumers take advantage of the zero-interest float period, the vast majority of consumers use an overdraft to pay the credit card bill when it is due, rather than rolling it over.

[4] For example, an individual who co-holds $500 dollars whilst typically spending $500 per day incurs very little excess interest cost (given the very short duration of co-holding) which is also small relative to their high level of consumption, whereas for an individual spending $50 per day the same level of co-holding would accrue higher excess interest cost (given the longer duration of co-holding) and represent a larger economic cost relative to their low level of consumption.

of individual × days in our baseline sample. The level of co-holding is typically modest when scaled by consumption. Conditional upon non-zero co-holding, the majority of days on which accounts co-hold involve co-holding of less than fifteen days' worth of consumption spending. Co-holding of more than one month's worth of spending is uncommon, restricted to fewer than one-in-five individual × days with positive co-holding in the sample. As a consequence, overall co-holding does not generate large excess interest costs for most of the individuals in the sample.[5] We see that persistent co-holding is limited to a subset of individuals who co-hold regularly over the sample period.

Our second contribution is to shed new light on the various explanations for co-holding offered in the previous literature by examining the behavior of co-holders. Given the institutional setting we study, we can rule-out the two standard explanations for co-holding arising in the prior literature, both of which are based upon liquidity needs, such as the need to previously access cash for many transactions. One standard argument is that co-holding might reflect a need to access cash. However, although this may have been probable at a time when cash was important as a means of payment and was expensive or difficult to borrow on credit cards, it is unlikely to be relevant now. Furthermore, in our setting co-holding cannot be explained by the need for cash liquidity, as overdraft balances can be used for all transaction types and cash transactions do not attract penalty interest rates.[6] A second argument is that individuals are reluctant to pay down lines of credit such as credit cards because of the risk that the lender would close the credit lint. However, in our setting co-holding is not explained by credit line risk, as in the model of Druedahl and Jørgensen (2018) and empirical study by Gorbachev and Luengo-Prado (2019).[7]

Our findings suggest that co-holding does not arise due to limited attention. Co-holding

[5] This finding is consistent with those from ongoing work in Vihriala (2019). That study uses Finnish data and calculates co-holding using information on liquid assets and unsecured debt (defined as credit card debt plus revolving bank loans). Between 11% and 16% of individual × days exhibit co-holding, depending on definition, similar to the 15% in our data. Calculations further show that co-holding has low persistence at the individual level, again consistent with our findings.

[6] In the model of Telyukova and Wright (2008), individuals undertake some types of expenditures that cannot be paid via credit card. Hence they maintain liquid savings balances as a solution to an optimal money demand problem.

[7] Specifically, the credit line risk explanation is that, in the credit card setting, individuals might be reluctant to pay-down their revolving credit card balances if there is a large likelihood that the credit card issuer will "chase-down" the credit limit, reducing the limit when the balance is repaid.

might be explained by individuals facing a fixed cost (such as the time, or psychological, cost) of paying attention to their accounts and optimizing their financial balances. We test this idea by examining how co-holding scales with financial cost and occurs when individuals are observed to pay attention. First, under rational inattention we would expect co-holding to reduce as financial stakes increase (and the cost of inattention therefore rises). However, we find a *positive* relationship between the level and duration of co-holding, indicating that individuals who co-hold more tend to do so for longer, hence incurring higher excess interest costs. Second, we find that co-holding is more likely to commence on days on which individuals login to the financial aggregator app, thereby paying attention to their accounts. These results are inconsistent with an explanation of co-holding based upon a model of limited attention.

Our findings also suggest that co-holding does not arise due to lack of coordination within the household unit. Lack of coordination might occur due to coordination costs or non-unitary decision making. In the model of Bertaut et al. (2009), patient "accountant" who manages the finances of the household and has sole access to liquid savings with which to pay down credit, decides to revolve debt in order to restrict the consumption opportunities of an impatient "shopper" who cannot access savings and is reliant on the credit decisions of the accountant. A stable equilibrium exists in which savings and credit are held simultaneously by the accountant-shopper. In their model the accountant-shopper either constitutes a two-person household or a single self-aware individual who undertakes planning behavior as an accountant to restrict the consumption opportunities they will be tempted to indulge in as a shopper. In our data, we find similar levels of co-holding at the household $\times$ day level to that when measured at the individual $\times$ day level. Hence, co-holding is not readily explained by one member of a household unit holding liquid savings while the other holds an overdraft balance (a pattern of behavior which would result in co-holding at the household level but not at the individual level).

Our results instead reveal that co-holding occurs in a manner consistent with mental accounting. This is seen is co-holding being related to the composition of consumption spending. We analyze the relationship between a spell of co-holding starting and consumption shares of durable, non-durable and cash consumption. Results indicate that higher shares of non-durable

consumption are positively related to spells of co-holding starting - in particular gambling and temptation purchases. In addition, the number of current accounts and number of savings accounts held by the individual are also positively related to spells of co-holding starting. Our results suggest that individual hold-back an account with positive savings, while spending into overdraft on a separate account in order to finance non-durable expenditure associated with temptation or lack of self-control. These results suggest that co-holding may arise as a result of a form of mental accounting, whereby individuals separate the financing of their current expenditure under a spending impulse from the holding of a buffer of savings - hence generating co-holding through a combination of concurrent mental accounts.

The main advantages of our study arise from the use of objective, granular and high-frequency data made available by the financial aggregator app. Most studies in the existing literature rely on survey data for the measurement of co-holding. Survey data may under-report levels of indebtedness though due to the reluctance of respondents to reveal their level of debt. Also, surveys face the challenge of designing questions which will accurately distinguish between revolving and transacting credit card balances. To our knowledge, ours is the first study to measure co-holding at daily frequency. Studies based on survey data typically measure co-holding at annual frequency, in some cases analyzing panel analysis over quite long time horizons of many years of low -frequency data. Furthermore, even studies that are based on credit report data have difficulties obtaining reliable measures of co-holding as transacting and revolving balances cannot be separated and it is therefore not feasible to know the amount of debt incurring interest.

A second advantage of our study is that we focus on overdraft usage. Overdrafts and credit cards are very similar products - both offer flexibility in spending and repayment, and typical Annual Percentage Rates (APRs) for overdraft lines are similar to typical APRs for credit cards. Credit card usage is not uncommon in the Icelandic credit card market, but overdrafts are used as a direct substitute for rolling over credit card debt. However, from the perspective of measurement of economic costs, co-holding liquid assets and overdraft balances is particularly advantageous due to the fact that there is no doubt about the amount of debt incurring interest as interest is levied on overdraft balances every day and the flexibility with which payments

can be made towards an overdraft line. Furthermore, while with credit cards co-holding may occur due to forecast errors (for example, a credit card balance might be held as a transacting balance in expectation, but held as a revolving balance *ex post* due to unanticipated shocks), the terms of overdraft balances are constant over time.

Our findings also relate the broader recent literature on suboptimal financial behavior within the field of household finance. Using Danish data, Andersen, Campbell, Nielsen, and Ramadorai (2020) find that many Danish households fail to refinance a mortgage to a much cheaper interest rate, even in a setting in which the frictions to mortgage refinancing are minimal.[8] Gathergood, Mahoney, Stewart, and Weber (2019) show that individuals in the United Kingdom who hold multiple credit cards misallocate, on average, 20% of their monthly repayment towards a lower-APR credit card.[9] Bhargava, Loewenstein, and Sydnor (2017) find that the majority of employees at a US firm choose a health care plan which is dominated by a lower-cost option, on average resulting in excess spending equivalent to 24% of chosen plan premiums. Recent studies also suggest individuals exhibit suboptimal responses to taxes (Chetty et al., 2009; Finkelstein, 2009; Taubinsky and Rees-Jones, 2018) For reviews of the household finance literature see Campbell (2006), Guiso and Sodini (2013), Beshears et al. (2018) and Gomes et al. (2020); and see Gabaix (2019) for a review of the literature on behavioral inattention.

The remainder of our paper proceeds as follows. Section 2 describes the transaction-level data we use in our analysis, provided by an online financial aggregator. This section also defines our measure of co-holding. Section 3 presents results on the measurement on co-holding. Section 4 presents results on the determinants of co-holding. Section 5 concludes.

## 2 Data

The data we use are provided by Meniga, a financial aggregation software provider to European banks and financial institutions, serving approximately 20 percent of the Icelandic adult population. Anyone who has an online bank account in Iceland can register at meniga.is to access the

[8] Other studies of sub-optimal mortgage refinancing include Agarwal et al. (2016), Keys et al. (2016), Agarwal et al. (2017) and Bajo and Barbi (2018).

[9] Also see Ponce et al. (2017).

personal financial management platform and all larger banks in Iceland allow their customers to easily sign up in their internet bank. The app recruits users via all the country's largest retail banks whose customers can effortlessly link all their accounts to the platform in their internet bank. Analysis of the Meniga data set shows that its user base is broadly representative of the Icelandic population.[10]

Meniga's account-aggregation platform allows users to view financial records from multiple products (either within or across financial providers) on a single platform. In order to provide the single-platform view, Meniga scrapes transaction-line level data from financial providers on a daily basis. Users of the platform provide one-time consent for Meniga to scrape these data, allowing the aggregator to scrape data "in the background" on an ongoing basis without requiring the consumer to re-consent.[11] These data are provided to us for our analysis. The data set we use in this paper covers the period 1 September 2014 to 31 January 2017. These data have been used previously in a series of studies to examine the spending responses of individuals to income arrivals (Olafsson and Pagel, 2018a), the drivers of individuals' attention to their personal finances (Olafsson and Pagel, 2017), how expenditures and financial decisions change around retirement (Olafsson and Pagel, 2018b), and to evaluate the extent to which the demand for high-cost credit can be attributed to adverse financial conditions or imperfect decision-making ("mistakes") (Carvalho et al., 2019).

The main advantage of accessing data via the financial aggregator is that we are able to obtain detailed, objective financial records at very high frequency (daily). The transaction-line data is exceptionally detailed, containing each individual transaction undertaken by the account holder with information on the transaction category (merchant category code), transaction amount and the date on which the transaction took place. The data is also objective, not relying on individual recalls. The main disadvantage of the traditional alternative data source for analysis of co-holding – survey data – is that surveys provide low-frequency data (often annual frequency) and are susceptible to self-reporting bias. This is particularly severe for credit card

[10] Carvalho et al. (2019) show the characteristics of the Meniga user base are in line with those of the Icelandic population as measured from nationally representative surveys.

[11] In some countries, data sharing regulations require consent of the consumer to be re-sought periodically for ongoing data sharing, for example every 90 days under Open Banking regulations in the UK. In the US, FINRA regulations require firms to notify consumers of the right to cancel their data sharing agreements.

debt, where the distinction between transacting and revolving balances is difficult to accurately measure in survey data. For example, Zinman (2009) shows that aggregate revolving credit card balances from the US Survey of Consumer Finances capture only half the total credit card debt held in the US. Using data from a South African lender, (Karlan and Zinman, 2008) show that more than half of individuals do not report their high-cost borrowing. Furthermore, even when using credit report data, perfect separation between transacting and revolving balances is not possible, resulting in inaccurate measures of the amount of debt incurring interest charges.

### 2.1 Sample selection

As of January 2017, the point of data extraction, approximately 20% of the Icelandic population use a Meniga account, equating to 53,000 users out of a total adult population in Iceland of 260,000 individuals. We restrict the sample for analysis in two ways to obtain a sample of individuals who appear to be well-integrated with the aggregation platform.

First, we restrict our sample to individuals who appear to be economically active, specifically individuals for whom we observe monthly income arrivals (e.g., labor market income or unemployment benefits, pension payments, invalidity benefits, and student loans). This restriction excludes cases where individuals are holding dormant accounts, or conducting their main banking activity via an account not observed in the Meniga data.

Second, we restrict to individuals for whom we can observe key demographic information about the person (age, sex, and postal code). The final sample selection we apply is that the level of spending is above a minimum level, which we define as requiring at least 5 food transactions in at least 23 months of a 24 months period.

Applying these sample restrictions provides 11,551 accounts. We focus on co-holding at the daily level, hence the main unit of data we use in our analysis is an individual $\times$ day. In total, the data provides approximately 10.2 million individual $\times$ day observations. This forms the baseline sample for our analysis.

# 3 Results I: Measuring co-holding

## 3.1 Co-holding calculation

Our main interest lies in measuring the extent of co-holding behavior among account holders in the sample. Our sample restrictions provide an analysis sample in which each individual × day observation shows a balance on the deposit account(s) and balance on the overdraft line(s), (either, or both, of which may be zero). Co-holding in this setting arises as an individual holding a positive liquid deposit account balance (either a checking account balance or a savings account balance) while simultaneously holding an overdraft balance. Importantly, both balances can be adjusted easily on a daily basis. An individual can spend against an overdraft line using a debit card in the same way as spending against a positive deposit account balance, and can transfer money to the pay down the overdraft line electronically at any point in time.

In our setting, the measurement of co-holding using overdraft and deposit account data is straightforward because i) both products allow individuals to move balances at any point, ii) overdraft balances incur interest on a daily basis from the first day of the balance. This simplifies measurement of co-holding compared with that on other products, such as credit cards, where calculation of co-holding needs to take into account the interest-free float period, which varies by transaction type (e.g., purchase transactions vs cash-in-advance transactions).[12]

Using an individual × day as the unit of observation, we measure co-holding as the *minima* of deposit account balances and (the absolute value of) overdraft balances. This provides a value of co-holding for each individual × day in the data period. For observations for which the individual either has zero deposit account balance, or alternatively zero overdraft balance, the value of co-holding is set to zero. This calculation returns an individual × day measure of co-holding in currency units, which can be interpreted as the amount of overdraft that the individual could pay down using readily-available liquid deposit account balances, while not reducing overall liquidity.[13]

[12] Furthermore, in the case of credit cards, co-holding might arise due to forecast errors. An individual may hold a credit card balance intending upon clearing the balance by the end of the interest-free "float" period, but unexpectedly revolve the balance due to a financial shock.

[13] Paying down the overdraft balance neither reduces overall liquidity in terms of balances available, nor the ease of liquidity, as overdraft lines and positive account balances are equally liquid.

This basic calculation of co-holding at the individual × day level provides a co-holding value in local currency. To generate an economically meaningful measure of co-holding for the household, we normalize the value of co-holding by average daily expenditure on the account. We do this to control for wide variation in levels of expenditure in the sample. If a household has a high level of daily expenditure, then a given amount of co-holding might be economically unimportant to the household as it is very short-lived (because positive deposit account balances will be spent very soon) and incurs minimal excess interest costs as a proportion of daily expenditure. However, the same level of co-holding among a household with a low level of daily expenditure would be much longer-lived (because positive deposit account balances will persist) and incur larger excess interest costs as a proportion of daily expenditure. Normalizing by average daily consumption therefore generates a more economically relevant measure of co-holding.

### 3.2 Co-holding at the daily level

We first illustrate the extent of co-holding in the sample of individual × days in the baseline sample. Figure 1 Panel A shows the joint distribution of deposit account balances and overdraft balances, measured in units of consumption-days, together with histograms for both variables shown in Panels B and C. The joint distribution plot in Panel A of Figure 1 illustrates the extent of co-holding in the sample of individual × days. For ease of visualization, the plot restricts to random sample of 3,000 individual × days from the total data used in analysis. The x-axis measures cash holdings (normalized by average daily expenditure on the account) and the y-axis measure overdraft holdings (also normalized). Hence, co-holding increases to the top-right of the joint distribution plot. Table 1 summarizes the joint distribution by binning the data into cells defined by consumption-days equivalent worth of overdraft holdings and cash deposit account holdings.

Figure 1 Panel A illustrates that the majority of individual × days are located on either axis, indicating zero co-holding, i.e. where the individual carries only a positive balance or only an overdraft. In total, approximately 85% of observations are located on either axis: Table 1 shows that 65.7% of observations have an (absolute value) overdraft balance equal to zero and

18.5% have a deposit account balance equal to zero (2.9% of observations have both a zero overdraft balance and a zero deposit account balance). Hence, these observations show zero co-holding. The marginal distributions (histograms) of deposit account and overdraft balances are shown in Figure A1, illustrating the large masses at zero in both distributions.

Approximately 15% of individual × days show positive levels of co-holding, illustrated within the interior of the plot. As seen in Figure 1, a small number of observations have high levels of co-holding, with co-holding balances which run to many hundreds of days of consumption. Table 1 summarizes co-holding, top-coding at 30 days of consumption. Co-holding commonly arises due to large overdraft holdings (>30 days, the bottom row of the matrix) alongside modest deposit account holdings days. Of the interior cells, the highest populated is >30 consumption-days of overdraft holdings held alongside 1-10 consumption-days of cash holdings, which contains 9.9% of all individual × days. In total, only 1.8% of observations show more than 30 days of consumption in both deposit account and overdraft holdings. These calculations at the individual × day level therefore reveal that co-holding is less common than prior studies in the literature suggest. The assumptions made regarding accounting obviously have a large influence on the fraction of co-holders in prior studies as the calculation is not straightforward as it is in our setting but the estimated share is typically between 25% and 60% (see, e.g., Fulford, 2015; Gorbachev and Luengo-Prado, 2019).

Table 2 summarizes the same joint distribution as in Table 1 in monetary amounts instead of consumption-days, with monetary amounts of cash holding binned in columns and monetary amounts of overdraft holding binned in rows. Of the interior cells, the highest populated cell translates to holdings of at least 80,000 ISK (approximately $8,000) combined with 1 - 20,000 ISK of cash deposit account holdings, accounting for 9.6% of all individual × days. The table shows that 4% of individual × days have at least 80,000 ISK of overdraft and cash deposit account holdings co-held on the day.

### 3.3 Co-holding at the monthly level

The detail of our data allows us to analyze co-holding at the daily level. We can also aggregate the daily data to construct measures of co-holding more similar to those used in the previous

literature. Previous studies typically analyze co-holding at the monthly level, measured either via survey questions which ask individuals about their financial balances (such as the US Survey of Consumer Finances) on their credit card statement for the previous month, or using credit card statement data showing accrued balances over the previous month (as in Gross and Souleles (2002). This distinction may be important for the measurement of co-holding. For example, an individual might incur a $10 spend on the 10th of the month. If this spend is incurred on a credit card, the individual will most likely hold the $10 credit card balance until month end and payment becomes due (given that pre-payment of credit card balances is very rare). If this spend is incurred on a bank overdraft, there is no equivalent payment due date on which the debt is due to be paid down by default, and hence payment before the end of the month is more likely. In this way, co-holding is likely to be more persistent in credit card data compared with overdraft data.[14]

To examine this, we draw upon the baseline sample and create an aggregate measure of co-holding to the individual × month level, creating a dummy variable for whether the individual exhibited co-holding on *at least one day* in the month. This measure is closer to the measurement of co-holding in credit card data, in which the end-of-month balance is a sum of spending over the month, with transaction occuring at any time over the previous month.

Using this measure, we find that 23.5% of individual × months exhibit non-zero co-holding, compared with 15% of individual × days. This calculation is closer to observed levels of co-holding in the US Survey of Consumer Finances (approximately 30%) based upon recent calculations by Vihriala (2019). Differences in measured levels of co-holding might therefore in part reflect the timing of purchases compared with the timing of payments within the month.

### 3.4 Patterns and cost of co-holding

#### *3.4.1 Co-holding at the individual level*

In this subsection we present calculations for co-holding at the individual level. There is wide variation in the extent of co-holding across individuals. In the baseline sample, 60% of

[14] It is also possible that co-holding might occur via credit card balances due to credit card holders confusing the float period with the revolving debt period, though this is unlikely to be a persistent behavior due to the prominence of interest due and minimum payment rules on credit card statements.

individuals exhibit zero co-holding throughout the entire sample period, i.e., on no day of the sample period do these individuals ever simultaneously hold overdraft balances and deposit balances.

Next we describe variation in co-holding among the remaining 40% of individuals that engage in co-holding on at least one day. Figure 2 shows a histogram of the fraction of days individuals exhibit co-holding. Each individual contributes one observation to the plot. More than half of individuals in this subsample exhibit co-holding on fewer than 10% of the days the individual is present in the sample. Approximately 15% of individuals in this conditional co-holding subsample exhibit co-holding on at least half of the days of the sample period. Hence, the majority of accounts that exhibit some co-holding do so for only a short period within the sample period, with a small concentration of accounts co-holding for at least half of the sample period.

The extent to which an individual co-holds can also be described by combining information on the fraction of days in the period the individual co-holds with the level of co-holding (measured in consumption-days). Table 3 reports the fraction of days with co-holding by various measures of the extent of co-holding ranging from co-holding at least three consumption-days of overdraft and cash deposit balances to co-holding at least thirty consumption-days of overdraft and cash deposit balances. The sample is restricted to individuals exhibiting at least one day of co-holding during the sample period. On average, individuals exhibit low level of co-holding of a minimum of three consumption-days of overdraft and cash deposit balances for approximately 21.6% of the sample period. Individuals exhibit high levels of co-holding (over thirty days) for approximately 11.7% of the sample period.

### *3.4.2 Frequency vs. duration of co-holding spells*

We describe the relationship between the *frequency* of co-holding (i.e., the number of spells of co-holding an individual exhibits) and the duration of a spell of co-holding over a number of days. There is a strong negative relationship between the frequency of co-holding and spell length.

Figure 3 illustrates the relationship between the frequency of co-holding spells and spell

duration using a binscatter plot. In Panel A the y-axis shows spell length and the x-axis shows the number of spells of each respective length. The binscatter plots the mean of the y-axis variable by fifteen equal density bins sorted along the x-axis, with a line of best fit plotted through the underlying data. Each individual contributes one observation to the plot, calculated as the mean spell length for the individual, and the total number of co-holding spells observed in the sample period for the individual. The length of spells ranges from 1 day, up to a top-coded 45 days (a small fraction of spells last much longer than 45 days).

Panel A of Figure 3 reveals a clear negative relationship between spell duration and the number of co-holding spells. Panels B illustrates the distributions of spell duration. The majority of spells last less than 10 days. A subset of 11% of spells last longer than 40 days. Durations of 40 or more days are rare. This relationship between the duration and frequency of co-holding spells is confirmed in Appendix Table A1, in which OLS regressions of spell length against frequency return a negative coefficient on the frequency variable in models with extensive controls for demographics, financial characteristics and household expenditure budget shares.

### *3.4.3 Cost of co-holding*

In this section we present estimates of the financial costs of co-holding. Co-holding creates excess interest payments, measured by the amount co-held multiplied by the difference between the interest rate on liquid savings and the interest rate on overdraft debt. For example, an individual who co-holds $1,000 comprising a deposit account offering 1% interest in credit and an overdraft incurring 13% in interest would incur an associated cost of co-holding of $120 per annum. In the sample period, the average interest rate of cash deposit balances was close to 0%, while the average interest rate of overdraft balances was 13%.

We adopt two approaches to aggregating the cost of co-holding. For these calculations, we restrict to the sample of individuals with positive value of co-holding on at least one day of the sample period. First, we calculate the cost of co-holding on-the-day for each individual × day observation and then multiply by 365 to create a simple annualized measure (which ignores compounding of overdraft interest charges, applied monthly, through the year). Second, we report average annual costs at the individual level among individuals who are observed to co-

hold for at least 365 days of the sample period. Given that persistent co-holding is concentrated among a relatively small subset of individuals or households, the average annual costs of co-holding (calculated using the second method) show a much lower standard deviation compared with the annualized daily costs (calculated using the first method).

Table 5 reports results from this exercise. The mean annualized daily cost of co-holding among co-holders is approximately 4,700 ISK, or approximately $47. The median value is zero, reflecting the fact that the majority of individual × days in the sample of co-holders exhibit zero co-holding. A subset of accounts incur very high costs associated with co-holding, with 10% of observations incurring redundant interest charges in excess of 12,800 ISK (≈ $128) and 5% of observations incurring redundant interest charges in excess of 26,900 ISK (≈ $269). The second row shows that average annual costs, which by construction have the same mean as annualized daily costs, have lower variance. This is due to all individuals in the sample co-holding on at least one day (hence all average annual cost values are non-zero) and also due to only very few individuals co-holding continually over the period. By this calculation, the interest costs of co-holding are slightly lower at the top of the distribution, with 5% of individuals incurring average annual excess interest costs above 20,800 ISK ($208).

## 4 Results II: Determinants of co-holding

In the remainder of the paper we examine the determinants of co-holding in the baseline sample. Co-holding was first identified by Morrison (1998) and Gross and Souleles (2002). Gross and Souleles (2002) analyzed how consumers respond to credit card limit increases and interest rate changes. They noted that, within their sample of US credit card holders, they observed surprisingly high deposit account balances among credit card debt revolvers. A number of explanations have subsequently been offered for co-holding. There exists little evidence on the empirical relevance of these though, mainly do to lack of data. In the following subsections we investigate whether our data provide empirical support for the existing theories.

### 4.1 Liquidity needs

First, in the portfolio model of Telyukova and Wright (2008), co-holding arises because agents require cash for certain transactions and credit card cash advances are expensive. Hence, agents do not pay down revolving balances because, were they to do so, they would then incur expensive cash advance fees. While individuals might hold credit card balances and deposit account balances simultaneously due to the need to access cash for payments (which is typically expensive to borrow on a credit card), this same motivation for co-holding does not apply in our setting because deposit account cash withdrawals cost the same when accounts are in the red as when they are in the black.

A second explanation for co-holding is credit line risk, as in the model of Druedahl and Jørgensen (2018). Here, individuals are reluctant to pay down their credit lines because of the risk that lenders "chase down" the credit lines as they are paid down, reducing the limit when the balance is repaid. Gorbachev and Luengo-Prado (2019) find evidence consistent with this explanation in US survey data. In their study, relative to individuals with no credit card debt but positive liquid assets, co-holders in the sample (referred to as "borrower-savers") have very different perceptions of future credit access risk and use credit cards for precautionary motives. Also, the study finds that, changing perceptions about credit access risk are essential for predicting transitions among the two groups. Again, this mechanism is not relevant in our institutional setting, in which individuals can choose to vary their overdraft limit over time, but overdraft reductions cannot be imposed by the lender for accounts in good standing.

### 4.2 Within-household coordination

One explanation provided in the previous literature is that co-holding arises due to a lack of coordination within couples in the household unit. Previous studies have suggested that co-holding could arise due to intra-household frictions which lead to non-cooperative financial sharing behavior. In the model of Bertaut et al. (2009), a household is characterized by a patient spouse, who holds back liquid savings so as not to unbind a liquidity constraint facing her impatient, debt-holding partner because to do so would result only in the impatient partner incurring new debts through impulsive spending. Bertaut et al. (2009) also suggest that this same

mechanism might operate within the individual, hence individuals co-hold as a commitment device (albeit an expensive commitment device). Gathergood and Weber (2014) find evidence from UK survey data consistent with this hypothesis.

We examine whether lack of within-household coordination can explain co-holding by calculating co-holding at both the individual and the couple level. Our baseline sample comprises individuals, with the unit of observation being an individual × day. To analyze co-holding at the couple level, we join individuals in the data who are in the same couple unit and calculate co-holding as the minima of total deposit account balances of the couple members and (the absolute value of) total overdraft balances of the couple members. We define a household unit based upon individuals who have chosen to link their financial data with a self-declared partner using the app.[15]

Household-level co-holding is, by construction, weakly larger than individual-level co-holding. For example, in the individual-level analysis, one individual may hold only deposits while a second individual in the same couple holds only overdraft, hence both exhibit zero co-holding. In the household-level analysis, the couple as a household unit would exhibit co-holding as the minima of one spouse's deposit balances and the other spouse's overdraft balances. If we were to randomly join individuals in the sample into hypothetical "household" units we would therefore measure an increase in the prevalence of co-holding among couples vs single. Using this method, we compare levels of co-holding among single individuals and among household units.

Figure 4 illustrates levels of co-holding among the sub-sample of single individuals (individuals that are not linked to another individual in the sample) shown in Panel A, among the sub-sample of individuals who are linked to a spouse in the sample shown in Panel B, and among couples shown in Panel B. The figures suggest very similar patterns in co-holding among the three sub-samples. Summary tables for the level of co-holding among single individuals compared with couples are shown in Table A2 and Table A4.

Levels of co-holding are only slightly higher among couples compared with singles. At the

[15] In Iceland, as in most Western nations, non-mortgage financial products are held in the names of single individuals only. Our construction of household units is therefore based upon self-declared linkages of individuals with each other.

extensive margin, co-holding among couples is a little more common: Among the sample of couple × days, 13% of observations exhibit cash holdings of between zero and 10 days alongside overdraft holdings in excess of 40 days. The equivalent percentage among the samples of linked individuals × days and single × days is 9%. At the intensive margin, co-holding among couples is slightly higher, but also less persistent, among couples compared with singles: The highest level of co-holding shown in the table, with more than 40 days of cash holdings and 40 days of overdraft holdings, accounts for 1.3% of singles × days, 1.1% among linked individuals, while it is 1.6% in the sample of couple × days.[16] However, the share of co-holding days for couples is lower than for singles (shown in Table A8, Table A9, and Table A10) and the duration of co-holding spells is shorter for couples compared with singles (shown in Table A11).

Given that co-holding among couples is weakly higher than singles, we interpret this mixed evidence for higher co-holding among couples as weak support for explanations of co-holding based upon lack of coordination with households. It may be the case that co-holding due to lack of coordination within the household (as in Bertaut et al. (2009)) is more likely to occur in more traditional societies with clearer distinctions in gender roles in financial management within the household. Given that within-household equity has increased over time in Western nations, the use of co-holding as a strategy by the accountant in the accountant-shopper model may no longer be feasible in modern households.

### 4.3 Limited attention

A further, but less explored, explanation for co-holding in the prior literature is that it arises due to rational inattention (Sims, 2003; Sims, 2006). Co-holding might be explained by individuals facing a fixed cost (such as the time, or psychological, cost) of paying attention to their accounts and optimizing their financial balances. To our knowledge, the existing literature has not investigated this explanation for co-holding empirically, possibly due to limited data available by which a rational inattention explanation could be tested.

To analyze this, we start by examining the relationship between the level of co-holding and the duration of co-holding. If co-holding is explained by rational inattention, we would

[16] Table A5, Table A6, and Table A11 report summary statistics by level of co-holding in currency.

expect a negative relationship between the level and duration of co-holding, illustrating that as the economic costs of co-holding increase (the level of co-holding), individuals are faster to terminate the spell of co-holding as, at high levels of co-holding, the costs of co-holding exceed the fixed cost of optimizing. However, we find a *positive* relationship between the level and duration of co-holding, indicating that individuals who co-hold more tend to do so for longer, hence incurring higher excess interest costs. Figure 5 illustrates the relationship between the level of co-holding, calculating as the average amount of co-holding (measured in consumption days) during a spell of co-holding, and the duration of the spell of co-holding in days.

Table 6 presents regression estimates of the relationship between the level and duration of co-holding. The dependent variable is the level of co-holding measured in consumption days, the independent variables are the duration of co-holding (in days) and a set of covariates capturing demographics, income receipt, and expenditure shares. Models are estimate with and without individual fixed effects. The individual fixed effect may be important here if individuals differ in their fixed cost of paying attention (due to, for example, variation in time, psychological or cognitive costs of paying attention across individuals). Estimates show the coefficient on the co-holding duration variable is positive and precisely defined in all specifications, with and without additional covariates and with and without individual fixed effects. This analysis provides further evidence that the pattern of co-holding levels vs. durations is inconsistent with an explanation based upon limited attention.

In addition, in the next subsection we examine the relationship between process attention to the financial aggregator account (measured by a login to the account) and the probability of a spell of co-holding beginning. Results indicate a positive relationship between process attention and co-holding, showing that when individuals do pay the time or psychic costs of attending to their accounts by logging-in, they are actually more likely to commence a spell of co-holding. This process-based evidence also goes against the rational inattention explanation for co-holding.

### 4.4 Mental accounting

In this final sub-section, we explore whether co-holding arises in a manner consistent with mental budgeting, whereby individuals assign balances on their financial products (here cash balances and overdrafts) to separate mental accounts. This explanation has not been considered in detail in the previous literature. In models of mental accounting (also referred to as mental budgeting) individuals organize their finances into budgets tagged by hypothesized purposes and needs, in contrast with economic accounting in which individuals organise their finances to minimize costs (Thaler, 1985; Prelec and Loewenstein, 1998; Thaler, 1999; Shefrin and Thaler, 2004; Quispe-Torreblanca et al., 2019)

To explore this idea further, we examine the association between the composition of consumption expenditure and the onset of a spell of co-holding. To do so, we take all individual $\times$ days in the baseline sample and identify the starting day of each spell of co-holding. We then estimate the relationship between consumption, covariates capturing individual characteristics and the probability of that individual $\times$ day being the starting day of a co-holding spell. We estimate models both with and without individual fixed effects. All models include a common set of demographic controls (age of individual, a gender dummy, a dummy for whether the individual is linked to a spouse in the sample) and income controls (log total income received that year and a dummy for whether the person receives benefits).

Results are shown in Table 7. The econometric models include a series of variables of interest, including a dummy variable for whether the individual $\times$ is a day on which the individual is paid, durables and non-durables spending as a share of individual-specific average expenditure, the number of current accounts and savings accounts held by the individual, the log of cash spending and credit card spending, dummy variables which denote whether the individual spends on temptation goods (lottery tickers, gambling, temptation purchases and alcohol) and finally a dummy variable to denote whether the individual made a login to the account on the day.

The coefficient estimates reveal a series of results consistent with our earlier analysis which rejects some of the commonly proposed explanations for co-holding. First, the coefficient on the linked individual dummy is negative, indicating that individuals linked to a spouse are

less likely to begin a co-holding spell. Second, the coefficient on the login dummy is positive, indicating that a spell of co-holding is more likely to begin on a day in which the individual made a login to the app. This goes against a limited attention explanation for co-holding, by which paying attention to the account (proxied by a login event) should reduce the likelihood of starting a spell of co-holding. Third, the coefficients on log cash spending and log credit card spending are positive but imply very small elasticities.

Estimates suggest that the probability of a co-holding spell commencing increases with the share of durables vs. non-durables in the individual's consumption and with purchases linked to temptation / self-control. Specifically, co-holding is more likely to occur when the individual has a higher share of non-durables in expenditure; and increases with spendings on gambling and temptation goods. Estimates also reveal that co-holding is more likely to begin when the individual holds more current accounts and savings accounts in their portfolio. Table 8 adds individual fixed effects to the econometric models shown in Table 7. With the inclusion of individual fixed effects the patterns on the coefficients are unchanged (though the coefficient on the gambling dummy variable is no longer statistically significant at the 10% level).

In additional analysis shown in Table 9, we incorporate add into the econometric model shown in Table 8 measures of credit card usage (in Table 9 coefficients for some variables are not shown). Column 4 reveals the coefficient on the share of the individual's total expenditure which is placed on the credit card is negative, indicating that heavier use of a credit card is associated with a lower likelihood of beginning a period of co-holding. Column 5 shows that the share of total expenditure placed on a credit card by category of spend is typically unrelated to the likelihood of a period of co-holding starting, with the exception of charity expenditure (whereby a larger share on the credit card reduces the likelihood of a period of co-holding starting) and lottery expenditure. These results indicate that the probability of co-holding starting is for the most part unrelated to credit card use. The pattern of coefficient estimates is broadly similar to that seen in Table 7, with the probability of co-holding increasing with temptation purchases, gambling purchases (which are more common on credit cards, reflected in the positive coefficient on the credit card gambling share variable in Table 9) and credit card

spending.[17]

Our results suggest that the composition of an individual's finances and spending patterns contribute to the likelihood of beginning a spell of co-holding in three ways.

First, the increased likelihood of co-holding with expenditure on gambling and temptation goods may suggest a role for self-control in driving co-holding (as in Bertaut et al., 2009 and Gathergood and Weber, 2014). Plausibly, individuals might prefer to assign their gambling and temptation purchases to a separate (mental) account, aside from their regular expenditure. This behavior might reflect narrow framing on the performance of a portfolio of gambles which are held in isolation from the main account.

Second, individuals with more current accounts and saving accounts have a higher likelihood of beginning a spell of co-holding. Note that all individuals in the sample have the potential to co-hold; this result relating to the number of accounts indicates that holding additional accounts further increases the risk of co-holding. The propensity to open additional accounts may be linked to a preference for assigning balances to accounts based upon hypothesized purposes and needs. Consumers might keep multiple mental accounts, and reflect this in their financial accounts. We cannot test the direction of relationship between co-holding and the number of accounts though, which might arise endogenously with the choice to co-hold.

Third, co-holding increases with the share of non-durable expenditure in total consumption. The coefficient on the non-durable share is six times larger than the coefficient on the durable share, imply a stronger relationship between non-durables spend and co-holding than for durables spend and co-holding. This may reflect a propensity for individuals to hold separate accounts for durable and non-durable purchases.

Overall, our results show that the probability of a spell of co-holding beginning is related to various dimensions of individual finances. The dimensions may each reflect desired mental accounts. We cannot test this hypothesis directly, though it may be possible in future work to elicit willingness to pay for non-financially optimal mental accounts compared with optimal financial accounting to determine whether mental account in this way is net beneficial to

[17] The precision of the coefficient on the gambling expenditure measure decreases with the inclusion of individual fixed effects, which remaining positive. In Table 9 the coefficient on the share of gambling in total credit card spending is positive and statistically significant at the 5% level.

individuals who gain the most from co-holding due to this motive.[18] Within the scope of this research we cannot, for example, experimentally manipulate the set of financial accounts held by the individual. However, our results suggest these aspects of individual financial management are important for understanding why individuals co-hold.

### 4.5 Additional Analysis

In additional analysis, we also examine the role of financial ability in determining co-holding. Co-holding might arise due to a lack of financial decision making. To explore this, we use a measure of decision making ability available for a sub-sample of the baseline sample who participated in an online survey administered by the financial aggregator (which provides approximately 0.5m observations for the regression analysis). Decision-making ability is measured by the internal consistency of individual choices in risk and ambiguity tasks undertaken by survey participants using the method developed by Kariv and Silverman (2013) and Choi et al. (2014), also used in Carvalho et al. (2019). Results are unchanged by the addition of the measure of decision-making ability, which has a weak positive relationship to co-holding. This result is in line with Gathergood and Weber (2014), who find a positive relationship between financial literacy and co-holding using a survey sample from the United Kingdom.

## 5 Conclusion

In this paper we explore one of the starkest violations of simple arbitrage on household balance sheets: holding low-yield, liquid savings while simultaneously holding high-cost unsecured credit on revolving credit lines. Previous studies, mostly using survey data, have shown this is a common behavior among individuals using credit cards in the UK and the US. We draw upon very detailed, high-frequency objective data from an online financial aggregator tool for a sample of individuals in Iceland. The most common form of revolving consumer credit in Iceland is a bank overdraft credit line held separately from a deposit account. In this setting,

[18] For example, Kueng (2018) finds considerable deviations from consumption smoothing in response to large, regular, predetermined, and salient payments from the Alaska Permanent Fund. However, the welfare losses from this behavior appear small, as households for whom the loss would be the largest violate the Permanent Income Hypothesis the least, while households for whom the loss is trivial deviate the most from predicted behavior.

co-holding is arguably an even simpler violation of no arbitrage than in the credit card setting. We first show that approximately 15% of observations in our main sample are characterized by co-holding. We also show that most spells of co-holding are relatively short, lasting less than one calendar month. These levels of co-holding or somewhat lower than previous studies have documented. By aggregating our data and comparing the co-holding measures based on the aggregated data and the disaggregated data we find that the high levels of co-holding documented in previous studies appear to be partly driven by the aggregated nature of the data on which they are based.

Next, we bring existing theories that have been put forward to explain the co-holding puzzle to the data. A variety of explanation for co-holding have been suggested in prior studies while there exists little evidence on their empirical relevance. We bring these potential explanations to the data and find that co-holding appears to be driven by behavioral rather than rational forces. Our institutional setting allows us to rule out demand for cash and credit limit risks as drivers of co-holding in our data. We also find little evidence in support of explanations based upon household composition; levels of co-holding at the individual and household levels are very similar, suggesting that co-holding does not arise due to within-household frictions. We also find evidence against an explanation based upon limited attention, with co-holding spells more likely to begin on days on which individuals pay attention to their financial accounts. Our analysis of spells of co-holding suggests that the composition of the probability of a spell of co-holding beginning is related to various dimensions of individual finances. The dimensions may each reflect desired mental accounts. Our paper therefore motivates a need to expand and develop models of mental accounting to better understand the reasons why individuals engage in co-holding.

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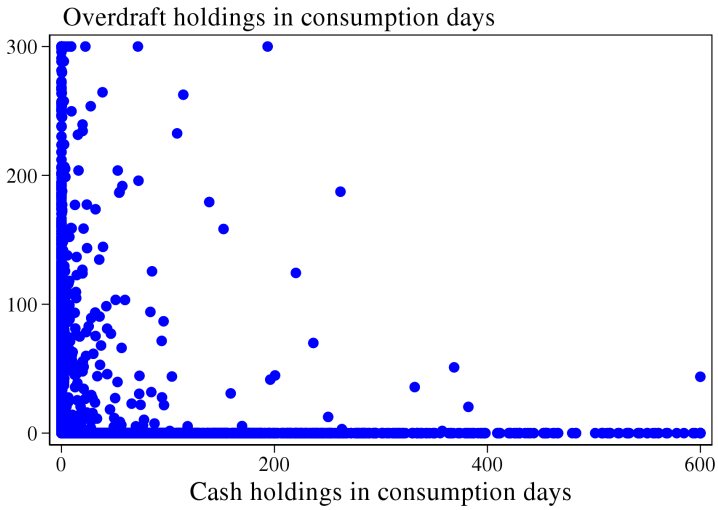
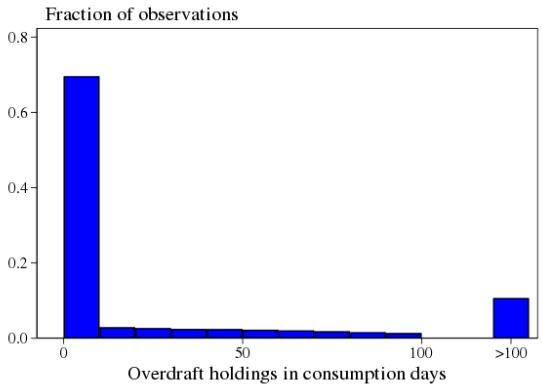
Figure 1: Co-holding Deposit Account Balances and Overdraft Balances

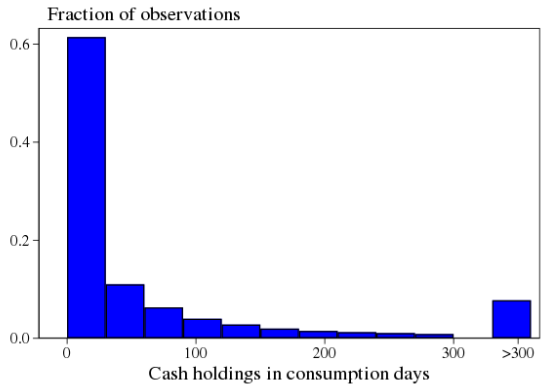
(A) Overdrafts vs. Desposit Balances




(B) Overdraft Balances

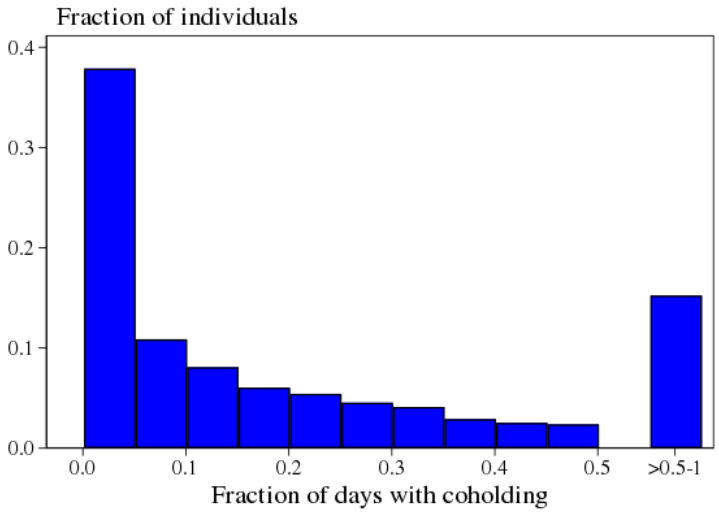



(C) Cash Balances




*Note:* Panel A shows a scatter plot of overdraft holdings and cash deposit account holdings, both measured in days of account-level average consumption expenditure. Panel B shows the distribution of overdraft holdings measured in days of account-level average consumption expenditure. Panel C shows the distribution of cash deposit account holdings measured in days of account-level average consumption expenditure. See Section 2 for details of sample restrictions.

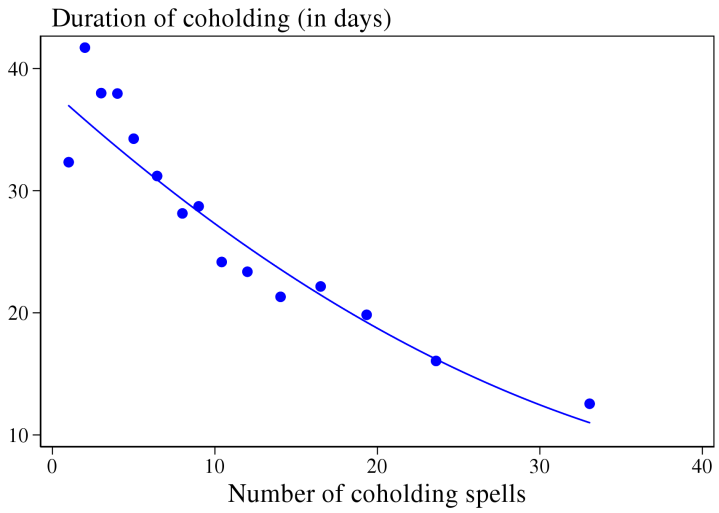
Figure 2: Share of Days Co-holding



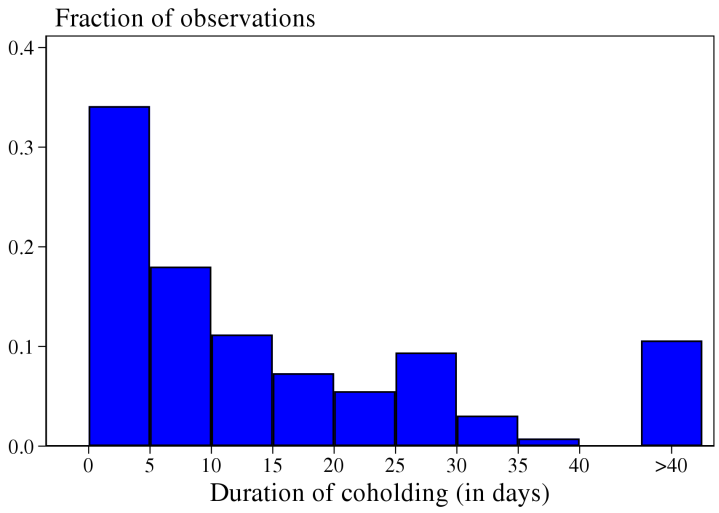

*Note:* Panel A shows a binned scatterplot of the number of spells of co-holding per account and the average duration of each holding spell. The sample includes accounts with at least one co-holding spell during the data period (using the definition of co-holding a minimum of three consumption-days of balances). See Section 2 for further details of sample restrictions.

Figure 3: Co-holding Spell Duration vs. Co-holding Frequency

(A) Spell Length vs. Frequency



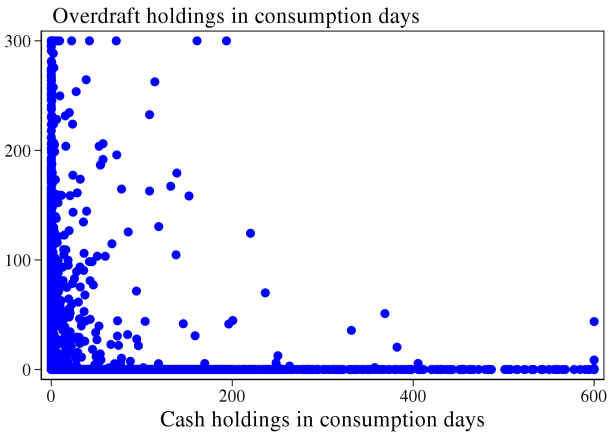

(B) Duration



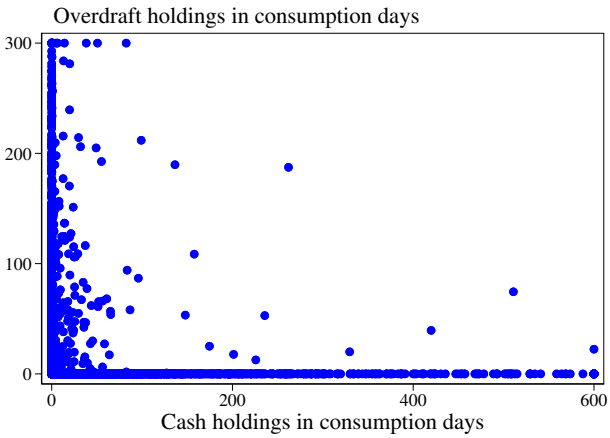

*Note:* Panel A shows a binned scatterplot of the number of spells of co-holding per account and the average duration of each holding spell. The sample includes accounts with at least one co-holding spell during the data period (using the definition of co-holding a minimum of three consumption-days of balances). See Section 2 for further details of sample restrictions.

Figure 4: Co-holding by Singles vs. Multi-Person Households

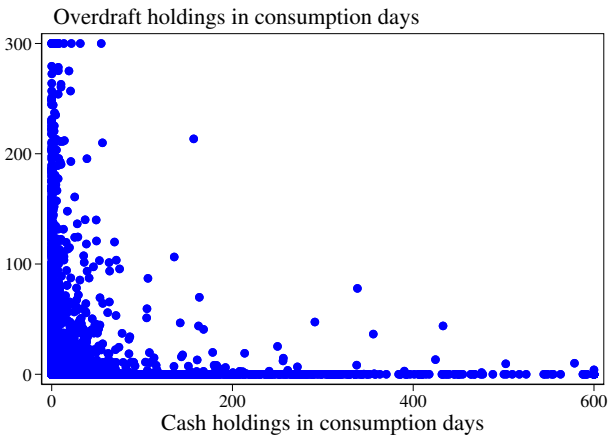
(A) Singles




(B) Linked Individuals

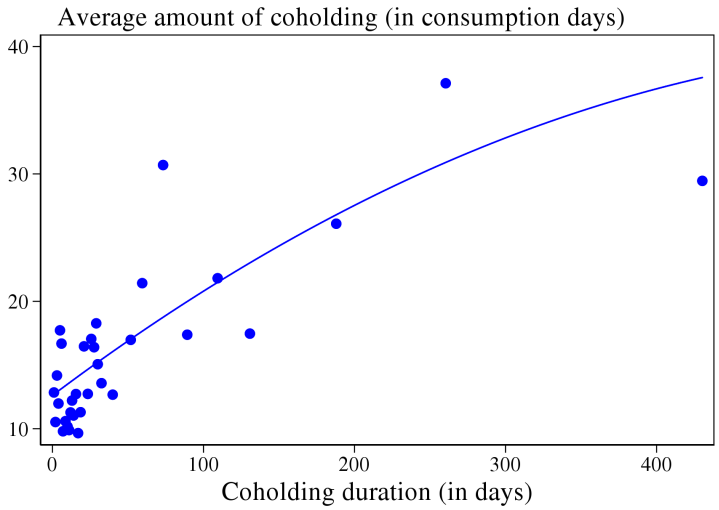



(C) Couples




*Note:* Panel A shows a scatter plot of overdraft holdings and cash deposit account holdings, both measured in days of individual-level average consumption expenditure, for single individuals who are never linked to another person during the sample period. Panel B shows an equivalent scatter for individuals who are linked to a spouse in the sample. Panel C shows an equivalent scatter plot for households that are comprised of the individuals observed in Panel B. See Section 2 for further details of sample restrictions.

Figure 5: Level vs. Duration of Co-holding




*Note:* Figure illustrates the amount of holding, measured in consumption-days (y-axis) and the duration of a co-holding spell, measured in days (x-axis). See Section 2 for further details of sample restrictions.

Table 1: Co-holding in the Baseline Sample, Measured in Consumption-Days

| | Cash holdings | | | | | |
|---|---|---|---|---|---|---|
| Overdraft holdings | 0 | >0-10 | >10-20 | >20-30 | >30 | Total |
| 0 | 2.95 | 15.65 | 6.79 | 4.88 | 35.47 | 65.73 |
| >0-10 | 1.65 | 1.27 | 0.19 | 0.10 | 0.63 | 3.83 |
| >10-20 | 1.23 | 1.12 | 0.15 | 0.07 | 0.35 | 2.93 |
| >20-30 | 1.16 | 1.04 | 0.14 | 0.07 | 0.28 | 2.70 |
| >30 | 11.50 | 9.90 | 1.02 | 0.55 | 1.83 | 24.81 |
| Total | 18.50 | 28.98 | 8.29 | 5.67 | 38.56 | 100.00 |

Note: Table illustrates joint distribution of cash holdings (in deposit and/or savings accounts) and overdraft holdings in the baseline sample of individual × days. Cash holdings and overdraft holdings are normalized by average daily consumption spend of the consumer. Each cell reports as percentage of observations. The cell (0,0) contains observations for which both cash and overdraft balance are zero.

Table 2: Co-holding in the Baseline Sampl, Measured in Monetary Units

| | Cash holdings | | | | | | |
|---|---|---|---|---|---|---|---|
| Overdraft holdings | 0 | >0-20,000 | >20,000-40,000 | >40,000-60,000 | >60,000-80,000 | >80,000 | Total |
| 0 | 2.95 | 8.82 | 3.76 | 2.92 | 2.40 | 44.87 | 65.73 |
| >0-20,000 | 0.60 | 0.38 | 0.05 | 0.03 | 0.03 | 0.35 | 1.43 |
| >20,000-40,000 | 0.45 | 0.30 | 0.04 | 0.03 | 0.02 | 0.23 | 1.08 |
| >40,000-60,000 | 0.41 | 0.31 | 0.05 | 0.02 | 0.03 | 0.20 | 1.01 |
| >60,000-80,000 | 0.39 | 0.26 | 0.04 | 0.02 | 0.02 | 0.17 | 0.90 |
| >80,000 | 13.70 | 9.57 | 1.22 | 0.79 | 0.57 | 4.00 | 29.84 |
| Total | 18.50 | 19.64 | 5.15 | 3.81 | 3.07 | 49.83 | 100.00 |

Note: Table illustrates joint distribution of cash holdings (in deposit and/or savings accounts) and overdraft holdings in the baseline sample of individual × days. Cash holdings and overdraft holdings are normalized by average daily consumption spend of the consumer. Each cell reports as percentage of observations. The cell (0,0) contains observations for which both cash and overdraft balance are zero.

Table 3: Share of Co-holding Days in the Baseline Sample

| | Mean | SD | p50 | p75 | p90 | p95 |
|---|---|---|---|---|---|---|
| Min(3,3) | 0.216 | 0.255 | 0.109 | 0.325 | 0.636 | 0.808 |
| Min(5,5) | 0.196 | 0.242 | 0.090 | 0.283 | 0.588 | 0.765 |
| Min(10,10) | 0.165 | 0.220 | 0.064 | 0.226 | 0.492 | 0.699 |
| Min(15,15) | 0.146 | 0.207 | 0.051 | 0.195 | 0.441 | 0.637 |
| Min(20,20) | 0.134 | 0.197 | 0.043 | 0.176 | 0.419 | 0.596 |
| Min(25,25) | 0.124 | 0.190 | 0.037 | 0.155 | 0.394 | 0.566 |
| Min(30,30) | 0.117 | 0.182 | 0.036 | 0.143 | 0.369 | 0.514 |

Note: Each row of the table reports summary statistics for the level of co-holding in the baseline sample, where the level is defined at the minimum of number of days' consumption held in overdraft balances and savings balance. For example, the first row reports that 21.6% of observations in the baseline sample with non-zero co-holding show at least 3 day's consumption co-held in savings and overdraft balanced.

Table 4: Duration of Co-holding Spells

| | Duration of Co-holding (#days) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Mean | SD | P50 | P75 | P90 | P95 | #obs |
| Individual x day level | 22.5 | 52.5 | 9.0 | 23.0 | 43.0 | 85.0 | 33,841 |
| Individual level | 29.6 | 61.4 | 13.0 | 27.6 | 65.5 | 112.2 | 3,985 |

Co-holding defined as $Min(3, 3)$, holding 3 days consumption in both cash and overdrafts. The unit of analysis is an individual. See Section 2 for sample restrictions and Section 3.2 for definition of duration.

Table 5: Cost of Co-holding

| | Mean | SD | P50 | P75 | P90 | P95 | #obs |
|---|---|---|---|---|---|---|---|
| *Individual × day:* | | | | | | | |
| Annualized daily costs | 4,702 | 16,673 | 0 | 1,403 | 12,793 | 26,917 | 3,522,740 |
| *Individual level:* | | | | | | | |
| Average annual costs | 4,702 | 9,813 | 1,198 | 4,548 | 12,518 | 20,823 | 3,522,740 |

Table presents measures of the cost of co-holding. Annualized daily costs refer to the cost of co-holding on-the-day for each individual × day observation and then multiply by 365 to create a simple annualized measure. Average annual costs report average annual costs from observed periods of 365 days. See Section 3.2 for further details of the calculations.

Table 6: Ordinary Least Squares Estimates for Level vs Duration of Co-Holding

| | Level of Co-holding | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Co-holding duration | 0.0504*** | 0.0508*** | 0.0488*** | 0.0538*** | 0.0519*** | 0.0493*** |
| | (0.0075) | (0.0073) | (0.0088) | (0.0096) | (0.0100) | (0.0131) |
| Age | | 0.0283 | 0.0019 | | 1.7998 | 1.9847 |
| | | (0.0381) | (0.0439) | | (1.3703) | (1.5277) |
| Female | | -2.6639*** | -2.9338*** | | | |
| | | (0.8193) | (0.9429) | | | |
| Linked | | 0.0000 | 0.0000 | | | |
| | | (.) | (.) | | | |
| Benefits person | | -0.4588 | -0.8367 | | | |
| | | (0.9877) | (1.0868) | | | |
| Log total income | | -0.2268 | -0.4045** | | -0.0875 | -0.1461 |
| | | (0.2046) | (0.1803) | | (0.1604) | (0.1766) |
| Payday[1] | | 0.8808 | 3.5411 | | 0.7293 | 1.4705 |
| | | (2.7631) | (2.5225) | | (2.0790) | (2.3532) |
| Durables[2] | | | -0.1226 | | | 0.0800 |
| | | | (0.1550) | | | (0.1242) |
| Non-durables[2] | | | -0.2179 | | | -0.0942 |
| | | | (0.2814) | | | (0.2350) |
| Nr. current accounts | | | -0.3150 | | | 1.5043 |
| | | | (0.6405) | | | (2.7441) |
| Nr. savngs accounts | | | 0.0481 | | | 0.3265 |
| | | | (0.3403) | | | (1.8414) |
| Log cash spendings | | | -0.1717* | | | -0.1592 |
| | | | (0.1026) | | | (0.1151) |
| Log credit card spendings | | | -0.0889 | | | -0.1455 |
| | | | (0.1171) | | | (0.1168) |
| Lottery[3] | | | 4.8766 | | | 1.3202 |
| | | | (4.9517) | | | (2.7423) |
| Gambling[3] | | | 0.0000 | | | 0.0000 |
| | | | (.) | | | (.) |
| Temptations[3] | | | -2.2545 | | | -0.4524 |
| | | | (4.7601) | | | (3.2136) |
| Alcohol[3] | | | 2.2710 | | | -0.0968 |
| | | | (5.2087) | | | (3.2573) |
| Logins[4] | | | 1.2595 | | | 0.7536 |
| | | | (0.8210) | | | (0.7868) |
| Constant | 13.8091*** | 8.5614*** | 12.3810*** | 13.6484*** | -68.2237 | -77.2890 |
| | (0.5421) | (2.9086) | (3.7816) | (0.4548) | (62.9489) | (69.4431) |
| FE[5] | | | | X | X | X |
| R-square | 0.068 | 0.093 | 0.092 | 0.054 | 0.061 | 0.048 |
| #Observations | 1,320 | 1,320 | 1,218 | 1,320 | 1,320 | 1,218 |

Note: ***, ** and * for the 1%, 5% and 10% significance level, respectively. [1]Dummy that equals 1 if person receives salary. [2] as a share of individual-specific average expenditures. [3] Dummies that equal 1 if expenditures of that category are positive. [4] Dummy that equals 1 if person logged into the Meniga app. [5] Standard errors are clustered at the individual level. Purchaser area dummies are included in all models but coefficients not reported. Total income, cash and credit card balance are inverse-hyperbolic-sine transformed. Additional controls are day of week and day of month, but coefficients are not reported.

Table 7: Ordinary Least Squares Estimates for Probability of Co-hold Period Starting, Baseline Sample

| | Probability of Co-hold Period Starting | | | | | | |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Age | 0.0001*** | 0.0000*** | 0.0001*** | 0.0001*** | 0.0001*** | 0.0001*** | 0.0000*** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Female | -0.0001 | -0.0001 | -0.0001 | -0.0001 | -0.0001 | -0.0001 | -0.0000 |
| | (0.0001) | (0.0001) | (0.0001) | (0.0001) | (0.0001) | (0.0001) | (0.0001) |
| Linked | -0.0004*** | -0.0005** | -0.0003 | -0.0004*** | -0.0004** | -0.0006*** | -0.0005*** |
| | (0.0002) | (0.0002) | (0.0002) | (0.0002) | (0.0002) | (0.0002) | (0.0002) |
| Benefits person | 0.0006*** | 0.0006*** | 0.0005*** | 0.0006*** | 0.0006*** | 0.0006*** | 0.0006*** |
| | (0.0001) | (0.0001) | (0.0001) | (0.0001) | (0.0001) | (0.0001) | (0.0001) |
| Log total income | 0.0008*** | 0.0006*** | 0.0005*** | 0.0005*** | 0.0005*** | 0.0005*** | 0.0008*** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0001) |
| Payday[1] | -0.0043*** | | | | | | -0.0050*** |
| | (0.0006) | | | | | | (0.0007) |
| Durables[2] | | 0.0001** | | | | | 0.0000 |
| | | (0.0000) | | | | | (0.0000) |
| Non-durables[2] | | 0.0006*** | | | | | 0.0002** |
| | | (0.0001) | | | | | (0.0001) |
| Nr. current accounts | | 0.0002** | | | | | 0.0000 |
| | | (0.0001) | | | | | (0.0001) |
| Nr. savngs accounts | | 0.0010*** | | | | | 0.0010*** |
| | | (0.0000) | | | | | (0.0000) |
| Log cash spend | | | 0.0003*** | | | | 0.0003*** |
| | | | (0.0000) | | | | (0.0000) |
| Log credit card spend | | | | 0.0001*** | | | 0.0000*** |
| | | | | (0.0000) | | | (0.0000) |
| Lottery[3] | | | | | -0.0000 | | -0.0011 |
| | | | | | (0.0006) | | (0.0007) |
| Gambling[3] | | | | | 0.0069*** | | 0.0062*** |
| | | | | | (0.0017) | | (0.0019) |
| Temptations[3] | | | | | 0.0021*** | | 0.0025*** |
| | | | | | (0.0006) | | (0.0007) |
| Alcohol[3] | | | | | -0.0008 | | -0.0022*** |
| | | | | | (0.0007) | | (0.0008) |
| Logins[4] | | | | | | 0.0015*** | 0.0016*** |
| | | | | | | (0.0003) | (0.0002) |
| Constant | 0.0113*** | 0.0112*** | 0.0099*** | 0.0111*** | 0.0111*** | 0.0113*** | 0.0103*** |
| | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0004) |
| R-square | 0.002 | 0.003 | 0.002 | 0.002 | 0.002 | 0.002 | 0.003 |
| #Observations | 3,521,856 | 3,094,876 | 3,521,856 | 3,521,856 | 3,521,856 | 3,376,880 | 2,969,361 |

Unit of analysis: Individual × day. ***, ** and * for the 1%, 5% and 10% significance level, respectively. [1]Dummy that equals 1 if person receives salary. [2] as a share of individual-specific average expenditures. [3] Dummies that equal 1 if expenditures of that category are positive. [4] Dummy that equals 1 if person logged into the Meniga app. Purchaser area dummies are included in all models but coefficients not reported. Total income, cash and credit card balance are inverse-hyperbolic-sine transformed. Additional controls are day of week and day of month, but coefficients are not reported.

Table 8: Individual and Month-by-Year Fixed Effects Model for Co-holders

| | Probability of Co-hold Period Starting | | | | | | |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Log total income | 0.0008*** | 0.0006*** | 0.0005*** | 0.0005*** | 0.0005*** | 0.0005*** | 0.0008*** |
| | (0.0001) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0001) |
| Payday[1] | -0.0044*** | | | | | | -0.0049*** |
| | (0.0010) | | | | | | (0.0012) |
| Durables[2] | | 0.0001*** | | | | | 0.0000 |
| | | (0.0000) | | | | | (0.0000) |
| Non-durables[2] | | 0.0006*** | | | | | 0.0001 |
| | | (0.0001) | | | | | (0.0001) |
| Nr. current accounts | | 0.0020*** | | | | | 0.0016*** |
| | | (0.0006) | | | | | (0.0006) |
| Nr. savngs accounts | | 0.0024*** | | | | | 0.0020*** |
| | | (0.0003) | | | | | (0.0003) |
| Log cash spendings | | | 0.0003*** | | | | 0.0003*** |
| | | | (0.0000) | | | | (0.0000) |
| Log credit card spendings | | | | 0.0001*** | | | 0.0001*** |
| | | | | (0.0000) | | | (0.0000) |
| Lottery[3] | | | | | 0.0001 | | -0.0008 |
| | | | | | (0.0007) | | (0.0008) |
| Gambling[3] | | | | | 0.0046 | | 0.0034 |
| | | | | | (0.0028) | | (0.0030) |
| Temptations[3] | | | | | 0.0020*** | | 0.0023*** |
| | | | | | (0.0006) | | (0.0008) |
| Alcohol[3] | | | | | -0.0006 | | -0.0019** |
| | | | | | (0.0007) | | (0.0008) |
| Logins[4] | | | | | | 0.0019*** | 0.0025*** |
| | | | | | | (0.0005) | (0.0007) |
| Constant | 0.0129** | 0.0110 | 0.0114* | 0.0127** | 0.0127** | 0.0128** | 0.0102 |
| | (0.0056) | (0.0072) | (0.0059) | (0.0056) | (0.0056) | (0.0055) | (0.0067) |
| R-square | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 |
| #Observations | 3,522,740 | 3,095,136 | 3,522,740 | 3,522,740 | 3,522,740 | 3,377,764 | 2,969,621 |
| #Individuals | 3,985 | 3,985 | 3,985 | 3,985 | 3,985 | 3,821 | 3,821 |

Unit of analysis: Individual × day. ***, ** and * for the 1%, 5% and 10% significance level, respectively. [1]Dummy that equals 1 if person receives salary. [2] as a share of individual-specific average expenditures. [3] Dummies that equal 1 if expenditures of that category are positive. [4] Dummy that equals 1 if person logged into the Meniga app. Purchaser area dummies are included in all models but coefficients not reported. Total income, cash and credit card balance are inverse-hyperbolic-sine transformed. Additional controls are day of week and day of month, but coefficients are not reported.

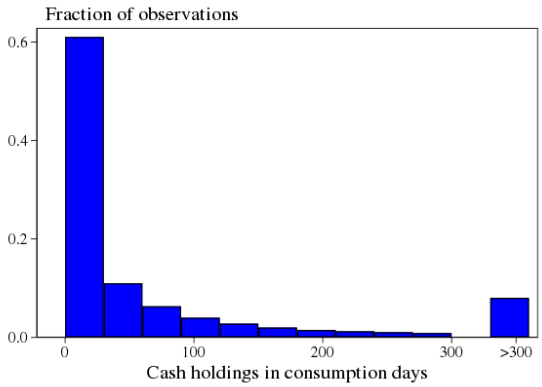
Table 9: Estimates Including Controls for Share of Expenditure on Credit Card

| | Probability of Co-Hold Period Starting | | | | | | |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Log total income | 0.0008*** | 0.0006*** | 0.0005*** | 0.0004*** | 0.0005*** | 0.0005*** | 0.0008*** |
| | (0.0001) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0001) |
| Log cash spendings | | | 0.0003*** | | | | 0.0003*** |
| | | | (0.0000) | | | | (0.0000) |
| Log credit card spendings | | | | | | | 0.0001*** |
| | | | | | | | (0.0000) |
| Share of total exp. | | | | -0.0026*** | | | |
| placed on credit card | | | | (0.0003) | | | |
| Share of groceries | | | | | 0.0001 | | |
| | | | | | (0.0003) | | |
| Share of pharmaceuticals | | | | | 0.0010 | | |
| | | | | | (0.0006) | | |
| Share of sports and activities | | | | | 0.0023 | | |
| | | | | | (0.0015) | | |
| Share of lottery (charity) | | | | | 0.0001 | | |
| | | | | | (0.0001) | | |
| Share of clothes and accessories | | | | | 0.0012** | | |
| | | | | | (0.0006) | | |
| Share of fuel | | | | | 0.0008** | | |
| | | | | | (0.0003) | | |
| Share of recreation | | | | | -0.0002 | | |
| | | | | | (0.0008) | | |
| Share of alcohol | | | | | 0.0007 | | |
| | | | | | (0.0007) | | |
| Share of gambling | | | | | 0.0065* | | |
| | | | | | (0.0035) | | |
| Share of transportation | | | | | 0.0005 | | |
| | | | | | (0.0005) | | |
| Share of charity | | | | | -0.0096*** | | |
| | | | | | (0.0025) | | |
| Share of lottery | | | | | 0.0023*** | | |
| | | | | | (0.0006) | | |
| Lottery[3] | | | | | | | -0.0008 |
| | | | | | | | (0.0008) |
| Gambling[3] | | | | | | | 0.0034 |
| | | | | | | | (0.0030) |
| Temptations[3] | | | | | | | 0.0023*** |
| | | | | | | | (0.0008) |
| Alcohol[3] | | | | | | | -0.0019** |
| | | | | | | | (0.0008) |
| Logins[4] | | | | | | 0.0019*** | 0.0025*** |
| | | | | | | (0.0005) | (0.0007) |
| Constant | 0.0129** | 0.0110 | 0.0114* | 0.0249*** | 0.0880*** | 0.0128** | 0.0102 |
| | (0.0056) | (0.0072) | (0.0059) | (0.0075) | (0.0058) | (0.0055) | (0.0067) |
| R-square | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 |
| #Observations | 3,522,740 | 3,095,136 | 3,522,740 | 2,206,559 | 1,354,090 | 3,377,764 | 2,969,621 |
| #Individuals | 3,985 | 3,985 | 3,985 | 3,985 | 3,772 | 3,821 | 3,821 |

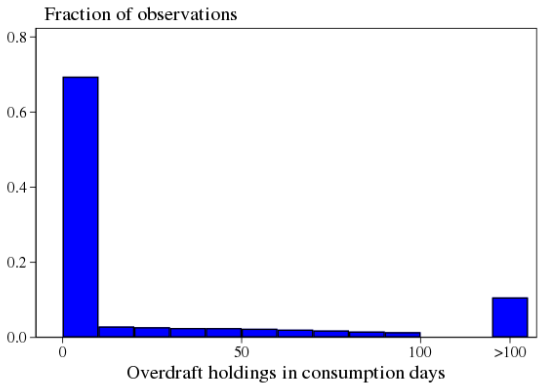
Unit of analysis: Individual × day. ***, ** and * for the 1%, 5% and 10% significance level, respectively. [1]Dummy that equals 1 if person receives salary. [2] as a share of individual-specific average expenditures. [3] Dummies that equal 1 if expenditures of that category are positive. [4] Dummy that equals 1 if person logged into the Meniga app. Purchaser area dummies are included in all models but coefficients not reported. Total income, cash and credit card balance are inverse-hyperbolic-sine transformed. Additional controls are day of week and day of month, but coefficients are not reported.

Figure A1: Distributions of Deposit Balances and Overdraft Balances

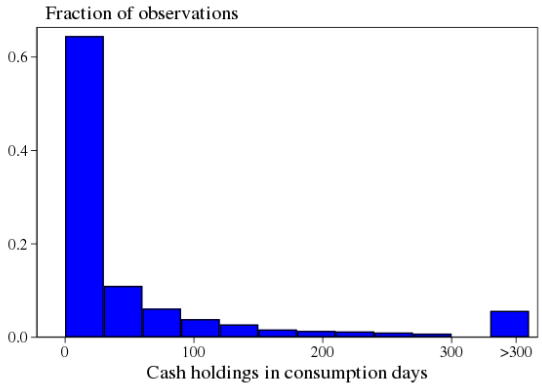
(A) Single Individuals - Cash



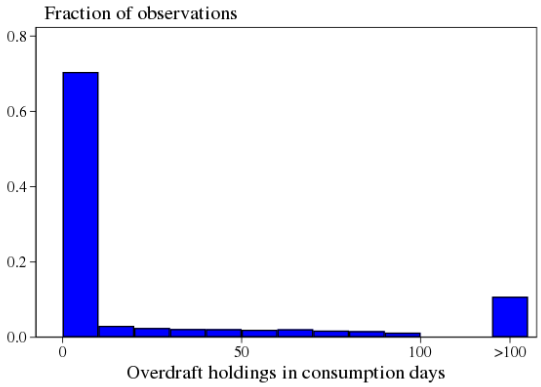

(B) Single Individuals - Overdraft



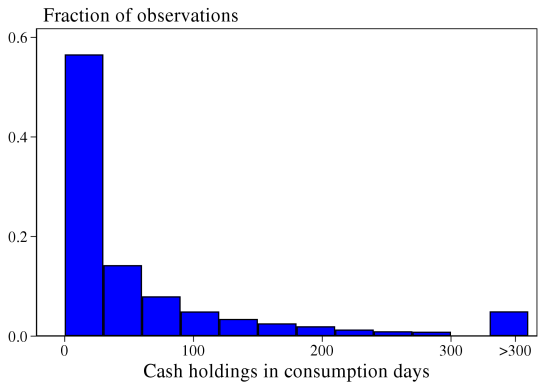

(C) Linked individuals - Cash



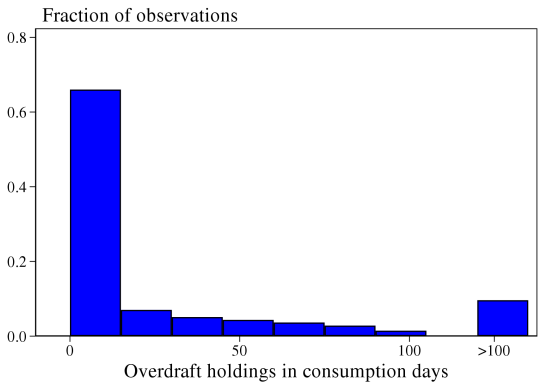

(D) Linked individuals - Overdraft




(E) Couples - Cash




(F) Couples - Overdraft




*Note:* Panels A-B show the sample of individual × days for individuals not linked with another person in the sample. Panels C-D show individual × days for individuals linked with another person in the sample. Panels E-F show household × days for multi-person household units. See Section 2 for details of sample restrictions.

Table A1: Ordinary Least Squares Estimates for Duration vs Frequency of Co-Holding

| | Spell Length | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Number of Spells | -0.8379*** | -0.8475*** | -0.3831*** |
| | (0.0919) | (0.0930) | (0.0928) |
| Age | | -0.0696 | -0.1471* |
| | | (0.0847) | (0.0850) |
| Female | | 6.4251*** | 1.0292 |
| | | (2.0374) | (2.6477) |
| Linked | | -3.0840 | -1.2053 |
| | | (3.1295) | (3.0071) |
| Benefits person | | 2.2848 | 2.2022 |
| | | (2.3273) | (3.2018) |
| Log total income | | -0.8445*** | -0.4166 |
| | | (0.2691) | (0.3477) |
| Payday[1] | | 10.3742*** | 5.8163 |
| | | (3.0706) | (3.9121) |
| Durables[2] | | | -0.0202 |
| | | | (0.0584) |
| Non-durables[2] | | | 0.5215 |
| | | | (0.8098) |
| Nr. current accounts | | | 0.0033 |
| | | | (1.2723) |
| Nr. savngs accounts | | | 2.0163*** |
| | | | (0.6631) |
| Log cash spendings | | | 0.1371 |
| | | | (0.2303) |
| Log credit card spendings | | | -0.1323 |
| | | | (0.2442) |
| Lottery[3] | | | -4.8440 |
| | | | (2.9692) |
| Gambling[3] | | | 0.0000 |
| | | | (.) |
| Temptations[3] | | | 5.5989 |
| | | | (4.1435) |
| Alcohol[3] | | | -3.6425 |
| | | | (5.2016) |
| Logins[4] | | | -0.6386 |
| | | | (1.2729) |
| Constant | 36.7262*** | 37.9977*** | 26.9655*** |
| | (1.7167) | (5.4741) | (7.4759) |
| R-square | 0.013 | 0.021 | 0.020 |
| #Observations | 3,985 | 3,984 | 1,428 |

Note: ***, ** and * for the 1%, 5% and 10% significance level, respectively. [1]Dummy that equals 1 if person receives salary. [2] as a share of individual-specific average expenditures. [3] Dummies that equal 1 if expenditures of that category are positive. [4] Dummy that equals 1 if person logged into the Meniga app. [5] Standard errors are clustered at the individual level. Purchaser area dummies are included in all models but coefficients not reported. Total income, cash and credit card balance are inverse-hyperbolic-sine transformed. Additional controls are day of week and day of month, but coefficients are not reported.

Table A2: Co-holding by Single Individuals

| | Cash holdings | | | | | | |
|---|---|---|---|---|---|---|---|
| Overdraft holdings | 0 | >0-10 | >10-20 | >20-30 | >30-40 | >40 | Total |
| 0 | 2.93 | 15.33 | 6.73 | 4.87 | 3.96 | 31.85 | 65.67 |
| >0-10 | 1.59 | 1.25 | 0.19 | 0.10 | 0.08 | 0.56 | 3.77 |
| >10-20 | 1.20 | 1.12 | 0.15 | 0.07 | 0.05 | 0.32 | 2.92 |
| >20-30 | 1.16 | 1.05 | 0.15 | 0.07 | 0.05 | 0.24 | 2.73 |
| >30-40 | 1.14 | 0.98 | 0.11 | 0.06 | 0.04 | 0.19 | 2.52 |
| >40 | 10.32 | 8.98 | 0.94 | 0.51 | 0.35 | 1.30 | 22.40 |
| Total | 18.35 | 28.71 | 8.28 | 5.69 | 4.53 | 34.45 | 100.00 |

Note: Table illustrates joint distribution of cash holdings (in deposit and/or savings accounts) and overdraft holdings in the baseline sample of individual × days. Cash holdings and overdraft holdings are normalized by average daily consumption spend of the consumer. Each cell reports as percentage of observations. The cell (0,0) contains observations for which both cash and overdraft balance are zero.

Table A3: Co-holding by Linked Individuals

| | Cash holdings | | | | | | |
|---|---|---|---|---|---|---|---|
| Overdraft holdings | 0 | >0-10 | >10-20 | >20-30 | >30-40 | >40 | Total |
| 0 | 3.10 | 17.98 | 7.21 | 4.94 | 4.12 | 28.88 | 66.23 |
| >0-10 | 2.07 | 1.40 | 0.16 | 0.07 | 0.06 | 0.46 | 4.24 |
| >10-20 | 1.45 | 1.14 | 0.14 | 0.05 | 0.03 | 0.24 | 3.05 |
| >20-30 | 1.18 | 0.97 | 0.09 | 0.04 | 0.02 | 0.18 | 2.48 |
| >30-40 | 1.09 | 0.85 | 0.08 | 0.05 | 0.02 | 0.11 | 2.20 |
| >40 | 10.74 | 8.59 | 0.73 | 0.36 | 0.30 | 1.07 | 21.80 |
| Total | 19.63 | 30.94 | 8.41 | 5.51 | 4.56 | 30.95 | 100.00 |

Note: Table illustrates joint distribution of cash holdings (in deposit and/or savings accounts) and overdraft holdings in the baseline sample of individual × days. Cash holdings and overdraft holdings are normalized by average daily consumption spend of the consumer. Each cell reports as percentage of observations. The cell (0,0) contains observations for which both cash and overdraft balance are zero.

Table A4: Co-holding by Couples

| | Cash holdings | | | | | | |
|---|---|---|---|---|---|---|---|
| Overdraft holdings | 0 | >0-10 | >10-20 | >20-30 | >30-40 | >40 | Total |
| 0 | 1.06 | 8.12 | 5.35 | 4.77 | 4.13 | 31.11 | 54.54 |
| >0-10 | 0.48 | 3.46 | 0.99 | 0.72 | 0.49 | 2.52 | 8.66 |
| >10-20 | 0.55 | 2.18 | 0.57 | 0.40 | 0.31 | 1.20 | 5.22 |
| >20-30 | 0.58 | 2.38 | 0.55 | 0.32 | 0.24 | 0.54 | 4.61 |
| >30-40 | 0.54 | 1.75 | 0.41 | 0.33 | 0.22 | 0.41 | 3.66 |
| >40 | 5.48 | 13.00 | 1.62 | 0.95 | 0.70 | 1.56 | 23.31 |
| Total | 8.69 | 30.89 | 9.50 | 7.49 | 6.09 | 37.33 | 100.00 |

Note: Table illustrates joint distribution of cash holdings (in deposit and/or savings accounts) and overdraft holdings in the baseline sample of individual × days. Cash holdings and overdraft holdings are normalized by average daily consumption spend of the consumer. Each cell reports as percentage of observations. The cell (0,0) contains observations for which both cash and overdraft balance are zero.

Table A5: Co-holding by Single Individuals (Monetary Values)

| | Cash holdings | | | | | | |
|---|---|---|---|---|---|---|---|
| Overdraft holdings | 0 | >0-20,000 | >20,000-40,000 | >40,000-60,000 | >60,000-80,000 | >80,000 | Total |
| 0 | 2.93 | 8.65 | 3.69 | 2.88 | 2.38 | 45.14 | 65.67 |
| >0-20,000 | 0.58 | 0.37 | 0.05 | 0.03 | 0.03 | 0.35 | 1.41 |
| >20,000-40,000 | 0.43 | 0.29 | 0.04 | 0.03 | 0.02 | 0.24 | 1.05 |
| >40,000-60,000 | 0.40 | 0.30 | 0.05 | 0.02 | 0.02 | 0.21 | 1.00 |
| >60,000-80,000 | 0.38 | 0.26 | 0.04 | 0.03 | 0.02 | 0.18 | 0.90 |
| >80,000 | 13.63 | 9.60 | 1.22 | 0.81 | 0.60 | 4.12 | 29.97 |
| Total | 18.35 | 19.47 | 5.07 | 3.80 | 3.07 | 50.24 | 100.00 |

Note: Table illustrates joint distribution of cash holdings (in deposit and/or savings accounts) and overdraft holdings in the baseline sample of individual × days. Cash holdings and overdraft holdings are normalized by average daily consumption spend of the consumer. Each cell reports as percentage of observations. The cell (0,0) contains observations for which both cash and overdraft balance are zero.

Table A6: Co-holding by Linked Individuals (Monetary Values)

| | Cash holdings | | | | | | |
|---|---|---|---|---|---|---|---|
| Overdraft holdings | 0 | >0-20,000 | >20,000-40,000 | >40,000-60,000 | >60,000-80,000 | >80,000 | Total |
| 0 | 3.10 | 10.07 | 4.34 | 3.20 | 2.61 | 42.92 | 66.23 |
| >0-20,000 | 0.77 | 0.43 | 0.07 | 0.03 | 0.02 | 0.31 | 1.62 |
| >20,000-40,000 | 0.60 | 0.39 | 0.04 | 0.02 | 0.03 | 0.17 | 1.26 |
| >40,000-60,000 | 0.49 | 0.36 | 0.03 | 0.02 | 0.05 | 0.16 | 1.11 |
| >60,000-80,000 | 0.46 | 0.25 | 0.03 | 0.01 | 0.01 | 0.13 | 0.89 |
| >80,000 | 14.21 | 9.35 | 1.22 | 0.62 | 0.35 | 3.14 | 28.89 |
| Total | 19.63 | 20.85 | 5.72 | 3.90 | 3.07 | 46.83 | 100.00 |

Note: Table illustrates joint distribution of cash holdings (in deposit and/or savings accounts) and overdraft holdings in the baseline sample of individual × days. Cash holdings and overdraft holdings are normalized by average daily consumption spend of the consumer. Each cell reports as percentage of observations. The cell (0,0) contains observations for which both cash and overdraft balance are zero.

Table A7: Co-holding by Couples (Monetary Values)

| | Cash holdings | | | | | | |
|---|---|---|---|---|---|---|---|
| Overdraft holdings | 0 | >0-20,000 | >20,000-40,000 | >40,000-60,000 | >60,000-80,000 | >80,000 | Total |
| 0 | 1.06 | 2.16 | 1.32 | 1.12 | 1.16 | 47.73 | 54.54 |
| >0-20,000 | 0.05 | 0.26 | 0.14 | 0.10 | 0.07 | 1.43 | 2.04 |
| >20,000-40,000 | 0.04 | 0.26 | 0.07 | 0.06 | 0.05 | 0.98 | 1.46 |
| >40,000-60,000 | 0.05 | 0.26 | 0.09 | 0.05 | 0.04 | 0.93 | 1.41 |
| >60,000-80,000 | 0.15 | 0.25 | 0.07 | 0.05 | 0.04 | 0.64 | 1.19 |
| >80,000 | 7.35 | 12.16 | 2.82 | 1.78 | 1.27 | 13.97 | 39.35 |
| Total | 8.69 | 15.35 | 4.52 | 3.15 | 2.63 | 65.67 | 100.00 |

Note: Table illustrates joint distribution of cash holdings (in deposit and/or savings accounts) and overdraft holdings in the baseline sample of individual × days. Cash holdings and overdraft holdings are normalized by average daily consumption spend of the consumer. Each cell reports as percentage of observations. The cell (0,0) contains observations for which both cash and overdraft balance are zero.

Table A8: Share of Co-holding Days for Single Individuals

| | Mean | SD | p50 | p75 | p90 | p95 |
|---|---|---|---|---|---|---|
| Min(3,3) | 0.219 | 0.257 | 0.109 | 0.328 | 0.641 | 0.808 |
| Min(5,5) | 0.198 | 0.243 | 0.093 | 0.290 | 0.598 | 0.766 |
| Min(10,10) | 0.166 | 0.221 | 0.066 | 0.229 | 0.500 | 0.700 |
| Min(15,15) | 0.147 | 0.208 | 0.051 | 0.197 | 0.446 | 0.640 |
| Min(20,20) | 0.135 | 0.198 | 0.043 | 0.180 | 0.413 | 0.603 |
| Min(25,25) | 0.124 | 0.191 | 0.037 | 0.157 | 0.391 | 0.563 |
| Min(30,30) | 0.116 | 0.182 | 0.035 | 0.144 | 0.356 | 0.516 |

Note: $Min(x, x)$ refers to a specific definition of co-holding, defining co-holding as simultaneously holds at least $(x, x)$ consumption days in both cash and overdrafts.

Table A9: Share of Co-holding Days for Linked Individuals

| | Mean | SD | p50 | p75 | p90 | p95 |
|---|---|---|---|---|---|---|
| Min(3,3) | 0.197 | 0.244 | 0.098 | 0.282 | 0.564 | 0.809 |
| Min(5,5) | 0.176 | 0.227 | 0.080 | 0.253 | 0.521 | 0.716 |
| Min(10,10) | 0.156 | 0.212 | 0.062 | 0.204 | 0.477 | 0.648 |
| Min(15,15) | 0.135 | 0.198 | 0.049 | 0.178 | 0.436 | 0.609 |
| Min(20,20) | 0.126 | 0.189 | 0.041 | 0.149 | 0.439 | 0.583 |
| Min(25,25) | 0.125 | 0.187 | 0.040 | 0.138 | 0.439 | 0.580 |
| Min(30,30) | 0.123 | 0.182 | 0.043 | 0.132 | 0.420 | 0.511 |

Note: $Min(x, x)$ refers to a specific definition of co-holding, defining co-holding as simultaneously holds at least $(x, x)$ consumption days in both cash and overdrafts.

Table A10: Share of Co-holding Days for Couples

| | Mean | SD | p50 | p75 | p90 | p95 |
|---|---|---|---|---|---|---|
| Min(3,3) | 0.249 | 0.248 | 0.169 | 0.364 | 0.641 | 0.822 |
| Min(5,5) | 0.205 | 0.230 | 0.111 | 0.288 | 0.572 | 0.753 |
| Min(10,10) | 0.148 | 0.200 | 0.057 | 0.199 | 0.475 | 0.615 |
| Min(15,15) | 0.115 | 0.174 | 0.035 | 0.147 | 0.390 | 0.520 |
| Min(20,20) | 0.095 | 0.158 | 0.024 | 0.111 | 0.313 | 0.454 |
| Min(25,25) | 0.081 | 0.146 | 0.019 | 0.090 | 0.250 | 0.406 |
| Min(30,30) | 0.070 | 0.134 | 0.015 | 0.067 | 0.219 | 0.351 |

Note: $Min(x, x)$ refers to a specific definition of co-holding, defining co-holding as simultaneously holds at least $(x, x)$ consumption days in both cash and overdrafts.

Table A11: Duration of Co-holding Spells

| | Duration of co-holding (days) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Mean | SD | P50 | P75 | P90 | P95 | #obs |
| Single individual x day level | 22.6 | 52.8 | 9.0 | 24.0 | 43.0 | 85.0 | 30,425 |
| Single individual level | 29.9 | 61.5 | 13.0 | 28.0 | 67.0 | 112.0 | 3,563 |
| Household x day level | 16.1 | 41.2 | 6.0 | 16.0 | 29.0 | 59.0 | 7,160 |
| Household level | 21.4 | 52.2 | 10.8 | 19.3 | 37.3 | 63.2 | 524 |

Co-holding defined as $Min(3, 3)$, holding 3 days consumption in both cash and overdrafts. The unit of analysis is an individual. See Section 2 for sample restrictions and Section 3.2 for definition of duration.