Intra-household Frictions, Anchoring, and the Credit Card Debt Puzzle

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Abstract

I study how intra-household frictions and anchoring contribute to the credit card debt puzzle, the co-holding of high-cost debt and low-yield liquid assets. First, I find couples co-hold 42 percent more as units than as individuals relative to income. Moreover, in a natural experiment, couples do not cooperate to reduce high-cost debt, suggesting that intra-household frictions contribute to co-holding. Second, I find individuals who regularly make credit card debt payments equal to or near the minimum account for 59 percent of individual co-holding. The evidence suggests anchoring to the minimum payment contributes to co-holding via these low payments.

Keywords: credit card debt puzzle, co-holding, intra-household frictions, anchoring
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1 Introduction

According to the Survey of Consumer Finances, around 30 percent of US households simultaneously hold substantial high-cost debt and low-yield liquid assets. The decision not to repay high-cost debt and thus save on interest is called the *credit card debt puzzle* or the *co-holding puzzle* and was first noted by Gross and Souleles (2002). Co-holding relates to other costly financial behaviors and requires an explanation to develop models of financial decision-making and to evaluate the potential for cost savings.

A central unknown of the credit card debt puzzle is the extent of household versus individual co-holding because earlier studies have lacked disaggregated data on co-holding. I use a new Finnish proprietary bank dataset to distinguish individual and household co-holding and–together with a natural experiment–test whether intra-household frictions contribute to co-holding. In addition to the household analysis, I consider a previously unexplored determinant of individual co-holding: anchoring to the minimum credit card debt payment. Focusing on intra-household frictions and anchoring is complementary because both can increase co-holding by depressing, respectively, household and individual debt repayment.

Co-holding can reflect individuals who hold assets and debts simultaneously; or households can co-hold as units if one individual holds the debts and the other the assets. Although earlier studies do not empirically distinguish individual and household co-holding, intra-household frictions are a key hypothesis for co-holding (Bertaut, Haliassos, and Reiter, 2009). In short, co-holding by a couple can indicate that the more patient partner with savings is unwilling to repay the debts of the more impatient partner.

My household analysis first documents a necessary condition for intra-household frictions to be relevant: couples co-hold 42 percent more as units than as individuals relative to income (figure 1). Second, I study whether noncooperation can explain the high co-holding by couples by examining a natural experiment in which couples have the option to reduce high-cost debt with low-cost liquidity. Consistent with intra-household frictions, I find individuals put less weight on the debts of their partner than on their own debts when deciding whether to seek low-cost liquidity. Finally, the intra-household frictions could represent (i) conflicts of interest (not wanting to help the partner), or (ii) incomplete information (not knowing

the partner needs help). I find co-holding by couples correlates with impulsive spending[1] and the probability of a breakup, suggesting that conflicts of interest likely contribute to the high co-holding by couples.

Although intra-household frictions matter, individual co-holding represents a majority of total co-holding and needs to be better understood. I am the first to study whether anchoring credit card debt payments to the minimum contributes to co-holding. Previous research has suggested anchoring as a reason for the prevalence of low credit card debt payments (Stewart, 2009; Navarro-Martinez et al., 2011; Hershfield and Roese, 2015; Guttman-Kenney, Leary, and Stewart, 2018; Keys and Wang, 2019). Yet my data on deposits allow my paper–unlike earlier work–to study co-holding and anchoring together and to rule out that low payments simply reflect liquidity constraints.

I connect the research on anchoring in credit card debt payments with the research on the credit card debt puzzle by documenting for the first time the relationship between low debt payments and co-holding. I use credit card invoice data–unavailable in earlier co-holding studies–to document that 40 percent of (non-autopay) credit card debt payments are equal to or near the minimum. Moreover, I find individuals with low regular payments account for 59 percent of total individual co-holding (figure 2). Therefore, understanding the reason for low regular debt payments is crucial to understanding individual co-holding.

Although the low payments are consistent with anchoring, I also consider alternative explanations. First, liquidity constraints could explain some low payments, but I document low payments despite high deposits. Second, low payments are unlikely a self-control mechanism for restricting spending because I study joint debit/credit cards that allow access to both deposit and credit accounts. Moreover, low payments often coincide with high available credit, inconsistent with self-control problems. Third, default-option effects do not explain why individuals make near-minimum payments by actively changing the default payment. In summary, anchoring–unlike the other hypotheses–can explain active near-minimum payments despite high liquidity. Yet I cannot quantify how much anchoring contributes to co-holding via low debt payments. For instance, it is impossible to distinguish whether making payments equal to the default payment reflects anchoring or a default-option effect.

[1]Gathergood and Weber (2014) also find household co-holding correlates with impulsive spending.

My paper can also comment on some of the other hypotheses for co-holding. Liquidity-based hypotheses (Zinman, 2007; Telyukova, 2013; Fulford, 2015; Druedahl and Jørgensen, 2018; Gorbachev and Luengo-Prado, 2018) are insufficient because I document co-holding despite high liquidity and low credit-limit risk. Strategic bankruptcy (Lehnert and Maki, 2002) does not explain co-holding in Finland, where personal bankruptcy does not exist. Further hypotheses for co-holding include individual self-control problems together with mental accounting (Bertaut, Haliassos, and Reiter, 2009; Gathergood and Olafsson, 2020), and variation in the "Big Five" personality traits (Choi and Laschever, 2018). Finally, financial illiteracy is an unlikely explanation because co-holding households are relatively sophisticated (Gathergood and Weber, 2014; Gorbachev and Luengo-Prado, 2018).

In addition to mechanisms, my high-frequency panel provides new descriptive statistics on the persistence and costs of co-holding. On average, households classified as co-holders in one month reduce co-holding over the subsequent year. Therefore, extrapolation from a cross section, a common practice in the literature, overestimates the average costs of co-holding by 14 percent. Furthermore, the cross section underestimates the variance in the costs of co-holding because it does not identify households on an increasing or decreasing trajectory of co-holding. Consequently, the spread in actual relative to extrapolated costs is significant (43 percent in the 10th percentile versus 128 percent in the 90th percentile).

Outside of the credit card debt puzzle, I contribute to the broader household-finance literature on costly financial behavior inconsistent with standard model predictions (for recent reviews, see Campbell, 2006; Guiso and Sodini, 2013; Beshears et al., 2018; Gomes, Haliassos, and Ramadorai, 2020). Anchoring to the minimum payment increases debt costs, in addition to, for instance, the balance-matching heuristic (Gathergood et al., 2019) and slow mortgage refinancing (Andersen et al., 2020). In addition to costly individual decisions, I find households incur costs because couples do not optimize their joint balance sheet (for a review of household decision-making, see Chiappori and Mazzocco, 2017).

Section 2 overviews the key models of co-holding. Section 3 defines co-holding and describes the data. Section 4 evaluates the role of intra-household frictions. Section 5 studies whether anchoring to the minimum payment contributes to co-holding. Section 6 studies whether other mechanisms can explain co-holding in my data. Section 7 concludes.

2 Models of Co-holding

This section introduces the key existing models of co-holding that will inform the empirical analysis.

2.1 Accountant-Shopper Model

Bertaut, Haliassos, and Reiter (2009) propose an accountant-shopper model for co-holding in which a patient accountant limits credit card debt payments and saves in cash to restrict credit card spending by a shopper. The model has both an intra-household interpretation (conflict of interest between a patient and an impatient partner) and a self-control interpretation (one individual with a patient and an impatient self).

In a stylized two-period model, the accountant and the shopper maximize $u_1(C_1) + \beta_i u_2(C_2)$, $i = a, s$. Because the accountant is more patient than the shopper, $\beta_a > \beta_s$. In the first period, the accountant first chooses how much credit card debt to repay given initial liquid assets and credit card debt. Following that, the shopper decides on first-period consumption based on the credit available, because the shopper can only spend with the credit card in period one. Although the accountant acts first, the accountant knows the consumption function of the shopper. Appendix B shows how the stylized model can generate co-holding, and Bertaut, Haliassos, and Reiter (2009) show that co-holding occurs in a quantitative life-cycle model with income risk.

Intuitively, the model can generate co-holding as a tool used by the patient accountant to consume less now and more later. In deciding whether to co-hold, the accountant trades off the incremental cost of co-holding determined by the interest rate spread between debt and liquid assets against the change in the intertemporal consumption allocation. Therefore, a necessary condition for co-holding to be optimal is that co-holding increases expected future consumption by restricting current consumption. Intuitively, co-holding is more valuable for the accountant the higher is the difference in patience between the accountant and the shopper. In the intra-household interpretation of the model, the more patient partner can control the spending of the relatively impatient partner by withholding liquid assets and not repaying the impatient partner's credit card debt.

2.2 Liquidity Premium of Cash over Credit Cards

Telyukova (2013) models co-holding by assuming that individuals can pay for certain consumption only with cash and not with credit cards.

Individuals in a stylized liquidity-premium model value both general consumption (purchasable with either cash or credit cards) and cash-only consumption: $u_t = u(C_{t,general}, z_{t,cash}C_{t,cash})$. The desire for cash-only consumption depends on the preference shock $z_{t,cash}$. The key timing assumption in the model is that individuals decide on debt repayment before the realization of $z_{t,cash}$ and before consumption. Hence, individuals are uncertain about their cash needs at the time of debt repayment.

The model can generate co-holding because individuals save in cash as insurance against a high $z_{t,cash}$. Yet if cash needs turn out small (low $z_{t,cash}$), individuals will have excess cash at the end of the month. Co-holding occurs because individuals cannot repay credit card debt with this excess cash within the month. Because co-holding is costly, individuals co-hold only to cover realistic monthly cash consumption needs, whereas highly liquid individuals repay any credit card debt in full.

2.3 Precautionary Borrowing

Fulford (2015) and Druedahl and Jørgensen (2018) model co-holding as the result of precautionary borrowing against negative credit-limit risk.

Consider a model in which the individual chooses debt repayment and consumption given beginning-of-period liquid assets and credit card debt. The key feature of the precautionary-borrowing model is that if the individual receives a bad income shock in the next period, the bank will prevent additional borrowing but cannot demand immediate repayment of debt: $B_{t+1,eop} \leq (B_t - P_t)R^B + C_{credit,t}$, where $B_{t+1,eop}$ is end-of-period debt in period $t+1$, B_t is beginning-of-period credit card debt in period t, P_t is debt repayment in period t, R^B is the interest rate on credit card debt, and $C_{credit,t}$ is new credit card spending in period t that includes an interest-free period typical to credit cards.

The model can generate co-holding because individuals save in cash as insurance against a bad income shock that would prevent new borrowing. An increment of co-holding costs the

interest spread betwen debt and liquid assets, but the cash savings allow higher consumption in the next period if the bad income shock occurs and prevents new borrowing. Conversely, precautionary co-holding is unnecessary with negligible credit-limit risk because in that case individuals can borrow only after the bad income shock.

3 Definitions and Data

3.1 Defining Puzzling Co-holding

Because low co-holding carries negligible costs, I follow the literature in defining puzzling co-holding as holding (i) non-negligible interest-accruing debt (over 500 EUR) and (ii) liquid assets above a buffer (over 1,500 EUR).[2] Because the relative costs of co-holding depend on income, I consider as an alternative measure of puzzling co-holding whether a household co-holds more than 25 percent of monthly disposable income. Next, I detail the assets and liabilities included in co-holding.

3.2 Data

My customer data from one of the largest banks in Finland includes information on assets, debts, income, and card expenditure. The main dataset is a monthly panel for 2014–17. I link individuals in the same household with an address-based identifier.

Unsecured debt includes interest-accruing debt on general-purpose credit cards (I disregard balances on interest-free periods) and borrowing on unsecured credit lines at the end of the month. Both credit cards and unsecured credit lines are completely liquid; that is, they allow free prepayment and redrawing of credit. Credit cards account for three-quarters of unsecured debt. Interest rates are product specific with a median nominal interest rate margin of 7 percent. The total interest rate is the margin plus the three-month Euribor (close to zero during the sample period). Total debt costs include account and invoicing fees.

[2]For instance, Telyukova (2013) uses a threshold of $500 for assets and debts, whereas the strict definition of Gorbachev and Luengo-Prado (2018) allows a liquidity buffer of one month's income.

Liquid assets include end-of-month balances held by adults in checking and savings accounts with no or limited withdrawal restrictions.[3] The nominal net interest rate on deposits averaged 0.1 percent during the sample. In appendix C, I show the main results do not change if I only consider checking account deposits or if I consider monthly average deposits. I focus on end-of-month balances because I observe average balances only for 2015, and average balances do not perfectly identify liquid and illiquid deposits.

Co-holding is the minimum of interest-accruing unsecured debt and deposits.

3.3 Sample Selection and Representativeness

Although my data benefit from high frequency, electronic precision, and the ability to study individual and household co-holding, using data from only one bank can be concerning. The data may be unrepresentative (i) because the customer base is unrepresentative or (ii) because individuals use multiple banks. Fortunately, as one of the largest banks in Finland, the bank in question has a large customer base that is geographically and socioeconomically diverse. Regarding the second concern, a loyalty scheme encourages individuals to concentrate their finances at the bank. Moreover, I implement restrictions to ensure my sample households use the bank as their main bank and I compare my data to national statistics on household finances. If I still miss a subset of customer finances after my sample restrictions, my measure of co-holding would represent a lower bound, because additional holdings of deposits and unsecured debt would weakly increase total co-holding.

My sample criteria require the household to have an unsecured credit account and the two oldest adults to have checking accounts (to allow for co-holding).[4] In addition, the household needs at least one person older than twenty-five and at most two members older than twenty to omit young people sharing a flat. These minimum criteria identify 598,330 households. In addition, I drop a household if any member states using a different main bank, and I require regular card expenditures by the two oldest adults.[5] These conditions leave

[3]Some savings accounts restrict the number of free withdrawals. Yet keeping funds in savings accounts is puzzling if the household may use unsecured debt, because these accounts yield near 0 percent.

[4]In the case of singles, the single individual needs to have a checking account.

[5]Regulations require banks to regularly ask customers about their main bank. I require card purchases in at least eight months in each year with average monthly purchases of at least 100 EUR in each year.

388,681 households and capture 70 percent of the unsecured debt in the minimum-criteria data. I also require household disposable income to exceed 500 EUR per month in 2015 to study co-holding relative to income, and I omit entrepreneurs so as not to mix personal and business accounts. All of these conditions leave 353,010 households and 65 percent of total unsecured debt. Finally, I focus on stable households with the same two oldest adults during 2014–17 to study the persistence of co-holding. Later, I compare stable and unstable households. Consequently, my baseline sample captures 294,026 households and 53 percent of total unsecured debt.

In supplementary material (table A.1), I compare my baseline sample with national statistics. My sample contains over 10 percent of Finnish households with a head older than twenty-five years. Although my sample is broadly in line with national statistics, I undersample households with heads older than seventy-five years and oversample mortgage holders. Moreover, disposable income is somewhat higher in my sample than in the population. These differences are correlated because older households have fewer mortgages and relatively low income. My requirement of regular card expenditures contributes to differences between my sample and national statistics, because the requirement drops disproportionately older households who use cash more. Unfortunately, I cannot compare sample and population co-holding, because national statistics do not record unsecured debt separately.

3.4 Sample Descriptive Statistics

Household co-holding is quite common in my data and significant in proportion to total unsecured debt. Table 1 documents that 40 percent of household-month observations co-hold some amount, and around 20 percent of observations classify as puzzling co-holding (co-holding at least 500 EUR and at least 1,500 EUR of deposits, or, in the alternative definition, co-holding over 25 percent of monthly disposable income). Co-holding averages 480 EUR for all observations and around 2,000 EUR for puzzling co-holding observations. Moreover, I find household co-holding equals 46 percent of total unsecured debt implying that households could pay off almost half of all interest-accruing unsecured debt. Furthermore, the median debtor co-holds all debt and could avoid co-holding altogether.

Table 2 compares co-holders with savers and borrowers. Co-holding households are rel-

atively large,[6] with above-average disposable income and expenditure. Co-holders are also relatively likely to have a mortgage. Unsurprisingly, co-holders are better off than borrowers but have fewer assets than savers. Co-holders are also younger than savers. Heterogeneity in interest rates does not explain co-holding, because interest rates vary little. The relative characteristics of co-holders accord with, for instance, Gathergood and Weber (2014).

In supplementary material (table A.3), I compare my baseline sample of *stable* households with the same two oldest adults over 2014–17 with *unstable* households whose members live in the same address in January 2015 but either do not live together in January 2014 or move apart before December 2017. Single households are stable if they remain single throughout the sample period. I find unstable households are younger and co-hold more. Hence, my focus on stable households somewhat underestimates overall co-holding.

3.5 Persistence and Costs of Co-holding

Evidence on the persistence of co-holding is scant because of a lack of high-frequency data. Although many respondents in the Survey of Consumer Finances do not typically repay their credit card balance, debtors may stop co-holding if their liquid assets decline. Gorbachev and Luengo-Prado (2018) find around 40 percent of co-holding households continue to co-hold after four years in the National Longitudinal Survey of Youth. In ongoing work, Gathergood and Olafsson (2020) find most co-holding spells in overdraft deposit accounts (without monthly billing as with credit cards) last less than one month.

My data on persistence suggests that a cross section neatly identifies households who tend to co-hold for a significant number of months in a year but that co-holders do not co-hold consistently over time. I find puzzling co-holders in January 2015 co-hold, on average, in nine months during 2015, whereas other groups co-hold for less than two months (table 2). In the full dataset, 75 percent of puzzling co-holders continue to co-hold over 500 EUR with 1,500 EUR in deposits after three months, and 66 percent still do so after twelve months (figure 3). In supplementary material (figure A.1), I show that persistence is higher at the

[6] I underestimate household size because I observe only customers of the bank. The bank has records on 52 (78) percent of children (adults) in Finland. I should observe a larger share of both because I study households for whom the bank is their main bank.

intensive margin because measuring co-holding relative to the baseline month captures that some co-holders increase co-holding.

To study how persistence affects the costs of co-holding, I calculate the yearly costs in two ways: (i) assuming no change in co-holding by extrapolating the monthly costs and (ii) allowing co-holding to either increase or decrease by measuring actual co-holding within twelve months of the baseline month. The monthly costs of co-holding equal the excess interest and the invoicing fees (θ in eq. 1) on interest-accruing debt.[7]

$$\text{costs} = \min(\text{deposits}, \text{unsecuredDebt}) * (r_{\text{unsecuredDebt}} - r_{\text{deposits}}) + \theta. \tag{1}$$

Overall, the costs of co-holding are relatively low (table 3). The median extrapolated yearly cost is 154 EUR, and the median actual cost is 135 EUR. The 90th percentile of costs is 313 EUR (extrapolated) and 285 EUR (actual).

I find extrapolation overestimates the costs of co-holding for roughly 70 percent of puzzling co-holders. The overestimation is relatively small because actual costs average 88 percent of extrapolated costs. Yet the spread in actual relative to extrapolated costs is significant (43 percent in the 10th percentile versus 128 percent in the 90th percentile) because some households increase and others decrease co-holding relative to the baseline month.

My results are a lower bound for the costs of co-holding for two reasons. First, I do not observe assets or debts at other banks, although I study households with the bank as their main bank. Second, I do not calculate the total annual percentage rate (APR) cost of debt because I consider account fees as unavoidable.

4 Intra-household Frictions and Co-holding

This section studies the empirical relevance of intra-household frictions as an explanation for co-holding. I can study whether couples co-hold more than individuals because I observe individual and household co-holding, unlike earlier studies that rely on only household data.[8]

[7] I fix interest rates at the sample midpoint (December 2015) to avoid discrepancies between extrapolated and actual costs from interest rate changes (variation of about 30 basis points during 2014–17).

[8] In ongoing work, Gathergood and Olafsson (2020) find couples co-hold more than individuals in overdraft deposit accounts, but the authors consider the differences minor.

Furthermore, I use a natural experiment to study whether couples act uncooperatively when given the chance to reduce co-holding.

4.1 Co-holding by Couples and Individuals

If intra-household frictions contribute to co-holding (as in the model in section 2.1), households co-hold more as units than as individuals. Hence, I document the prevalence of co-holding by couples, individuals within couples, and singles. I form couples from the two oldest adults. To omit single parents with an adult child, I drop "couples" with an age difference larger than seventeen years if the younger adult is twenty-five years old or less.[9] Co-holding by couples equals $\min[\sum_{i=1}^{2} \text{deposits}_\text{i}, \sum_{i=1}^{2} \text{debt}_\text{i}]$ and co-holding by couples relative to income equals $\frac{\min[\sum_{i=1}^{2} \text{deposits}_\text{i}, \sum_{i=1}^{2} \text{debt}_\text{i}]}{\sum_{i=1}^{2} \text{income}_\text{i}}$.

I find couples co-hold, on average, 18 percent relative to monthly disposable income compared with 13 percent for individuals within couples, or 42 percent more (figure 1). Couples are also 53 percent more likely than individuals within couples to co-hold over 25 percent of monthly income. Because I normalize co-holding by couples by total household income and co-holding by individuals by individual income, the higher co-holding by couples relative to income does not reflect any mechanical aggregation effect. To facilitate comparison to the earlier literature using absolute thresholds for co-holding, the third trio of columns in figure 1 plots the probability of couples, individuals within couples, and singles to co-hold at least 500 EUR with at least 1,500 EUR of deposits. Note that by this measure the co-holding rate by couples is an upper bound for the co-holding rate by individuals within couples. I find that 26 percent of couples co-hold at least 500 EUR with at least 1,500 EUR of deposits compared with 9 percent of individuals within couples. Therefore, large absolute co-holding is mostly a household phenomenon, which earlier papers relying on only household data could not document. Singles also co-hold less than couples although more than individuals within couples. Finally, co-holding is also more persistent for couples than for individuals (supplementary figure A.2).

I also calculate how much co-holding by couples reflects the aggregation of

[9] I also require both adults to have monthly disposable income of at least 250 EUR to study individual co-holding relative to income (this drops 6.1 percent of couples).

accounts instead of individual co-holding. Whereas household co-holding equals $\min[\sum_{i=1}^{2} \text{deposits}_i, \sum_{i=1}^{2} \text{debt}_i]$, total individual co-holding within a couple equals $\sum_{i=1}^{2} \min[\text{deposits}_i, \text{debt}_i]$. I find household co-holding averages 699 EUR and total individual co-holding averages 491 EUR. Hence, 29.8 percent [(699 − 491)/699] of co-holding by couples reflects the aggregation of accounts within the household.

4.2 Natural Experiment of Household Cooperation

The higher co-holding by couples is necessary but not sufficient evidence of intra-household frictions. Intra-household frictions in the accountant-shopper model (section 2.1) imply non-cooperation within the couple, which is a challenging hypothesis to test with observational data. I test whether co-holding couples cooperate in a natural experiment in which they had an option to reduce their high-cost debt.

I base my test of household cooperation on a surprise liquidity offer by the bank to all of its mortgage holders in February 2015. Mortgage holders received a free option to reduce the minimum mortgage principal payment to zero for up to twelve months. For instance, a household paying 500 EUR/month in principal could obtain 6,000 EUR of liquidity by taking up the offer, and the bank would extend the mortgage maturity by twelve months. Hence, the offer provided long-term liquidity to co-holders with a mortgage.

Co-holders could save money with the liquidity offer because the median nominal interest rate on unsecured debt was 7 percent, versus 1.3 percent on the mortgage. The bank, one of the largest in the country with reputational capital, also informed customers the liquidity offer would not affect future credit. Appendix D discusses further details of the offer and calculates the monetary benefits of the offer to co-holders. Yearly savings average 185 EUR, and the net present value of the cumulative savings over the life of the mortgage average 1,844 EUR (table A.5).

The liquidity offer provides a test of cooperation within co-holding couples because it allows me to study whether the distribution of assets and debts influences take-up. I compare take-up between couples with similar total deposits and unsecured debt but different distributions across individuals. If the couple cooperates, only total assets and debts–but not their distribution–influence take-up. If the couple does not cooperate, individuals put

more weight on their own financial situation.

To conduct the test, I derive information on individual characteristics of each mortgage holder and partner as well as common household characteristics. I estimate a linear probability model in which the dependent variable equals 1 if the mortgage holder takes up the liquidity offer on at least one mortgage:

$$\mathbb{1}_{\text{liquidity},p,h} = \beta_1 \frac{\text{debt}_p}{\text{debt}_h} + \beta_2 \frac{\text{deposits}_p}{\text{deposits}_h} + \sum_{b=1}^{10} \gamma_b \mathbb{1}_{\text{deposits}_\text{h} \in \text{depositBin}_\text{b}} + \sum_{b=1}^{10} \theta_b \mathbb{1}_{\text{debt}_\text{h} \in \text{debtBin}_\text{b}} + \Omega \mathbb{X}_h + \epsilon_{p,h}. \tag{2}$$

The subscript p refers to a mortgage holder in household h. The key explanatory variables are $\frac{\text{debt}_p}{\text{debt}_h}$ and $\frac{\text{deposits}_p}{\text{deposits}_h}$, which measure the share of total household unsecured debt and deposits held by the mortgage holder. Under household cooperation, the distribution of assets and debts does not affect take-up, and hence $\beta_1 = \beta_2 = 0$. But if the mortgage holder puts less weight on their partner, $\beta_1 > 0$ and $\beta_2 < 0$. That is, under limited cooperation, the take-up rate is higher if the mortgage holder has a larger share of debt or a smaller share of deposits. All regressions control for total household deposits and unsecured debt and other household characteristics $\mathbb{X}_h$.

To calculate deposits_p and debt_p, I need to define the (primary) mortgage holder p, which depends on whether the household has individual or joint mortgages. Individual mortgages have a clearly defined mortgage holder p who can apply for the liquidity offer without consulting their partner. In contrast, both partners are liable for a joint mortgage and need to agree to apply for the liquidity offer. For joint mortgages I use the bank's definition of the primary mortgage holder p (the bank records one of the debtors as the primary mortgage holder). The primary mortgage holder is often male (69 percent of cases), has higher deposits (median 1,506 EUR versus 1,012 EUR for the partner), and has more unsecured debt (median 1,017 EUR versus 685 EUR for the partner).

I reject intra-household cooperation when estimating the model with all co-holding couples (table 4, column 1). Yet the distribution of assets and debts affects take-up only moderately. If the primary mortgage holder holds all unsecured debt, the take-up rate is 3.9 percentage points higher (or 14 percent relative to the mean) than if the partner holds all

debt. Moreover, the deposit distribution does not affect take-up.

Yet the moderate overall effect masks significant heterogeneity by mortgage type. Holders of individual mortgages put substantially more weight on their own financial situation: the take-up rate is 8.6 percentage points higher (or 36 percent relative to the mean) if the mortgage holder holds all unsecured debt than if their partner holds all debt (column 3). Conversely, the intra-household distribution matters little for couples with joint mortgages (column 2). Joint mortgage holders do not consistenly favor either partner; the (quantitatively small) positive coefficient on debt implies a higher weight for the indebtedness of the primary mortgage holder, whereas the (quantitatively small) positive coefficient on deposits implies a higher weight for the liquidity constraints of the secondary mortgage holder. Furthermore, making the primary mortgage holder relatively worse off by decreasing their deposit share and increasing their unsecured debt share by an equal percentage would have almost no effect on their probability to apply for the liquidity offer. Therefore, couples with joint mortgages weigh the overall finances of both partners similarly when deciding on the liquidity offer.

The heterogeneity by mortgage type likely reflects that holders of individual mortgages do not need to consider their partner's preferences before applying for the liquidity offer. Conversely, the need for common agreement in the case of joint mortgages can equalize bargaining power within the couple. Alternatively, couples who value equal bargaining power may have self-selected ex ante by choosing a joint mortgage (and conversely for couples who value individual financial decision-making).

4.3 Sources of Intra-household Frictions

The high co-holding by couples together with the noncooperation in the natural experiment suggests intra-household frictions increase co-holding. Yet intra-household frictions could reflect either (i) conflicts of interest as in the accountant-shopper model in section 2.1 or (ii) incomplete information (partners do not help each other because they are unaware of the need to do so). Unfortunately, I do not observe information sharing within the couple. Moreover, the two mechanisms are likely endogenous: conflicts of interest can reduce information

sharing.[10]

To study whether conflicts of interest are likely to matter, I study whether they predict co-holding by couples. My proxies for conflicts of interest are (i) impulsive spending behavior (alcohol and gambling expenditure) and (ii) whether the couple breaks up before the end of the sample (partners move to different addresses). The spending-control motive in the accountant-shopper model implies higher co-holding by households with higher impulsive spending. Furthermore, conflicts of interest could affect not only co-holding but also the stability of the couple.

I estimate a cross-sectional linear probability model in which I regress measures of co-holding on proxies for conflicts of interest and control variables in the baseline month of January 2015. I run a cross-sectional regression because I include in the regression unstable couples for whom I cannot use panel data. My first two dependent variables are whether the household co-holds at least 500 EUR with at least 1,500 EUR in deposits, or, alternatively, more than 25 percent of monthly disposable income. The third dependent variable is household co-holding in EUR due only to the aggregation of accounts within the couple ($\min[\sum_{i=1}^{2} \text{deposits}_i, \sum_{i=1}^{2} \text{debt}_i] - \sum_{i=1}^{2} \min[\text{deposits}_i, \text{debt}_i]$). This final dependent variable ensures my results do not reflect the effect of the explanatory variables on only individual co-holding within the couple.[11]

I find the probability of co-holding increases in alcohol spending as a share of total expenditure in 2014 (table 5). According to the baseline estimates (model 1), a couple with alcohol spending in the top tercile in the previous year is 3.3 percentage points more likely to co-hold in January 2015 (or 12.3 percent relative to the mean) than a couple in the bottom tercile. Moreover, a dummy for positive gambling spending increases the co-holding probability by 7.6 percentage points (or 27.9 percent relative to the mean).[12] Finally, a dummy for couples who break up before the end of the sample increases the co-holding probability by 1.3 percentage points (or 4.7 percent relative to the mean).

[10] The causality should run from conflicts of interest to incomplete information; incomplete information among well-intentioned partners should not cause conflicts of interest.

[11] Alcohol and gambling could increase individual co-holding if individuals co-hold as a self-control mechanism. Moreover, individuals in couples who break up could co-hold more than individuals in stable couples for other reasons than conflicts of interests.

[12] 89 percent of couples buy alcohol in 2014 (and 17 percent gamble).

The correlation between the proxies for conflicts of interest and co-holding hold with alternative measures of co-holding. For instance, I document a strong relationship between gambling and household co-holding due only to the aggregation of accounts, consistent with one partner being unwilling to repay the gambling debts of the other (model 3). The overall results suggest that conflicts of interest likely contribute to the high co-holding by couples.

5 Anchoring and Individual Co-holding

Although couples co-hold more than individuals, the majority of total co-holding reflects individual co-holding. This section considers a previously unexplored determinant of individual co-holding: anchoring of credit card debt payments to the contractual minimum. I use data on credit card invoices and payments–previously unavailable for studying co-holding–to document that individuals who regularly make minimum or near-minimum debt payments account for more than half of individual co-holding. I consider anchoring and other explanations for the prevalence of low payments.

5.1 Data on Electronic Credit Card Invoices and Payments

I study the credit card debt payments of individuals with electronic credit card invoicing for whom I observe the contractual minimum payment, the invoice balance, the total credit balance, and the actual invoice payment during 2015–16 (data are incomplete in 2014 and 2017). The contractual minimum payment is a function of the credit limit. The invoice balance is the payment due in the billing cycle. The invoice balance by default equals the contractual minimum payment, but individuals can set a higher default invoice balance. The total credit balance is the sum of interest-free and interest-accruing balances.

I focus on individuals with electronic invoicing–58 percent of individuals who use a credit card at least once–because I do not observe the invoice balance and payment for mail invoicing. Individuals with electronic invoicing are slightly younger and co-hold somewhat more than individuals with mail invoicing (supplementary table A.6). I also only consider individuals with the bank's primary credit card–95 percent of all credit cards–because I do not observe invoices for niche cards.

I apply a number of further restrictions to the sample for feasibility. First, I omit the 12 percent of individuals who use autopay, because anchoring concerns an active choice. Second, to distinguish minimum and other payments, I study only invoices with a balance larger than the contractual minimum. Third, I consider only individuals with at least three invoices during 2015–16 to infer what kind of payments they regularly make. Finally, I omit the few percent of individuals with more than one credit card of the same type or who make payments on others' cards so I can avoid matching invoices to the wrong credit card account. I am left with 191,780 individuals with 3,251,400 invoices during 2015–16.

5.2 Prevalence of Low Credit Card Debt Payments

I first characterize each payment relative to the minimum and the total credit balance. The contractual minimum payment equals $\max[\tau * \text{creditLimit}, x]$, where τ measures a percentage of the credit limit and x is a euro threshold. I classify a payment as *minimum* if the payment equals the contractual minimum, as *near-minimum* if the payment is larger but within 50 EUR of the minimum, and as *maximum* if the payment equals the total credit balance. Minimum and near-minimum payments account for 39 percent of payments (table 6).

5.3 Low Credit Card Debt Payments and Co-holding

I study the connection between low payments and co-holding by classifying individuals according to their payer type. I classify an individual as a *minimum, near-minimum*, or *maximum payer* if over 50 percent of payments are of a given type and as a *mixed payer* otherwise (following Keys and Wang (2019)). Around 30 percent of individuals are minimum or near-minimum payers, whereas roughly one-third of individuals regularly pay the maximum (table 7). All payer types except maximum payers mostly pay only a small fraction of the total credit balance (supplementary figure A.3).

I find individuals with regular minimum or near-minimum payments are disproportionately likely to co-hold (table 7). These individuals co-hold more than 25 percent of monthly disposable income in almost half of the months during 2015–16. The link between low regular payments and co-holding is not mechanical for two reasons. First, if low payments reflected

low liquidity, co-holding would be small to nonexistent. Second, individuals with low invoice payments could make additional manual payments.

I find low regular payments contribute substantially to total individual co-holding. Minimum payers account for over 40 percent of total co-holding in euros and over 40 percent of observations with co-holding above 25 percent of monthly income (figure 2). Minimum and near-minimum payers together account for 59 percent of total co-holding in euros. Therefore, it is crucial to understand the reason for low regular payments to understand individual co-holding.

5.4 Explaining Low Credit Card Debt Payments

5.4.1 Liquidity Constraints or Liquidity Premium of Cash

I study whether liquidity constraints explain low payments–that is, whether individuals merely cannot afford to make higher payments. I find deposits exceed one month's disposable income in over a third of low payments (table 8).[13] Therefore, liquidity constraints are insufficient to explain the prevalence of low payments. Moreover, liquidity constraints imply low deposits and cannot explain the significant co-holding in the data that implies high deposits (table 7).

Similarly, in a liquidity-premium model of cash relative to credit cards (as in section 2.2), co-holding serves as a liquidity buffer against uncertain cash-expenditure needs within the month. But because co-holding is costly, the model predicts only a limited liquidity buffer. Therefore, the model cannot explain why some make low payments despite holding a multiple of their monthly income in deposits.

5.4.2 Self-Control

Self-control problems could explain low payments as a disciplinary device by the accountant self to restrict spending by the shopper self by limiting liquidity at the point of purchase (as in the model in section 2.1).

The first problem with the self-control hypothesis is that the credit cards I study are joint

[13]Results are qualitatively similar with average instead of end-of-month deposits (appendix C).

debit/credit cards. Any explanation for co-holding based on individual self-control requires that the individual be able to constrain themselves from spending their liquid deposits. This feat of self-control should be particularly difficult if the credit card can be used to access funds on their deposit account (as in my setting). Therefore, the joint debit/credit cards violate the key assumption of the individual accountant-shopper model that the shopper only has access to credit for spending.

As a further test of the self-control hypothesis, I calculate available credit as a percentage of the credit limit associated with low payments. The self-control explanation predicts low available credit because the impatient shopper is tempted to use the credit limit for consumption. If low payments coincide with high available credit, the individual does not have an overspending problem, nor do low payments restrict their spending. Table 8 documents that self-control may explain some low payments–the 25th percentile of available credit is only about 5 percent of the credit limit–but low payments often coincide with high available credit, inconsistent with the self-control hypothesis. Furthermore, anchoring to the minimum can itself lead to low available credit by depressing debt payments relative to the debt balance.

5.4.3 Default-Option Effect

Low payments despite high liquidity could reflect a default-option effect for individuals who make payments equal to a low default invoice balance. Paying the default invoice balance is the least time-consuming option because it only requires certifying the suggested payment (certification is necessary because I do not study individuals using autopay). By contrast, to pay a different amount, the individual needs to manually change the payment. Therefore, low payments could reflect a default-option effect due, for instance, to optimization costs. To avoid the default-option confounder, I separately study *active* near-minimum payments–payments in which the individual manually makes a larger payment than the invoice balance and the payment is within 50 EUR of the contractual minimum. Table 8 documents that individuals often have high liquidity even when making active near-minimum payments.

5.4.4 Anchoring

Anchoring means a salient cue–such as the contractual minimum payment on credit card debt–affects choice disproportionately to its value (Tversky and Kahneman, 1974). Instead of solving an optimal debt-repayment problem as in the models in section 2, individuals can, for instance, interpret the anchor as a recommendation. If the minimum anchors actual payments, co-holding arises if liquid individuals use credit cards.

Earlier studies–not looking at co-holding–suggest anchoring as a reason for low credit card payments (Stewart, 2009; Navarro-Martinez et al., 2011; Hershfield and Roese, 2015; Guttman-Kenney, Leary, and Stewart, 2018; Keys and Wang, 2019). Keys and Wang (2019) use actual credit card payment data–similar to my invoice data–and find 29 percent of credit card accounts in the US regularly make minimum or near-minimum payments, close to my findings. The authors use changes in minimum-payment rules to argue that anchoring contributes to the low payments.

Despite the earlier work on anchoring in credit card payments, my study is the first to observe how much liquidity individuals have when making low debt payments. Observing liquidity is crucial because "if liquidity-constrained consumers round up from the minimum, then their responsiveness to changes in the minimum would be observationally similar to what we interpret as anchoring, but would have different welfare implications" (Keys and Wang, 2019). Above I was able to rule out liquidity constraints as a sufficient explanation for low payments (section 5.4.1). I can also rule out the hypothesis that near-minimum payments reflect rounding, because the minimum payment in my data is already a round number (unlike in Keys and Wang (2019)).

In summary, anchoring–unlike the other hypotheses–can explain why individuals actively make low credit card debt payments despite high liquidity. Yet I cannot quantify how much anchoring contributes to total individual co-holding via low payments, because for certain types of low payments anchoring is indistinguishable from other potential mechanisms. For instance, it is impossible to determine whether payments equal to the default invoice balance reflect anchoring or a default-option effect. Although the exact contribution of anchoring is unknown, low regular payments as a whole contribute significantly to co-holding because

individuals regularly making minimum or near-minimum payments account for 59 percent of total individual co-holding in euros.

6 Other Mechanisms for Co-holding

This section considers whether co-holding in my full dataset can reflect a liquidity premium of cash over credit cards or a precautionary-borrowing motive.

6.1 Liquidity Premium of Cash over Credit Cards

The liquidity-premium model in section 2.2 explained co-holding with a modest liquidity buffer against uncertainty in monthly cash-only expenditure. Yet I find the median co-holding household has over 4,500 EUR in deposits, and deposits exceed twice the monthly income in almost 40 percent of observations (supplementary table A.7). Moreover, I calculate the monthly risk of large deposit decreases to provide an upper bound for cash-expenditure risk (upper bound because not all deposit decreases reflect cash-only expenditure needs). I find that the probability of deposits decreasing to below 500 EUR is less than two percent among all co-holding observations, and less than one percent in the top four deciles of observations by the initial level of deposits relative to income (supplementary table A.8). Although the risk of an over-fifty-percent drop in deposits is larger, initial deposit balances are so large that an over-fifty-percent drop would still leave households with almost 2,000 EUR in deposits on average (and households in the top decile with over 15,000 EUR in deposits on average). Therefore, monthly cash-expenditure risk is insufficient to explain co-holding in my main household dataset. Although insufficient, my results do not imply that the liquidity-premium model could not contribute to co-holding for households with modest initial deposits.

Finally, according to the liquidity-premium explanation, the benefits of liquidity outweigh the high cost of unsecured debt for co-holders. Therefore, co-holders should value additional liquidity at a lower interest rate, either to further increase liquidity or to decrease interest costs. Yet only less than one-third of co-holders apply for the low-cost liquidity offer in 2015, and I find no evidence that access to low-cost liquidity influences co-holding (appendix E).

6.2 Precautionary Borrowing

For the precautionary-borrowing model (section 2.3) to explain co-holding, households need to face substantial negative credit-limit risk. Yet I find only 0.4 percent of credit accounts open in January observe a limit decrease during the year (supplementary table A.9). Even if all limit decreases were involuntary, which I do not observe, the risk would be low compared with the *quarterly* risk of 12 percent in the US (Fulford, 2015). Moreover, the yearly risk of an account closure by the bank is 0.2 percent, a fraction of the 5.4 percent in the US (Fulford, 2015). Yet co-holding occurs in Finland despite negligible negative credit-limit risk. Finally, similarly to the liquidity-premium model, precautionary borrowing also predicts high take-up of the liquidity offer for mortgage holders, contrary to the data.

7 Conclusions

I studied the credit card debt puzzle: why households co-hold high-cost debt and low-yield liquid assets and in doing so incur interest costs. My main contributions are the new evidence on the role of intra-household frictions and anchoring in co-holding.

My first main finding is that couples co-hold substantially more as units than as individuals. Moreover, I find couples do not cooperate when given a chance to reduce high-cost debt, suggesting that intra-household frictions contribute to co-holding by couples. Couples not repaying each other's debts is not necessarily puzzling. Yet the failure to optimize the joint household balance sheet is costly and likely generalizes beyond co-holding. Subsequent research should consider whether other behaviors that would seem suboptimal for the household as a unit could be rationalized by allowing for frictions or conflicts of interests within members of the household.

My second main finding is that individuals with low regular credit card debt payments account for 59 percent of total individual co-holding, which anchoring payments to the minimum helps explain. The results are consistent with the burgeoning literature on debt repayment that highlights the role of heuristics and salient information in contrast to assuming that households consciously solve for optimal debt repayment. Further research should study how to reduce the costs of anchoring to minimum payments without complicating the

debt-repayment choice.

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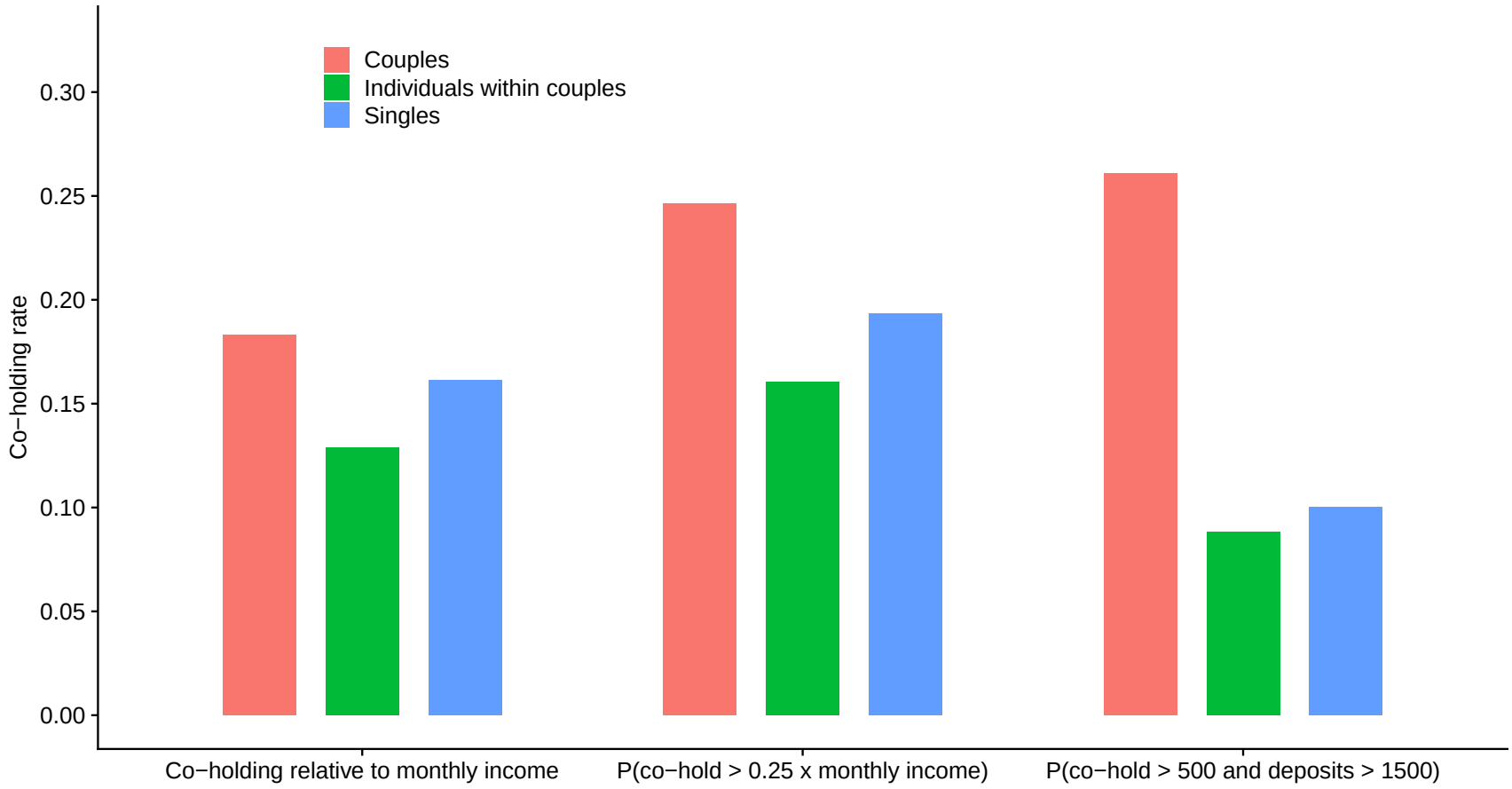
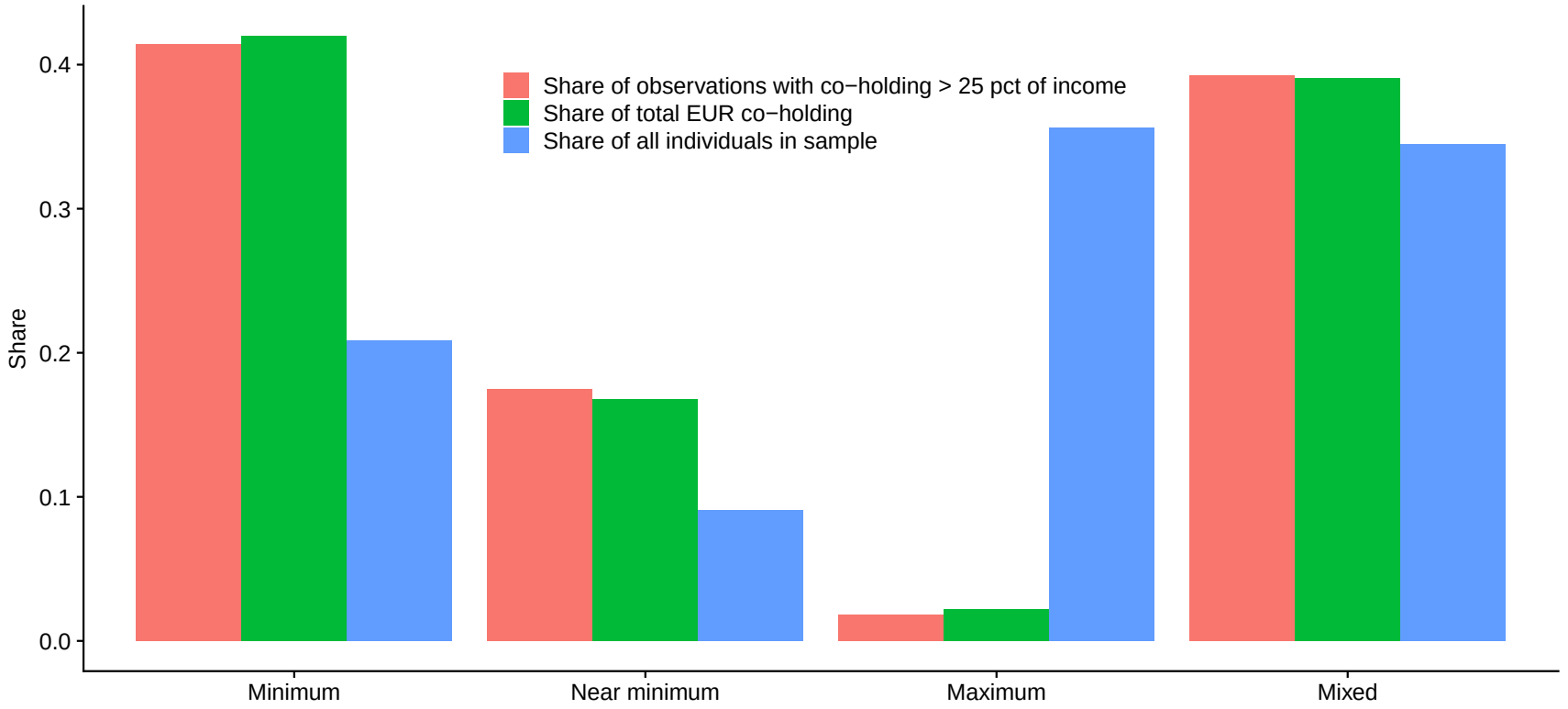


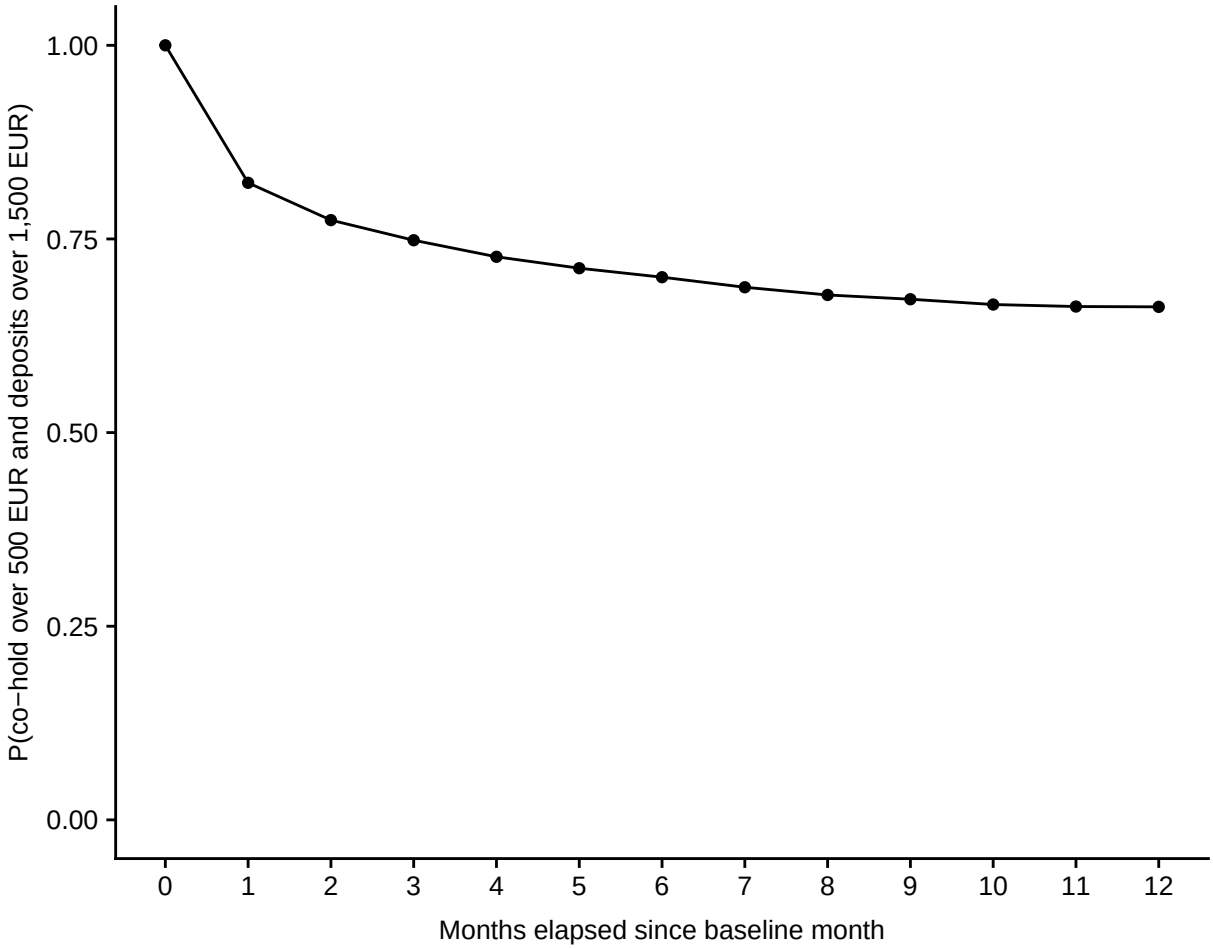
Note: I plot the average co−holding of couples, individuals within couples, and singles from 2014 to 2017. Measures of co−holding relative to income normalize co−holding by couples by total household income and co−holding by individuals by individual income. In the last two trios of columns, the probability of co−holding above a given threshold for individuals equals the share of individuals co−holding above the threshold.

Figure 1: Co-holding by couples, individuals within couples, and singles



Note: The figure plots the share of each payer type in total co−holding among individuals with electronic credit card invoicing during 2015−−16. A minimum payer makes the contractual minimum payment for at least 50 percent of invoices. A near−minimum payer makes payments within 50 EUR of the contractual minimum for at least 50 percent of invoices. A maximum payer pays the total credit balance for at least 50 percent of invoices. The residual cases are mixed payers.

Figure 2: Share of total individual co-holding by payer type



Note: The figure plots the probability of co−holding over 500 EUR and having deposits over 1,500 EUR for households who co−hold over 500 EUR and have deposits over 1,500 EUR in the baseline months of January 2014 to December 2016.

Figure 3: Persistence of co-holding at the extensive margin

Table 1: Distribution of co-holding at the household-month level

	N	Obs. share	Mean	Q0.01	Q0.25	Q0.5	Q0.75	Q0.99
All observations								
Deposits	14,113,248		19,513	-785	1,688	6,553	20,951	172,916
Unsecured debt	14,113,248		1,043	0	0	0	1,248	9,279
Co-holding	14,113,248		480	0	0	0	496	5,008
Co-holding $>$ 0								
Deposits	5,614,180	0.40	7,469	5	680	2,131	6,418	80,546
Unsecured debt	5,614,180	0.40	2,487	8	705	1,706	3,501	11,025
Co-holding	5,614,180	0.40	1,207	3	281	773	1,643	6,576
Co-holding $\geq$ 500 EUR and deposits $\geq$ 1,500 EUR								
Deposits	2,498,801	0.18	11,000	1,532	2,513	4,529	10,451	95,344
Unsecured debt	2,498,801	0.18	2,822	519	1,085	1,969	3,746	11,185
Co-holding	2,498,801	0.18	2,170	519	1,085	1,780	2,710	7,967
Co-holding $\geq$ 0.25 x monthly disposable income								
Deposits	3,078,742	0.22	7,453	338	1,344	2,662	6,507	74,278
Unsecured debt	3,078,742	0.22	3,016	377	1,324	2,258	4,004	11,219
Co-holding	3,078,742	0.22	1,927	294	929	1,518	2,425	7,631

Note: Co-holding equals $\max[0, \min[\text{deposits}, \text{debt}]]$.

Table 2: Mean characteristics by household type in January 2015

	Borrower	Co-holder	Neutral	Saver
N	45,655	52,825	20,332	175,214
Adults	1.38	1.77	1.23	1.54
Children	0.48	0.74	0.33	0.42
Age of oldest adult	48.37	47.35	50.37	53.08
Deposits	350	10,051	453	27,495
Interest-accruing unsecured debt	3,257	2,817	63	21
Unsecured credit limit	4,431	5,376	2,468	3,264
Co-holding	524	2,140	51	21
Co-holding months in 2015	1.65	8.74	0.33	0.45
Monthly disposable income in 2015	2,389	3,510	2,026	2,931
Card expenditure	976	1,642	931	1,303
Mortgage dummy	0.57	0.71	0.47	0.44
Mortgage balance	49,524	79,231	35,293	40,573
Other financial assets	917	4,584	3,350	20,574
Other debt	7,938	9,699	5,130	4,168
Unsecured debt interest rate	6.97	7.02	7.11	7.09
Deposit interest rate	0.08	0.10	0.08	0.13
Mortgage interest rate	1.42	1.34	1.41	1.30

Note: Monetary figures are in euros. Borrower: deposits < 1500 and (unsecured) debt ≥ 500; co-holder: deposits ≥ 1500 and debt ≥ 500; saver: deposits ≥ 1500 and debt < 500; neutral: deposits < 1500 and debt < 500.

Table 3: Costs of co-holding

	N	Mean	Q0.1	Q0.25	Q0.5	Q0.75	Q0.9
Extrapolated yearly costs	1,904,849	183	91	112	154	221	313
Actual yearly costs	1,904,849	157	57	90	135	200	285
Actual to extrapolated ratio	1,904,849	0.88	0.43	0.66	0.89	1.04	1.28

Note: The table presents two estimates of the yearly costs of co-holding for household-month observations with unsecured debt over 500 EUR and deposits over 1,500 EUR. I derive both estimates from the interest rate difference between liquid assets and unsecured debt and the amount of liquid assets available to reduce debt (equation 1). 'Extrapolated yearly costs' calculates yearly costs as proportional to co-holding in the baseline month (January 2014–January 2017). 'Actual yearly costs' uses data on actual co-holding within twelve months of each baseline month. I also calculate the ratio of actual to extrapolated costs for each co-holding household-month observation; the final row presents the distribution of this ratio.

Table 4: Intra-household distribution of assets and debts and take-up of low-cost liquidity

	Dependent variable:		
	Liquidity offer take-up (0/1)		
	(1)	(2)	(3)
Deposit share	0.002 (0.006)	0.021*** (0.007)	−0.052*** (0.012)
Unsecured-debt share	0.039*** (0.004)	0.016*** (0.006)	0.086*** (0.009)
Sample	All co-holding couples	Joint mortgages	Individual mortgages
Household controls	See footnote	See footnote	See footnote
Take-up rate	0.28	0.3	0.24
Observations	52,752	38,022	11,051
Adjusted R^2	0.094	0.100	0.086

Note: *p<0.1; **p<0.05; ***p<0.01
The table presents estimation results of eq. 2. Model (1) includes couples with positive co-holding and a mortgage in January 2015, model (2) only households w/ joint mortgages, and model (3) only households w/ individual mortgages. The unit of observation is an individual primary mortgage holder. Controls: fixed effects for the number of adults and children and for municipality; quintiles of total unsecured debt; deciles of total deposits, age, mortgage value, principal payment, mortgage interest rate, property value, income, and expenditure. Heteroskedastic standard errors in parentheses.

Table 5: Co-holding by couples and proxies for conflicts of interest

	Co-holding > 500 EUR and deposits > 1,500 EUR	Co-holding > 0.25 x monthly income	Househ. co-holding - ind. co-holding
	(1)	(2)	(3)
Alcohol spend share 2/3	0.019*** (0.003)	0.013*** (0.003)	9.316** (4.125)
Alcohol spend share 3/3	0.033*** (0.003)	0.031*** (0.003)	23.014*** (4.412)
Positive gambling	0.076*** (0.003)	0.086*** (0.003)	101.706*** (5.592)
Couple breaks up	0.013*** (0.003)	0.015*** (0.003)	18.713*** (4.678)
Household controls	See footnote	See footnote	See footnote
Mean dep. var.	0.27	0.25	213
Observations	166,914	166,914	166,914
Adjusted R^2	0.075	0.088	0.019

Note: *p<0.1; **p<0.05; ***p<0.01
The table summarizes linear probability models of co-holding by couples in January 2015. The dependent variables in models (1) and (2) are dummies. The dependent variable in model (3) is co-holding in euros due to aggregation of household accounts (household co-holding minus the sum of individual co-holding). Controls: fixed effects for the number of children; age decile; income decile; and dummies for mortgage, other financial assets, and other debt. Heteroskedastic standard errors in parentheses.

Table 6: Descriptive statistics on electronic invoice payments during 2015–16

	Payment type			
	Minimum	Near minimum	Maximum	Other
Obs.	811,142	455,696	923,567	1,060,995
Obs. share	0.25	0.14	0.28	0.33
Mean				
Invoice balance	82	88	374	175
Payment	81	95	496	329
Contractual minimum payment	81	70	76	76
Total credit balance	1,929	1,626	496	1,445
Credit limit	2,700	2,332	2,543	2,544

Note: The table presents descriptive statistics on electronic invoice payments by payment type. Minimum payments: payment equals the contractual minimum. Near-minimum payments: payment within 50 EUR of the minimum. Maximum payments: payment equals the total credit balance. Other payments are the residual. 'Invoice balance' refers to the payment due in the billing cycle. 'Contractual minimum payment' refers to the minimum payment due given the credit limit. 'Total credit balance' refers to the total credit used (sum of interest-free and interest-accruing balance).

Table 7: Co-holding by credit card debt payer type

Payer type	N	Mean co-holding to income	P(co-holding to income > 0.25)	P(co-holding to income > 1)
Maximum	68,272	0.01	0.01	0.00
Minimum	39,990	0.40	0.48	0.10
Mixed	66,137	0.21	0.27	0.04
Near minimum	17,381	0.38	0.46	0.09

Note: The table presents descriptive statistics on co-holding by the credit card debt payer type of individuals. A minimum payer makes the contractual minimum payment for at least 50 percent of invoices. A near-minimum payer makes payments within 50 EUR of the contractual minimum for at least 50 percent of invoices. A maximum payer pays the total credit balance for at least 50 percent of invoices. The residual cases are mixed payers.

Table 8: Liquidity when making low credit card debt payments

	N	Q25	Q50	Q60	Q70	Q80	Q90	Q95
		Deposits (share of monthly income)						
Minimum payments	811,142	0.17	0.57	0.83	1.20	1.95	4.31	8.34
All near-minimum payments	455,696	0.17	0.57	0.82	1.18	1.90	4.13	7.81
Active near-minimum payments	159,695	0.21	0.61	0.87	1.21	1.86	3.69	6.65
		Available credit (share of credit limit)						
Minimum payments	811,142	0.04	0.15	0.26	0.42	0.63	0.83	0.91
All near-minimum payments	455,696	0.05	0.19	0.31	0.48	0.67	0.84	0.91
Active near-minimum payments	159,695	0.07	0.25	0.38	0.54	0.71	0.87	0.93

Note: The table presents the distribution of individual deposits (as a share of monthly disposable income) and available credit (unused credit as a share of the credit limit) for minimum or near-minimum credit card debt payments. Minimum payments: payment equals the contractual minimum. Near-minimum payments: payment within 50 EUR of the contractual minimum. Active near-minimum payments: the individual pays a larger amount than the invoice balance (default payment) but within 50 EUR of the contractual minimum. Deposits measured on the last day of the invoice month.

Supplementary material

A Variable Definitions and Concepts

Deposits: End-of-month balances on checking and savings accounts.

Unsecured debt: End-of-month interest-accruing balances on credit cards and on unsecured credit lines. Both credit cards and unsecured credit lines are completely liquid; that is, they allow free prepayment and redrawing of credit. For a few percent of credit cards, the bank does not separately record the interest-accruing balance and the transaction balance. For these credit cards, I impute the interest-accruing balance from credit card interest payments.

Co-holding: Minimum of deposits and unsecured debt.

Disposable income: I derive monthly disposable income from administrative tax percentile data. I observe each individual's percentile rank in the 2015 income distribution. I derive monthly disposable income by combining tax percentile data with public data on the income distribution and tax rates. The income measure excludes income from assets.

Unsecured credit limit: The credit limit on unsecured credit products.

Card expenditure: Expenditure with credit and debit cards issued by the bank.

Other financial assets: Financial assets other than liquid deposits, for instance, stocks and mutual funds.

Other debt: Other debt except mortgage debt and unsecured debt included in my co-holding measure, for instance, collateralized consumer loans.

Liquidity available from offer: The amount of mortgage principal payments that the household can defer by applying for the liquidity offer made by the bank in February 2015.

Joint mortgage: Mortgage for which both members of the couple are liable. Applying for the liquidity offer on a joint mortgage requires approval by both members of the couple.

Individual mortgage: Mortgage for which only one member of the couple is liable. Applying for the liquidity offer on an individual mortgage does not require approval by the partner.

Invoice balance: Payment due in the credit card billing cycle.

Contractual minimum payment: Minimum payment on credit card debt as a function of the credit limit.

Total credit balance: Sum of interest-free and interest-accruing credit card balances.

Minimum payment: Credit card debt payment equal to the contractual minimum pay-

ment.

Near-minimum payment: Credit card debt payment larger but within 50 EUR of the contractual minimum payment.

Active near-minimum payment: Subset of all near-minimum payments in which the individual manually changes the default payment (=invoice balance) to make a larger payment within 50 EUR of the contractual minimum.

Maximum payment: Credit card debt payment equal to the total credit balance.

Stable and unstable households: Stable households have the same two oldest adults over the sample period. Single households are stable if they remain single throughout the sample period. Unstable households live in the same address in January 2015 but either do not live together in January 2014 or move apart before December 2017.

B Accountant-shopper Model

Bertaut, Haliassos, and Reiter (2009) propose an accountant-shopper model for co-holding in which a patient accountant limits credit card debt payments and saves in cash to restrict credit card spending by a shopper. The model has both an intra-household interpretation (conflict of interest between a patient and an impatient partner) and a self-control interpretation (one individual with a patient and an impatient self). This section explains how the accountant-shopper model can generate co-holding.

In a stylized two-period model, the accountant and the shopper maximize $u_1(C_1) + \beta_i u_2(C_2)$, $i = a, s$. Because the accountant is more patient than the shopper, $\beta_a > \beta_s$. In the first period, the accountant first chooses credit card debt repayment P_1 given the state variables of liquid assets A_1 and initial credit card debt B_1 on an interest-free period.[14] Following the accountant's choice, the shopper decides on first-period consumption C_1 given the state variables of remaining credit card debt $B_1 - P_1$ and liquid assets $A_1 - P_1$ after debt repayment. Crucially, the shopper cannot use liquid assets saved by the accountant for first-period consumption. Although the accountant acts first, the accountant knows the consumption function of the shopper. The stylized two-period model does not include income, and hence no income risk, which are neither necessary nor preventative of co-holding. Bertaut, Haliassos, and Reiter (2009) provide a quantitative accountant-shopper model with a full life-cycle structure and income risk.

The transition equations and constraints are:

[14] I consider B_1 to be on an interest-free period so that the initial conditions do not imply positive co-holding to begin with.

$$B_2 = (B_1 - P_1)R^B + C_1, \tag{3}$$
$$A_2 = (A_1 - P_1)R^A \text{ where } R^A < R^B, \tag{4}$$
$$B_1 - P_1 + C_1 \leq B^{max,1}, \tag{5}$$
$$B_1 - P_1 \geq 0, \tag{6}$$
$$A_1 - P_1 \geq 0, \tag{7}$$
$$P_1 \geq 0. \tag{8}$$

The credit card debt transition equation (3) means existing credit card debt not fully repaid accrues interest, while new credit card spending has an interest-free period. The transition equation for the liquid asset (eq. (4)) specifies that the liquid asset has a lower interest rate than credit card debt. Equation (5) specifies the credit limit in period one. The last three equations are constraints on the debt payment in period one (debt payment cannot exceed debt balance or liquid assets, and debt payment cannot be negative).

To show how the accountant-shopper can generate co-holding, I solve the two-period model by backward induction. I use the same assumption as in Bertaut, Haliassos, and Reiter (2009) that the shopper can use the credit card to spend in the last period of life. One way to rationalize the ability to borrow in the last period of life is that people know their own time of death better than the bank. Empirically it is also not uncommon for old people to have credit cards. Although people retain the ability to borrow, the bank can still limit its risk by adjusting the credit limit downwards as people age.

In the solution to the two-period model, the shopper will maximize consumption by spending up to the credit limit $B^{max,2}$ in period two. Moreover, to maximize consumption, in period two the accountant will also not repay any credit card debt: $P_2 = 0$. Instead the accountant transfers any remaining liquid assets to the shopper for additional consumption. Because the stylized model features no income, or income risk, consumption in period two is a deterministic outcome of period one choices: people spend all available credit plus any remaining liquid assets carried over from period one: $C_2 = B^{max,2} - [(B_1 - P_1)R^B + C_1] + (A_1 - P_1)R^A$.

Consequently, in period one the shopper's problem is:

$$\max_{C_1} u_1(C_1) + \beta_s u_2(B^{max,2} - [(B_1 - P_1)R^B + C_1] + (A_1 - P_1)R^A), \tag{9}$$

subject to the credit limit constraint in equation (5).

Anticipating the problem of the shopper, the accountant's problem is:

$$\max_{P_1} u_1(C_1) + \beta_a u_2(B^{max,2} - [(B_1 - P_1)R^B + C_1] + (A_1 - P_1)R^A), \tag{10}$$

subject to the constraints in equations (6), (7), and (8).

Because co-holding at the end of period one equals $\min[(A_1 - P_1), (B_1 - P_1)]$, the accountant determines the amount of co-holding before the consumption decision of the shopper. If there is an interior solution to the problem, that is, if $P_1 < A_1$ and $P_1 < B_1$ and $P_1 > 0$, the first-order condition of the accountant needs to satisfy:

$$\frac{\partial u_1}{\partial C_1}\frac{\partial C_1}{\partial P_1} + \beta_a \frac{\partial u_2}{\partial C_2}[R^B - R^A - \frac{\partial C_1}{\partial P_1}] = 0. \tag{11}$$

A marginal decrease in debt payments that would increase co-holding in period one has three effects: (i) an effect on first-period utility if consumption in period one responds to debt payments in period one, (ii) a direct effect on second-period consumption by decreasing net worth in period two by the interest rate spread between debt and liquid assets ($R^B - R^A$), (iii) an indirect effect on second-period consumption via potential changes in first-period consumption. Hence, the first-order condition for the accountant depends on the consumption elasticity of the shopper from additional debt payments by the accountant ($\frac{\partial C_1}{\partial P_1}$).

Let us assume that the shopper is sufficiently impatient to always spend the full credit limit in period one. Note that a sufficiently low β_s will trivially result in such behavior (Bertaut, Haliassos, and Reiter (2009) show that co-holding occurs in a realistic quantitative model). Consequently, $C_1 = B^{max,1} - B_1 + P_1$. Hence, $\frac{\partial C_1}{\partial P_1} = 1$, which means that decreasing debt payments will decrease first-period consumption one-to-one. Hence, to limit consumption of the shopper, the accountant needs to pay off less of the debt, which leads to more co-holding. Given that $\frac{\partial C_1}{\partial P_1} > 0$, the first term in the first-order condition of the accountant in equation (11) is positive. Consequently, for equation (11) to hold, the second term needs to be negative, which is true if $\frac{\partial C_1}{\partial P_1} > R^B - R^A$. Given that with a sufficiently impatient shopper $\frac{\partial C_1}{\partial P_1} = 1$, the condition implies that $1 > R^B - R^A$, meaning that the interest rate on credit card debt cannot exceed the interest rate on liquid assets by 100 percentage points. Although empirically satisfied with arguably all credit cards, the intuition is that it would make no sense for the accountant to co-hold if the cost of doing so ($R^B - R^A$) would be so great that consumption in period two would actually decrease. Finally, also the boundary solution of $P_1 = 0$ leads to co-holding conditional on positive initial liquid assets and credit card debt. If the zero-debt-payment solution was the best available, the accountant might want to tilt consumption even more towards the future but could not do so because the accountant cannot make negative debt payments (equation (8)).

To summarize, the first-order condition of the accountant shows that a necessary condition for co-holding to be optimal is that co-holding increases future consumption by restricting current consumption. In deciding whether to co-hold, the accountant trades off the incremental cost of co-holding determined by the interest rate spread $R^B - R^A$ against the change in the intertemporal consumption allocation $[C_1, C_2]$. Intuitively, co-holding is more valuable for the accountant the higher is the difference in patience between the accountant and the shopper.

C Alternative Deposit Measures

C.1 Co-holding and only Checking Account Deposits

Table A.10 compares co-holding depending on whether I consider my baseline measure of deposits or only deposits on checking accounts when calculating co-holding. Mean co-holding is 480 EUR based on the baseline measure and 434 EUR based on checking account deposits

only. The co-holding rate (at least 500 EUR of unsecured debt and at least 1,500 EUR of deposits) averages 17.7 percent with baseline deposits and 15.5 percent with checking account deposits only.

C.2 End-of-month versus Mean Deposits

The main analysis uses information on end-of-month deposits. A concern is that end-of-month balances are not representative, for instance, because of salary payments. This section shows that using average deposits within the month instead of end-of-month deposits does not change the main results.

I use end-of-month deposits in the main analysis because information on average deposits is incomplete. First, I only observe average deposits in 2015. Second, I do not observe average deposits at the account level but only at the customer level. Therefore, average deposits include also funds on illiquid accounts. In comparing end-of-month and average deposits, I include illiquid deposits also in the end-of-month balances for an apples-to-apples comparison. Fortunately, illiquid deposits account on average for only 3.1 percent of total deposits so they do not quantitatively skew the analysis. I also only consider observations with positive end-of-month deposits, because data on average deposits excludes negative deposits.

I redo the main analyses with average deposits to show that the main results do not change. First, the overall deposit distribution is similar with both end-of-month and average balances (table A.11). Second, the deposit distribution is also similar among co-holding observations with the two measures. Finally, the finding that low credit card debt payments often coincide with significant liquidity remains with average deposits (table A.12). Even though average deposits are somewhat lower, in more than a quarter of low payments average deposits exceed one month's disposable income.

D Details of the Natural Experiment

D.1 Environment

The bank promoted the low-cost liquidity offer for mortgage holders as a way to jump start the Finnish economy. At the time of the offer in 2015, the Finnish economy had been stagnant for multiple years following the financial crisis and the eurozone crisis. The bank portrayed the liquidity offer as a way to help struggling households given the lack of recent economic progress.

Given the ambitious aim to jump start economy, the liquidity offer was salient and the bank marketed it widely. The offer was the headline national news on the day of the launch, and media interest in the offer persisted during the five month application window. For instance, the main national newspaper, Helsingin Sanomat, had the liquidity offer as their lead article the day after the offer launch (Helsingin Sanomat, February 6th 2015 edition). The term for the liquidity offer ("lyhennysvapaa") returns 26 articles published during the application window in Helsingin Sanomat's digital archive.[15] The national broadcasting

[15] https://www.hs.fi/haku/. Search date: 20th of March 2019.

company Yle (equivalent to BBC) also covered the offer.

The aim and framing of the offer was supported by a guarantee that applying for the free offer would not lead to any negative repercussions in terms of access or cost of credit. Hence, the framing and aim should have reduced any worries that applying for the offer would send a bad signal to the bank. Indeed, given that the aim was to jump start the economy, applying for the offer was framed as pro-social behavior.

Households could apply for the option to reduce minimum principal payments for one to twelve months. If a household applied for the policy, the default principal payment would decline to zero for the length of the policy. Yet the offer did not force "too much" liquidity on the households, because almost all mortgages are adjustable-rate and have no restrictions on free extra principal payments. Therefore, even after applying for the policy, households could continue positive principal payments during the policy and/or make free extra principal payments after the end of the policy.

Virtually all mortgage holders were eligible for the offer and application was easy. Only mortgage holders with severe payment difficulties were exempt; for others the bank granted the liquidity offer after application. Households could apply online in a few minutes. Although online banking is widespread in Finland, households could also apply by contacting the bank by other means.

D.2 Benefits of Low-cost Liquidity to Co-holders

I calculate the per period potential savings from using the liquidity offer to reduce unsecured debt for households that co-hold in January 2015 (unsecured debt above 500 EUR and deposits above 1,500 EUR) as:

$$\text{savings} = \min(\text{flexLiquidity}, \text{unsecuredDebt}) * (r_{\text{unsecuredDebt}} - r_{\text{mortgage}}) + \theta, \tag{12}$$

where flexLiquidity refers to the amount of liquidity that a household can gain from applying for the offer and θ refers to the avoidable invoicing fees on unsecured debt if the additional liquidity is sufficient to repay interest-accruing unsecured debt fully.

Table A.5 provides two measures of potential savings for January 2015 co-holders with a mortgage (N = 36,425).[16] The first measure is the yearly savings from lower interest rate costs and avoidable invoicing fees on unsecured debt if the household reduces unsecured debt with the liquidity offer. The second measure is the net present value of cumulative savings during the lifetime of the mortgage in which I multiply the yearly savings by mortgage maturity and use a three percent annual discount rate. The cumulative savings measure assumes that the decrease in unsecured debt persists until the end of the mortgage. I base both measures of potential savings on the average amount of unsecured debt from February 2014 to January 2015 because of imperfect persistence of co-holding.[17] The average yearly

[16] I calculate benefits for households that co-hold in January 2015 for whom I observe information on scheduled principal payments (and hence the amount of liquidity available from the offer), with a mortgage maturity of at least twelve months, and a mortgage interest rate lower than the unsecured credit rate.

[17] I measure average unsecured debt before the offer because unsecured debt after the offer can be endogenous to the decision to apply for the liquidity offer.

savings equal 185 EUR, and average cumulative savings equal 1,844 EUR.

E Liquidity-based Hypotheses and the Natural Experiment

E.1 Demand for Low-cost Liquidity by Co-holders

Table A.13 presents the take-up rate of the liquidity offer by households that co-hold in January 2015. Overall, the take-up rate is 29 percent. Predictably, take-up increases with potential yearly savings but is only 39 percent even in the top quartile. I do not find a connection between take-up and the total months a household co-holds in 2015. Therefore, the low take-up is not a result of most households stopping co-holding quickly and having no need for additional liquidity.

The low take-up of low-cost liquidity by co-holders is at odds with the liquidity preference and precautionary borrowing hypotheses. Both argue that households value liquidity sufficiently to borrow at the unsecured debt interest rate. Therefore, co-holders should value additional low-cost liquidity, if only to repay high-cost debt whilst keeping equal or greater total liquidity.

Although the bank marketed the liquidity offer widely and the offer received a lot of media coverage, some households may still have been inattentive to the offer. To further address inattention, I focus on households who almost certainly knew about offer. I identify eligible co-holding households in which at least one household member was an *employee* of the bank that provided the liquidity offer (N = 1,503). These households arguably knew about the offer by their employer. Yet only 44 percent of co-holding bank-employee households with a mortgage take up the offer.[18]

E.2 Effect of Low-cost Liquidity Offer on Co-holding

In addition to overall take-up, the liquidity offer allows me to test if access to new liquidity affects co-holding. If liquidity needs drive co-holding, co-holding should decrease if households have sufficient liquidity. The liquidity offer should have provided households sufficient liquidity to reduce co-holding, because liquidity available from the offer averaged multiples of monthly disposable income.[19] Therefore, I use an intention-to-treat framework to compare the evolution of co-holding by household eligibility for the liquidity offer.

The identification strategy is to compare co-holding households who have a mortage (=treated) with co-holding households who do not have a mortgage (=control). A caveat is that some competitor banks also made similar offers to their mortgage holders in 2015. Therefore, some households in my control group may have had a mortgage at one of the

[18]Employee households are somewhat more likely to co-hold than regular customers. For instance, in January 2015 the employee household co-holding rate is 22 percent versus 18 percent among all customers.

[19]If households had low liquidity to begin with and the liquidity offer provided only limited liquidity, co-holding could in principle increase following the liquidity offer. Yet the median household was co-holding all of its unsecured debt prior to the liquidity offer, and liquidity available from the offer would have been sufficient to repay all of the unsecured debt.

competitor banks and would have been also 'treated'. However, as detailed in the sample selection section, I focus on households that used the bank that I have data for as their main bank. Therefore, it is unlikely that a substantial portion of control households were eligible for a liquidity offer from another bank.

First, figure A.4 panel A plots the overall co-holding rate by mortgage status before and after the liquidity offer. Because the liquidity offer was introduced in February 2015, the offer is exogenous relative to decisions made up to January 2015. Although co-holding is more common among mortgage households, the trends in both groups are similar. In particular, I do not observe a discontinuity in co-holding among households eligible for the liquidity offer after January 2015.

The unconditional comparison in figure A.4 panel A does not account for characteristics that differ systematically between mortgage and non-mortgage households and influence co-holding. Therefore, I create a matched sample of households with propensity score matching to find for each household with a mortgage a non-mortgage match that is similar in terms of observable characteristics. The household characteristics that I use for matching are the number of adults and children, age of the oldest individual, deposits, unsecured debt and co-holding in the baseline month of January 2015, average card expenditure over 2014 and the average monthly disposable income over 2015. The next section contains further details on the matching procedure.

I study the relationship between eligibility for the liquidity offer and co-holding while accounting for differences in household characteristics using a a difference-in-difference regression:

$$\begin{aligned}\mathbb{1}_{\text{puzzle},h,m} =& \delta_h + \gamma_{\text{pre}}\mathbb{1}_{m<\text{Jan2015}} + \beta_{\text{pre}}\mathbb{1}_{m<\text{Jan2015}} * \mathbb{1}_{\text{mortgage}} + \\ & \gamma_{\text{post}}\mathbb{1}_{m>\text{Jan2015}} + \beta_{\text{post}}\mathbb{1}_{m>\text{Jan2015}} * \mathbb{1}_{\text{mortgage}} + \epsilon_{h,m},\end{aligned} \tag{13}$$

where h refers to the household, m to the month and δ_h refers to household fixed effects. The regression tests whether co-holding decreases disproportionately after the offer for households eligible for additional liquidity ($\beta_{\text{post}} < 0$). The regression also tests for equality of pre-trends ($\beta_{\text{pre}} = 0$) as a validity check of the difference-in-difference approach. The baseline month to which I compare the change in co-holding is January 2015. I estimate the regression with a panel that spans from January 2014 to December 2016.

Table A.14 presents the estimation results of the effects of the liquidity offer on co-holding when I measure co-holding by a dummy variable. The first two columns present results for specifications in which I use the full sample of households without matching. Columns 3–4 provide estimation results with the matched sample. No specification finds that households eligible for the liquidity offer reduced their co-holding propensity relative to non-eligible households after the offer. The results imply some concern about constant pre-trends because the difference of $\hat{\beta}_{\text{pre}}$ from zero is statistically significant also in specifications 2–4. Yet differences in pre-trends are quantitatively small and $\hat{\beta}_{\text{pre}}$ is statistically significant only at a 10 percent significance level in specification 4 (matched sample with household fixed effects) Note that statistical significance in specification 1 (full sample without household fixed effects) is not a concern, because in that specification $\hat{\beta}_{\text{pre}}$ picks up level differences in co-holding between eligible and ineligible households.

Even if the liquidity offer did not affect the probability to co-hold at the extensive margin, the offer could reduce co-holding at the intensive margin. Therefore, I estimate a second difference-in-difference regression in which I change the dependent variable from a co-holding dummy to a continuous EUR variable. Results for this specification are presented in table A.15. Again, I find no evidence for mortgagors reducing co-holding after the offer.

In summary, (i) only less than one-third of eligible co-holding households take-up the offer of additional low-cost liquidity, (ii) I find no evidence that co-holding decreases for eligible households after the liquidity offer. Consequently, the results of this section further strengthen the evidence that liquidity-based hypotheses are unlikely to sufficiently explain the credit card debt puzzle. Yet my results do not imply that liquidity-based explanations could not contribute to co-holding. These mechanisms can matter for households with limited liquidity and in countries with high negative credit-limit risk (Fulford, 2015; Druedahl and Jørgensen, 2018; Gorbachev and Luengo-Prado, 2018).

E.3 Matching Households with and without Mortgage

I create the matched sample of households with and without mortgage by nearest-neighbor propensity score matching with replacement. I use the following logit regression to calculate the propensity score based on information in January 2015:

$$\begin{aligned}\mathbb{1}_{\text{mortgage},h} = &\sum_{i}^{n} \alpha_i \mathbb{1}_{\text{adults}=i} + \sum_{i}^{n} \beta_i \mathbb{1}_{\text{children}=i} + \gamma \mathbb{1}_{\text{deposits}<0} + \delta \mathbb{1}_{\text{unsecuredDebt}=0} + \zeta \mathbb{1}_{\text{co-holding}>0} + \\ &\sum_{b=1}^{10} \eta_b \mathbb{1}_{\text{age}_\text{h} \in \text{ageBin}_\text{b}} + \sum_{b=1}^{10} \theta_b \mathbb{1}_{\text{unsecuredDebt}_\text{h} \in \text{unsecuredDebtBin}_\text{b}} + \sum_{b=1}^{10} \iota_b \mathbb{1}_{\text{deposits}_\text{h} \in \text{depositBin}_\text{b}} + \\ &\sum_{b=1}^{10} \kappa_b \mathbb{1}_{\text{co-holding}_\text{h} \in \text{coholdingBin}_\text{b}} + \sum_{b=1}^{10} \lambda_b \mathbb{1}_{\text{cardExp}_\text{h} \in \text{cardExpBin}_\text{b}} + \sum_{b=1}^{10} \mu_b \mathbb{1}_{\text{dispInc}_\text{h} \in \text{dispIncBin}_\text{b}} + \epsilon_h.\end{aligned}$$

The regression includes dummies for the number of adults and children, negative deposits, zero unsecured debt, and positive co-holding. In addition, the regression includes dummies for deciles of household age, unsecured debt, deposits, co-holding, card expenditure, and disposable income.[20]

After estimating the propensity score, I find for each household with a mortgage a match from the pool of households without a mortgage. I match exactly on the number of adults and children in the household, on the dummy for positive co-holding, and on the dummy for no unsecured debt. Within the remaining pool of potential matches, I use nearest-neighbor propensity score matching with replacement. Replacement means that a household without a mortgage can be matched to multiple households with a mortgage.

Table A.16 documents mean household characteristics before and after matching in January 2015.[21] Average household characteristics are in general similar after matching, except

[20] Card expenditure is the average over 2014. Disposable income is the average over 2015.

[21] Compared to full data, the matched data drops a few households with a mortgage, because I require an exact match on the number of adults and children in the household, on the dummy for positive co-holding, and on the dummy for no unsecured debt. Furthermore, because I match with replacement, the unique

for other financial assets and other debt, which I did not match on.

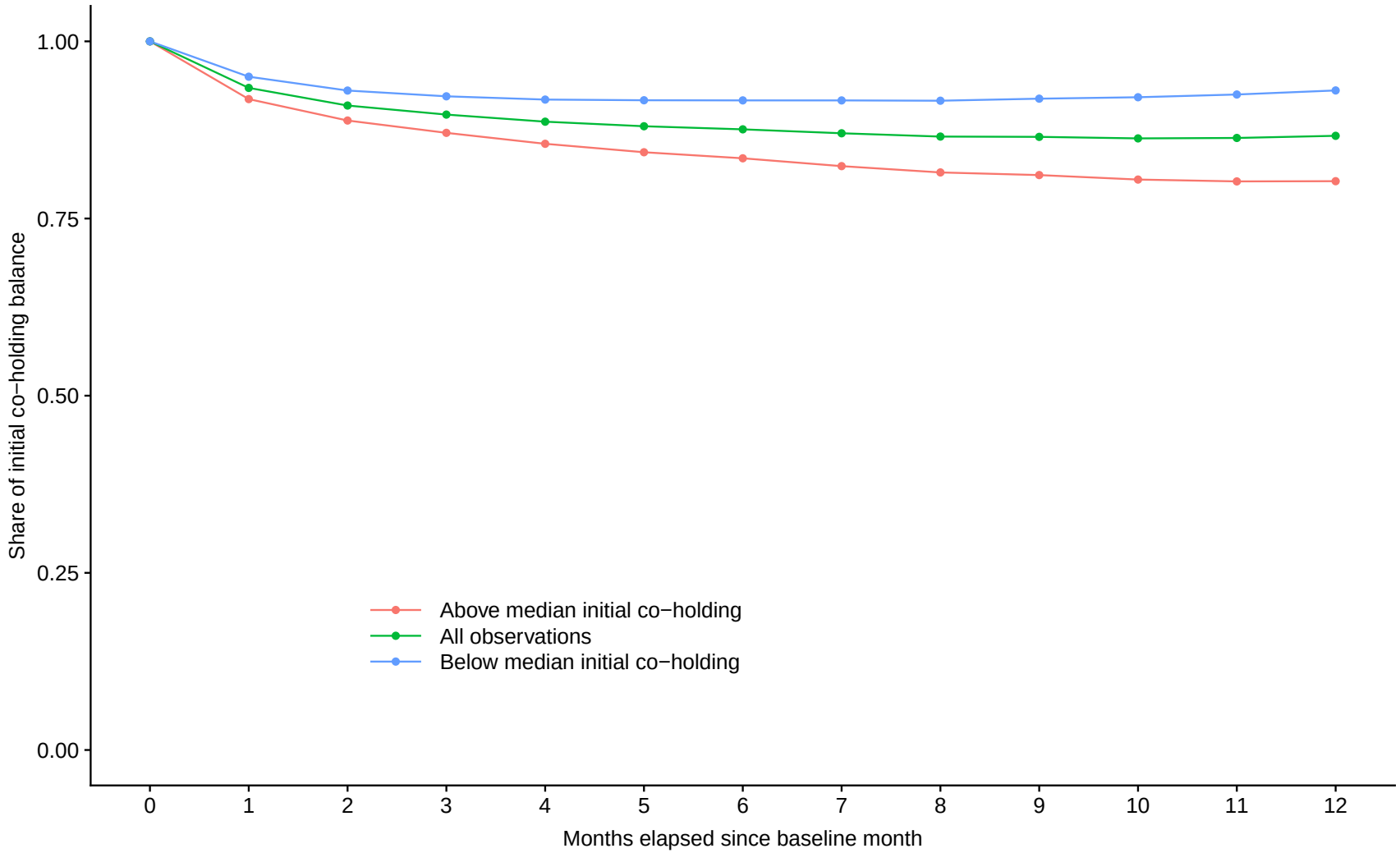
Finally, figure A.4 panel B plots the time-series of co-holding by eligibility for the liquidity offer with matched data (counterpart to panel A with full data). Again, I do not find evidence that access to new cheap liquidity would have reduced co-holding.

F Strategic Bankruptcy Motive for Co-holding

Co-holding in the US could reflect a bankruptcy motive because bankruptcy eliminates unsecured debts but safeguards a buffer of liquid assets in the US (Lehnert and Maki, 2002). Yet personal bankruptcy does not exist in Finland. Instead, individuals can apply to a court for debt restructuring, which may result in a repayment program followed by debt forgiveness. Moreover, the court can deny debt restructuring if, for instance, the payment difficulties are temporary. Indeed, fewer than 4,300 individuals applied to a court for debt restructuring in Finland in 2015.[22] Without official or private debt restructuring, debts expire after fifteen to twenty years, before which time debtors can garnish debts from income or through asset sales.

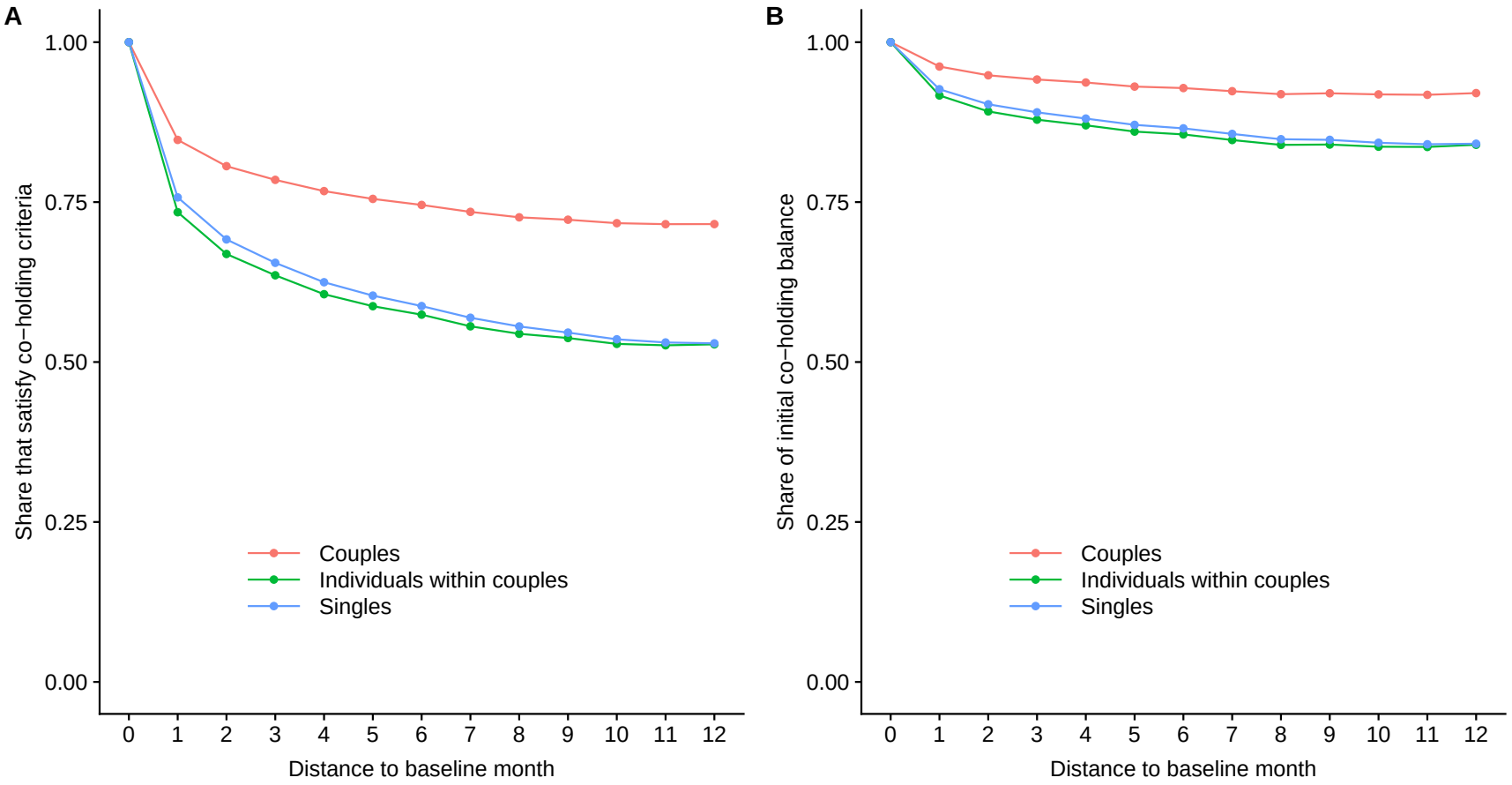
number of households without a mortgage is smaller than the number of households with a mortgage in the matched dataset.

[22] http://tilastokeskus.fi/til/velj/2015/04/velj_2015_04_2016-01-27_tau_001_fi.html



Note: The figure depicts the average persistence of co−holding for households who co−hold at some point during January 2014 to December 2016. I measure persistence by the amount co−held relative to co−holding in the baseline month. I also present results separately depending on whether the initial level of co−holding is below median co−holding in the baseline month. I study persistence of co−holding among households that satisfy the puzzle criteria (unsecured debt above 500 EUR and deposits above 1,500 EUR) in the baseline month.

Figure A.1: Persistence of co-holding at the intensive margin



Note: Panel A depicts the share of couples, individuals within couples, and singles that continue to satisfy the co−holding criteria (unsecured debt above 500 EUR and deposits above 1,500 EUR) conditional on satisfying the co−holding criteria in the baseline month (January 2014−December 2016). Panel B depicts the persistence of co−holding at the intensive margin by calculating co−holding relative to co−holding in the baseline month for couples, individuals within couples, and singles (conditional on co−holding at least 25 percent of disposable income in the baseline month).

Figure A.2: Persistence of co-holding by couples, by individuals within couples, and by singles

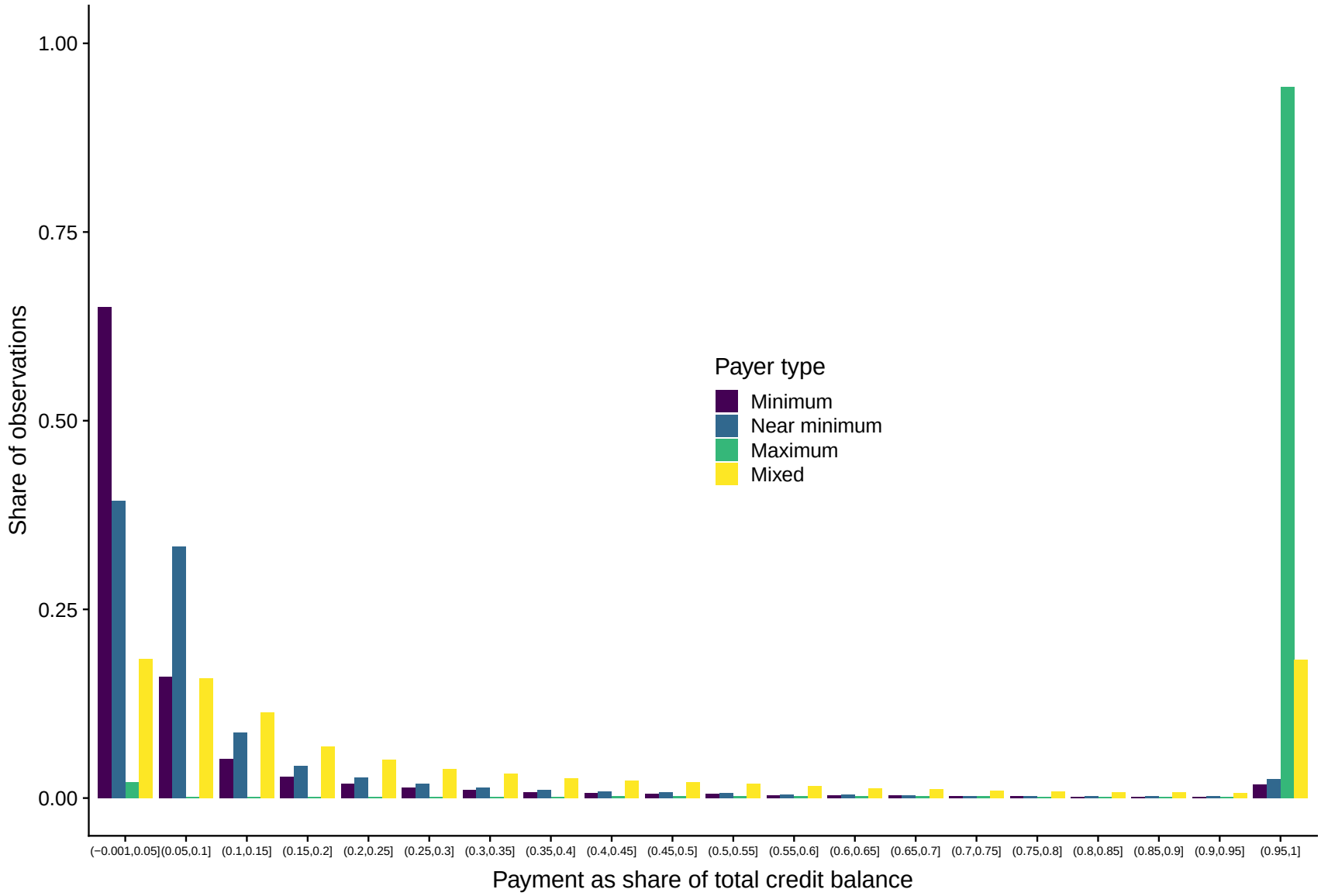
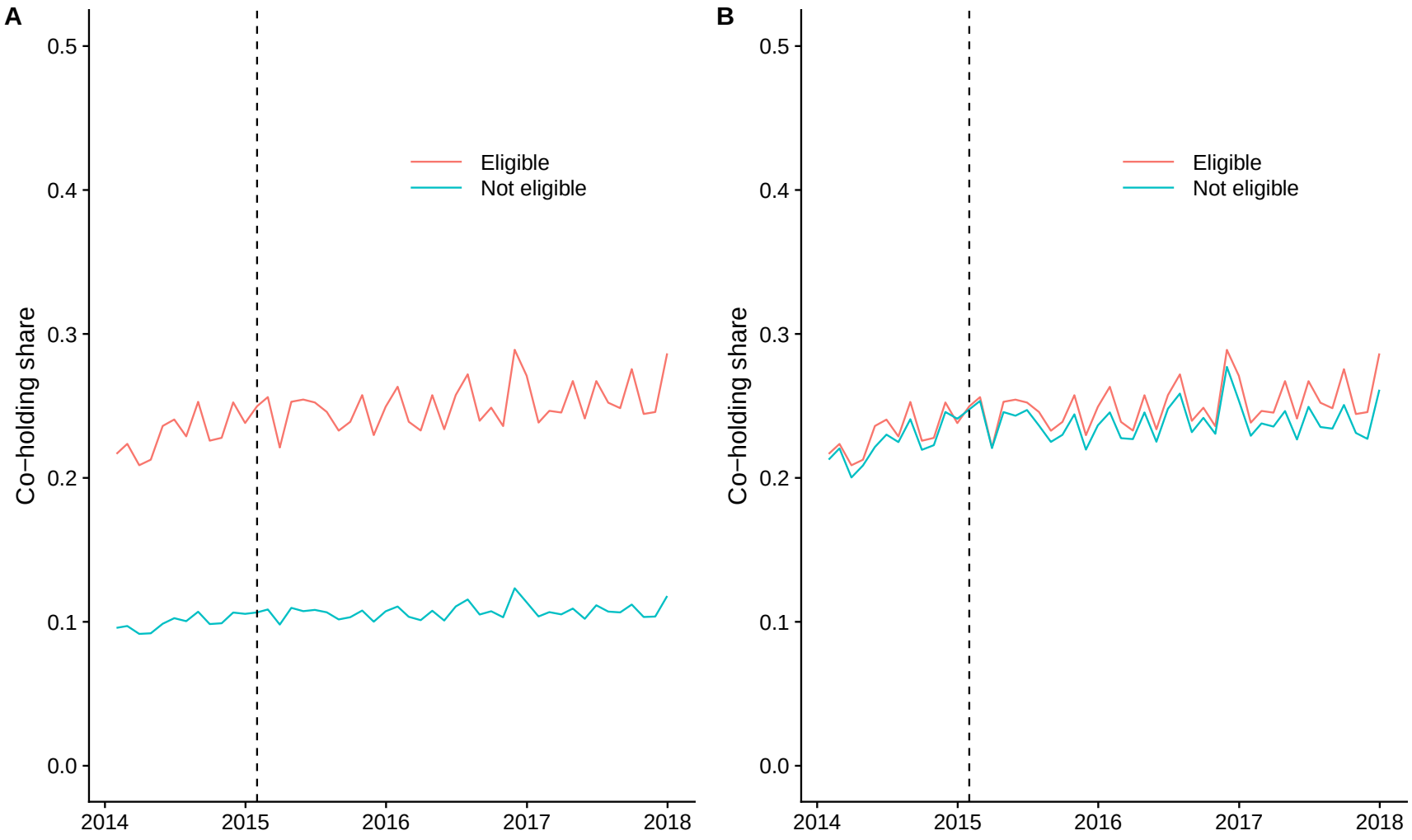


Figure A.3: Distribution of credit card invoice payments as a share of total credit balance by payer type



Note: The figure plots the share of households satisfying the co−holding criteria (unsecured debt above 500 EUR and deposits above 1,500 EUR) before and after the liquidity offer in February 2015 (denoted by the dashed line) depending on whether households had a mortgage and were eligible for the offer. Panel A describes the full sample and panel B the matched sample.

Figure A.4: Probability of co-holding by eligibility before and after the liquidity offer

Table A.1: Representativeness of household sample

	Sample	Population
Number of households	294,026	2,434,908
Demographic shares		
Household head 25-34 years	0.15	0.16
Household head 35-44 years	0.21	0.16
Household head 45-54 years	0.21	0.19
Household head 55-64 years	0.21	0.19
Household head 65-74 years	0.16	0.16
Household head 75+ years	0.05	0.13
Deposits		
Mean deposits	18,276	20,516
Median deposits	6,342	5,030
Income		
Mean monthly disposable income	2,888	2,663
Monthly disposable income Q25	1,707	1,380
Monthly disposable income Q50	2,538	2,239
Monthly disposable income Q75	3,855	3,578
Debt		
Share with mortgage	0.51	0.35
Mean total debt	55,385	46,405

[a] The table compares my baseline sample of stable households to national statistics. Sample values are from January 2015 (except disposable income for the full 2015). Population equivalents for demographics and debt are from the Statistics Finland Indebtedness database for year end 2014 (https://tilastokeskus.fi/til/velk/index_en.html). Population values for deposits are an average over the 2013 and 2016 waves of the Household Wealth Survey (https://www.stat.fi/til/vtutk/index_en.html). I calculate population values for the income distribution from tax percentile microdata with the restrictions that I focus on households with monthly disposable income over 500 EUR in 2015 and a household head of at least 25 years (same restrictions as in sample statistics). I calculate other population values, except deposits, for households with a household head of at least 25 years (again same restriction as in sample statistics). Population values for deposits pertain to the full population because I do not have microdata to compute the median deposits for households with a household head of at least 25 years.

Table A.2: Co-holding share by income and age

	Disposable income quintile					
Age quintile	All	Q1	Q2	Q3	Q4	Q5
A) Co-holding >= 500 EUR and deposits >= 1,500 EUR						
All	0.18	0.07	0.12	0.16	0.26	0.28
Q1	0.21	0.10	0.13	0.19	0.29	0.27
Q2	0.24	0.11	0.14	0.18	0.30	0.31
Q3	0.21	0.10	0.13	0.17	0.27	0.30
Q4	0.15	0.08	0.11	0.15	0.22	0.22
Q5	0.08	0.05	0.08	0.11	0.13	0.15
B) Co-holding > 25 percent of monthly disposable income						
All	0.22	0.18	0.22	0.21	0.26	0.22
Q1	0.27	0.32	0.28	0.25	0.29	0.21
Q2	0.27	0.30	0.27	0.25	0.30	0.25
Q3	0.25	0.25	0.24	0.23	0.28	0.24
Q4	0.19	0.18	0.19	0.19	0.21	0.17
Q5	0.11	0.11	0.11	0.12	0.12	0.11

[a] The table tabulates the share of co-holders in each age and income quantile over the full sample period.

Table A.3: Comparison of stable and unstable households

	Mean value		Median value	
	Stable	Unstable	Stable	Unstable
Group size	294,026	58,984	294,026	58,984
Demographics				
Adults	1.53	1.72	2.00	2.00
Children	0.48	0.60	0.00	0.00
Age of oldest adult	51.13	44.48	51.00	42.00
Co-holding				
Deposits	18,276	17,046	6,342	5,903
Interest-accruing unsecured debt	1,029	1,167	0	0
Unsecured credit limit	3,770	4,029	3,000	3,000
Co-holding	482	613	0	0
Puzzle share	0.18	0.24	0.00	0.00
Income/expenditure				
Disposable income	2,888	3,320	2,538	3,193
Card expenditure	1,288	1,564	1,046	1,366
Other debts and assets				
Mortgage dummy	0.51	0.57	1.00	1.00
Mortgage balance	48,543	65,666	3,121	27,660
Other financial assets	13,458	14,085	0	0
Other debt	5,814	7,378	0	0
Interest rates				
Unsecured debt interest rate	7.06	7.06	7.08	7.08
Deposit interest rate	0.11	0.11	0.07	0.07
Mortgage interest rate	1.34	1.36	1.25	1.28

[a] The table compares characteristics of stable and unstable households. The two oldest adults of stable households do not change during the sample period 2014–17. Unstable households are present in the data in January 2015 but either form after January 2014 or dissolve before December 2017. Values refer in general to January 2015, but disposable income is a monthly average over 2015. Interest rates are nominal rates (not APRs) and do not include non-interest credit fees.

Table A.4: Co-holding by couples, individuals within couples, and singles

Threshold	Couples	Individuals within couples	Singles
Mean co-holding (EUR)			
	699	246	280
Mean co-holding to income			
	0.18	0.13	0.16
P(co-holding to income > threshold)			
0.00	0.44	0.31	0.36
0.10	0.35	0.23	0.27
0.25	0.25	0.16	0.19
0.50	0.13	0.09	0.11
0.75	0.07	0.05	0.07
1.00	0.04	0.03	0.04

[a] The table calculates descriptive statistics on co-holding by couples, individuals within couples, and singles. I normalize co-holding by couples (individuals) by household (individual) income.

Table A.5: Potential savings from the liquidity offer for January 2015 co-holders

	N	Mean	Q0.01	Q0.1	Q0.25	Q0.5	Q0.75	Q0.9	Q0.99
Population descriptives									
Unsecured debt	36,425	2,820	171	570	1,045	2,016	3,803	6,208	11,299
Liquidity available from offer	36,425	8,005	1,218	3,240	4,874	7,191	10,096	13,486	23,564
Unsecured interest rate	36,425	6.51	2.35	5.22	6.46	7.04	7.04	7.04	7.90
Mortgage interest rate	36,425	1.34	0.24	0.72	0.99	1.26	1.63	2.09	2.79
Potential savings									
Yearly savings	36,425	185	15	58	96	155	245	352	586
Cumulative savings by mortgage maturity	36,425	1,844	88	366	769	1,459	2,519	3,816	6,728

[a] The table calculates the potential savings from using the liquidity offer to reduce unsecured debt for households that co-hold in January 2015 (unsecured debt above 500 EUR and deposits above 1,500 EUR). The savings accrue from the interest rate spread on mortgage and unsecured debt and from avoidable unsecured debt invoicing fees (equation 3). The net present value of cumulative savings by mortgage maturity equals yearly savings multiplied by mortgage maturity discounted by an annual discount rate of three percent. The amount of unsecured debt refers to the average value from February 2014 to January 2015. 'Liquidity available from offer' equals the amount of mortgage principal payments that the household can defer by applying for the liquidity offer. Although interest rates can change over time, I assume that the spread between the unsecured credit rate and the mortgage interest rate stays constant because both rates are tied to Euribor.

Table A.6: Comparison of individuals with electronic and mail credit card invoicing

	Mean value		Median value	
	Electronic	Mail	Electronic	Mail
Number of individuals	254,313	181,541	254,313	181,541
Deposits	12,463	12,373	3,346	3,326
Unsecured debt	859	653	0	0
Monthly disposable income	2,137	1,903	2,015	1,840
Co-holding (EUR)	331	244	0	0
Co-holding-to-income	0.18	0.14	0.00	0.00
Co-hold $>$ 25 pct of income	0.22	0.17	0.00	0.00
Age	47.07	48.38	46.00	47.00
Female share	0.52	0.50	1.00	1.00

[a] The table compares individuals with electronic and mail invoicing in 2015–16. I only consider individuals with active credit cards (at least one credit card invoice during 2015–16). Electronic invoice individuals include all individuals that receive at least one electronic invoice during 2015–16.

Table A.7: Household liquidity in co-holding observations

Liquidity measure	N	Q25	Q50	Q60	Q70	Q80	Q90	Q95
Deposits in EUR	2,498,801	2,513	4,529	6,058	8,559	13,084	23,750	38,984
Deposits-to-income ratio	2,498,801	0.83	1.46	1.93	2.70	4.14	7.70	12.81

[a] The table presents the distribution of liquid assets at the household level associated with co-holding observations (unsecured debt above 500 EUR and deposits above 1,500 EUR). The two measures of liquidity are end-of-month deposits in EUR, and deposits scaled by average monthly disposable income over 2015.

Table A.8: Risk of liquidity decrease for co-holders

Deposits-to-income decile	P(deposits decline below 500 EUR)	P(deposits decline > 50 %)	Deposits after > 50 % decline (mean)
All	1.9	8.8	1,903
1	5.0	13.9	581
2	3.7	13.2	747
3	3.1	12.2	871
4	2.6	11.3	1,003
5	1.9	9.7	1,210
6	1.3	8.2	1,508
7	0.9	6.6	2,007
8	0.6	5.3	2,953
9	0.3	4.3	4,953
10	0.1	3.5	15,265

[a] The table presents the probability of a significant monthly liquidity decrease associated with co-holding observations (unsecured debt above 500 EUR and deposits above 1,500 EUR). The first row provides results for all co-holding observations, and the following rows by the decile of initial deposits relative to average monthly disposable income over 2015 (ranked from lowest to highest). The first risk measure is the probability that deposits decrease to below 500 EUR. The second risk measure is the probability that deposits decrease by over fifty percent. The final column presents the average remaining deposits in each initial deposits-to-income decile after an over-fifty-percent drop in deposits. Probabilities in the second and third columns are in percentage points.

Table A.9: Credit-limit risk

Year	Number of accounts	P(limit increase)	P(limit decrease)	P(Customer closure)	P(Bank closure)
2014	461,361	3.3	0.3	0.3	0.2
2015	460,407	3.0	0.3	2.1	0.2
2016	465,725	3.1	0.3	0.9	0.2
2017	470,097	3.1	0.6	0.9	0.3
Average		3.1	0.4	1.1	0.2

[a] The table presents the yearly risk of credit limit changes on unsecured products at the credit account level for the sample population over 2014–17. The probability of a limit change or account closure in a given year equals the number of accounts that experience a limit change or closure during the year conditional on the account being open in January of the particular year. Values refer to percentage points.

Table A.10: Co-holding with baseline deposits and only checking account deposits

	N	Mean	Q0.01	Q0.1	Q0.25	Q0.5	Q0.75	Q0.9	Q0.99
Co-holding with baseline deposits	14,113,248	480	0	0	0	0	496	1,636	5,008
Co-holding with only checking account deposits	14,113,248	434	0	0	0	0	432	1,486	4,571

[a] The table provides descriptive statistics on household co-holding both when calculating co-holding based on baseline deposits and when calculating co-holding based on deposits on checking accounts only.

Table A.11: Distribution of end-of-month and average deposits in 2015

	N	Mean	Q0.01	Q0.1	Q0.25	Q0.50	Q0.75	Q0.9	Q0.99
All observations									
Total deposits (e-o-m)	3,388,279	20,964	17	528	1,942	7,205	22,353	52,344	184,911
Total deposits (mean)	3,388,279	20,780	198	751	2,059	7,444	22,473	51,880	177,684
Puzzle observations									
Total deposits (e-o-m)	604,068	11,124	1,510	1,830	2,514	4,596	10,704	24,199	96,678
Total deposits (mean)	604,068	10,444	437	1,162	2,090	4,386	10,553	23,712	89,475

[a] The table plots the distribution of end-of-month deposits and average deposits within the month at the household level in 2015. Total deposits include both the baseline measure of liquid deposits and other deposits, because data on average deposits is only available at the customer and not at the account level. For an apples-to-apples comparison, I only consider household-month observations with positive end-of-month deposits because average deposits within the month do not consider negative deposits.

Table A.12: Low credit card payments and end-of-month and average deposits

	N	Q25	Q50	Q60	Q70	Q80	Q90	Q95
A) Minimum payments								
Total deposits-to-income (e-o-m)	355,119	0.20	0.64	0.91	1.31	2.17	4.85	9.31
Total deposits-to-income (mean)	355,119	0.16	0.45	0.64	0.99	1.74	4.02	7.91
B) All near-minimum payments								
Total deposits-to-income (e-o-m)	198,960	0.20	0.61	0.88	1.26	2.07	4.48	8.47
Total deposits-to-income (mean)	198,960	0.16	0.43	0.61	0.93	1.64	3.77	7.22
C) Active near-minimum payments								
Total deposits-to-income (e-o-m)	71,618	0.23	0.64	0.91	1.26	1.98	3.94	7.06
Total deposits-to-income (mean)	71,618	0.13	0.41	0.58	0.86	1.45	3.16	5.82

[a] The table presents the distribution of individual deposits relative to monthly disposable income in the case of minimum and near-minimum credit card debt payments in 2015. I only study the year 2015 because I do not have information on average deposits for other years. Panel A presents the distribution of the deposit-to-income ratio when the payment equals the contractual minimum. Panel B presents the distribution of deposit-to-income ratio when the payment is larger but within 50 EUR of the contractual minimum. Panel C presents the distribution of the deposit-to-income ratio when the individual pays a larger amount than the invoice balance (default payment) but within 50 EUR of the contractual minimum. "Total deposits-to-income (e-o-m)" refer to end-of-month deposits in the invoice month. "Total deposits-to-income (mean)" refer to average deposits in the invoice month. Total deposits include both the baseline measure of liquid deposits and other deposits, because data on average deposits is only available at the customer and not at the account level. For an apples-to-apples comparison, I only consider household-month observations with positive end-of-month deposits because average deposits within the month do not consider negative deposits.

Table A.13: Take-up of the low-cost liquidity offer by January 2015 co-holders

	Potential yearly savings quartile				
	All	Lowest quartile	Second quartile	Third quartile	Top quartile
Co-holding months in 2015					
All	0.29	0.22	0.25	0.30	0.39
1 to 3	0.29	0.23	0.26	0.34	0.46
4 to 6	0.30	0.23	0.28	0.32	0.41
7 to 9	0.31	0.23	0.27	0.32	0.42
10 to 12	0.28	0.20	0.23	0.28	0.37

[a] The table presents the take-up rate of the liquidity offer by households that co-hold in January 2015 (unsecured debt above 500 EUR and deposits above 1,500 EUR). In addition to the overall take-up rate, I tabulate the take-up rate in bins by potential yearly savings from using the liquidity offer to reduce unsecured debt (equation 3), and by the number of months that the household co-holds during 2015 (unsecured debt above 500 EUR and deposits above 1,500 EUR).

Table A.14: Effect of the liquidity offer on co-holding at the extensive margin

	Dependent variable:			
	Co-holding (0/1)			
	(1)	(2)	(3)	(4)
$\mathbb{1}_{m<\text{Jan2015}} * \mathbb{1}_{\text{mortgage}}$	0.13^{***}	-0.01^{***}	0.01^{**}	0.004^{*}
	(0.001)	(0.001)	(0.003)	(0.002)
$\mathbb{1}_{m>\text{Jan2015}} * \mathbb{1}_{\text{mortgage}}$	0.14^{***}	-0.001	0.01^{***}	0.01^{***}
	(0.001)	(0.001)	(0.003)	(0.003)
Sample	Full	Full	Matched	Matched
Household FEs	No	Yes	No	Yes
Co-holding share	0.18	0.18	0.24	0.24
Unique households with mortgage	150,067	150,067	149,991	149,991
Unique households without mortgage	143,959	143,959	60,619	60,619
Observations	10,584,936	10,584,936	7,581,960	7,581,960

Note: *p<0.1; **p<0.05; ***p<0.01

The table presents estimation results for different specifications of equation 4. The data is a panel from January 2014 to December 2016. The dependent variable takes the value 1 if the household co-holds in a given month (unsecured debt over 500 EUR and deposits over 1,500 EUR) and 0 otherwise. January 2015 is the baseline month because it prececed the bank's liquidity campaign for mortgage households that started in February 2015. Standard errors are clustered at the household level. The specification in column 1 does not include household fixed effects and hence the coefficients estimate the overall difference in co-holding probability by mortgage status before and after the offer. The specification in column 2 includes household fixed effects and hence the coefficients estimate the difference in the trend of co-holding by mortgage status before and after the offer. Columns 3–4 provide equivalent estimates using the matched sample after I find for each household eligible for the liquidity offer a similar-on-observables non-eligible household using propensity score matching.

Table A.15: Effect of the liquidity offer on co-holding at the intensive margin

	Dependent variable:			
	Co − holding(EUR)			
	(1)	(2)	(3)	(4)
$\mathbb{1}_{m<\text{Jan2015}} * \mathbb{1}_{\text{mortgage}}$	354.96***	−30.79***	10.95	11.52**
	(3.23)	(1.91)	(9.97)	(5.39)
$\mathbb{1}_{m>\text{Jan2015}} * \mathbb{1}_{\text{mortgage}}$	394.59***	8.83***	14.77	15.34**
	(3.33)	(2.13)	(10.72)	(6.55)
Sample	Full	Full	Matched	Matched
Household FEs	No	Yes	No	Yes
Mean co-holding (EUR)	474.3	474.3	657.1	657.1
Unique households with mortgage	150,067	150,067	149,991	149,991
Unique households without mortgage	143,959	143,959	60,619	60,619
Observations	10,584,936	10,584,936	7,581,960	7,581,960

Note: *p<0.1; **p<0.05; ***p<0.01

The table presents estimation results for a variation of equation 4 in which I change the dependent variable to the EUR amount of co-holding. The data is a panel from January 2014 to December 2016. January 2015 is the baseline month because it prececed the bank's liquidity campaign for mortgage households that started in February 2015. Standard errors are clustered at the household level. The specification in column 1 does not include household fixed effects and hence the coefficients estimate the overall difference in co-holding by mortgage status before and after the offer. The specification in column 2 includes household fixed effects and hence the coefficients estimate the difference in the trend of co-holding by mortgage status before and after the offer. Columns 3–4 provide equivalent estimates using the matched sample after I find for each household eligible for the liquidity offer a similar-on-observables non-eligible household using propensity score matching.

Table A.16: Average household characteristics before and after matching

	Before matching		After matching	
	Mortgage	No mortgage	Mortgage	No mortgage
Unique households	150,067	143,959	149,991	60,619
Demographics				
Adults	1.67	1.39	1.67	1.67
Children	0.77	0.18	0.77	0.77
Age of oldest adult	46.14	56.33	46.15	46.87
Co-holding				
Deposits	11,830	24,996	11,834	11,933
Interest-accruing unsecured debt	1,374	669	1,373	1,373
Unsecured credit limit	4,321	3,195	4,322	4,167
Co-holding	671	285	671	671
Income/expenditure				
Disposable income	3,450	2,302	3,449	3,420
Card expenditure	1,561	1,003	1,560	1,586
Other debts and assets				
Other financial assets	7,061	20,127	7,064	11,361
Other debt	7,305	4,259	7,295	12,389
Interest rates				
Unsecured debt interest rate	7.07	7.06	7.07	7.03
Deposit interest rate	0.10	0.13	0.10	0.10

[a] The table presents household characteristics by mortgage status before and after matching. Values refer in general to January 2015, but disposable income is a monthly average over 2015.