

# Balance Sheet Dynamics of Households in Financial Distress\*

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## Abstract

What are the costs of household delinquency? To answer that question, we provide novel evidence on the dynamics of household balance sheets around delinquencies. To that end, we combine an administrative credit register featuring delinquency information with administrative data on household income and wealth. We document four facts. First, delinquency is partial. On average, households become delinquent on 30% of their debt. Second, delinquency is highly persistent. 60% of households that become delinquent are still so five years later. Third, delinquency is strategic. More than 90% of newly delinquent households have a disposable income above the subsistence level—and could thus afford to repay more. While ability to pay is important to predict delinquency, strategic motives matter more. Debtors with above median debt-to-income are 40% more likely to default than those with lower debt. Fourth, delinquency is costly. Relative to households with similar income and wealth, delinquent households cut back consumption by about 6% after delinquency. Our results suggest that the costs of delinquency are high and long-lasting.

**Keywords:** Household debt, financial distress, delinquency, bankruptcy, default, credit cards, mortgages.

**JEL Classification:** D14, G21, G51.

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# 1 Introduction

Households can smooth consumption by borrowing or saving. They can build up savings during good times and use them during bad times. Likewise, they can borrow during bad times and repay during good times. Unlike savings, debt introduces another dimension of insurance. When their economic situation does not improve, borrowers can default on their debt. Default makes debt service state-contingent.

While formal default in the form of personal bankruptcy (such as Chapter 7 or 13 in the US) has been the main focus of economic research, informal default in the form of delinquency is much more common. Whereas bankruptcy rates are as low as 1% in the US, 6% of households become delinquent on their unsecured debt in a typical year both in the US (Exler and Tertilt 2020; Athreya et al. 2018) and in Denmark (cf. Table 3).

However, despite the high prevalence of household delinquency, there is little empirical evidence on how it affects households. From a theoretical point of view, delinquency can be beneficial as it offers households the possibility of a soft default, especially in countries where formal bankruptcy is costly (Athreya et al. 2018; Hannon 2022). It can also be detrimental if households become trapped in a state with high debt and interest rates (Exler 2021). Hence, there is a need for more evidence about how households use delinquency. Such evidence furthers our understanding of two key issues. First, what events lead to delinquency? Second, what are the (socio-)economic consequences of household delinquency?

In this paper, we use comprehensive micro-data from Denmark to document novel evidence on the dynamics of household balance sheets around delinquency. To this end, we combine administrative credit register data on the universe of household loans in Denmark with administrative tax data on household income and wealth. The loan data give us information on outstanding amounts, interest payments, and, importantly, the delinquency and bankruptcy status of all loans in Denmark, together with information about the borrower and the lender. The link with the register data provides detailed information on the balance sheets of households, their income patterns and socio-economic circumstances.

Relative to the previous literature, our data has four key advantages: first, it is comprehensive and representative: our data set covers the universe of unsecured loans in Denmark, and the population of Danish households. Second, it has a long time series: we have data from 2003-2018 on delinquencies, which allow us to study the long-run dynamics around delinquency. Third, our data can be merged with the rich registry data, allowing us to observe complete household balance sheets around delinquency. Fourth, it is of high quality, as all underlying data is administrative.

The Danish context is particularly useful for two reasons. First, the rich administrative data in Denmark gives us a comprehensive view of household balance sheets during

periods of financial distress. Second, the Danish bankruptcy system has been introduced (1984) and reformed (2005) at similar times as the US bankruptcy system. Furthermore, a bankruptcy in Denmark resembles a US Chapter 13 filing that features debt restructuring, a court-enforced repayment plan, and ultimately debt relief.

We document four facts. First, delinquencies are partial. On average, households become delinquent on around 30 per cent of their unsecured debt, which is a significant amount. At the time of delinquency, households have, on average, outstanding unsecured debt corresponding to 150 per cent of their disposable income, meaning that they become delinquent on debt corresponding to around 50 per cent of their disposable income. At the loan level, we show that delinquency leads to a steadily increasing loan balance relative to non-delinquent loans. On average, after five years, the loan balance of a delinquent loan is 20 per cent higher than the loan balance of a non-delinquent loan.

Second, delinquencies are persistent. Around 60 per cent of households that become delinquent are still delinquent five years later. This fact is consistent with international evidence at the loan level evidence for unsecured debt from the US (Athreya et al. 2018) and mortgages for the Eurozone (Hannon 2022). We show that this is also true at the household level. Similar to Hannon (2022), we also find that the transition from delinquency to a household being current is frequent, with an annual transition rate of around 14 per cent. In contrast, the transition rate to bankruptcy is low, with a transition rate of around 5 per cent. In addition, we show that households in delinquency retain high levels of debt and pay high interest rates on that debt.

Third, delinquencies are strategic. To establish that fact, we follow Gerardi, Herkenhoff, Ohanian, and Willen (2018) in comparing the disposable income of households at the time of delinquency to a subsistence level, defined by Danish social insurance benefits. Besides being able to leverage high quality annual administrative data on the universe of households and loans, our contribution relative to that paper is twofold. First, we are the first to document strategic delinquency in the market for unsecured debt. Second, we provide evidence for strategic delinquency, not outright bankruptcy. In our data, households experience a fall in disposable income before delinquency, typically driven by job loss and a resulting fall in labour income. However, despite the fall in disposable income, the income of more than 90 per cent of those households that become delinquent remains above the subsistence level guaranteed by Danish social insurance. This subsistence level is a relevant comparison, as it corresponds to the disposable income households would be allowed to retain if they were to enter formal default. This degree of strategic default is high compared to Gerardi et al. (2018), who find that about 70 per cent of households in the US can pay their mortgage. A unique feature of Danish regulation may drive this high degree of strategic default on unsecured debt. In Denmark, private creditors cannot garnish wages, and this regulation implies that creditors with unsecured debt are in a weak position when a borrower stops repaying.

Fourth, delinquencies are costly. To establish this fact, we compare the total spending of households that become delinquent to that of similar households that do not become delinquent. Our rich microdata allows us to find a very similar control group, matched on a range of sociodemographic and balance sheet characteristics. Specifically, we match households on the municipality where they live, their homeownership status, family status, employment status, age, and the time of the delinquency. Importantly, we also match them on their disposable income level and net worth. We find that, relative to households that are similar in all of these characteristics, delinquent households reduce total spending by about 6 per cent. This decline is highly persistent. Further, delinquents experience an increase in borrowing cost: they both face higher interest rates on their existing loans and substitute into more costly forms of credit such as non-bank loans. They also pay taxes late.

These four facts imply that delinquencies are costly and long-lasting events. One key challenge for theoretical work that arises from our results will be to reconcile the high prevalence of strategic delinquency with the high and long-lasting costs of delinquency.

**Literature** There is substantial empirical work on consumer debt and bankruptcy. There is an empirical literature (e.g. Fay, Hurst, and White (2002) and Gerardi et al. (2018)) that relies on surveys like the PSID. While these surveys provide a good picture of the general financial situation of American households, relatively rare events like defaults and bankruptcies are not well represented. Additionally, households in financial distress might not accurately summarize their financial situation to the surveyor. Furthermore, the lack of a panel dimension limits the insights into dynamics before and after financial distress.

Other papers in the spirit of Dobbie and Song (2015) and Dobbie, Goldsmith-Pinkham, and Yang (2017) rely on high-quality administrative data from bankruptcy courts. In these data, income, debts, and assets are well represented and tracked, and random judge allocation allows for clear identification. However, these data only represent a highly selective portion of the population (those seeking debt relief through bankruptcy) and do not capture developments before the court filing or debtors that default informally without court involvement.

Finally, some authors rely on data on credit card lender data. There, credit (card) accounts are the unit of observation with the limitation of not being able to link different accounts to one individual and not observing assets of the debtors, (see, for example, Gross and Souleles 2002; Agarwal et al. 2015; Athreya et al. 2018).

We contribute to this empirical literature by leveraging our unique data set and documenting balance sheet dynamics around delinquency in representative, administrative, and long-run data. Kreiner, Leth-Petersen, and Willerslev-Olsen (2020) use similar data to document inter-generational persistence in delinquency but abstract from any dynam-

ics. In a similar event study setup, Diamond, Guren, and Tan (2020) investigate the effect of household foreclosures in Cook County, Illinois.

We also provide novel insights into the quantitative structural literature of consumer debt and default. Most quantitative work focuses on dynamic heterogeneous agent models with endogenous default through official bankruptcy in the tradition of Livshits, MacGee, and Tertilt (2007) and Chatterjee et al. (2007). See Exler and Tertilt (2020) for a recent survey. These models typically abstract from delinquency and prolonged periods of financial distress, which has important implications for their policy evaluation and welfare assessments. There has been some work to introduce informal default through delinquency explicitly (cf. Athreya et al. 2018; Athreya, Mustre-Del-Río, and Sánchez 2019; Exler 2021). While allowing for a more realistic set of nonpayment options, these models benefit from rigorous evidence on the cost of prolonged periods of financial distress and delinquency.

**Roadmap** The rest of the paper proceeds as follows. Section 2 describes the bankruptcy regulation in Denmark and introduces the data. Section 3 introduces the event study specification. Section 4 shows that delinquencies are partial and persistent. Section 5 discusses whether delinquencies are strategic. Section 6 discusses the costs of delinquency. Finally, section 7 concludes.

## 2 Institutional Framework and Data

Section 2.1 gives a short overview over bankruptcy regulation in Denmark. Section 2.2 discusses credit ratings. Section 2.3 describes our core dataset, the loan-level data. Section 2.4 describes how we merge the loan-level data with the household level data. Section 2.5 defines the treatment. Section 2.6 discusses comparability of the treatment group and the control group.

### 2.1 Bankruptcy regulation

Denmark was the first continental European country to introduce a personal bankruptcy law in May 1984.<sup>1</sup> The main goal of the introduction of this law was to reduce wasteful debt collection efforts. These were seen as a contradiction to the Danish welfare state, as indebted households were on the one hand subject to strict debt collection laws, but received on the other hand generous social security benefits. This new bankruptcy law was intended to give a way out of debt for people without “unclear economic circumstances” who are “hopelessly indebted” besides only dedicating a “reasonable” amount

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1. This entire section cites heavily from an excellent overview of the history of the Danish bankruptcy system in Kilborn (2009).

of their income to living expenses. “Unclear economic circumstances” include, for example, temporary unemployment. It was left to local bankruptcy courts to decide what “hopelessly indebted” and “reasonable expenses” mean. Moreover, under the original law, the bankruptcy courts had to evaluate whether “the debtor’s behavior and circumstances speak in favor of debt adjustment.” In October 2005, a major reform of the personal insolvency law was introduced to reduce the discretion of bankruptcy courts, standardizing the evaluation of debtors’ “behavior and circumstances.” Nonetheless, these legal hurdles imply that it is difficult for a borrower to be granted formal bankruptcy. For example, in 2020, 3568 individuals were seeking bankruptcy at a court, but only approximately 50% of bankruptcies were granted.<sup>2</sup>

Similar to US Chapter 13, bankruptcies are also costly. As part of the bankruptcy process, the debtor agrees to fulfill certain requirements, which for example involve liquidating assets and following a partial debt repayment plan for a period of five years. The repayment plan requires the household to use all disposable income above a fixed allowance for debt repayment. Before the 2005 reform, the allowance was up to the discretion of the court, with the only guidance by the law requiring that it should allow the household to maintain a “modest standard of living.” After the 2005 reform, allowances were standardized, and certain transfer payments, like child alimony, exempted. Once the bankruptcy court has agreed to the repayment plan, it *immediately* forgives the remainder of the outstanding debt.<sup>3</sup>

While access to the bankruptcy system is restricted and bankruptcy is costly, it is rather debtor friendly. Creditors have no say in whether a payment plan is approved or not. The debtor neither has to renegotiate their debt with his creditors before applying for personal bankruptcy. Additionally, garnishing wages for private claims is not allowed. This implies that private creditors with unsecured claims have a strong incentive to renegotiate their claims before bankruptcy. Alternatively, they either recover a small portion of the debt in bankruptcy or are forced to write it off.

Secured claims, like mortgages, are exempt from bankruptcy proceedings and are fully recourse. If liquidation of the collateral is insufficient to cover the secured debt, the remaining claim will be added on top of the debt repayment agreed in the debt repayment plan. In that case, the 2005 reform allows for an adjustment of the debt repayment plan to preserve its economic feasibility. In contrast, should the economic circumstances of the debtor improve after the repayment plan has been approved, an upward adjustment of repayments is not allowed.

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2. See <https://domstol.dk/om-os/tal-og-fakta/skiftesager/>.

3. However, in the data, debt is only written off at the end of the repayment period.

## 2.2 Credit ratings

Denmark does not have a credit rating mechanism similar to FICO scores in the US. However, there are two registers maintained by private companies that list persons which have failed to pay their bills. A creditor can register a debtor if they have failed to repay due payments despite having received three reminder letters. Being on one of these lists means that a debtor will have reduced access to credit, as many financial firms will choose not to lend to him. A debtor can be deleted from the list, if they have repaid their outstanding debt. Otherwise, entries are deleted five years after registration.

## 2.3 Loan-level data

Our primary data set is based on administrative records from the Danish tax authority. It contains the universe of bank loans and mortgages of households in Denmark between 2003 to 2020.<sup>4</sup> The tax authority requires all lenders in Denmark to report information on each loan. This information is collected for the purpose of checking the correctness of households' self-reported interest rate expense deductions in their income tax statement. The lenders report end of year loan balances, interest paid during the year, flags for whether a loan is in delinquency or whether it has been part of a debt forgiveness, and the type of the loan. These flags are included in the data, as interest expense on loans in delinquency is not tax-deductible. A loan is reported as being in delinquency when, at the end of the year, there were overdue interest payments from the preceding year. A loan is being reported as being part of a debt forgiveness, when the debtor has been declared bankrupt by a court, or when the creditors and the debtor reach an agreement to reduce the size of the loan.

Table 1 provides summary statistics at the loan level. The unit of observation is a loan-year. We report the outstanding amount, interest payments, the imputed interest rate, the contractual interest rate, the type of loan, the sector of the lender, and the delinquency and bankruptcy status of the loan. We also split the sample by the delinquency flag.

## 2.4 Household-level data

Through the unique borrower identifier for the borrower, we link the loan level data with other registers, which contain for example information about the balance sheet, labor market status, demographics and hospital admissions of an individual. We then collapse the data to the household level, as most economic decisions are taken at the household level. Appendix A contains a detailed data description of the various registers we use.

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4. The data has previously been used in Jensen and Johannesen (2017) and Kreiner, Leth-Petersen, and Willerslev-Olsen (2020).

Table 1: Debt portfolios of individuals with and without delinquency.

## (a) Loans of never-delinquent individuals

	1 (largest)	2	3	4	5+ (smallest)
Outstanding amount (DKK)	461,550	138,776	62,796	35,320	6,871
Annual interest payment (DKK)	14,196	5,585	3,360	2,630	2,278
Delinquency rate (%)	0	0	0	0	0
Private debt relief rate (%)	0	0	0	0	0
Public debt relief rate (%)	0	0	0	0	0
Bank loan share (%)	31	57	62	64	67
Non-bank loan share (%)	7	13	17	18	17
Leasing share (%)	2	3	4	4	3
Mortgage share (%)	53	22	13	10	10
Student loan share (%)	5	3	3	2	1
Public loan share (%)	1	1	2	2	2
Share of sample with loan (%)	100	77	58	43	31

## (b) Loans of individuals with any delinquency

	1 (largest)	2	3	4	5+ (smallest)
Outstanding amount (DKK)	504,465	178,599	94,052	59,771	10,094
Annual interest payment (DKK)	15,071	6,757	4,108	3,030	1,490
Delinquency rate (%)	19	19	20	21	21
Private debt relief rate (%)	1	1	1	1	0
Public debt relief rate (%)	0	0	0	0	0
Bank loan share (%)	33	45	45	43	41
Non-bank loan share (%)	15	20	22	22	18
Leasing share (%)	3	5	5	5	3
Mortgage share (%)	34	14	7	5	4
Student loan share (%)	8	4	3	2	1
Public loan share (%)	6	12	17	22	33
Share of sample with loan (%)	100	93	83	73	63

*Note:* This table shows the average debt portfolio for a one percent random subsample of the full sample. The full sample is the population of Danish individuals with a loan. The unit of observation is a person-year. For each individual, we sort their loans in a given year according to the outstanding amount. We rank loans according to size, giving the largest loan rank 1, the second largest loan rank 2, and so on. We then compute averages across individuals within each loan rank. Panel a reports summary statistics for individuals that never experience a delinquency or debt relief during the sample period, panel b summary statistics for individuals that do. Mortgages, student loans and public loans are identified directly in the data. Bank loans are non-mortgage loans issued by banks. Non-bank loans are non-mortgage loans issued by other types of credit institutions. Leases are non-mortgage loans issued by leasing firms. Sample period: 2003-2020. DKK amounts are deflated with the Danish CPI.



## Construction of budget sets

- Definition of ability to pay: disposable income + liquid assets - subsistence amount
- Definition of subsistence amount based on kontanthjaelp, which depends on age, number of adults and number of children
- Definition of debt-to-income: (total loans - mortgage loans)/gross income

**Spending imputation** Following Browning and Leth-Petersen (2003), total spending of households is imputed as disposable income minus savings, where savings are defined as the change in assets minus the change in liabilities.

$$\text{Total Spending} = \text{Disposable Income} - \Delta\text{Assets} + \Delta\text{Liabilities}. \quad (1)$$

This measure of total spending includes purchases of durables and non-durables. It captures well the spending of households with simple financial lives. Disposable income is total income of a household net of child support, taxes, and interest payments (see A.4.1 for more details). The change in liabilities is comprised of debt repayment and potential new debts taken out. A change in assets stems either from (dis)saving or capital gains. A shortcoming of this measure is that it does not correct for capital gains, which are important for housing wealth and stocks. For households prone to delinquency, stocks are usually only a minor part of their wealth. However, housing wealth is important, and many households have a housing transaction around a delinquency. Therefore, we check robustness by focusing on households which remain renters throughout the sample period.

## 2.5 Treatment definition

In our baseline estimation strategy, we describe the dynamics around the time when a household becomes delinquent on its debt. A household is defined as delinquent, when at least one of its members becomes delinquent on at least one of its bank loans or mortgages.<sup>5</sup> Delinquency is defined as having an unpaid interest balance from the year prior to the reporting year. This is the most comprehensive definition of delinquency that is possible in our data. Specifically, let  $D_{i,t}$  denote the delinquency status of the household, with  $D_{i,t} = 0$  if the household is not delinquent and  $D_{i,t} = 1$  if the household is delinquent.

Our treatment  $d_{i,t}$  is the first observed change in the delinquency status. That is,  $d_{i,t} = 1$  in the year *prior to the year* where the household is reported as delinquent for

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5. There is not a single case of a household being delinquent on a mortgage while not being delinquent on a bank loan in our data.

the first time and  $d_{i,t} = 0$  in all other periods. We focus on the first delinquency, as this is likely to be the most informative to the lenders about unobserved characteristics of the household. A second advantage of defining the treatment as becoming delinquent for the first time is that this is an absorbing treatment, which avoids potential issues with people moving in and out of treatment.

## 2.6 Ex ante comparison of treatment and control group

As we want to be able to observe outcomes in a window of five years around the treatment, our treatment group consists of all households that become delinquent for the first time between 2009 and 2014. We discard households that become delinquent for the first time before 2009 or after 2014. The control group consists of all other households.

**Matching procedure** To ensure a high comparability between treatment and control group, we covariate balance our control group. We do so by estimating a propensity score for the probability of being treated (i.e. becoming delinquent) based on information one year prior to the treatment, and remove observations that do not lie in the common support. To estimate the propensity score, we use the following variables: total assets, total liabilities, total income, family status, age of the household head, socio-economic status of the household head, municipality of residence, number of children, home ownership and car ownership.

**Matching outcome** Table 2 provides summary statistics at the household level. The first column shows summary statistics for the treatment group, the second column summary statistics for the matched control group. For those two groups, we report summary statistics prior to the treatment or pseudo-treatment year. The last column shows summary statistics for the entire sample. There are around 28 million observations, corresponding to household-years. We observe around 4.8 million unique households. The first panel reports basic demographics. The average household household head is 43 years old. 38 percent of household heads are female. The average household consists of 1.5 adults and 0.8 children.

## 2.7 Household balance sheets prior to delinquency

The top panel reports information on income, savings, and expenditure. The average total household income is around 590 thousand DKK. Disposable income, which is total income minus interest expense and taxes, is around 356 thousand DKK. Households' net borrowing 18 thousand DKK, which implies that total spending is 369 thousand DKK.

The medium part of Table 3 reports summary statistics for the households' balance sheet. The typical household has total assets of around 1.09 million DKK and total

Table 2: Demographics and matching.

	Treatment group mean/b	Matched control group mean/b	Difference mean/b	Full sample mean/b
Age	42.0	41.9	-0.1	42.9
Pct. female	36.1	36.0	-0.0	38.3
Pct. natives	88.8	88.7	-0.2	87.4
Number of adults	1.6	1.6	0.0	1.5
Number of children	1.0	1.0	-0.0	0.8
Pct. home owner	46.3	46.6	0.3	47.1
Pct. high-skilled	18.2	18.2	0.0	19.1
Pct. low-skilled	46.2	46.4	0.3	51.6
Pct. unemployed	3.7	3.7	-0.0	2.6
Pct. on social benefits	10.3	9.9	-0.5	6.5
Pct. retired	8.3	7.8	-0.5	7.2
Capital region	30.7	30.1	-0.6	29.2
Metropolitan region	11.4	11.2	-0.2	12.9
Provincial region	22.5	22.5	-0.0	22.3
Commuter region	15.3	15.6	0.3	15.5
Rural region	20.1	20.6	0.5	20.0
Primary ed. or less	32.1	31.7	-0.4	27.1
Secondary ed.	5.0	5.0	-0.1	4.3
Short-cycle tertiary ed.	55.8	56.1	0.3	59.3
Higher ed.	4.7	4.8	0.1	6.9
Observations	11,247	10,889	22,136	2,814,170
Unique households				480,254

*Note:* This table shows demographic summary statistics for the treatment group, the control group, and the full sample. The summary statistics for the treatment group and the control group are computed in years before the treatment year. All variables included in the table are used in the matching procedure, which we describe in the main text. Sample period: 12003-2020.

liabilities of about 1.04 million DKK, which implies a net worth of around 48 thousand DKK.<sup>6</sup> A large fraction of assets is housing wealth. Liabilities consist of around 30 percent of bank loans, 12 percent of non-bank loans and leasing, and 51 percent of mortgages and 7.5 percent of other loans.

Table 3: Household balance sheets.

	Treatment group mean	Matched control group mean	Full sample mean
Total income	618,547.0	611,676.7	592,160.8
Disposable income	359,865.6	366,261.8	357,210.9
Net savings	-32,681.6	-35,181.4	-15,542.5
Total spending	396,615.2	407,351.7	369,305.7
Total assets	1,123,335.7	1,030,359.7	1,080,012.9
Housing share	41.2	40.7	40.4
Liquid asset share	54.4	54.0	53.8
Illiquid asset share	4.4	5.3	5.8
Total liabilities	1,422,632.4	1,305,350.4	1,029,391.2
Mortgage share	40.0	42.6	50.3
Bank loan share	39.1	40.5	29.8
Non-bank loan & leasing share	14.4	9.1	11.9
Public & student loan share	6.2	7.7	7.7
Pct. delinquent	0.0	0.0	5.6
Pct. private debt relief	0.0	0.0	0.5
Pct. public debt relief	0.0	0.0	0.2
Observations	11,247	10,889	2,814,170

*Note:* This table shows summary statistics at the household level. In columns 1 and 2, households are split by whether they ever experience a delinquency during the sample period (column 2) or not (column 1). The monetary unit is the Danish Krone (DKK), where one Euro is approximately 7.44 DKK. Sample period: 2003-2020.

The second column displays summary statistics for households in our treatment group, which are households that become delinquent between 2009 and 2014.<sup>7</sup> About 2.6 million observations are belong to the treatment group. Households in delinquency have similar demographics, but are more likely to be divorced and less likely to be married. They have fewer assets and fewer liabilities than the average household. They have more loans and fewer mortgages than the average household, as they are less likely to be homeowners. Their net worth is on average negative at around -300 thousand DKK. Both their income and their disposable income is much lower than the income of the average household. Similar to the average household, they have a debt to income ratio of around 1.8. Their

6. The DKK is pegged to the EUR at 7.44:1 which implies an average net worth of ca. 6,400 EUR.

7. Note that we look at household-years. This implies that these summary statistics do not include the household-years during which the household is not delinquent.

liabilities to assets ratio is however much higher at around 1.5 (vs. 0.75 for the general population).

### 3 Event-study methodology

This section describes the methodology used in the rest of the paper. Section 3.1 presents the regression specification.

#### 3.1 Econometric specification

We follow the notation in Schmidheiny and Siegloch (2019) and estimate the following model:

$$Y_{i,t} = \alpha + \sum_{k=K_{min}}^{K_{max}} \mu_k b_{i,t}^k + \gamma_i + \gamma_{c(i)} \times \gamma_t + \varepsilon_{i,t}, \quad (2)$$

with

$$b_{i,t}^k = \begin{cases} \sum_{s=t-K_{min}}^{T_{max}-K_{min}} d_{i,s} & \text{if } k = K_{min} \\ d_{i,t-k} & \text{if } K_{min} < k < K_{max} \\ \sum_{s=T_{min}-K_{max}}^{t-K_{max}} d_{i,s} & \text{if } k = K_{max} \end{cases} .$$

Here,  $\alpha$  is a constant.  $\gamma_i$  is an individual fixed effect which controls for unobserved characteristics of the individual or household that are constant over time.  $\varepsilon_{i,t}$  is an error term.<sup>8</sup> As described above,  $d_{i,t-k}$  is a dummy that is 1 if individual  $i$  becomes delinquent in period  $t - k$  and 0 otherwise.  $b_{i,t}^k$  is equal to  $d_{i,t-k}$  if  $k$  is inside the event window ranging from  $K_{min} = -5$  years before to  $K_{max} = 6$  years after delinquency. That is, inside the event window, the coefficient  $\mu_k$  describes the effect of delinquency  $k$  periods ago on the outcome in period  $t$ .

At and beyond the boundaries of the event window  $K_{min}$  and  $K_{max}$ ,  $b_{i,t}^k$  is equal to 1 whenever the individual becomes delinquent at least  $|K_{min}|$  periods in the future or at least  $K_{max}$  periods in the past. That is to say, we assume that the effect of delinquency outside the event window is constant, i.e.  $\mu_k = \mu_{K_{min}}$  for  $k \leq K_{min}$  and  $\mu_k = \mu_{K_{max}}$  for  $k \geq K_{max}$ . We set  $K_{min} = -5$  and  $K_{max} = 6$ . As there are many changes that happen five years after a delinquency (e.g. deletion of the debtor from the "bad payer" registers), we include a time period of up to six years after delinquency. Schmidheiny and Siegloch (2019) recommend binning the treatment indicator, as failure to do so implies that the

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8. For a recent theoretical literature that discusses the validity of two-way fixed effects event studies, see Abraham and Sun (2018), Athey and Imbens (2018), Borusyak and Jaravel (2017), Callaway and Sant'Anna (2020), De Chaisemartin and d'Haultfoeuille (2020) and Goodman-Bacon (2018). For applications that use identification through random timing, see Fadlon and Nielsen (2015), Druedahl and Martinello (2017) and Fadlon and Nielsen (2019).

event study coefficients in a two-way fixed effects regression are only identified up to a linear trend (Borusyak and Jaravel (2017)).

The inclusion of individual fixed effects requires moreover that one  $\mu_k$  needs to be normalized. We normalize the coefficients  $\mu_k$  relative to the coefficient five years before delinquency,  $\mu_{-5} = 0$ . Intuitively, we assume that households that become delinquent do not systematically differ from the control group, i.e. from households that do not become delinquent 5 years before the delinquency, conditional on observables.

## 4 Delinquencies are partial and persistent

In this section, we conduct event studies to analyze the dynamics of household balance sheets around delinquency.<sup>9</sup> First, we document that delinquency is persistent and partial. Second, we document that delinquency is associated with substantial reductions in assets, but no deleveraging. As one would expect, we find that delinquency is related to substantial reductions in household income and substantial increases in their debt before a delinquency.

### 4.1 Loan-level event study

As a first exercise, we estimate a loan-level event study. The event study includes loan and year fixed effects. The treatment is the first time the loan enters delinquency status. Figure 1 shows the result. Prior to delinquency, there is no difference in loan repayment between treated and non-treated loans. At the time when a loan enters delinquency, its balance increases relative to untreated loans. The increase in the balance accumulates and increases by around 20 per cent after 5 years relative to a non-delinquent loan. This shows that delinquency is a persistent state at the loan-level.

### 4.2 A typical delinquency spell

Figure 2 displays dynamics of household delinquencies. It shows delinquencies at the household level. As delinquency is reported with a one year lag in the data, the delinquency indicator jumps to 1 one year after the household becomes delinquent. Around 20 percent of delinquent households leave delinquency in the year after. As in the US (cf. Athreya, Mustre-Del-Río, and Sánchez 2019), delinquency is persistent for the remainder of households. Almost 60 percent of households that declare delinquency in year zero are still delinquent five years later. Delinquencies are partial but substantial: households default on average on around 30 percent of their outstanding debt.

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9. Our approach is very similar in spirit to Dobkin et al. (2018).

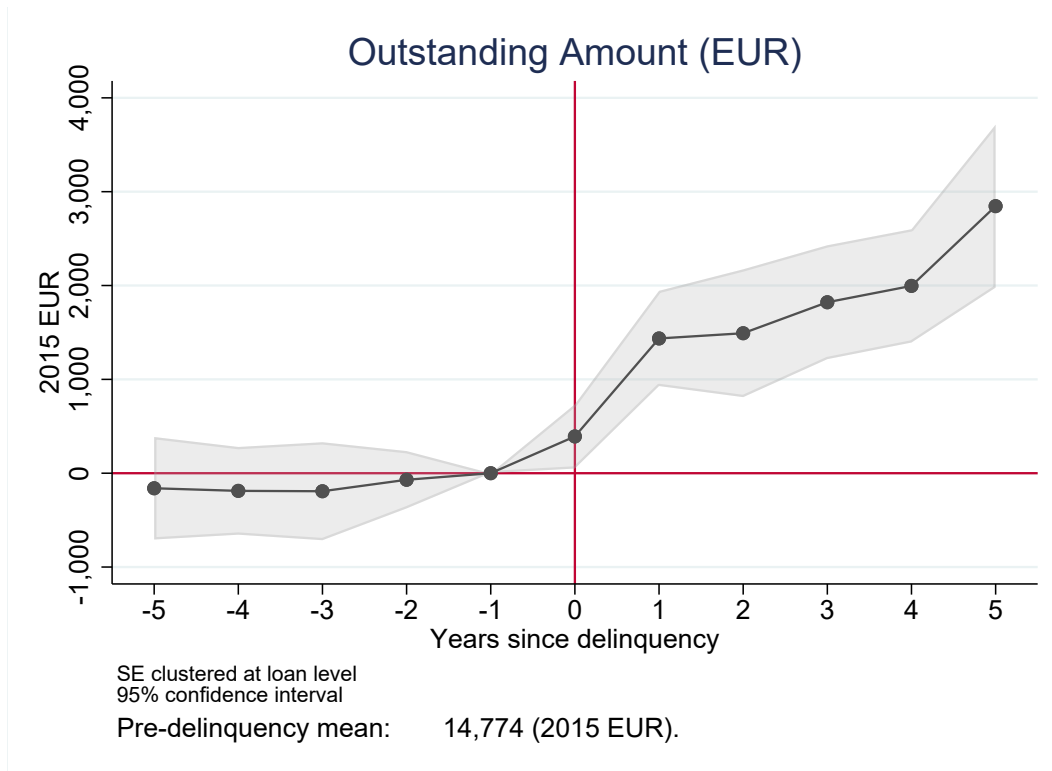


Figure 1: The effect of delinquency on the balance of a delinquent loan.

*Note:* This figure shows the results of estimating an event study at the loan level. The treatment is the first time a loan enters delinquency. The event study includes time and loan fixed effects. Standard errors are clustered at the loan level. Sample period: 2003-2018.

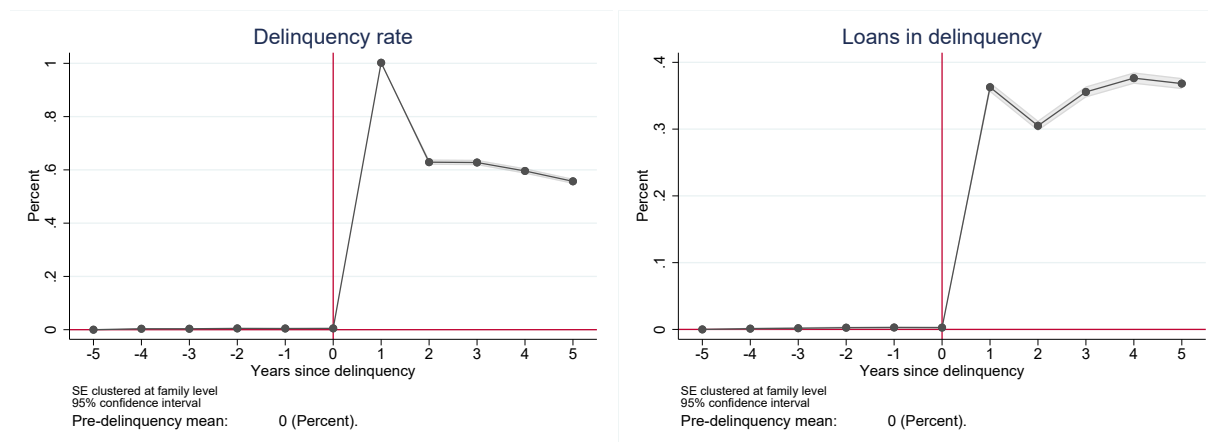


Figure 2: The effect of delinquency on the delinquency status of a household (left) and the fraction of loans in delinquency (right).

*Note:* This figure shows the results of estimating the event study specification (equation 2) at the household level. The treatment is the first time a household enters delinquency. The event study includes cohort  $\times$  time and household fixed effects. Standard errors are clustered at the household and year level. Sample period: 2003-2016.

Table 4: Annual transition probabilities.

	to current	to delinquent	to bankruptcy
current	98.49	1.32	0.18
delinquent	13.37	80.90	5.72
bankruptcy	19.27	17.35	63.38

*Note:* This table shows annual transition probabilities at the household level between the household being current on its loans, being delinquent on its loans and being bankrupt on its loans. The current state of the loan is depicted in the rows, the future state in the columns.

Table 4 investigates the persistence and the flows into and out of delinquency more closely. It shows transition probabilities between three possible states *solvent*, *delinquent* and *in bankruptcy* at the household level. The probability that a household stays in delinquency conditional on having been delinquent in the previous year is around 81 percent. Delinquency is the natural precursor to bankruptcy. Households do not transition from solvency into bankruptcy directly. This is consistent with economic intuition: before declaring costly bankruptcy, households informally default. If a drop in income was the cause, they might be looking for a new job; if they have significant (illiquid) assets, they might try to sell them. This behavior is also consistent with the Danish bankruptcy regulation, which requires households to be "hopelessly indebted" to be eligible for bankruptcy. One criterion for this is that households have not been able to service their debt for an extended period of time.

## 5 Delinquencies are strategic

### 5.1 Balance sheet dynamics around delinquencies

Figures 3 and 4 document aggregate balance sheet dynamics of households around delinquency. There are substantial pre-trends: households experience a fall in their total assets and a rise in total liabilities, which leads to a substantial fall in net worth.

Assets fall by around 200 thousand DKK during the five years preceding delinquency, and by a further 300 thousand DKK in the five years after. Households lose around 65 percent of their total assets around a delinquency. Looking at the components of the fall in total assets and the rise in total liabilities, the majority of the fall in assets is driven by a reduction in housing wealth, followed by liquid financial assets (bank deposits) and illiquid financial assets (stocks, bonds).

Total liabilities rise by around 90 thousand DKK, or around 10 percent, up until two years before delinquency. They then fall back to their initial level in the first year after delinquency and continue to decrease, levelling out at around 40 thousand DKK below the initial level. The rise in liabilities is mainly driven by a large increase in bank loans of



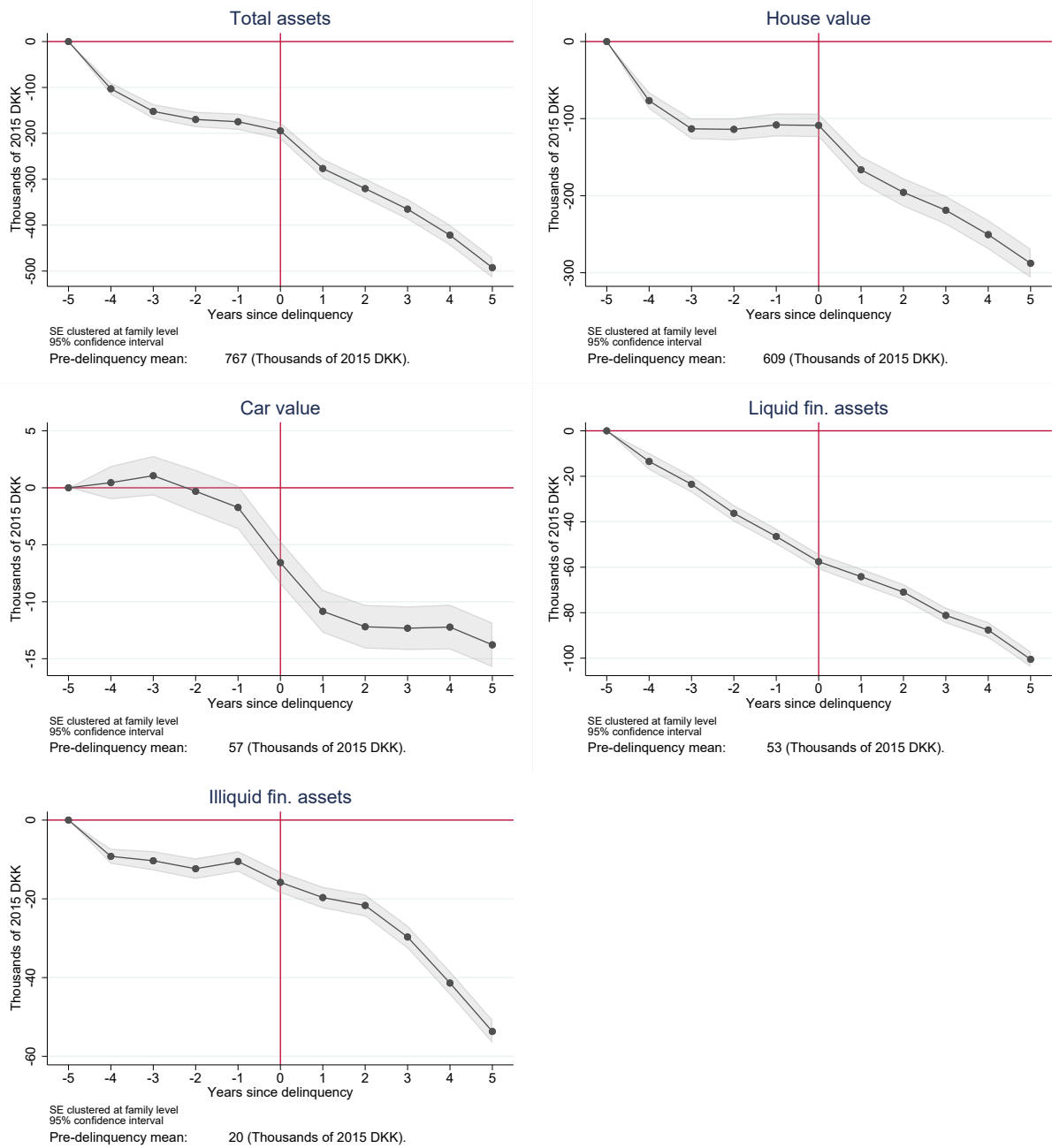


Figure 3: Total assets and its components around a delinquency.

*Note:* This figure shows the results of estimating the event study specification (equation 2) at the household level. The treatment is the first time a household enters delinquency. The event study includes cohort  $\times$  time and household fixed effects. Standard errors are clustered at the household and year level. Sample period: 2003-2016.

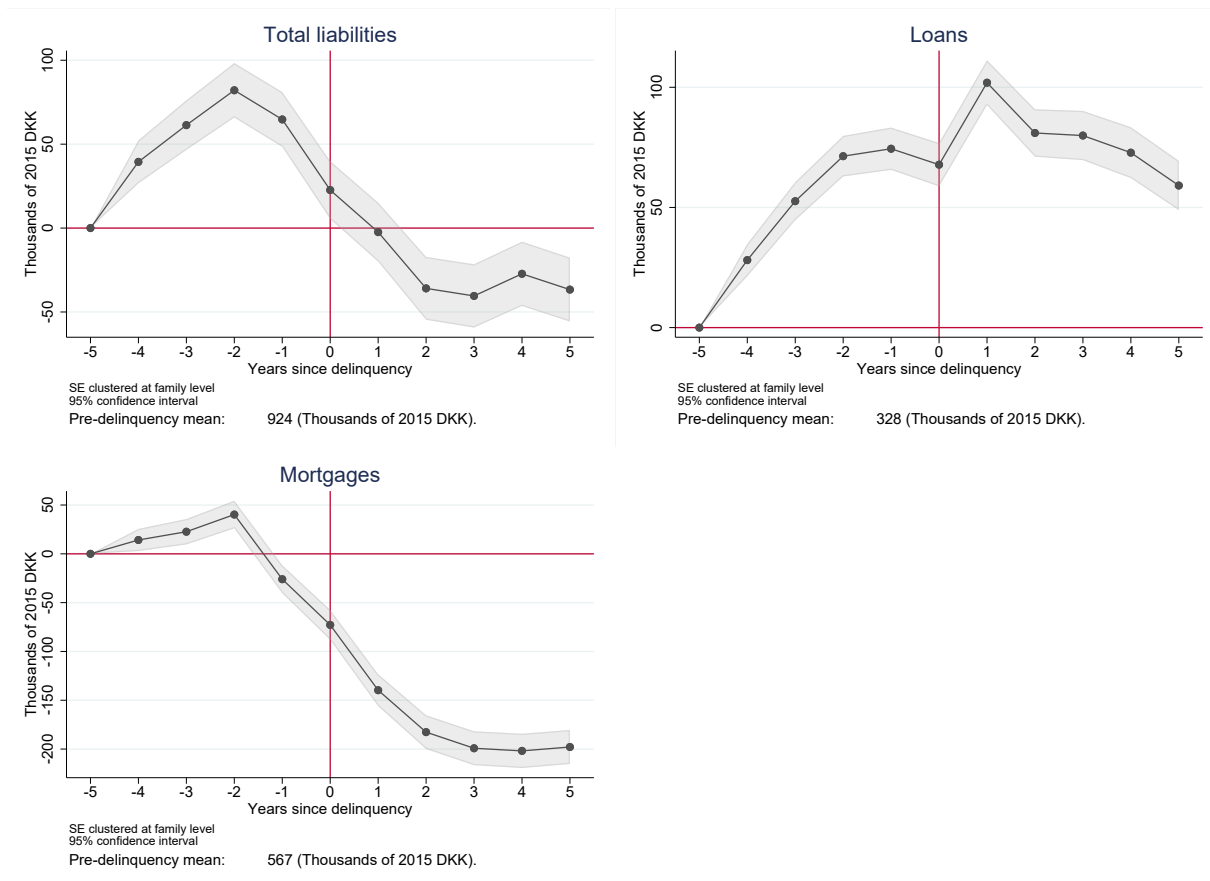


Figure 4: Total liabilities and its components around a delinquency.

*Note:* This figure shows the results of estimating the event study specification (equation 2) at the household level. The treatment is the first time a household enters delinquency. The event study includes cohort  $\times$  time and household fixed effects. Standard errors are clustered at the household and year level. Sample period: 2003-2016.

around 60 thousand DKK (18 percent), and a small increase in mortgages, by around 30 thousand DKK (5 percent). The fall in liabilities is driven entirely by a fall in mortgages, while bank loans stay persistently elevated.

Even five years before their delinquency, households which eventually become delinquent have a negative net worth of around -178 thousand DKK. The fall in assets and the rise in liabilities mean that the households' net worth falls by another 400 thousand DKK by the time of delinquency.

## 5.2 Income and savings dynamics around delinquencies

Figure 5 investigates households' income dynamics around a delinquency. In the five years before a delinquency, total household income falls by around 80 thousand DKK, levelling out thereafter. This is a substantial fall, corresponding to an income decline of around 17 percent relative to five years before delinquency. This decline is mostly driven by labor income, which drops by around 60 thousand DKK (17 percent). After taxes and interest payments, this decline translates into a fall in disposable income of around 40 thousand DKK, or around 14 percent relative to five years before the delinquency.

Consistent with Figure 3, we document lower savings and higher borrowing. While this allows the household to initially maintain its total spending (our proxy for consumption) for a few periods, there is a reversal in the period before delinquency, in which households drastically reduce borrowing, leading to a decline in total spending of around 90 thousand DKK, or 23 percent relative to five years before delinquency. This fall in total spending is much bigger than the fall in disposable income, consistent with households cutting total spending to reduce borrowing and to avoid becoming delinquent.

## 5.3 Can't pay or won't pay?

Why do households become delinquent? The fact that they reduce spending (our proxy for consumption) to reduce their debt suggests that households would not be able to repay their debts while maintaining their level of total spending. In other words, the households' ability to pay has reduced. However, maintaining the original level of total spending is a very generous way of defining households' ability to repay their debt.

Alternatively, we use the level of social security benefits as a natural lower bound for households' spending. In this rather harsh scenario, households only consume the level of social benefits and their ability to repay debt is their disposable income minus social benefits. The level of social benefits depends on the age of the household head as well as the cohabiting status and the number of children in the household. Figure 6 investigates the distance of the households from the Danish social security benefit level. While the distance of households' disposable income from the level of social security benefits decreases around delinquency, it still remains comfortably above it. In other

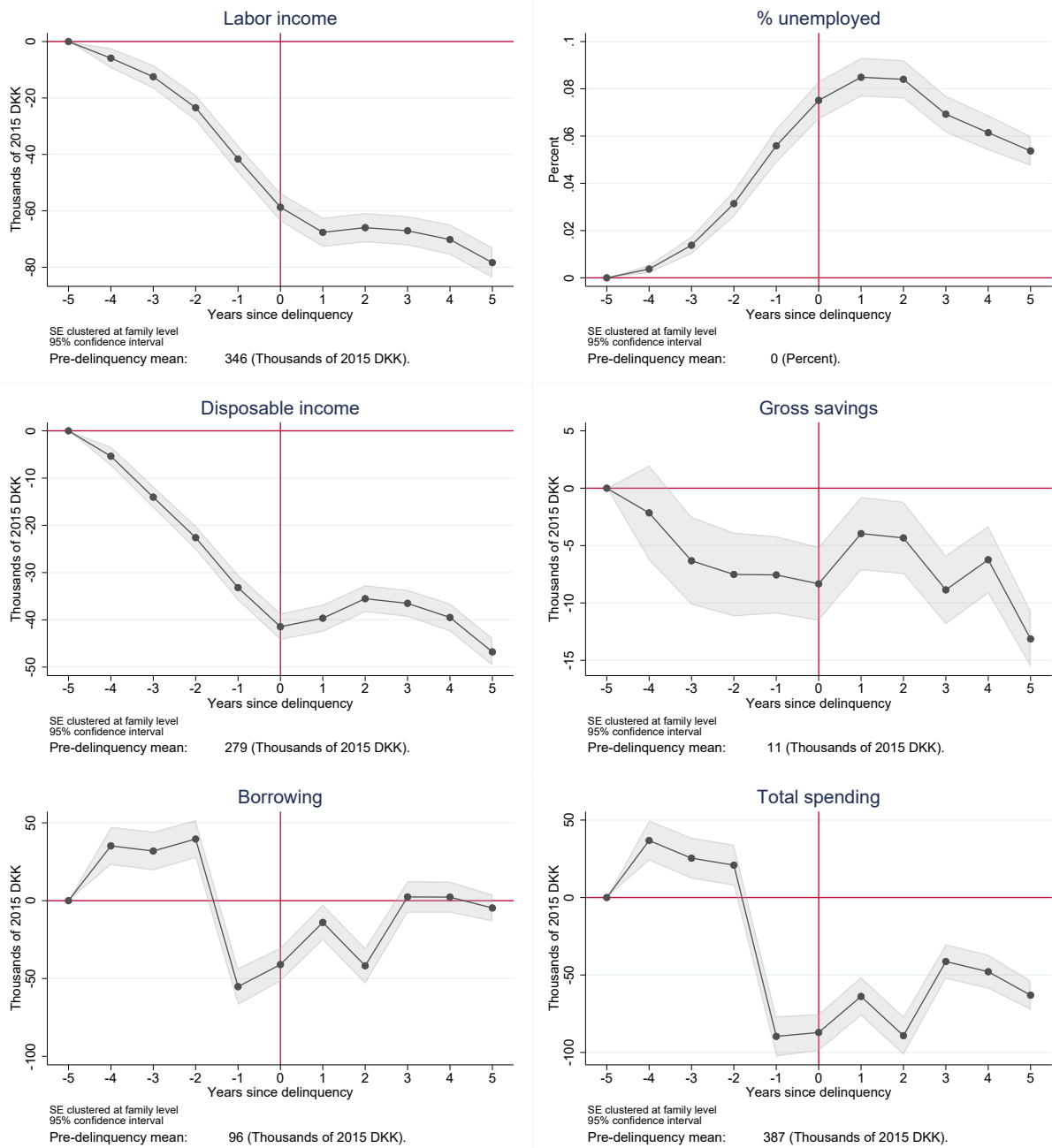


Figure 5: Income, savings and consumption.

*Note:* This figure shows the results of estimating the event study specification (equation 2) at the household level. The treatment is the first time a household enters delinquency. The event study includes cohort  $\times$  time and household fixed effects. Standard errors are clustered at the household and year level. Sample period: 2003-2016.

words, were households to only consume at the social benefit level they could repay much more debt. This is true for almost 90 percent of the households that become delinquent.

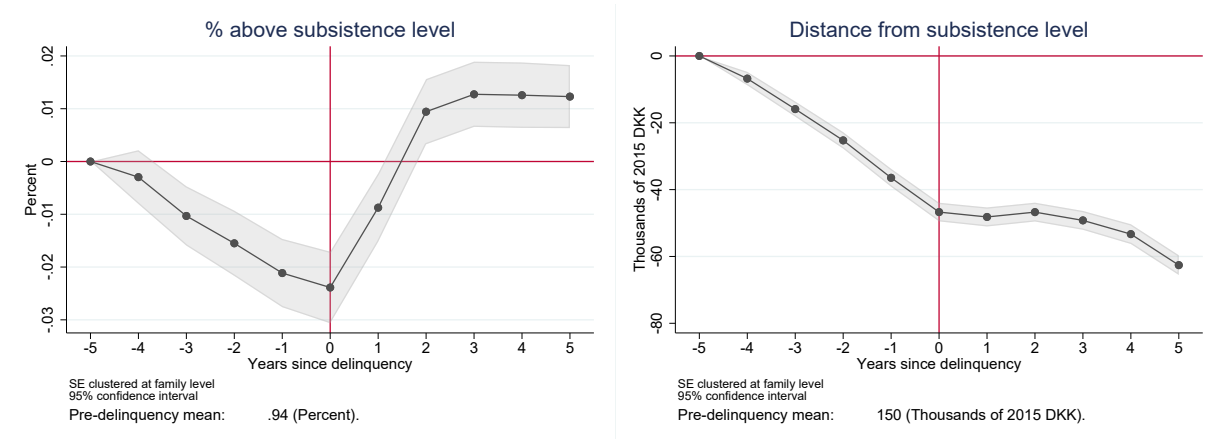


Figure 6: Ability to pay measure.

*Note:* This figure shows the results of estimating the event study specification (equation 2) at the household level. The subsistence level is defined as the level of Danish social security benefits the household is eligible for. The treatment is the first time a household enters delinquency. The event study includes cohort  $\times$  time and household fixed effects. Standard errors are clustered at the household and year level. Sample period: 2003-2016.

Thus, while experiencing a decline in their ability to pay, Figure 6 suggests that delinquency is at least partially driven by strategic incentives. For example, not repaying their loans is a way for households to force renegotiation of their credit contracts with their lenders, which could lead to a reduction in interest payments or a reduction of the outstanding balance. To investigate whether this is the case, Figure XX runs an event study that compares interest payments and loan amounts of loans that households become delinquent upon versus those that the same households do not become delinquent upon.

To shed more light on the relative importance between strategic motives and liquidity driven delinquencies, we separate our sample in two dimensions: first, we distinguish between delinquents with debt-to-income ratios below and above the median debt-to-income ratio. Higher outstanding debt relative to income increases the strategic motives for default. The higher the debt burden, the higher the gain from defaulting on it. Second, we distinguish between high and low ability to pay. Ability to pay is measured as

$$\begin{aligned}
 \textit{Ability to pay} = & \textit{Disposable income excl. interest} + \textit{bank deposits} \\
 & - \textit{avg. predelinquency interest payment} - \textit{subsistence level}.
 \end{aligned}
 \tag{3}$$

This measure classifies borrowers to have a high ability to pay if they can cover their interest payments and afford subsistence level consumption with their disposable income or bank deposits. As evident in Table 5, having a low ability to pay increases the

	D/I $\leq$ Median	D/I $>$ Median	Total
Low Ability to pay	1.21	1.71	1.23
High Ability to pay	1.00	1.40	1.00
Total	1.00	1.40	

Table 5: Odds Ratio for first delinquency

probability to be delinquent by 23%. However, holding debt (relative to income) larger than the median increases the likelihood to be delinquent by 40%. Thus, we conclude that while liquidity concerns are important to explain default, the strategic component matters more.

## 5.4 Potential drivers of delinquency

The literature has identified various drivers of delinquency and bankruptcy on unsecured debt. Broadly, they can be categorized into income shocks and expenditure shocks. Income shocks – i.e. a sudden reduction in income – can result from hospitalizations or unemployment. Expenditure shocks – i.e. large unforeseen expenses could follow divorces that trigger lawyer fees or alimony payments or unexpected pregnancies. Albeit more foreseeable, we also consider house purchases and car purchases as a financial burden that might trigger payment problems when combined with irrational expectations on one’s ability to pay or with a lack of financial planning.

Figure 7 considers how events that trigger income or expense shocks evolve around a typical delinquency. Around a delinquency, there is a large, persistent rise in unemployment, and a large increase in the likelihood of being divorced. In contrast, there is only an insignificant increase in the likelihood of hospitalization. There is no evidence for new car or house purchases that might tip the scales: households rather reduce the value of these assets leading up to delinquency. Note that Figure 7 documents the probabilities of these shocks for all delinquent households relative to solvent households.

## 5.5 Heterogeneous Dynamics

XXX TODO: we should look at our four take-home messages: 1. partial, 2. persistent, 3. strategic, 4. costly. are those still true?

This subsection explores heterogeneous dynamics around delinquency. First, one might be concerned about the effects of changes in house ownership around a delinquency. Therefore, section 5.5.1 splits the sample into house owners versus renters. Second, section 5.5.2 shows that households break up at an elevated rate around delinquencies, and therefore splits the sample into married couples and singles. Finally, section 5.5.3 splits

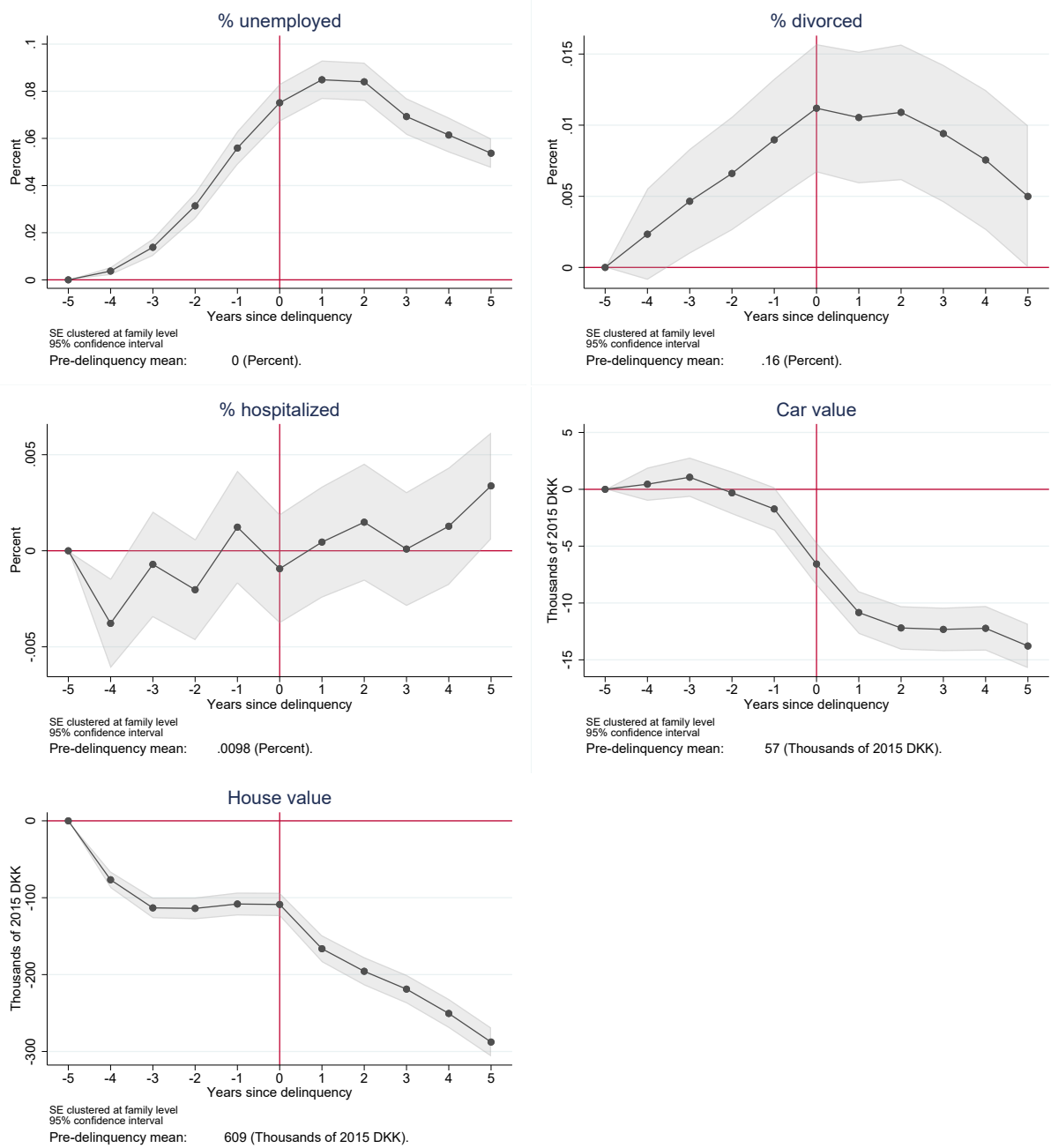


Figure 7: Potential drivers of delinquency.

*Note:* This figure shows the results of estimating the event study specification (equation 2) at the household level. The treatment is the first time a household enters delinquency. The event study includes cohort  $\times$  time and household fixed effects. Standard errors are clustered at the household and year level. Sample period: 2003-2016.

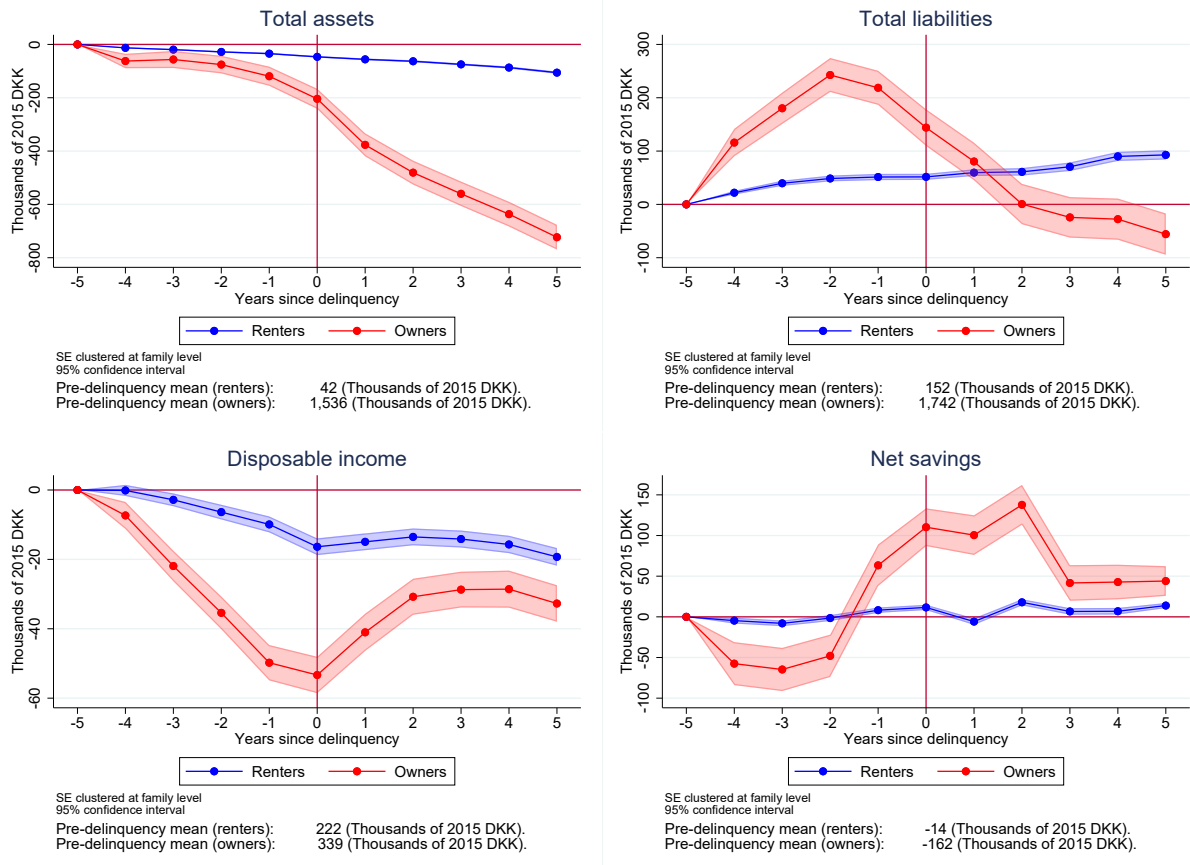


Figure 8: Heterogeneous effects for renters and owners.

*Note:* This figure shows the results of estimating the event study specification (equation 2) at the household level. We split the sample into households that ever own a house during the sample period (owners) and households that never own a house during the sample period (renters). The treatment is the first time a household enters delinquency. The event study includes cohort  $\times$  time and household fixed effects. Standard errors are clustered at the household and year level. Sample period: 2003-2016.

the sample into households that become only delinquent for one year and households that are persistently delinquent.

### 5.5.1 Renters vs owners

A potential driver of the balance sheet dynamics presented above could be sales of large assets such as houses. That could present a problem, as housing transactions are very large relative to the balance sheets of households, and could thus overshadow the dynamics around a delinquency. To address this concern, we repeat our event study focusing on households who are always renters in the 10 years around their delinquency.

Indeed, these results show that the fall of liabilities in the wake of a delinquency is driven by the dynamics of households selling their houses and repaying their mortgages. Renters experience a persistent increase in liabilities following a delinquency, instead of a strong increase followed by a decline observed for the full sample.



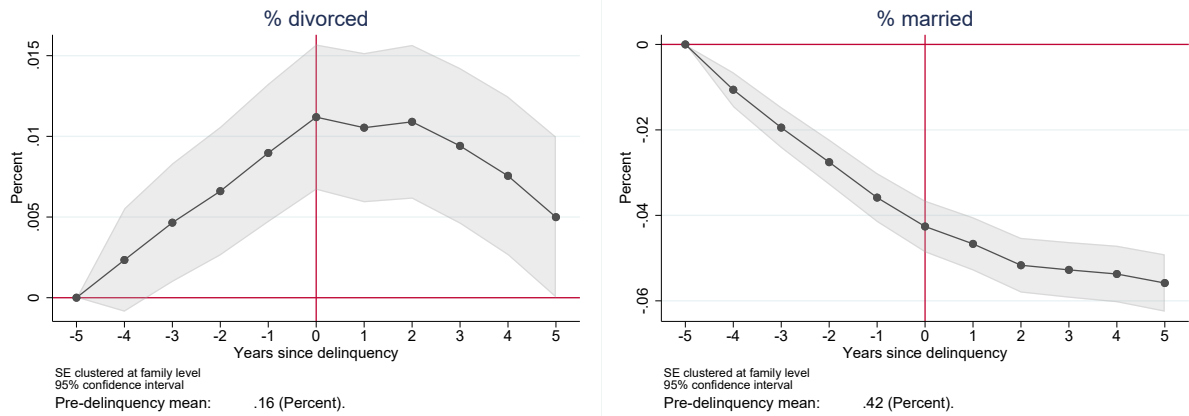


Figure 9: Family Disruptions around Delinquency.

*Note:* This figure shows the results of estimating the event study specification (equation 2) at the household level. The treatment is the first time a household enters delinquency. The event study includes cohort  $\times$  time and household fixed effects. Standard errors are clustered at the household and year level. Sample period: 2003-2016.

### 5.5.2 Singles vs couples

Delinquency is associated with family disruptions. Figure 9 documents that when households become delinquent, they are more likely to be divorced and less likely to be married. This effect leads to non-random attrition, as financial distress is strongly related to family disruptions. Some households disappear from the sample, which influences the observed balance sheet dynamics. To address this concern, this section investigates the balance sheet dynamics for households that are single person households throughout the sample period.

### 5.5.3 Persistent defaulters

Finally, our definition of delinquency includes transitory as well as persistent delinquencies. The former might just stem from a household forgetting to repay a small debt, while the latter might represent a household in dire financial distress. Of course, these two types of delinquencies have very different implications. To address this concern, Figure 10 distinguishes between households that are only delinquent for one year and households that are delinquent for more than one year. While the rise in liabilities and the drop in income are comparable prior to delinquency, persistent delinquencies are preceded by a larger reduction in assets. Naturally, one-year delinquencies are associated with a quicker recovery of income and liabilities. However, they do not seem to merely represent households who forgot to pay one installment of their loans.

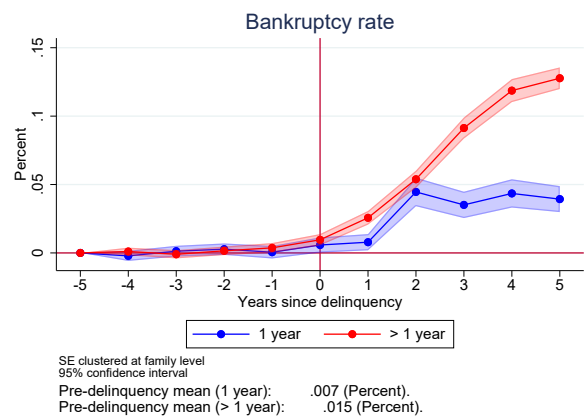
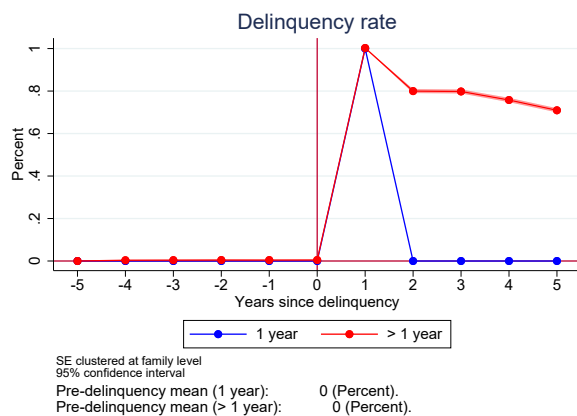
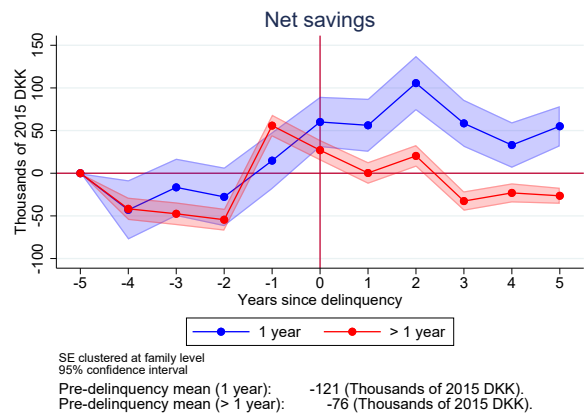
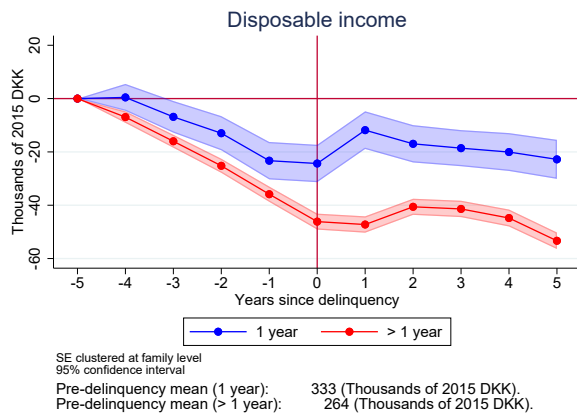
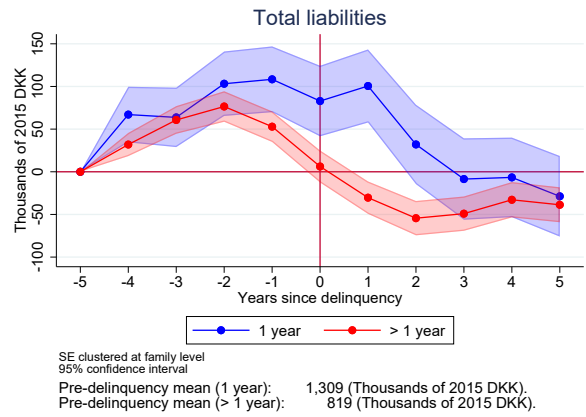
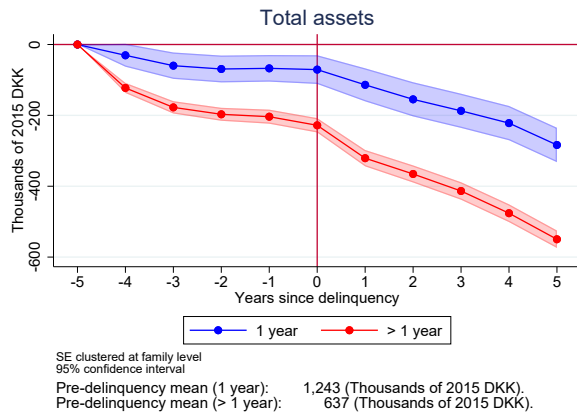


Figure 10: Assets, liabilities, income and total spending - transitory vs. persistent delinquency.

*Note:* This figure shows the results of estimating the event study specification (equation 2) at the household level. We split the sample according to whether households are delinquent for only one year (1 year) or whether they are delinquent for more than one year ( $\geq 1$  year). The treatment is the first time a household enters delinquency. The event study includes cohort  $\times$  time and household fixed effects. Standard errors are clustered at the household and year level. Sample period: 2003-2016.

## 6 Delinquencies are costly

The previous section documented substantial pre-trends in income and balance sheets around a typical delinquency. These make it difficult to identify the effects of delinquency. To make some progress towards identifying the effects of a delinquency, this section extends the event study approach of the previous section by conditioning on a very rich set of household characteristics, including income quantiles and net worth quantiles. We introduce these controls as interacted fixed effects.

The identification assumption for the effect of a delinquency on total spending is that compared to households with the same assets, the same liabilities, the same disposable income and the same homeownership status, living in the same municipality, having the same amount of children, and controlling for household fixed effects, there are no unobserved variables that are correlated with both total spending and the decision of a household to become delinquent.

### 6.1 Specification

We estimate the following model:

$$Y_{i,t} = \alpha + \sum_{k=K_{min}}^{K_{max}} \mu_k b_{i,t}^k + \gamma_i + \gamma_{income} \times \gamma_{networth} \times \gamma_{couple} \times \gamma_{owner} \times \gamma_{children} \times \gamma_{municipality} \times \gamma_{cohort} \times \gamma_{time} + \varepsilon_{i,t}. \quad (4)$$

We include interacted fixed effects for ten disposable income bins ( $\gamma_{income}$ ), ten net worth bins ( $\gamma_{networth}$ ), for whether a household consists of a couple ( $\gamma_{couple}$ ), for whether a household owns a house ( $\gamma_{owner}$ ), for the number of children ( $\gamma_{children}$ ), for the municipality in which a household lives ( $\gamma_{municipality}$ ), the cohort of the household head ( $\gamma_{cohort}$ ) and the year ( $\gamma_{year}$ ). These highly granular fixed effects allow us to compare the balance sheet dynamics of households that are similar in many characteristics, including income and net worth, but which differ in whether they became delinquent in period  $t - k$  or not.

For example, we compare the consumption of two married couples in their early thirties, living in Tønder municipality, with two children, owning a house, and having a disposable income in the third income decile and a net worth in the fifth decile in 2013. The difference between the couples is that one of them became delinquent in 2009, while the other one did not. These highly granular fixed effects, as well as the inclusion of household fixed effects, make it plausible to associate the difference in outcomes between those two households to their differential exposure to financial distress.

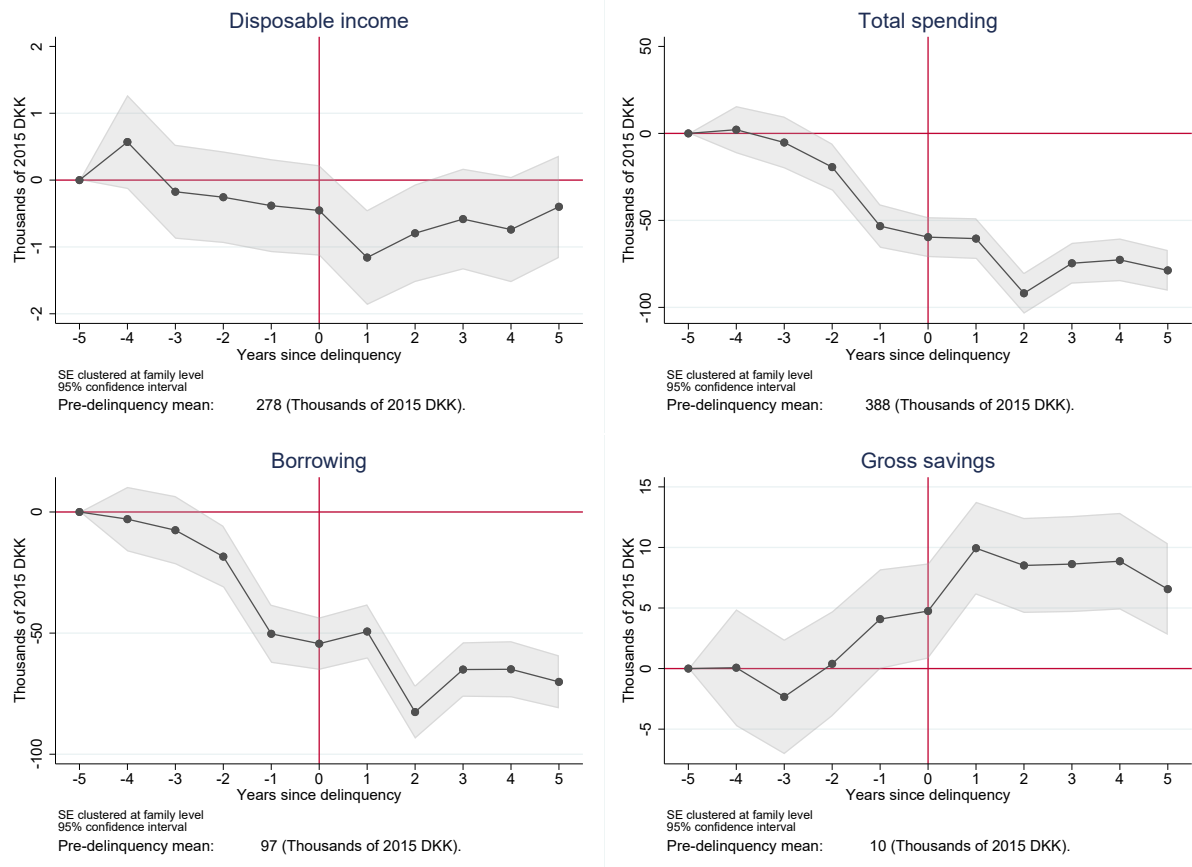


Figure 11: The effects of delinquency on consumption and savings.

*Note:* This figure shows the results of estimating the event study specification (equation 4) at the household level. The treatment is the first time a household enters delinquency. The event study includes cohort  $\times$  time and household fixed effects. Standard errors are clustered at the household and year level. Sample period: 2003-2016.

## 6.2 Borrowing, saving and total spending

Figure 11 shows the results of estimating equation 4. First, even within a relatively narrow for net worth, households that become delinquent experience a slightly larger decline in disposable income than other households. The size of that decline is however very small. In contrast, delinquent households contract total spending substantially around the delinquency. The peak fall in total spending is around 100,000 DKK. This is a fall of about 25 per cent relative to pre-delinquency total spending. This decline in spending is highly persistent, as household spending does not recover in the five years after delinquency.

As disposable income is constant, and as total spending is defined as disposable income minus net savings, the decline in total spending must see a similar increase in net savings. The bottom two panels of Figure 11 decompose the decline in net savings into borrowing and gross savings. While gross savings slightly increase, borrowing declines substantially. It drives the bulk of the increase in net savings. At its trough, borrowing declines by

90,000 DKK and remains depressed.

These results show that delinquency entails a substantial cost for households. Relative to households that are similar in income, net worth, and a range of other characteristics, consumption and borrowing decline substantially and persistently.

## 7 Conclusion

We provide novel evidence on the dynamics of household balance sheets during times of financial distress. To that end, we leverage administrative data on the universe of Danish bank loans and mortgages, which we merge with rich Danish register data to generate the first comprehensive administrative data set containing both, rich balance sheet information and the universe of nonpayment events. Using an event study approach, we document four facts. First, delinquency is partial. Second, delinquency is persistent. Third, delinquency is strategic, and fourth, delinquency is costly.

Our results indicate that delinquency has substantial and long-lasting negative effects on households. An important avenue for future research is to reconcile these large negative effects with the evidence that delinquency is strategic. It would be interesting to explore whether borrower optimism about the costs of delinquency can help to reconcile these observations.

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# Appendix

## A Data Appendix

### A.1 Data description

Our main dataset are two datasets, URTE and PANT, from the Danish tax authority.<sup>10</sup>

### A.2 URTE

URTE is an annual dataset that contains all non-mortgage loans of all individuals that have a Danish registration (CPR) number. The data is at the loan level. It is reported by the lender institution, which can be a bank, a credit card provider (kortudsteder), a loan company (finansieringsselskab), a mortgage bank or a municipality. An example for a credit card provider are for example gas station chains that offer cars. An example for a loan company are consumer credit companies. Mortgage banks are big, specialized financial institutions that are particular to the Danish financial system. They issue mortgage credit financed by special mortgage bonds.

URTE contains the following information: The ID of the borrower, the ID of the reporting institution, the account number, an indicator about joint ownership of the account, the account type, the outstanding amount, the remaining maturity, a default indicator, the interest paid in the current year and the notional interest rate. There are three groups of account types - student loans (account identifiers 41, 42, 44, 54, 55 and 58), public loans (account identifiers 59, 60 and 66) and bank loans (account identifiers 53, 56 and 57). The default indicator can take on 6 different values: 0 - not in arrears, 2 - debt in arrears in the preceding year, 4 - debt forgiveness as part of a public debt forgiveness, 5 - debt forgiveness as part of a private (conditional) debt forgiveness, 6 - as 5, but indicating that a new agreement has been made in the current year, 7 - debt forgiveness ceased. We recode this variable as three dummies. The first, default, takes the value 1 if the original indicator is 2. The second, public bankruptcy, takes the value 1 if the original indicator is 4, and the third takes the value 1 if the original indicator is 5, 6 or 7.

Before collapsing the data set to the individual level, we drop the following observations:

- We drop all student loans (account identifiers 41, 42, 44, 54, 55 and 58)
- We drop public loans (account identifiers 59, 60 and 66).

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10. The data is documented at <https://skat.dk/skat.aspx?oid=2231323>.

- We focus on loans where at least one debtor lives in Denmark (owner identifiers 0 and 4).
- We drop all bank accounts, which are flagged as containing a typing error (error flag 1 or 2).

We then collapse the data to the individual level as follows: we sum up interest payments and the outstanding amount for each individual across bank accounts. We take the maximum of the default and bankruptcy dummies across bank accounts. This implies that we treat an individual as in default if it has defaulted on at least one bank account. We take the average of interest rates across bank accounts. In addition, we calculate the debt in default as the sum of all bank accounts where the default dummy is 1, and we also include a count of the number of bank accounts.

### A.3 PANT

PANT is a similar dataset that contains all mortgage loans issued by mortgage banks. It contains the same information as URTE. There's only one type of account types, 33 - priority loans at mortgage institutions and mortgage credit lending funds. The default indicator can take on 4 values: 0 - not in arrears, 1 - debt in arrears in the preceding year, 5 - private (conditional) debt forgiveness, 9 - foreclosure during the year. We recode this variable as three dummies, one for each code. We aggregate the data to the individual level in the same way as in URTE.

### A.4 Other registers

As the data contains a unique identifier for each individual, it can be merged to the rich register data from Statistics Denmark, which allow us to match the data on defaults with data on individual demographic characteristics and household balance sheets. We merge the data with data on the balance sheet of households (IND), demographics (BEF), education (UDDA), pensions (INPI, INHP), employment (IDAP), house ownership (EJER) and hospitalizations (SYHB).<sup>11</sup>

#### A.4.1 IND

From IND, we obtain household balance sheet data.

**Assets** We calculate liquid assets, which are defined as liquid deposits at banks (bankakt). We also calculate financial assets, which are defined as holdings of stocks (kursakt + ud-lakt) and bonds (oblakt + bankakt). The last asset class of individuals are the values

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11. The data is documented at <http://www.dst.dk/extranet/forskningvariabellister/Oversigt%20over%20registre.html>.

of their properties (ejendomsvurdering). Note that this property valuation is the public property valuation used for tax purposes, which can deviate significantly from the market-based property valuation. We obtain a market-based property valuation from FORMEJER, as described below. Total assets (qaktiv\_ny05) are the sum of all of these variables.

**Liabilities** Individuals have bank debt (bankgaeld), mortgage debt (oblgaeld + pantgaeld) and debt at foreign banks (udprigael). Total liabilities (qpassivn) is the sum of these variables. The difference between total assets and total liabilities is the net worth of individuals (formrest\_ny05).

**Income** An individual's labor income (erhvervindk\_13) is the sum of salaries (loenmv\_13), fees (hony) or the surplus from owning a company (netovskud\_13). The other income categories are public transfers (off\_overfoersel\_13), private pensions (privat\_pension\_13), capital income (formueindk\_brutto) and other income (resuink\_13). The sum of them is the total income of an individual (perindkialt\_13). Disposable income (dispon\_13) is total income plus the rental value of the own house (lejev\_egen\_bolig) minus interest payments (rentudgpr), taxes (skatmvialt\_13) and child support (underhold).

**Savings and Expenditure** Savings are not directly observed. We approximate savings by the change in assets relative to the last year (qaktiv\_ny05) plus private pension savings (qpripen) minus the change in liabilities relative to the last year (qpassivn) minus pension payouts (atp\_engang - atp\_engang\_af + sp\_pension - sp\_pension\_af + ld\_udbetal - ld\_udbetal\_af + haevpen - haevpen\_af). This definition of savings includes measurement error due to the inclusion of capital gains. Domestic stock holdings are adjusted by the year-on-year change in the Danish stock index times last years stock holdings. This assumes that households own domestic stocks in proportion to the domestic stock index. Expenditure is computed as disposable income minus savings.

#### A.4.2 BEF

From BEF, we obtain the following data: the ID of an individual, the ID of his or her partner, the family ID the individual belongs to, the age and the sex of the individual and his or her marital status. The marital status can take on the following values: E - widowed, F - divorced, G - married, L - longest living in a civil union, O - ceased civil union, P - civil union, U - unmarried. We define an individual as married if his/her marital status is G or P, and as divorced if his/her marital status is S or O.

### **A.4.3 AKM**

From AKM, we obtain the variable `socio13`, which describes the socioeconomic status of an individual. This variable contains a detailed list of socioeconomic status values, e.g. a person being self-employed, employed, unemployed, a retiree, etc..<sup>12</sup>

### **A.4.4 UDDA**

UDDA contains information about the education level of individuals. We use the highest fulfilled degree for each person. The variable containing that information has many different degrees at a four digit level code. We aggregate these degrees to 10 single digit education categories, namely 0 - lower childhood education, 1 - primary, 2 - lower secondary, 3 - upper secondary, 4 - short cycle tertiary, 5 - short cycle tertiary II, 6 - bachelor or equivalent, 7 - master or equivalent, 8 - PhD or equivalent, 9 - not elsewhere classified.

### **A.4.5 IDAP**

From IDAP, we obtain information about the number of weeks that a household is unemployed. There are two different unemployment concepts: "nettoledighed" and "bruttoledighed". The former, "nettoledighed", include people receiving unemployment benefits of social benefits, but excludes people that receive unemployment training. The latter measure includes this last group. We define a person as being unemployed in a year if he/she is unemployed according to the "nettoledighed" concept for more than 13 weeks during a year.

### **A.4.6 EJER, FORMEJER**

From EJER, we obtain the property ID of each building in Denmark and the ID of its owner. We combine this data with FORMEJER, which contains estimated market values for each property. We collapse the information to the individual level by counting all the properties that each person owns. If a property is owned by multiple people, it is counted separately for each person. We define a person as a property owner if he/she owns at least one property.

### **A.4.7 SYHB**

From SYHB, we obtain the number of days that each person spent in a hospital due to illness during each year. This excludes days in the hospital due to pregnancy. We define a person as being hospitalized in a given year if he/she spends more than 14 days in the hospital during that year.

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12. A documentation can be found [on the website of Statistics Denmark](#).

## **A.5 Aggregation at the household level**

We aggregate all individual variables to the household level in the following way: we sum up all variables expressed in DKK across individuals in a household. For interest rates, we take averages across all individuals in a household. For dummy variables, we take the maximum across individuals. That is, if any individual in a household is in default, the household is considered to be in default. For demographics, we take the age, sex, socioeconomic status and education of the household head, which is defined to be the person with the highest overall income in the current year.

## **A.6 Sample selection**

The data set covers the years 2003-2016. For feasibility reasons, we use a random 10 percent sample of the population. We exclude data for 2017 and 2018, as there appear to be important changes to reporting in URTE and PANT. We start with URTE and merge it with PANT, keeping all observations that appear in both URTE or PANT or only in URTE. We then merge the resulting data set with the other registers, dropping observations from the other registers that do not appear in the main data set. We then impose the following sample restrictions:

- We drop observations with negative debt from URTE or PANT
- We only include households in which the household head is between 25-60.
- We drop all observations with negative debt, interest payments, wage income and disposable income, or with missing values for those variables.
- We drop all observations that are in default throughout the sample period, as we do not know when these people entered default.

We deflate all variables with the Danish CPI deflator. We then winsorize all variables at the upper 0.1 percent tail. Variables in levels are then transformed using the inverse hyperbolic sine transformation.

## **A.7 Variable definitions**

code	name	comments	data source
<b>Outcomes</b>			
rest_gaeld_blb	bank loans	excludes mortgages	URTE
rest_gaeld_blb_pant	mortgages	includes mortgages issues by banks and mortgage institutions	PANT
rest_gaeld_blb + rest_gaeld_blb_pant	total debt		URTE & PANT
rnt_fod_pct	interest rate on bank loans	reported at single digit level	URTE
rnt_fod_pct_pant	interest rate on mortgages	reported at single digit level	PANT
dispon_13	disposable income	includes the imputed rental value of property ownership	IND
loennv_13	wage income	does not include bonuses	IND
formrest_ny05	net worth	includes the estimated value of the house	IND
bank_akt	liquid assets	includes bank deposits	IND
indestpi - bank_akt + kurs_akt + udl_akt	financial assets	financial assets include all stocks and bonds	IND
<b>Inputs to the consumption imputation</b>			
atp_engang, sp_pension, ld_udbetal, haevpen	pension payout		INHP
atp_engangaf, sp_ensiomaf, ld_udbetalaf, haevpenaf	taxes on pension payout		INHP
op_indestpi	$\Delta$ bank deposits <sub>t</sub>		IND
op_kursakt	$\Delta$ domestic stocks <sub>t</sub>		IND
op_udlakt	$\Delta$ international stocks <sub>t</sub>		IND
af_realgaeld	$\Delta$ mortgage debt <sub>t</sub>		REAL
af_bankgaeld	$\Delta$ bank loans <sub>t</sub>		IND
af_pantgaeld	$\Delta$ collateralized bank loans <sub>t</sub>		IND
prpensindbetal	$\Delta$ private pension savings <sub>t</sub>		INPI

Table 6: Data definitions.