

How do Households Respond to Unemployment Shocks?

Lessons from Multiple High-Frequency Data Sets*

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Abstract

We provide precise and comprehensive evidence on how households respond to unemployment shocks by linking multiple high-frequency administrative data sets from government agencies, covering the entire Danish population, with transaction-level data from a major bank. The data tracks households for 72 months between January 2009 and December 2014, allowing us to use an event study design to achieve compelling identification of the impact of unemployment along key response margins. By studying responses for the same individuals using the same research design, we are able to assess the relative importance of the various margins. We find almost no change in spousal labor supply; a significant increase in the use of interest-only and adjustable-rate mortgage products, albeit with little impact on monthly payments; no increase in mortgage debt, but a moderate increase in non-collateralized debt and a sizeable depletion of liquid assets. The largest effect is on household spending. Spending drops, on average, by 6 percent on impact and stays at this lower level over a two-year period following job loss. The cumulative effect on spending over this period corresponds to 35 percent of the cumulative income loss.

Keywords: unemployment, consumption smoothing, event study

JEL codes: E21, E24, H31, J63

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1 Introduction

Job loss is one of the major economic risks that households face. It affects many people and it typically results in a large and persistent drop in income for the individual experiencing the shock (Jacobson, LaLonde and Sullivan 1993; Kawano and Lalumia 2015). The extent to which households can respond to the shock of job loss and mitigate its impact on consumption is important for household well-being and, more broadly, the optimal design of social insurance policy (Baily 1978; Chetty 2006, 2008) and the macroeconomic consequences of business cycle shocks (De Santis 2007; Ellison and Sargent 2015). Moreover, understanding the ways that households respond to unemployment is important for the design of other economic policies, such as financial regulation. (Hurst and Stafford 2004; Cocco 2013).

Different strands of literature have focused on single margins by which households respond to job loss. Yet, for a shock of such prevalence and severity, surprisingly little is known about the relative importance of each margin of response in coping with the income loss. Households might self-insure through an increase in spousal labor supply (Lundberg 1985; Cullen and Gruber 2000; Stephens 2002; Hardoy and Schøne 2014; Halla, Schmieder and Weber 2017). They can avoid large drops in consumption by running down liquid assets (Basten, Fagereng and Telle 2016), by refinancing mortgage loans and tapping into home equity (Hurst and Stafford 2004), or through unsecured borrowing (Sullivan 2008). Another way to cushion the effect of the income loss is to postpone the renewal of durable goods (Browning and Crossley 2001, 2009). Finally, households might have to cut back on consumption of non-durable goods (Ganong and Noel 2018).¹

This paper is the first to provide a comprehensive assessment of the relative importance of all these response margins. Existing studies typically analyse a single response margin, often relying on survey data collected at the annual frequency, with samples and methods varying across studies. In contrast, a key feature of our analysis is that we measure responses on all margins to the same event, for the same households, using the same research design. We use data from Denmark, an ideal setting for this analysis because of the possibility to match individual-level data from multiple administrative data sources, recording unemployment and behavior on all response margins at the monthly frequency.² Compared to analyses using annual data, we provide much more compelling identification of the responses to job loss by exploiting the high frequency of the data and the long panel dimension - the data covers 72 months from January 2009 to December 2014 – in an event study design, similar to the

¹This list of response margins is not exhaustive. For example, households might receive transfers from parents or other family members during unemployment. We do not consider this response margin. Existing evidence on Danish data suggests that this type of risk sharing is negligible (Kolodziejczyk and Leth-Petersen 2013), which is in line with evidence from other countries (e.g. Bentolila and Ichino 2008).

²Matching across data sources is made possible by the existence of a unique personal identity number assigned to all Danes at birth or first residence. Technically, the data sets from the different sources are sent by the data owners to Statistics Denmark who de-identify the data and store it on secure servers with access for researchers. The Danish microdata and data infrastructure are known for their high quality and have been emphasized as a blueprint for data construction (see Card et al. 2010).

approach in Dobkin et al. 2018.

We combine data from four sources. The starting point is the population register at Statistics Denmark, containing information on individual demographics, including the identity, if any, of spouses. We join information on income from monthly payroll and public transfer records, collected by the Danish tax agency (SKAT). This data is based on third party reports by employers and government agencies and is used to calculate individual tax burdens. The data has been used for research purposes to study labor supply and tax compliance behavior (Chetty et al. 2011; Kleven et al. 2011; Kreiner, Leth-Petersen and Skov 2016). We gather information on all mortgage loans from data collected from mortgage banks by the Danish central bank (Nationalbanken). This data contains loan-level information on loan type, outstanding balance, interest rate and time to maturity, and it has previously been used to study whether households refinance their mortgages optimally (Andersen et al. 2015). Finally, we obtain monthly information on spending, consumer debt and assets from the transaction and account data of a major Danish bank, with coverage of a third of the entire population. This data is similar to the JP Morgan Chase data used by Ganong and Noel 2018 in their recent study of spending through unemployment spells. An advantage of our data is the possibility to link it to the other administrative data, thereby directly addressing key concerns of completeness and representativeness (Baker 2018).

We provide four sets of results. First, we examine the consequences of unemployment for the individual's own income. Our sample consists of workers in midlife who have been employed full time for at least eighteen consecutive months before experiencing an unemployment shock. Wage income drops sharply at the onset of unemployment. This is compensated by a steep increase in transfers, but only partially, such that disposable income drops to less than 50 percent of its pre-displacement level in the first month of unemployment on average. After the initial drop, income recovers steadily in the following months but does not catch up to the pre-displacement level within the two-year horizon that we study. This is in line with previous findings showing persistent income losses following the transition into unemployment (Jacobson, LaLonde and Sullivan 1993; Kawano and Lalumia 2015). The cumulative effect over the 24 months after job loss corresponds to a loss of about six months of pre-event after-tax earnings.³

Second, we examine by how much the income loss is compensated through an increase in spousal labor supply, often referred to as the 'added worker effect'. We find that the quantitative importance of this self-insurance channel is negligible. The point estimates show that spouse's after-tax labor income increases by less than one percent of the unemployed

³This is in line with evidence from the US (Jacobson, LaLonde and Sullivan 1993; Kawano and Lalumia 2015) and stands in contrast to the picture sometimes presented in the international public debate of Denmark as a country with massive social insurance and redistribution. One reason for the similarity of findings is that UI benefits in Denmark are capped at a fairly low level, implying a modest rate of compensation for high-wage earners. Further, workers may choose not to be part of the UI benefits system, which is partly financed by member contributions. Non-members may qualify for social assistance, but since this is a means-tested program, most high-income workers are not eligible when they become unemployed.

person's pre-displacement disposable income, and the cumulative effect over the two years following the unemployment shock amounts to just six percent of the cumulative income loss.⁴

Third, we examine whether and how households use financial assets and/or credit to alleviate the impact of unemployment shocks. Recent literature emphasizes the importance of home equity and mortgage loans for household consumption smoothing in many different contexts (Leth-Petersen 2010; Mian and Sufi 2011; Abdallah and Lastrapes 2012; Cocco 2013; Mian, Rao and Sufi 2013; Bhutta and Keys 2016; Agarwal and Qian 2017). Understanding how households use alternative mortgage products is relevant for the ongoing debate over the pros and cons of giving homeowners access to more risky mortgage products, such as interest-only and adjustable-rate mortgages (Cocco 2013). We find clear evidence that some homeowners soften the effects of job loss by switching to these loan types. This reduces their monthly mortgage payments, thus allowing for better consumption smoothing. However, for the average homeowner, the cumulative reduction in mortgage payments up to 24 months after job loss corresponds to just 3 percent of the cumulative income loss. Thus, the overall consumption smoothing effect is small. We do not observe any increase in mortgage debt. However, households do obtain some extra liquidity by increasing their unsecured loan balances. We also find that households run down liquid assets (securities and deposits). This channel is quantitatively more important than the borrowing responses. In total, the extra liquidity obtained through these channels corresponds to about 15 percent of the cumulative income loss for the average household in our sample.

Fourth and finally, we examine the effects on household spending. Total spending drops by 6 percent at the onset of unemployment and then remains roughly at this level throughout the 24 months after the shock for the average person, despite the gradual recovery of average income during this period. The cumulative drop in spending in the observation window corresponds to about 30 percent of the cumulative income loss. Hence, reduced spending is, by far, the most important response margin. In line with theory, households maintain spending on consumption commitments (Chetty and Szeidl 2007, 2016), as proxied by payments of utility bills, but cut down significantly on discretionary goods, as proxied by restaurant and bar spending. Moreover, we observe a considerable drop in grocery spending. This demonstrates that spending adjustments are not only concentrated on luxury goods and durables and suggests that unemployment shocks have severe welfare consequences.

The remainder of the paper is organized as follows. The next section describes the data and the institutional context. Section 3 presents the identification strategy and the empirical results. Section 4 concludes.

⁴The negligible overall effect is in line with recent evidence from Austria based on wage records at the quarterly frequency (Halla, Schmieder and Weber 2017).

2 The Danish Setting: Institutional Context and Data

The Danish Labor Market and Financial Market

The Danish labor market is characterized by the so-called “flexicurity” model, which combines flexible hiring and firing rules for employers with income security for employees (Andersen and Svarer 2007). Employment terms are regulated through legislation as well as through collective agreements between employers and employees. Dismissing individual workers is relatively easy for Danish employers (OECD 2013), but workers must be given notice three to six months in advance if they have been employed for at least six months.⁵ This means that workers who are laid off typically have a few months to prepare for the impending drop in wage income.

The security element of the model comes from an unemployment insurance benefit system that is generous by international standards: Participation in the system is voluntary but approximately 80% of all workers are members. The system is partly funded by the members, with a flat membership fee covering two-thirds of the expenses, and partly funded by the government (covering one-third of the costs). The members of the insurance system receive benefits worth 90 percent of the pre-unemployment wage, but only up to a threshold of around US\$ 3,000 per month beyond which compensation is capped. Because of this cap, actual compensation rates are modest for many wage earners.⁶ Benefits are taxed the same way as labor income. The maximum duration of the membership-based unemployment insurance is two years. Non-members who are unemployed or temporarily unable to work may receive a means-tested basic social transfer of around US\$ 1,700 per month. There is a supplement for those with children and a further supplement for single parents, but a reduced rate for immigrants and for people below the age of 30. Members of the insurance system who have exhausted their benefits also qualify for this basic transfer, but the means-testing implies that many will not be eligible.

Households in Denmark buy financial services from two main types of financial institutions: Banks and specialized mortgage lending institutions. Banks offer a wide range of financial services, including deposit accounts and various credit facilities. The specialized mortgage institutions only offer mortgage loans financed by issuance of covered bonds. At origination, mortgage borrowers always face the current rate in the covered bond market, and mortgaging is a comparatively cheap source of credit for Danish homeowners. There is no difference in price or loan terms between mortgages used to finance purchases and home equity loans used for consumption or other purposes. The maximum allowed loan-to-value ratio for mortgage loans is 80 percent.⁷ As in the US mortgage market, a 30-year fixed rate annuity

⁵This follows from The Employers’ and Salaried Employees’ Act (Funktionærloven), which covers an estimated two-thirds of Danish wage earner (Scheuer and Hansen 2011).

⁶In 2010, 91 percent of all wage earners in the age group studied in this paper had wage income exceeding the cap. 34 percent had wage income exceeding twice the size of the cap.

⁷Homeowners can go beyond the 80% limit by taking out additional collateralized loans from non-mortgage banks, but these are more expensive.

mortgage has historically been the standard way of financing house purchases in Denmark. However, new products have been introduced in the mortgage market over the last couple of decades, and they have since become very popular (Andersen et al. 2012 4th quarter, part 2). Fixed-rate mortgages can be refinanced at a fairly low cost. Borrowers are allowed to refinance at any time, as long as the outstanding principal balance stays the same.⁸ Mortgage debt is full recourse in Denmark, and foreclosures are rare. Even in the years after the financial crisis, only around 0.2 percent of all houses were in foreclosure.

Data sources

We draw on several administrative data sources to create our data set. The key feature of the Danish administrative data is the existence of a common unique personal identifier – the CPR-number – that is used in all public registers, as well as in many administrative data sets from private companies. This identifier allows us to match individuals across all the data sources mentioned below.

The backbone of our data is the population register provided by Statistics Denmark, which contains annual demographic information about the entire Danish population since 1980. This includes information about each person’s age, gender, and address. Importantly, the personal ID numbers of the closest family members – including the spouse – are also included, allowing us to infer household structures at the turn of each calendar year.⁹ To this we add annual information on total gross income and taxes paid from the income register (based on annual tax returns) and annual end-of-year information on about all properties owned by each individual from Statistics Denmark’s homeowner register. The latter allows us to track changes in an individual’s portfolio of houses over time. We also add end-of-year information about all interest-bearing loans and deposits. This data, which is third-party reported by financial institutions to the Danish tax authority, contains account-level information about balances as well as a unique identifier for the reporting financial institution, allowing us to infer whether individuals are banked at more than one institution at the turn of the year.

We combine the annual information with *high-frequency* data from three sources:

Employment and income: We use data from the E-indkomst register, which is a monthly income register administered by the Danish tax authority. This register contains detailed monthly information about all salary payments paid by Danish employers, as well as all payments from government income transfer programs. The records in the register are reported by employers and government agencies and used by the Danish tax authority to compute tax liabilities of Danish households.¹⁰ Each record contains information about the amount paid,

⁸See Andersen et al. (2015) for a detailed description of refinancing in the Danish mortgage market

⁹We use the term *spouse* when referring to a person’s life partner, regardless of marital status. Statistics Denmark definition of a partner, which we adopt, is primarily based on co-habitation, rather than marriage. Same-sex couples must be either married or officially registered partners to appear as partners in our data set.

¹⁰Statistics Denmark also use them for constructing official statistics on employment. The register has also been used for academic research by Chetty et al. (2011) and Kreiner, Leth-Petersen and Skov (2016).

the month in which the amount was earned, a unique employer ID and industry code (for salary payments), a transfer program code (for income transfers), and the personal identification number (CPR) of the individual receiving the payment. The data covers the time period from January 2008 to March 2016 and we use it to construct measures of total monthly income from wages and income transfers for all individuals and their spouses. We also use the information to identify the individual's main employer in each month, defined as the firm from which the individual received the largest total amount.¹¹

Mortgage loans: For mortgage loans we use a loan-level data set collected from Danish mortgage banks by the Danish Ministry of Business and Growth and the Danish Central Bank (Danmarks Nationalbank).¹² The data set provides an end-of-year snapshot of all active mortgage loans to private individuals in Denmark in each year from 2009 to 2015. It contains detailed information about the date of origin, time to maturity, original and outstanding balance, and interest rate on each loan. It also describes the type of loan, including whether it is a fixed- or adjustable-rate loan and whether it is an interest-only loan. Combining the end-of-year snapshot in a given year with that of the previous year, we can detect whether there were any changes to an individual's portfolio of mortgage loans during the calendar year. We can then use the information on dates-of-origin for the new loan(s) to determine exactly when this change happened, and thus construct a high-frequency data set with information about mortgage loans held at the end of each month between December 2009 and December 2015.¹³

Spending, deposits and securities, and consumer loan balances: Finally, we add data from a major Danish bank (henceforth, "the bank"). We have access to the bank's entire customer records, covering more than 1 million individuals per month between January 2009 and December 2016. The customer records contain daily balances on all deposit and loan accounts, and prices and quantities of financial assets (stocks, bonds and mutual funds). In addition, the data contains detailed, transaction-level information about all inflows and outflows to accounts. We use the transaction data to construct a measure of monthly spending. Starting from the universe of outgoing transaction in a given month, we focus on three types of payment – debit or credit card, mobile, and bill – and cash withdrawals from ATMs. Combined, these categories account for more than 80 percent of all outflows from accounts. Figure A.9 in the appendix shows the breakdown of average total expenditure into these categories (grouping card and mobile payments into one category).

For card and mobile payments, we can categorize the type of spending using the four-digit Merchant Category Code (MCC) of the recipient business. MCCs are an international standard for classifying merchants by the type of goods and services they provide. For bill

¹¹We use the terms "firm" and "employer" interchangeably throughout the paper. But it should be kept in mind that our data covers all types of employers, including public sector employers and not-for-profit organisations.

¹²Andersen et al. (2015) use the same data source to study refinancing decisions of Danish mortgage borrowers.

¹³Cases where one or more loans cease to exist without being replaced by new loans are rare but do occur in our sample. In such cases, we use data on total interest payments on mortgage loans from annual tax returns to infer when the loans were terminated.

payments, we know the identity of the creditor for each transaction. The bank maintains a grouping of creditors into categories that correspond to the MCC grouping and we use this to categorize spending into the same groups as for card and mobile payments.¹⁴

To construct our baseline measure of total (non-housing) expenditure, we sum outgoing transactions by each of the payment methods and all cash withdrawals from ATMs. We use the categorization of spending to remove tax, debt, rent, or other housing-related payments from this calculation.¹⁵

Baker (2018) identifies a number of limitations of using account and transaction data from banks or aggregators. Our combined data and setting allow us to address these limitations more completely than has been possible in previous studies. First, the payments landscape in Denmark means we can mostly avoid problems associated with opacity surrounding the purposes of cash or check transactions. Card usage is higher in Denmark than in any other European country (Danmarks Nationalbank 2017a). Moreover, cash usage is low: only 23 percent of point-of-sale retail transactions – and only 16 percent in value terms – are in cash (Danmarks Nationalbank 2017b) relative to 39 percent in the USA (Greene and Stavins, 2018). Finally, checks are no longer in use (Danmarks Nationalbank 2017b) meaning that almost all bill payments are made electronically, with over 95 percent of Danish households paying bills by direct debit (Danish Competition and Consumer Authority 2014).

Second, users of aggregators or customers of single banks are typically not representative of the population. Two features of our data minimize the extent of this problem. First, the bank providing the data is the largest in the country, with over 41 percent of households seen to be transacting in the data in 2014 (see Table A2 in the appendix). Second, we observe rich socio-demographics for the entire population meaning we can directly test for selection in-sample and assess the impact of selection on our estimates.

Finally, Baker (2018) notes that sources of account data might not be complete in their coverage of households' finances due to only observing a limited number of accounts owned by each individual, possibly split across many different banks. A distinct but related concern is that data from banks or aggregators contains limited information about household structure, making it hard to measure outcomes at the household level. By linking the data from the bank to the population registers at Statistics Denmark, we are able to overcome these problems. First, using data on end-of-year bank relationships, we are able to focus on a group of households who are exclusive customers of the bank, meaning that they are not banked at any other Danish bank at either the beginning or the end of the calendar year. Second, information on household structure from the population register allows us to aggregate spending and balances to the household level.¹⁶

¹⁴For example, the MCC "5411" identifies card or mobile payments at grocery stores and supermarkets. The bank labels all creditors, paid via bill, that deliver groceries as such and thus we are able to create a measure of total spending in this category that includes card, mobile and bill payments.

¹⁵We focus on non-housing expenditure such that our results are comparable for renters and homeowners.

¹⁶We find that over 30% of actual couples are not linked to each other in the bank data, where a link is inferred from the existence of a joint account or a household identifier based on self-reporting relationships. Without information

Combined, these features make Denmark particularly suited towards analyses of household consumption behavior using transaction-based spending measures. Moreover, they demonstrate the advantages from joining bank and population administrative data. Figures A.10 and A.11 in the appendix compare the development in selected components of our spending measure to corresponding aggregate times series from official sources. The high level of correspondence in the figures suggests that our spending data is characterized by a high level of completeness and timeliness, and that it also does well in terms of representativeness of the broader population.

3 Empirical Analysis

Identification strategy

To analyse the dynamic effects of unemployment shocks, we estimate non-parametric event study models of the following form

$$y_{im} = \gamma_m + \delta_i + \sum_{h \in \{-23, \dots, -7, -5, \dots, 24\}} \beta_h \cdot \mathbb{1}[e_{im} = h] + \varepsilon_{im}, \quad (1)$$

in which i indexes individuals and m indexes calendar months. Here, y_{im} is some outcome of interest, γ_m is a year-by-calendar month fixed effect, δ_i is an individual fixed effect, and e_{im} is relative time, i.e. the number of months that has passed since the individual experienced an unemployment shock (to be defined below). A negative value of e_{im} indicates that individual i has not yet lost his/her job in month m . The coefficients of key interest are the β_h 's, which summarize the dynamics of the outcome variable around the time of the job loss. Each coefficient estimates the difference in the outcome in month m relative to the pre-event level.¹⁷ We cluster standard errors at the household level so as to allow for arbitrary forms of heteroskedasticity and autocorrelation within observations for the same household.

We define an unemployment shock as a situation where the salary payments from the individual's main employer cease and total monthly wage income drops below 1,000 DKK (appr. 190 USD). The first month where these conditions are met is defined as the month of the job loss. To focus on actual unemployment *shocks*, we restrict attention to individuals who have wage income of at least 10,000 DKK (1,920 USD) in each of the 18 months preceding the job loss and receive unemployment benefits or social insurance at some point within the first three months after the job loss. We also require that individuals do not receive student stipends, sickness or parental leave benefits at any time between one month before the job loss and three months after. Finally, we require that individuals do not return to the same

on household structure from the population register, these individuals would be treated as separate households.

¹⁷We include observations up to 24 months before and after the event month and omit the dummy for $h = -6$. However, the inclusion of calendar fixed effects and individual fixed effects means that we must impose another restriction to make the model fully identified Borusyak and Jaravel 2018. Following Dobkin et al. (2018), we add an extra normalization by also omitting the dummy for $h = -24$.

employer within three months after the job loss.

The unit of analysis is individual-by-month, but outcome variables are generally measured at the household level by summing over the main person and the spouse, if any. To facilitate comparisons across individuals with different income levels pre-job loss, we normalize nominal outcomes in DKK by measuring them relative to the main person's average disposable income in the months before the unemployment shock.¹⁸ To limit the influence of extreme outliers, we censor all outcome variables at the 1st and 99th percentiles within each calendar month.

Our analysis sample consists of individuals born between 1953 and 1978 who experienced an unemployment shock between July 2009 and December 2015.¹⁹ We focus on stable households by requiring that the individual either stays single or has the same spouse in all of the months in which they enter the analysis. We also exclude individuals if they or their spouse bought or sold real estate, or if they worked at the same firm as their spouse prior to the job loss. The former restriction is imposed because housing transactions are associated with massive financial transactions, making it difficult to measure the savings- and spending responses to the unemployment event. The latter restriction is imposed because a double job-loss prevents us from cleanly examining the added worker effect. Finally, to produce our main results we limit the sample to cases where all adult members of the individual's household are exclusive customers at the bank. This ensures that we have a complete picture of the household's finances, but it also reduces the sample size substantially. In the appendix we therefore also present results based on a sample where this restriction is not imposed.

These restrictions produce a sample of 9,820 individuals. For each of these, we include observations up to 24 months before and after the month of the job loss in our estimations. The limitation to households who are exclusive customers of the bank confines the analysis period to the years 2009-14, leaving us with a sample of about 330,000 individual-month observations.

Table 1 reports summary statistics for these individuals, measured 6 months before the month of job loss. Forty-four percent of the individuals in our sample are female, and the average age is 45 years. The vast majority worked in services industries or the public sector before becoming unemployed. Almost sixty percent are homeowners, and nearly half have a mortgage. In terms of income, the average person earned about 19,000 DKK per month (after tax) before becoming unemployed. This is about 20 percent above the average monthly wage income for the full population of individuals born in the same years, but about 8 percent below the average among the subgroup of those that have positive wage income. Thus, before

¹⁸Specifically, we calculate the pre-displacement disposable income as the mean of the individual's total after-tax income (including wage income and any government transfers) in months -18 to -6 relative to the month of the job loss.

¹⁹The data on wage income and transfers covers January 2008 to March 2016. Since the definition of an event requires 18 months of data pre-event and 3 months post-event, this means that the unemployment shock must happen between July 2009 and Dec. 2015 to satisfy all criteria. This, in turn, implies that individuals in the sample are between 30 and 62 years old when the shock occurs.

Table 1: Summary statistics, six months before job loss

| | Obs. | Mean | Std. dev. |
|--|-------|---------|-----------|
| Single | 9,820 | 0.42 | 0.49 |
| Female | 9,820 | 0.44 | 0.50 |
| Age | 9,820 | 45.03 | 7.38 |
| Copenhagen resident | 9,820 | 0.42 | 0.49 |
| Higher education | 9,820 | 0.23 | 0.42 |
| Primary sector | 9,820 | 0.01 | 0.09 |
| Manufacturing | 9,820 | 0.18 | 0.38 |
| Construction | 9,820 | 0.07 | 0.26 |
| Trade or transport | 9,820 | 0.27 | 0.44 |
| Other business services | 9,820 | 0.20 | 0.40 |
| Public administration, teaching or health sector | 9,820 | 0.24 | 0.43 |
| Arts and entertainment | 9,820 | 0.03 | 0.17 |
| Wage income after tax (main person), DKK | 9,812 | 19,104 | 7,093 |
| Household disposable income, DKK | 9,817 | 29,574 | 14,629 |
| Homeowner | 9,820 | 0.57 | 0.49 |
| Household spending, DKK | 7,931 | 22,056 | 13,247 |
| Household bank deposit balances, DKK | 7,931 | 111,161 | 172,304 |
| Household consumer loan balances, DKK | 7,931 | 18,313 | 41,637 |
| At least one mortgage loan | 8,044 | 0.46 | 0.50 |
| Household mortgage debt (cond. on at least one mortgage loan), DKK | 3,709 | 727,536 | 420,229 |
| Monthly mortgage payments (cond. on at least one mortgage loan), DKK | 3,608 | 5,605 | 3,239 |

The table shows summary statistics for the individuals in our analysis sample. All variables are measured 6 months before month of job loss. Statistics for household spending, bank deposits and consumer loan balances are for the subsample of individuals who belonged to a household in which all adults were exclusive customers at the bank in this particular month. Mortgage variable statistics are based on individuals who lose their job in July 2010 or later due to limited data coverage. Variables measured in DKK are deflated to January 2010 price level using the CPI and winsorized at the 1st and 99th percentiles within each calendar before computing summary stats.

becoming unemployed the individuals in our sample have only slightly lower income than the general working population in the same age group. It is also worth noting that restricting the sample exclusive customers at the bank does not change its representativeness. This can be seen by comparing the information in Table 1 to that in Table A1 in the appendix, which displays summary statistics for a broader sample that is not limited to exclusive customers.

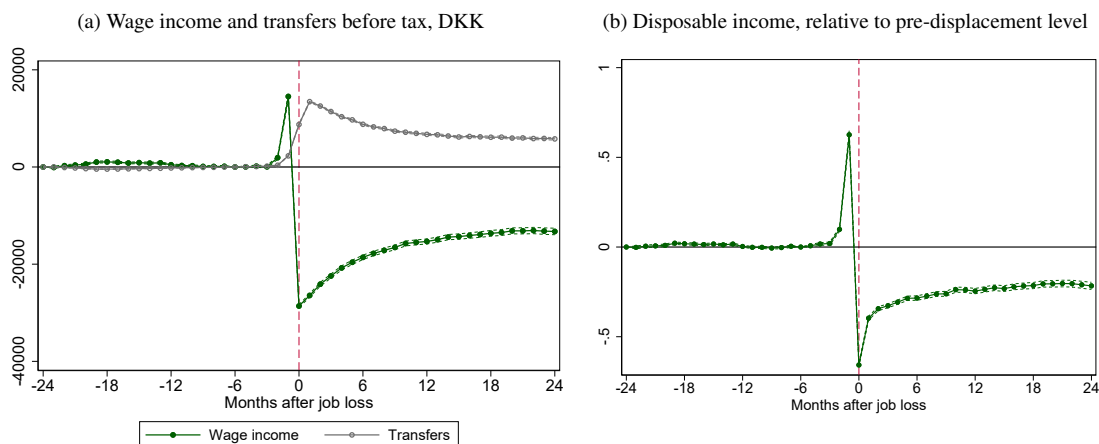
Results

This section presents estimation results for equation (1). We illustrate the results graphically by plotting the estimated β_h coefficients, as well as their 95% confidence intervals, for a range of different outcome variables in each of the four categories described in the introduction. Detailed descriptions of each outcome variable are in the appendix.

Wage, transfers, income, and employment (main person): Panel a of Figure 1 shows the dynamics of wage income and government transfers (both measured in DKK) for the main person in the household, i.e. the person experiencing the unemployment shock. Wage income is highly stable in the two-year period leading up to the job loss but then spikes up in the month immediately before. This is due to payout of severance pay (mandatory for most high-tenure workers) and so-called “Holiday pay”.²⁰ At the time of the job loss, wage income

²⁰Most employees in Denmark earn the right to Holiday pay when they work. When an employment relation

Figure 1: Wage income, transfers, and disposable income for main person



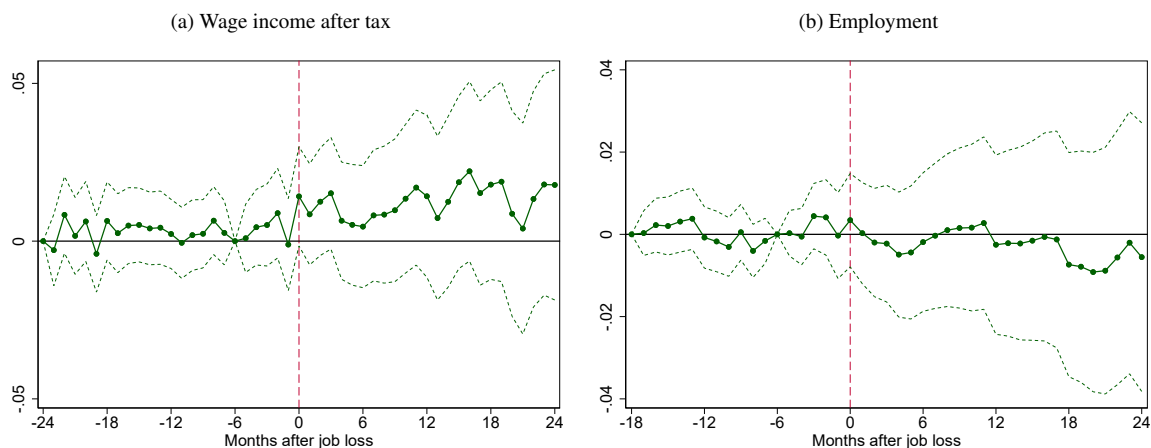
The figure shows results from estimation of equation (1) for different outcome variables. Panel a shows results for wage income and income from government transfers for the main person, i.e. the person that becomes unemployed. Both variables are before-tax figures and measured in DKK at January 2010 prices. Panel b shows results for disposable income, i.e. total after-tax income from wages and transfers, measured relative to the main persons's average disposable income in the months before the unemployment event. The connected dots show the coefficients estimates for the event time dummies, while the dashed lines show their 95 percent confidence intervals. The omitted event month categories are -24 and -6.

drops sharply and income from government transfers increases. This follows by construction from the way we have defined the unemployment shock. What is more interesting to note is that the increase in income transfers is substantially smaller than the drop in wage income for the average person. The net effect is summarized in panel b, which shows the main person's disposable income, i.e. the total after-tax income from wages and transfers, measured relative to its own pre-displacement level. After the initial spike, disposable income drops by more than 50 percent. It then recovers somewhat in the following months but remains 22 percent below the pre-displacement level two years later. This reflects that a substantial fraction of the individuals in our sample remain out of employment at this point, as shown in appendix Figure A.8. Combining these results, we find that the total cumulative effect – counting from six months before the job loss to 24 months after – is an income drop corresponding to six months of pre-displacement income. Overall, these findings are in line with the results for the US in Jacobson, LaLonde and Sullivan (1993) who find that job separations have long-lasting effects on wage earners' income of a similar magnitude as documented here.

Spousal labor supply: We find almost no effects of unemployment on spousal employment and income. Panel a of Figure 2 shows estimation results for the subsample of non-single individuals using the spouse's after-tax wage income as the outcome variable. The coefficient estimates for the months after the job loss are consistently positive, but the estimated effects are economically small, suggesting an increase in the spouse's monthly after-tax wage

terminates, the employer pays out the amount of Holiday pay that the worker has earned but not yet spent.

Figure 2: Spousal wage income and employment



The figure shows estimation results for equation (1), estimated on the subsample of non-single households. Panel a shows results for the spouse's after-tax wage income, normalized by the main persons's average disposable income in the months before the unemployment event. Panel b displays results for a dummy variable equal to 1 if the spouse has wage income before tax of at least 10,000 DKK. The connected dots show the coefficients estimates for the event time dummies, while the dashed lines show their 95 percent confidence intervals. The omitted event month categories are -24 and -6.

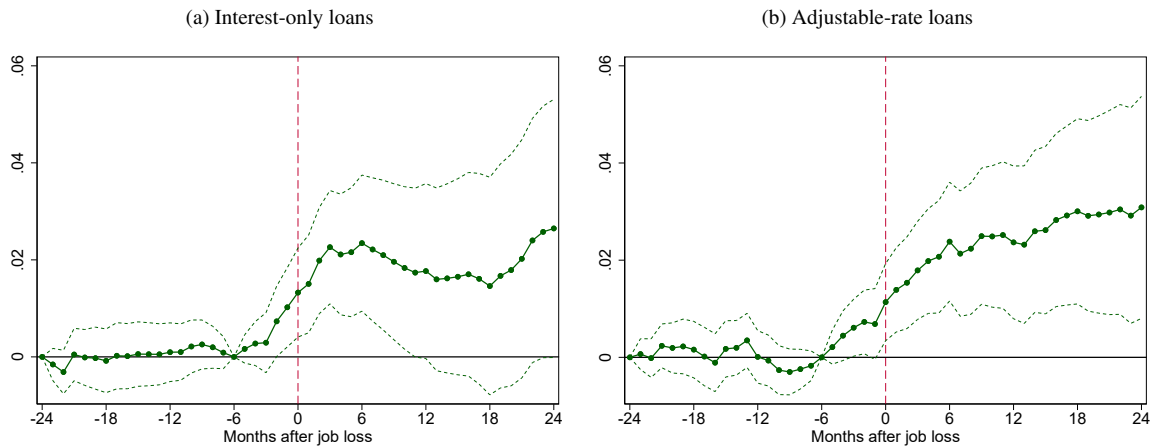
income of around 1 percent of the main person's pre-displacement disposable income.²¹ The cumulative effect at month 24 after the job loss (counted since six months before) is an increase equivalent to one third of the pre-displacement income, corresponding to just 6 percent of the main person's cumulative income loss.

Turning to panel B, we find no effect on the rate of employment for the spouse, as measured by the share of spouses with monthly pre-tax labor income of at least 10,000 DKK. This suggests that the small positive effect on spousal labor income, if any, must come from an increase in labor supply along the intensive margin. But overall, the lesson from Figure 2 is that the added worker effect plays a negligible role in Danish households' responses to unemployment shocks.

Liabilities/loans: Figure 3 shows a statistically clear impact of unemployment shocks on the share of households with interest-only mortgages (panel a) and adjustable-rate mortgages (panel b). Compared to the pre-displacement level, the share of individuals with these loan types increases by about 2 percentage points for each type. It is worth noting that the increase in usage of these low-payment loan types is visible around six months before the recorded month of job loss. This is consistent with the hypothesis that (some) laid-off workers respond to the change in circumstances at the time when they first learn about their impending dismissal. As explained in section 2, this happens several months before salary payments stop

²¹We find similar-sized effects when looking at a broader sample drawn from the full population. Using this larger sample, some of the post-event coefficient estimates are individually significant, and they are jointly significantly different from zero at the five percent level. See Figure A.2 in the appendix.

Figure 3: Mortgage loan types



The figure shows estimation results for equation (1), estimated on the subsample of households that have at least one mortgage loan. Panel a shows results for a dummy variable equal to 1 if the household has an interest-only loan. Panel b shows results for a dummy variable equal to 1 if the household has an adjustable-rate loan. The connected dots show the coefficients estimates for the event time dummies, while the dashed lines show their 95 percent confidence intervals. The omitted event month categories are -24 and -6.

coming in for many workers, due to employment protection regulations. Further supporting this interpretation, we show below that there is a sharp drop in fuel spending starting around six months before month zero (see Figure A.9). This indicates that some workers are not only notified in advance of their pending dismissal, many of them have actually stopped going to work already at this point.

Refinancing from a traditional mortgage loan to an interest-only or adjustable-rate loan may substantially boost the available liquid resources for the individual borrower. However, although statistically clear, the increase in the share of borrowers with these loan types is modest in absolute terms, and the impact on available resources is modest for the average mortgage borrower. This is clearly illustrated in panel a of Figure 4, which shows a decrease in average monthly mortgage payments starting around month -6.²² The effect is precisely estimated and clearly significantly different from zero in a statistical sense, but it is practically insignificant in an economic sense. Monthly mortgage payments drop by less than 1 percent of net pre-displacement income for the average *mortgage borrower*, implying an even smaller average effect among all individuals in our sample, since only half of them have any mortgage payments to reduce in the first place (see Table 1).

Turning to panels b and c of Figure 4, we find opposite effects for balances on mortgage loans vs. consumer loans. We find no increase in the balance on outstanding mortgage loans, suggesting that home equity withdrawals do not play any significant role in the response

²²We find qualitatively identical results for all mortgage outcomes if we use data from the full population and do not limit the sample to households that are exclusive customers at the bank. See Figures A.3 and A.4 in the appendix.

to unemployment shocks for the average person. If anything, we find that mortgage loan balances drop after the unemployment shock, perhaps as a consequence of tightened access to new credit and, hence, *less* equity withdrawal. In contrast, we find a clear increase in the amount of outstanding consumer loan balances, where the effect after 24 months is in the order of magnitude of 10 percent of pre-displacement disposable income.

Financial assets: We find a clear impact of unemployment on the balances of the household's deposit accounts at the bank, as shown in Figure 5. Balances spike up just before the month of the job loss, reflecting both higher inflows due to severance pay and holiday money pay-out (shown above) and lower outflows due to reduced spending (shown below). We then see a sharp reversal at the time of job loss when disposable income drops. For the average household, the extra reserves built up immediately before the job loss are depleted just 2-3 months after the displacement. The deterioration of balances continues after this point. Two years after job loss, deposit balances have been reduced by an amount corresponding to 56 percent of the unemployed person's monthly pre-displacement income – or 9 percent of the total cumulative income loss.

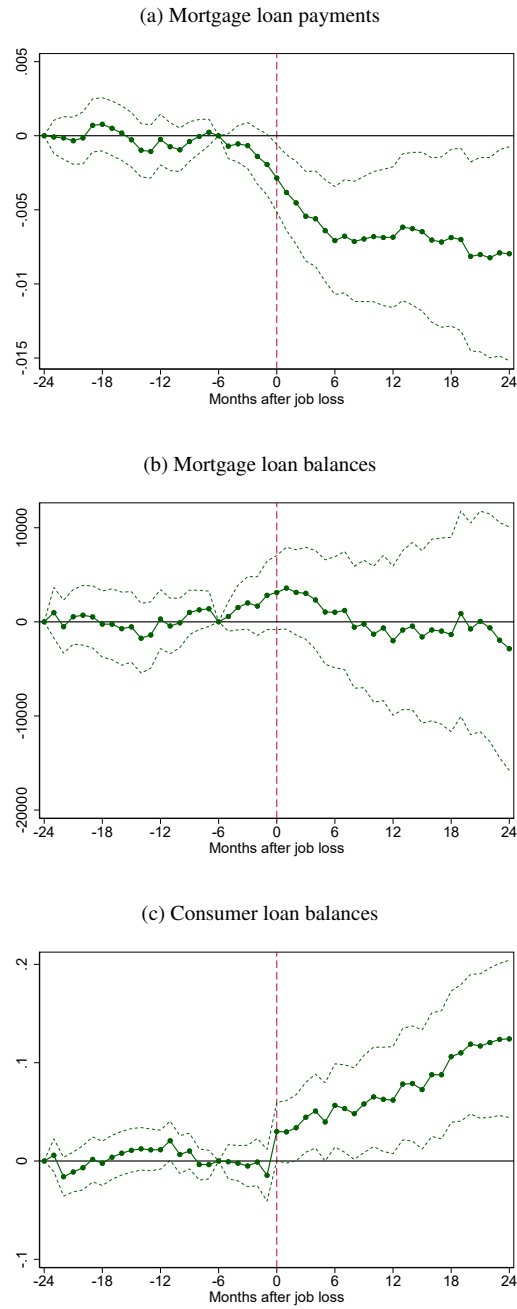
We find little evidence of an effect working through the value of household security portfolios. The event time coefficients are consistently negative after month -6 for this variable, but they are small and neither individually nor jointly significant. One explanation for this lack of impact is the fact that few Danish households own securities of any significant amount to begin with. Among the individuals in our sample, only 12 percent belonged to households with securities worth at least one month of household disposable income prior to the month of job loss.²³

Spending: The main response the drop in disposable income associated with unemployment is a drop in household spending. As shown in Figure 6, we find that total spending starts declining four months before the recorded month of job loss. The largest effect is seen in the first month after the event, where total spending is reduced by 7 percent of the main person's pre-displacement disposable income. Measuring relative to its own pre-displacement level, this corresponds to a 6 percent decline in household spending for the average person. We find that spending stays at this lower level throughout the window of analysis for the average person, despite the gradual increase in income described above. Counting from month -6 to month 24 after the month of job loss, the cumulative impact on total household spending is equivalent to 1.7 months of the main persons's pre-displacement earnings, corresponding to 30 percent of the cumulative after-tax income loss.

Figure 7 shows the dynamics of selected subcategories of spending around the time of the unemployment shock. We find a sharp reduction in fuel spending beginning around five months before the recorded month of job loss, suggesting that many of the individuals in our sample have in reality stopped working several months before they stopped receiving

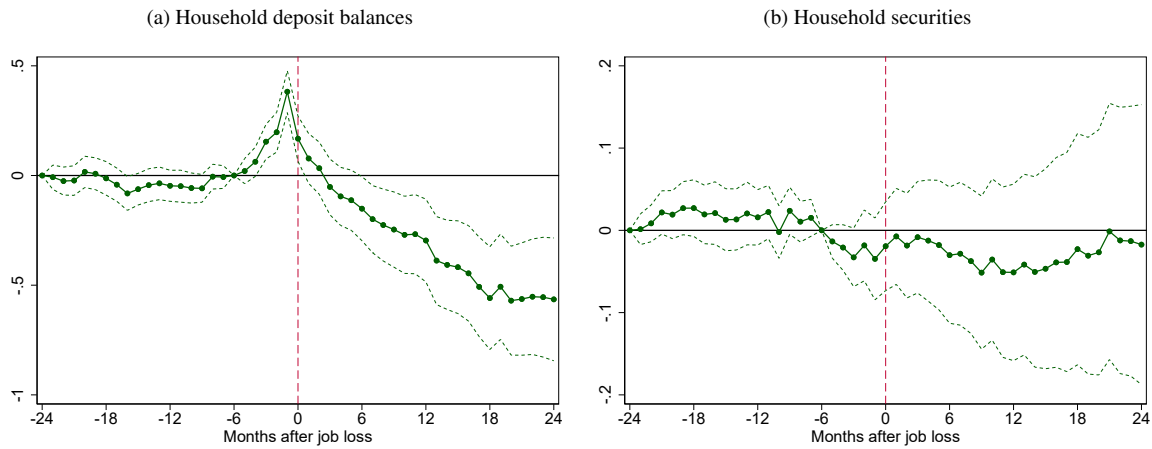
²³In results not reported, we find weak evidence of a decline in the share of households with any securities after the month of unemployment, whereas we see little or no effect on the value of security portfolios, conditional on having one.

Figure 4: Loan payments and balances



The figure shows estimation results for equation (1) for different outcome variables. Panels a and b show results for mortgage loan payments and -balances, respectively, for the subsample of households with at least one mortgage loan. Panel c shows consumer loan balances for all households in the sample. All outcomes are normalized by the main persons's average disposable income in the months before the unemployment event. Loan balances are measured in absolute terms, so that a more positive number reflects a larger debt. The connected dots show the coefficients estimates for the event time dummies, while the dashed lines show their 95 percent confidence intervals. The omitted event month categories are -24 and -6.

Figure 5: Financial assets



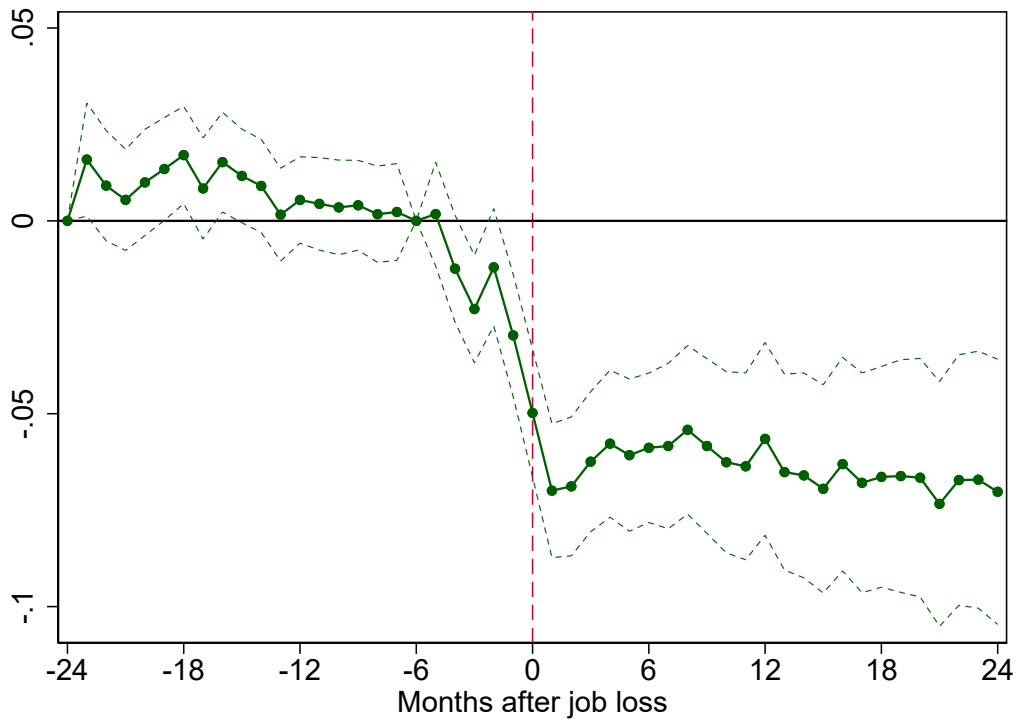
The figure shows estimation results for equation (1) for different outcome variables. Panel a shows results for bank deposit balances, while panel b shows the value of securities held in custody at the bank. Both variables are normalized by the main persons's average disposable income in the months before the unemployment event. The connected dots show the coefficients estimates for the event time dummies, while the dashed lines show their 95 percent confidence intervals. The omitted event month categories are -24 and -6.

salary payments. Also supporting this interpretation is the fact that average fuel spending then recovers in the months after the event, and at roughly the same speed as employment and average income, as described above. We also find a sharp decrease in spending in restaurants and bars, suggesting that households cut back on luxury items and services. Spending on groceries also drops sharply, however, showing that the cut-back in expenditure is not confined to such luxuries. In contrast, we find almost no effect on utility payments. This suggests that households insulate spending on necessities from the downward pressure affecting other types of spending. It is also consistent with the hypothesis that households mainly cut back on spending items that are easily adjusted in the short run, rather than expenditure on 'consumption commitments' (Chetty and Szeidl 2007).

4 Conclusion

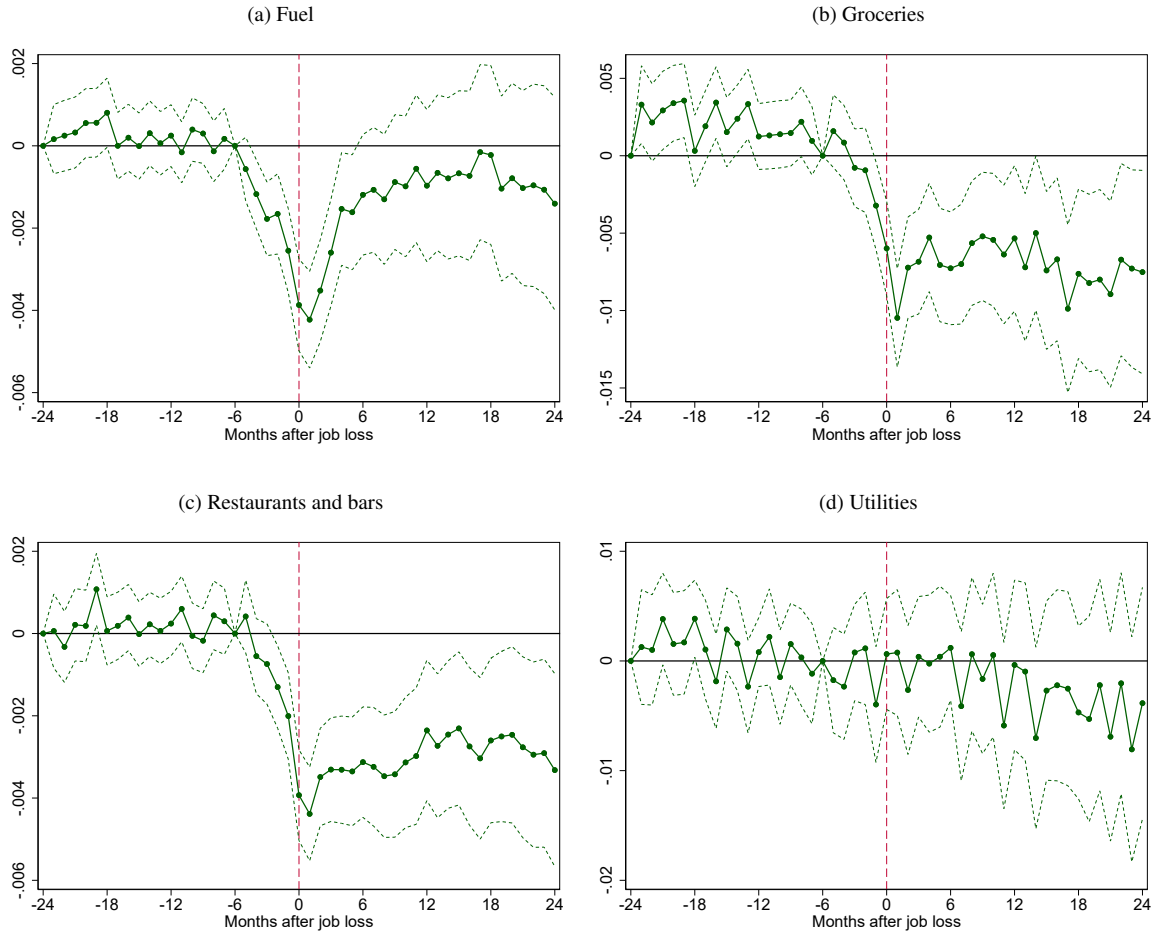
Understanding how households adjust to unemployment shocks is important for practical economic policy and is the focus of research in Labor Economics, Public Economics, Financial Economics and the Consumption Literature. This paper is the first to provide a comprehensive assessment of the relative importance of the response margins studied in these different strands of literature. This is made possible by the Danish research data infrastructure enabling us to link, at the individual level, high frequency data from multiple sources. Exploiting the combined data, we measure responses along all the relevant margins to the same event for the same households using the same research design. In this way, we are able to assess the rela-

Figure 6: Total spending



The figure shows estimation results for equation (1) with total household spending as the outcome variable. Total spending is the sum of monthly spending for the main person and the spouse, if any, deflated to January 2010 prices using the CPI and normalized by the main persons's average disposable income in the months before the unemployment event. The connected dots show the coefficients estimates for the event time dummies, while the dashed lines show their 95 percent confidence intervals. The omitted event month categories are -24 and -6.

Figure 7: Selected spending categories



The figure shows estimation results for equation (1), using selected subcomponents of household spending as the dependent variable. Panel a shows results for fuel spending, while panel b shows groceries spending. Panels c and show d results for spending in restaurants and bars and utility bills, respectively. All variables are measured as the sum for the main person and the spouse, if any, and normalized by the main persons's average disposable income in the months before the unemployment event. The connected dots show the coefficients estimates for the event time dummies, while the dashed lines show their 95 percent confidence intervals. The omitted event month categories are -24 and -6.

tive importance of each of the adjustment channels and thereby to discriminate between the various theories of how households cope with the economic consequences of unemployment.

Our analysis shows that the two most important response margins are decumulation of liquid assets and cutting down on spending. We observe a negligible adjustment of spousal labor income. The fact that the ‘added worker effect’ does not appear to be important in Denmark is perhaps not very surprising. In Denmark, labor market participation rates are high for both men and women (82 percent for men and 77 percent for women), which limits the possibilities to increase spousal labor supply.

We find clear evidence that homeowners take up adjustable-rate mortgage loans and interest-only loans in response to unemployment. These are loan types that are typically associated with lower debt service and hence provide more liquidity. However, the overall reduction of monthly mortgage payments is small compared to the average income loss. We do not observe any increase in the mortgage debt, suggesting that, on average, there is practically no home equity extraction in relation to the unemployment shock. On the other hand, we do observe some increase in the level of unsecured debt.

The absence of significant use of alternative mortgage products, at a point where the demand for instruments that can facilitate consumption smoothing is high, is remarkable, however, because credit markets have undergone substantial liberalization, and many new types of mortgage products have been introduced over the past two decades. The fact that the most important response margin is the adjustment of spending is also remarkable. Denmark is a country with a relatively generous UI benefit level, but the significant drop in spending suggests that unemployment is associated with significant welfare losses even in a country with a high degree of social insurance.

Our analysis is positive in nature, i.e. it documents behavior in a given context. This means that we cannot make normative conclusions based on the evidence presented in the paper. For example, we cannot rule out that the added worker effect would be relatively more important in economies where (female) labor supply is more limited. Moreover, our study does not resolve whether the limited use of alternative mortgage products and home equity extraction is the result of household decisions or due to limited access to such loans during unemployment spells, for example because mortgage banks screen costumers based on their ability to service the loan. Learning about these aspects is an important avenue for future research.

References

- Abdallah, Chadi S and William D Lastrapes. 2012. "Home equity lending and retail spending: Evidence from a natural experiment in Texas." *American Economic Journal: Macroeconomics* 4(4):94–125.
- Agarwal, Sumit and Wenlan Qian. 2017. "Access to home equity and consumption: Evidence from a policy experiment." *Review of Economics and Statistics* 99(1):40–52.
- Andersen, Asger Lau, Anders Møller Christensen, Charlotte Duus and Ri Kaarup. 2012 4th quarter, part 2. "Danish Families' Financial Robustness, Variable Rates and Deferred Amortisation." *Danmarks Nationalbank, Monetary Review* .
- Andersen, Steffen, John Y. Campbell, Kasper Meisner Nielsen and Tarun Ramadorai. 2015. Inattention and Inertia in Household Finance: Evidence from the Danish Mortgage Market. Working Paper 21386 National Bureau of Economic Research.
URL: <http://www.nber.org/papers/w21386>
- Andersen, Torben M. and Michael Svarer. 2007. "'Flexicurity – Labour Market Performance in Denmark'." *CESifo Economic Studies* 53(3):389–429.
- Baily, Martin Neil. 1978. "Some aspects of optimal unemployment insurance." *Journal of Public Economics* 10(3):379–402.
- Baker, Scott R. 2018. "Debt and the Response to Household Income Shocks: Validation and Application of Linked Financial Account Data." *Journal of Political Economy* 126(4):1504–1557.
URL: <https://doi.org/10.1086/698106>
- Basten, Christoph, Adreas Fagereng and Kjetil Telle. 2016. "Saving and Portfolio Allocation Before and After Job Loss." *Journal of Money, Credit and Banking* 48(2-3):293–324.
URL: <http://dx.doi.org/10.1111/jmcb.12301>
- Bentolila, Samuel and Andrea Ichino. 2008. "Unemployment and consumption near and far away from the Mediterranean." *Journal of Population Economics* 21(2):255–280.
- Bhutta, Neil and Benjamin J Keys. 2016. "Interest rates and equity extraction during the housing boom." *The American Economic Review* 106(7):1742–1774.
- Borusyak, Kirill and Xavier Jaravel. 2018. "Revisiting Event Study Designs".
- Browning, Martin and Thomas F Crossley. 2001. "Unemployment insurance benefit levels and consumption changes." *Journal of public Economics* 80(1):1–23.

- Browning, Martin and Thomas F Crossley. 2009. "Shocks, stocks, and socks: Smoothing consumption over a temporary income loss." *Journal of the European Economic Association* 7(6):1169–1192.
- Card, David, Raj Chetty, Martin S Feldstein and Emmanuel Saez. 2010. Expanding access to administrative data for research in the United States. Technical report White paper for the initiative "Future Research in the Social, Behavioral & Economic Sciences", U.S. National Science Foundation.
- Chetty, Raj. 2006. "A general formula for the optimal level of social insurance." *Journal of Public Economics* 90(10):1879–1901.
- Chetty, Raj. 2008. "Moral hazard versus liquidity and optimal unemployment insurance." *Journal of political Economy* 116(2):173–234.
- Chetty, Raj and Adam Szeidl. 2007. "Consumption commitments and risk preferences." *The Quarterly Journal of Economics* 122(2):831–877.
- Chetty, Raj and Adam Szeidl. 2016. "Consumption commitments and habit formation." *Econometrica* 84(2):855–890.
- Chetty, Raj, John N. Friedman, Tore Olsen and Luigi Pistaferri. 2011. "Adjustment Costs, Firm Responses, and Micro vs. Macro Labor Supply Elasticities: Evidence from Danish Tax Records." *Quarterly Journal of Economics* 126(2):749–804.
- Cocco, João F. 2013. "Evidence on the Benefits of Alternative Mortgage Products." *The Journal of Finance* 68(4):1663–1690.
URL: <http://dx.doi.org/10.1111/jofi.12049>
- Cullen, Julie Berry and Jonathan Gruber. 2000. "Does unemployment insurance crowd out spousal labor supply?" *Journal of labor Economics* 18(3):546–572.
- Danish Competition and Consumer Authority. 2014. Betalingsservice. Technical report Danish Competition and Consumer Authority.
URL: <https://www.kfst.dk/media/2799/20140624-betalingserviceanalyse-2014.pdf>
- Danmarks Nationalbank. 2017a. "Danes are Front-runners in Electronic Payments." *Analysis no. 6*.
- Danmarks Nationalbank. 2017b. "Danish households opt out of cash payments." *Analysis no. 24*.
- De Santis, Massimiliano. 2007. "Individual Consumption Risk and the Welfare Cost of Business Cycles." *The American Economic Review* 97(4):1488–1506.
URL: <http://www.jstor.org/stable/30034103>

- Dobkin, Carlos, Amy Finkelstein, Raymond Kluender and Matthew J. Notowidigdo. 2018. "The Economic Consequences of Hospital Admissions." *American Economic Review* 108(2):308–52.
URL: <http://www.aeaweb.org/articles?id=10.1257/aer.20161038>
- Ellison, Martin and Thomas J Sargent. 2015. "Welfare cost of business cycles with idiosyncratic consumption risk and a preference for robustness." *American Economic Journal: Macroeconomics* 7(2):40–57.
- Ganong, Peter and Pascal Noel. 2018. "Consumer Spending During Unemployment: Positive and Normative Implications." *American Economic Review (Conditional accepted)* .
- Halla, Martin, Julia Schmieder and Andrea Weber. 2017. "Job displacement, family dynamics and spousal labor supply." Working paper, to be presented at the ASSA Annual Meeting 2018.
URL: www.aeaweb.org/conference/2018/preliminary/1192?q=eNqrVipOLS7OzM8LqSxIVbKqhnGVrAxrawGICArI
- Hardoy, Inés and Pål Schøne. 2014. "Displacement and household adaptation: insured by the spouse or the state?" *Journal of Population Economics* 27(3):683–703.
- Hurst, Erik and Frank P Stafford. 2004. "Home is where the equity is: Mortgage refinancing and household consumption." *Journal of money, Credit, and Banking* 36(6):985–1014.
- Jacobson, Louis S, Robert J LaLonde and Daniel G Sullivan. 1993. "Earnings losses of displaced workers." *The American economic review* pp. 685–709.
- Kawano, Laura and Sara Lalumia. 2015. "How Income Changes During Unemployment. Evidence from Tax Return Data." *Journal of Human Resources* 52(2):418–456.
- Kleven, Henrik Jacobsen, Martin B Knudsen, Claus Thustrup Kreiner, Søren Pedersen and Emmanuel Saez. 2011. "Unwilling or unable to cheat? Evidence from a tax audit experiment in Denmark." *Econometrica* 79(3):651–692.
- Kolodziejczyk, Christophe and Søren Leth-Petersen. 2013. "Do First-Time House Buyers Receive Financial Transfers from Their Parents?" *The Scandinavian Journal of Economics* 115(4):1020–1045.
- Kreiner, Claus Thustrup, Søren Leth-Petersen and Peer Ebbesen Skov. 2016. "Tax Reforms and Intertemporal Shifting of Wage Income: Evidence from Danish Monthly Payroll Records." *American Economic Journal: Economic Policy* 8:233–257.
- Leth-Petersen, Søren. 2010. "Intertemporal consumption and credit constraints: Does total expenditure respond to an exogenous shock to credit?" *The American Economic Review* 100(3):1080–1103.

- Lundberg, Shelly. 1985. "The added worker effect." *Journal of Labor Economics* 3(1, Part 1):11–37.
- Mian, Atif and Amir Sufi. 2011. "House prices, home equity–based borrowing, and the us household leverage crisis." *The American Economic Review* 101(5):2132–2156.
- Mian, Atif R, Kamalesh Rao and Amir Sufi. 2013. "Household balance sheets, consumption, and the economic slump." *The Quarterly Journal of Economics* 128(13-42):1687–1726.
- OECD. 2013. "Protecting jobs, enhancing flexibility: A new look at employment protection legislation." OECD Publishing.
- Scheuer, Steen and Kristian Rune Hansen. 2011. "Funktionærloven: En lønmodtagerlov for de fleste?" *Samfundsoekonomen* (2):24–31.
- Stephens, Jr, Melvin. 2002. "Worker displacement and the added worker effect." *Journal of Labor Economics* 20(3):504–537.
- Sullivan, James X. 2008. "Borrowing during unemployment unsecured debt as a safety net." *Journal of human resources* 43(2):383–412.

Appendix

Outcome variables used in regressions

This part of the appendix gives detailed descriptions of each of the outcome variables used in the event study analyses presented in the main text.

Wage, transfers, income, and employment (main person)

Wage income: Total wage income, net of taxes. Calculated by summing over all employment records in E-indkomst register for that individual in that month. Data in E-indkomst are recorded before tax. We convert to an after-tax measure using annual data from the Danish tax authority. We calculate the individual's tax rate as the average tax rate paid in the calendar year by dividing total taxes paid in the year with total taxable income in that year.

Government income transfers: Total income from government income transfers programs, net of taxes. Calculated by summing over all the income transfer records in E-indkomst for that individual in that month. Tax calculation is as described above for wage income.

Disposable income: The sum of wage income and government income transfers (both net of taxes).

Spousal labor supply

Wage income: Calculated exactly like wage income for main person, but for the spouse (if any). The identity of the spouse is determined using information from the population register for the beginning of the calendar year.

Employment: Dummy variable equal to 1 if the spouse had wage income of at least 10,000 DKK in that month (before tax, deflated to January 2010 price level using the CPI).

Liabilities/loans

Interest-only loans: Dummy variable equal to one if the main person or spouse (if any) has at least one interest-only mortgage loan at the end of the month.

Adjustable-rate loans: Dummy variable equal to one if the main person or spouse (if any) has at least one adjustable-rate mortgage loan at the end of the month.

Mortgage loan payments: Average monthly mortgage payments with current mortgage loans. Calculated by determining the average monthly payment over a full calendar year for each loan, then summing across all loans that the individual had at the end of the current month. This implies that any change in the portfolio of loans will have an

immediate impact on the measure of monthly payments, even if the next installment does not occur until several months later. We aggregate to household level by summing monthly payments for the main person and the spouse, if any.

Mortgage loan balances: The outstanding balance on all current mortgage loans, measured at par value. Aggregated to household level by summing values for the main person and the spouse, if any.

Consumer loan balances: The outstanding balance on non-collateralized loans from the bank. Aggregated to household level by summing values for the main person and the spouse, if any.

Financial assets

Deposit balances: The balance on deposit accounts at the bank, summed over all accounts owned by the individual or the spouse, if any, in that month. Balances on joint accounts are split equally among the account two owners before summing, so as to avoid double counting.

Securities: The value of the household's portfolio of stocks, bonds, and mutual fund shares at the end of the month. Does not include securities in pension depot accounts.

Spending

Total spending: The sum of all outgoing transactions from the individual's accounts using either of the payment methods card, mobile phone, and bill, plus cash withdrawals. We remove payments categorized as tax, debt, rent, or other housing-related payments from this calculation. We aggregate to the household level by summing spending for the main person and the spouse, if any. Outflows from joint accounts are split evenly between the two account owners before summing so as to avoid double-counting.

Fuel spending: The value of the subset of transactions in total spending measure with MCC "5542", "5541", or "5983", or bill payment label "fuel".

Restaurant and bar spending: The value of the subset of transactions in total spending measure with MCC "5813", "5462", "5811", "5812", or "5814".

Grocery spending: The value of the subset of transactions in total spending measure with MCC "5411", "5422", "5441", "5499", or "5921", or bill payment label "groceries".

Utilities: The value of the subset of transactions in total spending measure with MCC "4900", "4812", "4814", "4821", "4899", or bill payment label "utilities", "elec", "gas", "water", "heating", "internet", "cable TV", "telephone", or "TV license"

Appendix figures and tables for sample drawn from full population

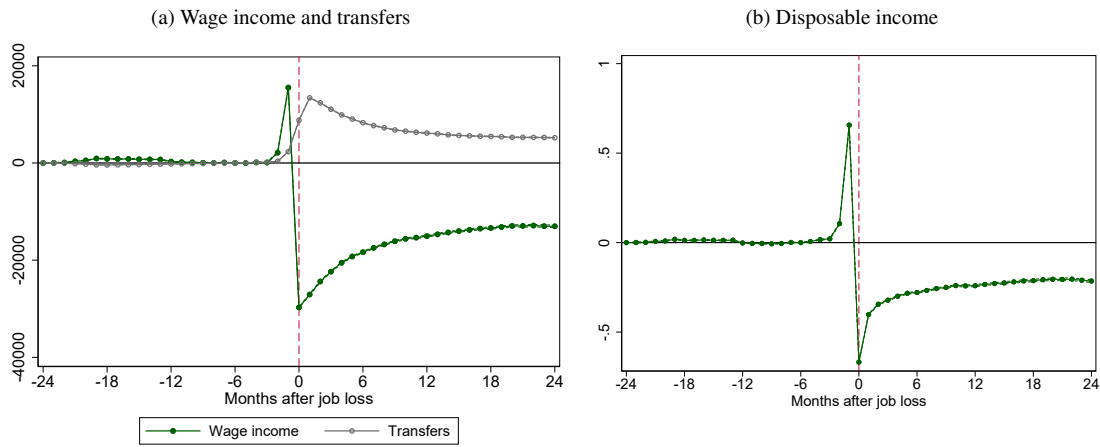
This part of the appendix presents figures and tables showing estimation results for samples drawn from the largest possible population, i.e. without limiting to households that are exclusive customers at the bank. The general principle here is that we use as much data as possible in each regression model. This implies that the sample of individuals and the number of observations entering the regressions varies across outcomes. For income and employment variables for the main person and the spouse we use a sample drawn from the full population and for all months between January 2008 and March 2016. For mortgage outcomes we use a sample drawn from the full population of mortgage borrowers and using observation from December 2009 to December 2015. For outcomes constructed from the bank data (including spending) we limit the sample to observations from months between January 2009 and December 2016 in which both the main person and the spouse (if any) had at least five spending transactions. Any outgoing transaction done by card, cell phone, bill or cash is counted as a spending transaction, regardless of the transacted amount. We reproduce results on these broader samples for all outcomes studied in the main text.

Table A1: Summary statistics, six months before job loss, broad sample

| | Obs. | Mean | Std. dev. |
|--|--------|---------|-----------|
| Single | 52,886 | 0.32 | 0.47 |
| Female | 52,886 | 0.45 | 0.50 |
| Age | 52,886 | 45.55 | 7.31 |
| Copenhagen resident | 52,886 | 0.33 | 0.47 |
| Higher education | 52,886 | 0.23 | 0.42 |
| Primary sector | 52,885 | 0.01 | 0.10 |
| Manufacturing | 52,885 | 0.19 | 0.39 |
| Construction | 52,885 | 0.07 | 0.26 |
| Trade or transport | 52,885 | 0.26 | 0.44 |
| Other business services | 52,885 | 0.20 | 0.40 |
| Public administration, teaching or health sector | 52,885 | 0.23 | 0.42 |
| Arts and entertainment | 52,885 | 0.03 | 0.18 |
| Wage income after tax (main person), DKK | 52,860 | 19,544 | 7,371 |
| Household disposable income, DKK | 52,864 | 31,903 | 14,694 |
| Homeowner | 52,886 | 0.66 | 0.47 |
| Household spending, DKK | 13,505 | 23,837 | 14,203 |
| Household bank deposit balances, DKK | 13,505 | 116,597 | 188,375 |
| Household consumer loan balances, DKK | 13,454 | 20,681 | 46,402 |
| At least one mortgage loan | 42,970 | 0.50 | 0.50 |
| Household mortgage debt (cond. on at least one mortgage loan), DKK | 21,358 | 730,580 | 436,563 |
| Monthly mortgage payments (cond. on at least one mortgage loan), DKK | 20,483 | 5,384 | 3,304 |

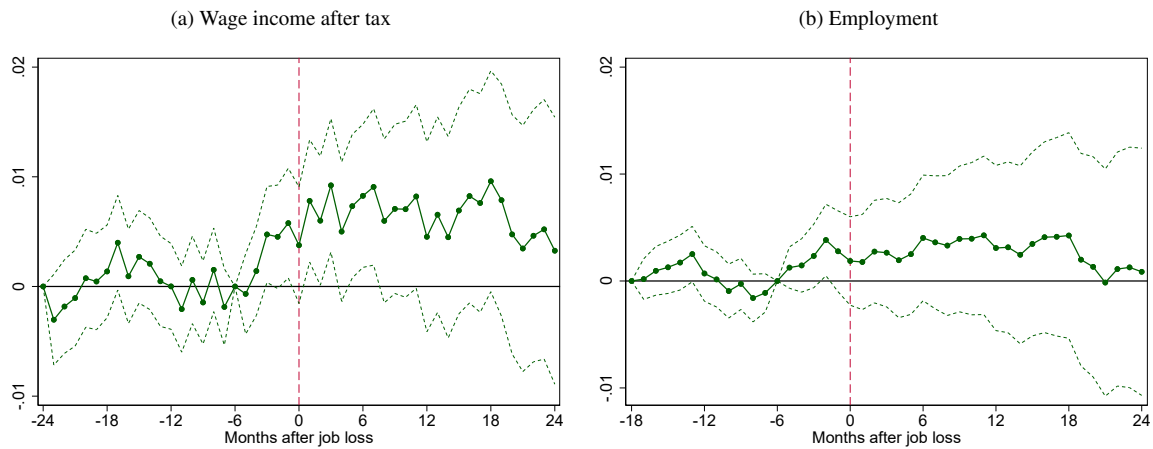
The table shows summary stats for a broader sample of individuals than the main sample. All variables measured 6 months before month of job loss. Statistics for household spending, bank deposits and consumer loan balances are for the subsample of individuals who belonged to a household in which all adults members had at least five spending transactions in the bank in that month. Mortgage variable statistics are based on individuals who lost their job in July 2010 or later due to limited data coverage. Variables measured in DKK are deflated to January 2010 price level using the CPI and winsorized at the 1st and 99th percentiles within each calendar before computing summary stats.

Figure A.1: Wage income, transfers, and disposable income for main person, broad sample



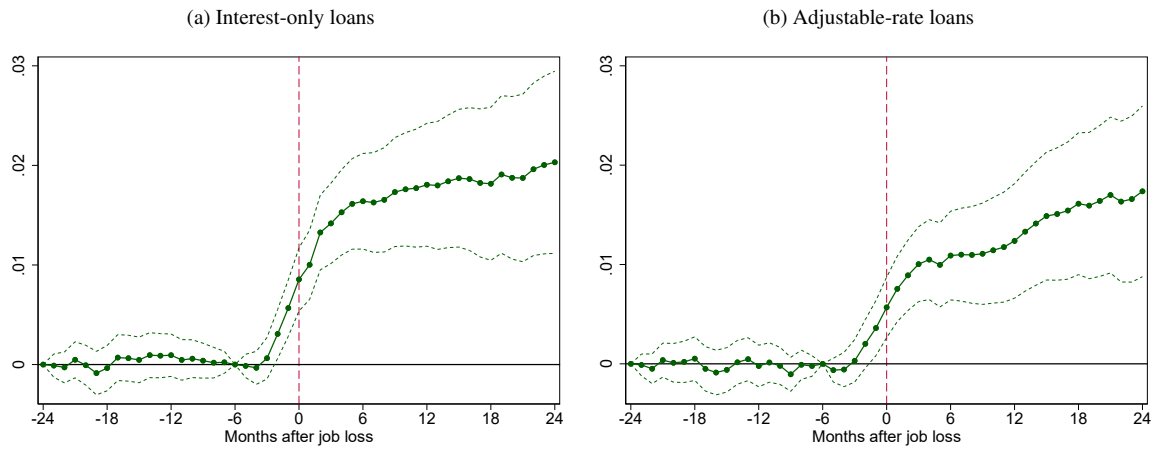
The figure parallels Figure 1 in the main text, but using a broader of individuals. Panel a shows results for the main person's wage income and income from government transfers, both before tax and measured in DKK at January 2010 prices. Panel b shows results for disposable income, i.e. total after-tax income from wages and transfers, measured relative to the main persons's average disposable income in the months before the unemployment event. The connected dots show the coefficients estimates for the event time dummies, while the dashed lines show their 95 percent confidence intervals. The omitted event month categories are -24 and -6.

Figure A.2: Spousal wage income and employment, broad sample



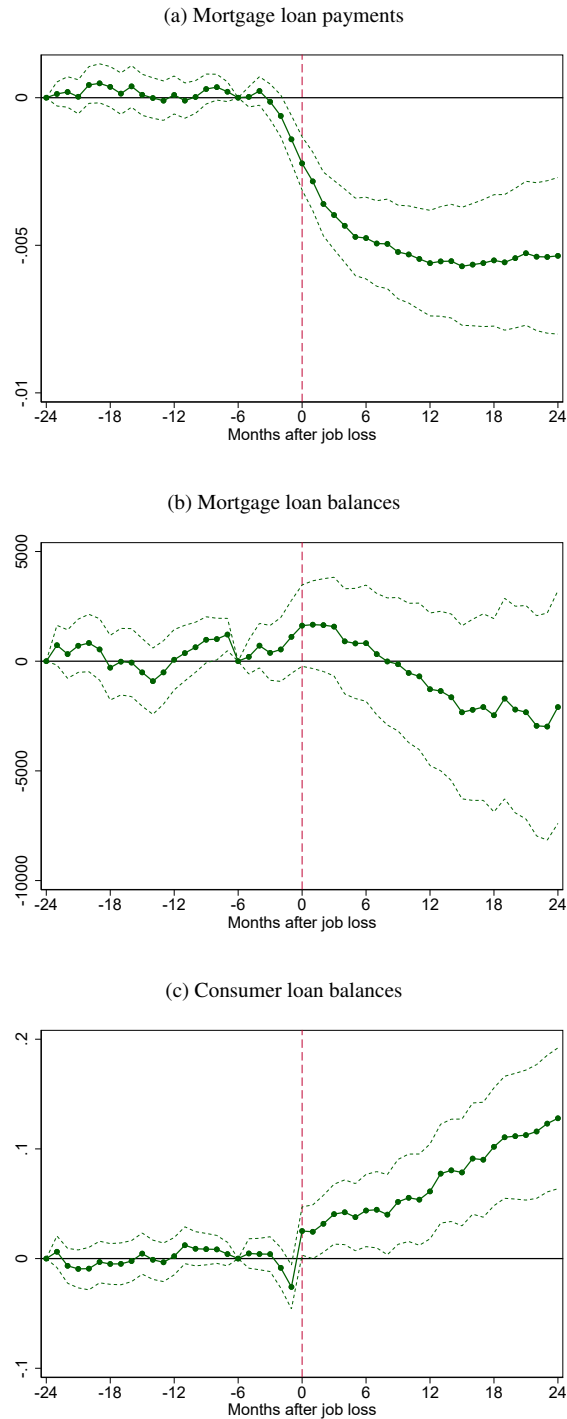
The figure parallels Figure 2 in the main text, but using a broader of non-single individuals. Panel a shows results for the spouse's after-tax wage income, normalized by the main persons's average disposable income in the months before the unemployment event. Panel b displays results for a dummy variable equal to 1 if the spouse has wage income before tax of at least 10,000 DKK. The connected dots show the coefficients estimates for the event time dummies, while the dashed lines show their 95 percent confidence intervals. The omitted event month categories are -24 and -6.

Figure A.3: Mortgage loan types, broad sample



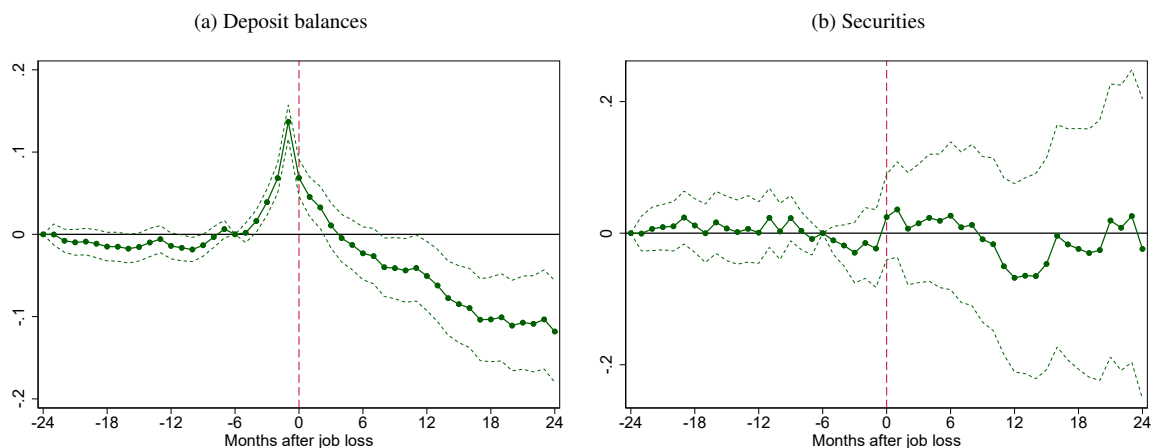
The figure parallels Figure 3 in the main text, but using a larger sample based on the full population of mortgage borrowers. Panel a shows results for a dummy variable equal to 1 if the household has an interest-only loan. Panel b shows results for a dummy variable equal to 1 if the household has an adjustable-rate loan. The connected dots show the coefficients estimates for the event time dummies, while the dashed lines show their 95 percent confidence intervals. The omitted event month categories are -24 and -6.

Figure A.4: Loan payments and balances, broad sample



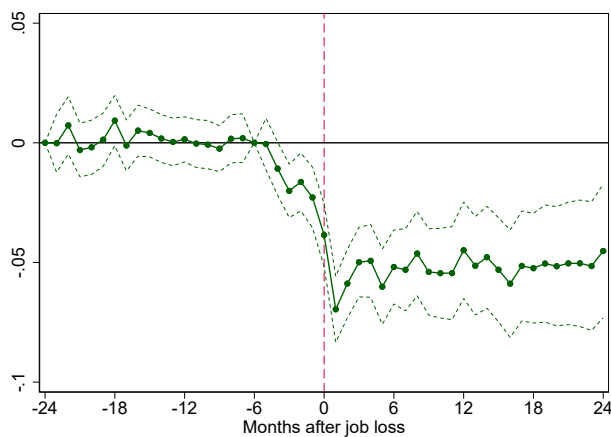
The figure parallels Figure 4 in the main text, but using a larger sample. Panels a and b show results for mortgage loan payments and -balances, respectively, for the subsample of households with at least one mortgage loan. Panel c shows consumer loan balances for all households in the sample. All outcomes are normalized by the main persons's average disposable income in the months before the unemployment event. Loan balances are measured in absolute terms, so that a more positive number reflects a larger debt. The connected dots show the coefficients estimates for the event time dummies, while the dashed lines show their 95 percent confidence intervals. The omitted event month categories are -24 and -6.

Figure A.5: Financial assets, broad sample



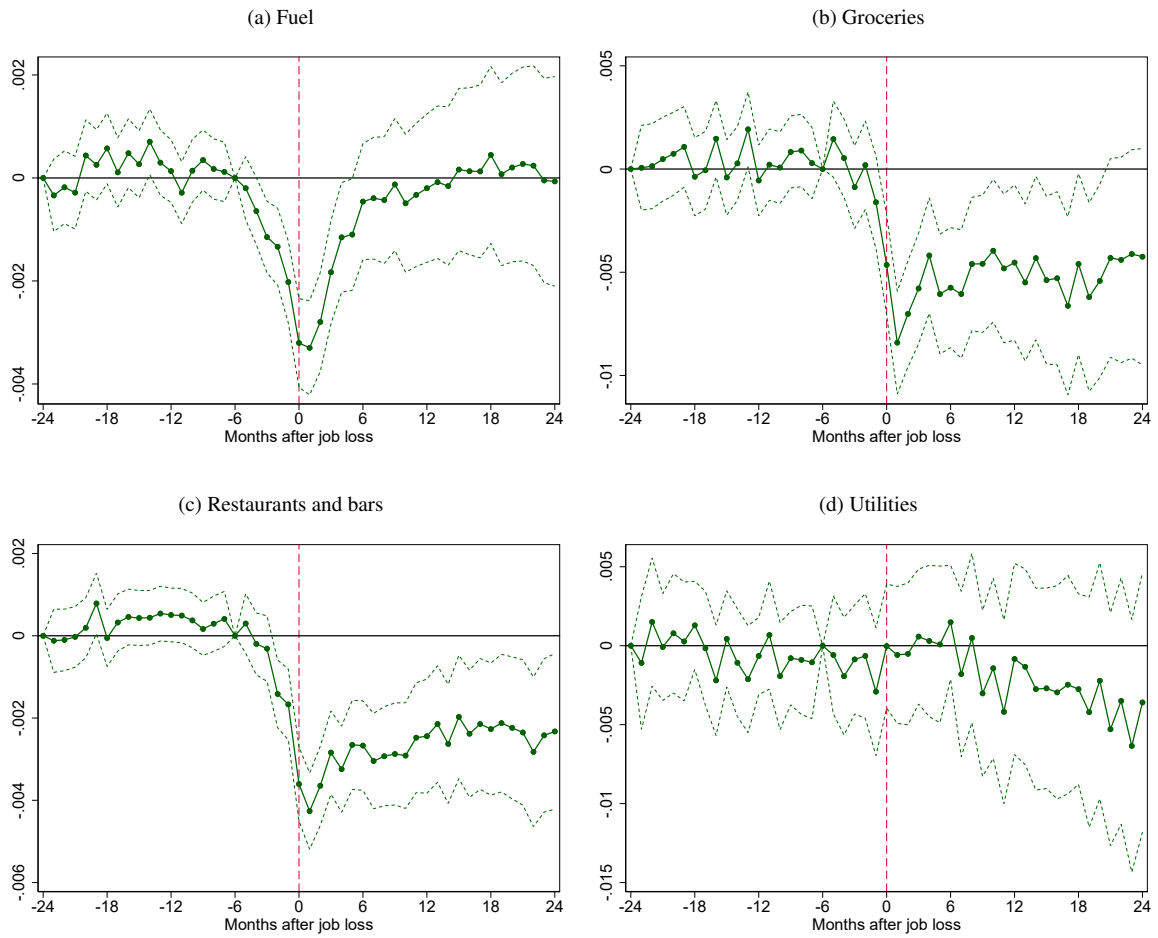
The figure parallels Figure 5 in the main text, but using a larger sample. Panel a shows results for bank deposit balances, while panel b shows the value of securities held in custody at the bank. Both variables are normalized by the main persons's average disposable income in the months before the unemployment event. The connected dots show the coefficients estimates for the event time dummies, while the dashed lines show their 95 percent confidence intervals. The omitted event month categories are -24 and -6.

Figure A.6: Total spending, broad sample



The figure parallels Figure 6 in the main text, but using a larger sample. Total spending is the sum of monthly spending for the main person and the spouse, if any, deflated to January 2010 prices using the CPI and normalized by the main persons's average disposable income in the months before the unemployment event. The connected dots show the coefficients estimates for the event time dummies, while the dashed lines show their 95 percent confidence intervals. The omitted event month categories are -24 and -6.

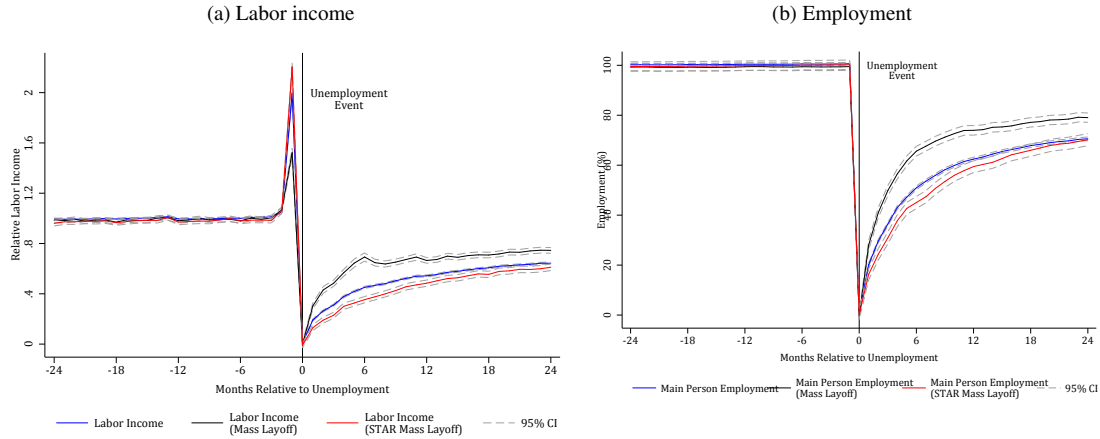
Figure A.7: Selected spending categories, broad sample



The figure parallels Figure 7 in the main text, but using a larger sample. Panel a shows results for fuel spending, while panel b shows grocery spending. Panels c and show d results for spending in restaurants and bars and utility bills, respectively. All variables are measured as the sum for the main person and the spouse, if any, and normalized by the main persons's average disposable income in the months before the unemployment event. The connected dots show the coefficients estimates for the event time dummies, while the dashed lines show their 95 percent confidence intervals. The omitted event month categories are -24 and -6.

Appendix figures and tables for mass layoff samples

Figure A.8: Labor income and employment: Full sample vs. mass layoff subsamples

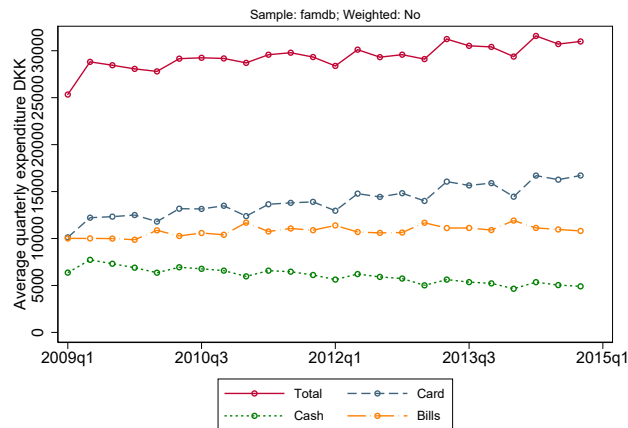


The figure shows the development in labor income and employment for the main person around the time of the unemployment shock. Labor income is measured relative to its own pre-displacement level. Employment is proxied by a dummy variable for labor income above 1,000 DKK before tax (January 2010 price level). The blue curves illustrate results for the sample drawn from the full population. Black curves show results for the subsample of individuals who lost their jobs during a mass layoff event, using the 30 percent decrease in no. of employees criterion. Red curves show results for the subsample of individuals who lost their jobs during a mass layoff event according to official records from the Agency for Labor Market and Recruitment.

Measuring household expenditure

This part of the appendix presents figures and tables documenting the measure of household expenditure that we construct from bank transaction data.

Figure A.9: Total spending by method of payment and quarter



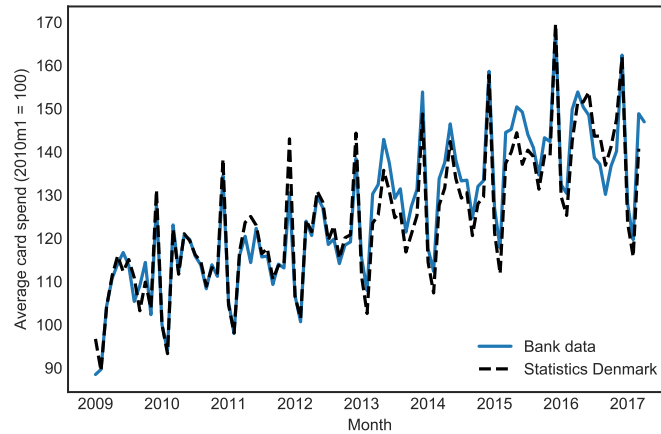
The figure shows the breakdown of the spending measure on categories of outflows. Card payments include payments via cellular phone.

Table A2: Bank customers

| Year | #Individuals, full population | #Households, full population | %Individuals in bank data | %Households in bank data | %Individuals exclusive customers | %Households exclusive customers |
|------|-------------------------------|------------------------------|---------------------------|--------------------------|----------------------------------|---------------------------------|
| 2014 | 5,627,235 | 2,916,677 | 33.6 | 41.0 | 17.7 | 15.8 |

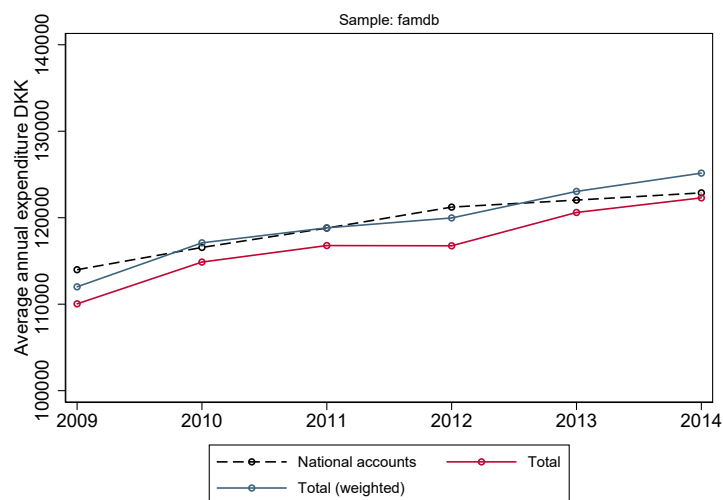
The table shows the number of individuals and households in the full Danish population, as well as the share of each who are customers at the bank. “%Individuals in bank data” and “%Households in bank data” denote the percentage share of individuals and households, respectively, who are represented in some way in the data from the bank. “%Individuals exclusive customers” reports the share of customers who are customers at the bank without being banked anywhere else, while “%Households exclusive customers” shows the share of households in which the same criterion is satisfied for all adult members.

Figure A.10: Average card spending per person in bank data vs. aggregate per capita card spending from Statistics Denmark, by month



The figure compares the development in card spending per person in the bank data with the development in aggregate per capita card spending according to official statistics from Statistics Denmark. The solid blue line shows average monthly card spending per person among the group of exclusive customers in our bank data, i.e. customers who are not banked anywhere else. The dashed black line shows aggregate per capita card spending calculated from official statistics published by Statistics Denmark. To construct the series, we have divided total aggregate card spending in each month by the number of persons in the population aged 18 or older.

Figure A.11: Average spending (all payment methods) per person in bank data, vs. aggregate per capita non-housing consumption from National Accounts, by year



The figure compares the level of and development in total spending per person in the bank data with the corresponding level and development in aggregate per capita non-housing consumption according to official statistics from Statistics Denmark. The solid red line shows the unweighted average annual spending per person among the group of exclusive customers in our bank data, i.e. customers who are not banked anywhere else. The solid blue line shows the same series, but where the sample of households in the bank data has been weighted to match the full population in terms of age, number of children, income and education. The dashed black line shows aggregate non-housing consumption per capita calculated from official statistics published by Statistics Denmark. To construct the series, we have divided total aggregate non-housing consumption from the National Accounts by the number of persons in the population aged 18 or older.