

Early pension withdrawals and optimal liquidity

Henrik Yde Andersen¹ Alina Bartscher²
Søren Leth-Petersen³ Patrick Moran⁴

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¹Danmarks Nationalbank ²Frankfurt School ³University of Copenhagen ⁴Federal Reserve Board

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- many retirement systems have subsidized, illiquid accounts
- liquidity restrained by penalty for early withdrawal (EW) → may act as commitment device for tempted individuals
- uncertainty among policymakers about optimal design
- increasing importance of individual financial decisions (DC)
- behavioral biases \Rightarrow need for good pension policies
- trade-off between commitment and flexibility

Questions

- How does individuals' valuation of liquidity depend on
 - changes in the cost of liquidity
 - life events with negative financial consequences?
- Is there a trade-off between consumption smoothing (of rational consumers) and commitment needs (of tempted consumers)?
- How should policymakers balance this trade-off? What is the optimal level of liquidity for individual retirement accounts?
- Can policymakers improve individuals' wellbeing with state-contingent policies?

What we are doing

- Register data
 - study withdrawal behavior in response to exogenous variation in withdrawal cost (natural experiment in Denmark)
 - study withdrawal behavior in response to life events
- Model
 - estimate life-cycle model → quantify trade-off between flexibility and commitment
 - study optimal liquidity and evaluate policies

Contribution to literature

- life events and pension contributions as revealed preference tools: Coyne et al. (2022), Choukhmane et al. (2023), Briere et al. (2025)
- penalty waivers: Agarwal et al. (2020), Goda et al. (2022), Stuart and Bryant (2022)
- EW as stimulus: Hamilton et al. (2023), Bateman et al. (2023)
- theoretical literature posits trade-off between flexibility and commitment (e.g., Amador et al., 2006; Beshears et al., 2025)
- our goal: combine data with model to assess strength of trade-off

Institutional background and data

The Danish pension system

- three pillars (public DB, occupational DC, private DC)
- lower capital gains tax (15.3% vs. 27%-42%), tax deduction
- early withdrawal possible from pillar 3
- regular withdrawal: upon retirement age = 60+ years at **40%**
- early withdrawal penalty of **20%**

The reform

- 2012 reform: owners of “capital pensions” could withdraw early at **10%** penalty in 2013-2015 (later: 12%)
- no change in rules for other pension schemes
- ! note: people could simply keep their balance and keep enjoying tax benefits
- goal: compare individuals with private capital pension (T) to other private pension holders (C)
- don't see pension types directly → infer from contributions

▶ awareness

▶ assignment

▶ summary stats

- microdata from several Danish registers (third-party-reported)
 - pension contributions + withdrawals
 - demographic and labor market data
 - household income (3-year MA) and wealth
- individuals 25-59 who live and are fully tax liable in Denmark in given year, 2009 – 2019
- savers with private capital pension or annuity pension accounts (last pay-in after 2003) (2014: 42% of Danes 25-59 had private pensions; 19% of pen. & 14% of all fin. assets)

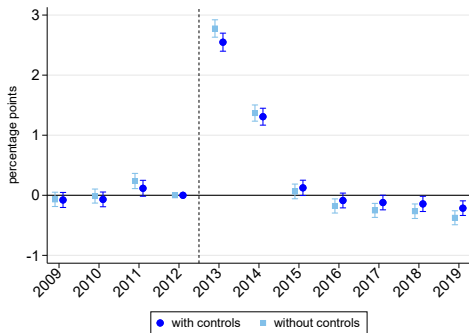
Empirical analysis

- pension savings may act as a commitment device for tempted consumers
- reduction of the early withdrawal penalty has direct price effects, but also lowers commitment value of pension account
- can only estimate joint effect in data → life-cycle model for structural interpretation
- use 2012 reform to study exogenous reduction in EW penalty in a DiD design

$$y_{it} = \beta_0 + \delta_t + \gamma_i + \beta_1 \delta_t \times treat + \Phi' x_{it} + \epsilon_{it}.$$

- δ_t : year FE
- γ_i : individual FE
- x_{it} : pre-det. municipality \times year, pre-det. income decile \times year, age \times year FE

DiD: propensity to withdraw early



▶ IPW, AN

▶ levels, fam

▶ long

▶ min. cont

▶ min. thld

- Do people spend withdrawn money, or reallocate it to other assets? → event studies of real “active” savings around EW

1. twoway fixed effects

- $$y_{it} = \sum_{l=\underline{l}}^{\bar{l}} \tau^l D_{it}^l + \delta_t + \gamma_i + \Gamma' x_{it} + \varepsilon_{it}$$

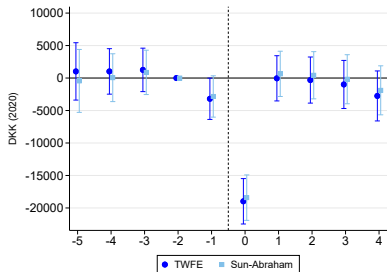
- D_{it}^l : event indicators; γ_i : ind. FE; δ_t : year FE; x_{it} : pre-det. municipality × year, income decile × year, age

2. possibility of heterogeneous treatment effects → Sun and Abraham (2021) robust estimator

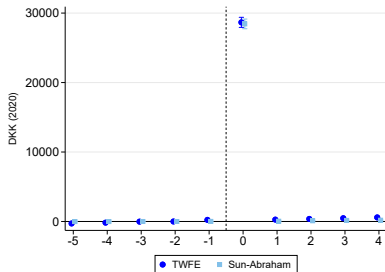
- effects may build up over 2 calendar years → allow one anticipation period (cf. also Coyne et al. 2022)

Event study: dissaving around EW

Active financial savings



Post-tax early withdrawals



- no reaction if people just reinvested money in other assets
- however: pronounced reduction of financial savings (more than half of withdrawn amount)
- rest used in equal parts for liquid savings and debt repayment

► rel. to inc.

► real est.

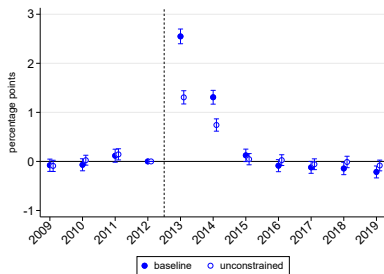
► C post-2012

- role for income, liquidity and borrowing constraints
 - stronger reaction of younger people, weaker reaction with more income
 - stronger reaction with lower financial assets and higher bank debt
 - stronger reaction with higher mortgage debt

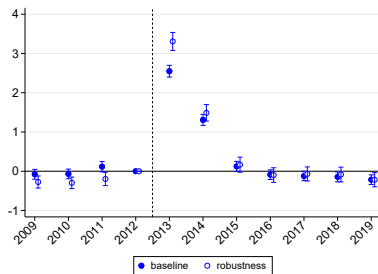
▶ graphs

A role for temptation?

“Unconstrained” sample



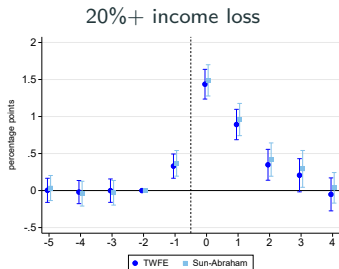
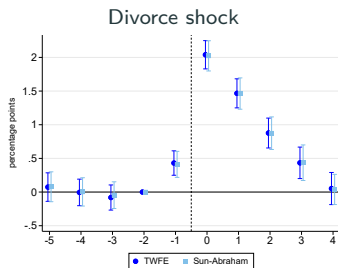
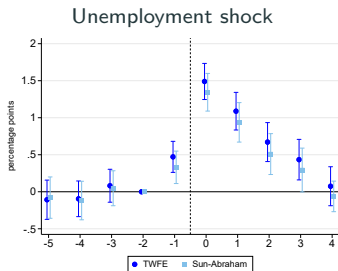
Recent, regular contributors



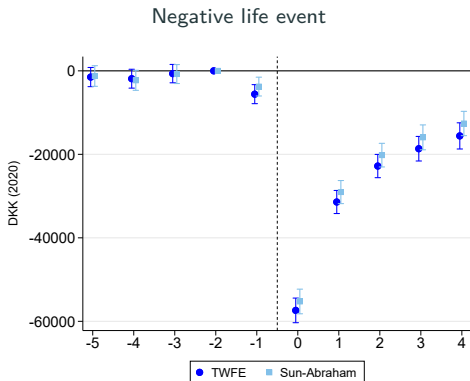
- even unconstrained individuals w/o negative life events withdraw
- even individuals who contributed right up to the reform withdraw

- EW may allow to smooth consumption in face of life events with neg. financial consequences
 - divorce: separation between $t - 1$ and t
 - unemployment: above-median unemp. spell in t (but not $t - 1$)
 - general negative income shock of at least 20%
- same estimators and sample criteria as for event studies around EW

EW response to negative life events



Financial savings



- no persistent reduction in savings around negative life events

- early pension withdrawals are flexible smoothing tool in face of life events with negative financial consequences
- strong reaction to 2012 reform reducing EW penalties
- role for liquidity and borrowing constraints
- also role for temptation?

Quantifying the trade-off

Quantifying the trade-off between flexibility and commitment

Questions

- To what extent do individuals value greater liquidity in retirement accounts?
- If individuals also value commitment, what is the optimal degree of illiquidity?

What we do

- develop and estimate a life-cycle model of individual behavior (inspired by Deaton 1991, Attanasio and Browning 1995, Carroll 1997)
- temptation preferences generate commitment (Attanasio et al., 2024; Gul and Pesendorfer, 2001, 2004; Kovacs et al., 2021)
- estimation is work in progress → preliminary results

Model: Key Features

Individuals choose:

- consumption
- liquid savings
- illiquid retirement savings

Individuals get (dis-)utility from:

- consumption
- temptation

Risks & uncertainty:

- income shocks
- unemployment shocks

Taxes:

- progressive income taxation
- capital gains taxation
- retirement savings subsidies, early withdrawal penalties

Preferences, income and assets

- temptation preferences (Gul and Pesendorfer, 2001, 2004):
 - tempting, feasible alternative: not chosen but affects utility
 - commitment: reduce temptation by “locking away” wealth
- stochastic income, unemployment shocks → unemployment benefits $b^u(z_{i,t})$
- retirement income from social security + ind. pension savings
- retirement asset partially illiquid due to EW penalty

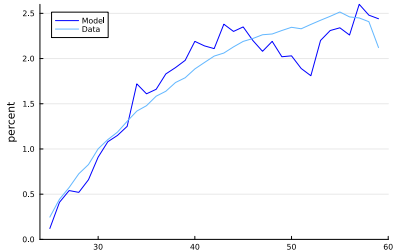
▶ details

A first calibration

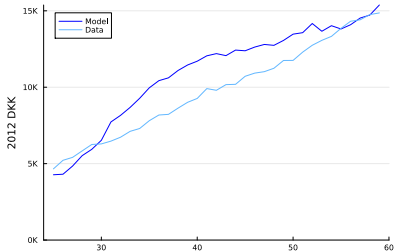
Name	Value	Definition	Target/source
<i>A. Externally calibrated parameters</i>			
λ^{tempt}	0.149	temptation parameter	Attanasio et al. (2024)
r_b	0.05	pension interest rate	register data
τ_{rw}	0.4	regular withdrawal tax rate	
τ_{ew}	0.2	early withdrawal tax penalty	
DP^{max}	50.000	maximum pension deduction	
<i>B. Internally calibrated parameters</i>			
β^{rat}	0.97	discount factor rational	
β^{tempt}	0.99	discount factor tempted	
γ^{rat}	2.48	risk aversion rational	
γ^{tempt}	3.00	risk aversion tempted	
r_a	0.05	liquid interest rate	
f_{ew}	4.500	fix cost (in DKK)	
s_{tempt}	0.15	share of tempted individuals	

Model fit to targeted moments with preliminary calibration

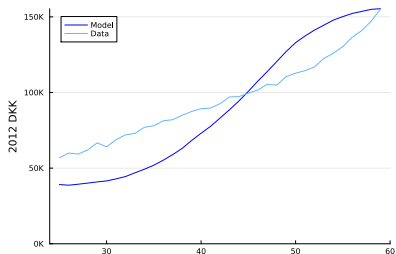
EW propensity



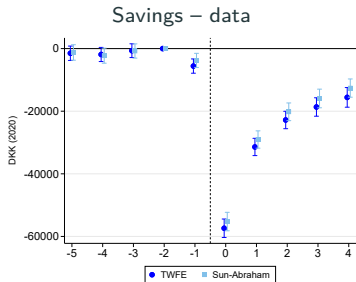
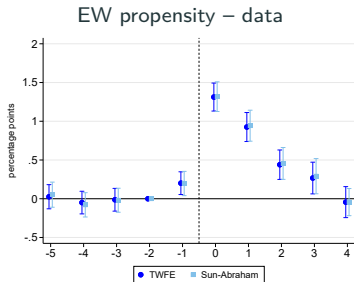
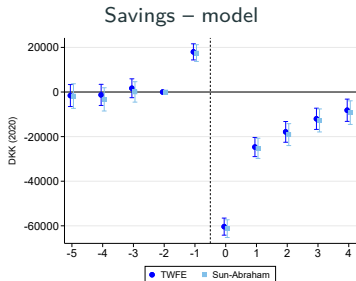
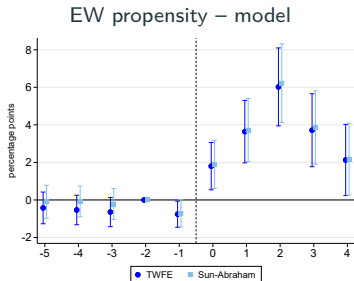
Pension contributions



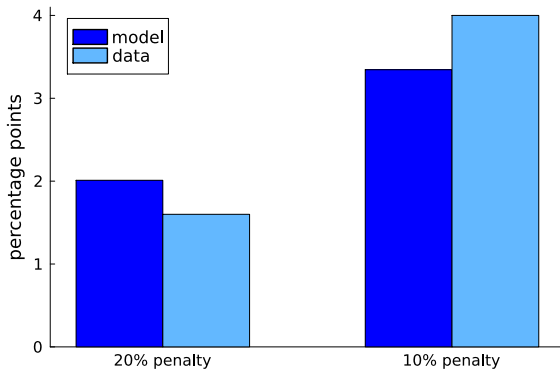
Liquid assets



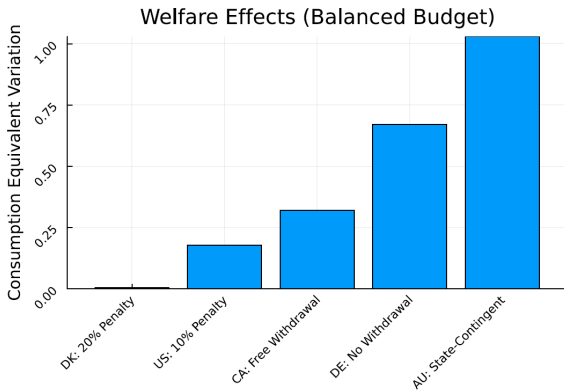
EW and savings response to life events (untargeted)



Reducing the EW penalty from 20% to 10% (untargeted)



Preliminary policy counterfactuals



Conclusion

- strong response to exogenous variation in EW penalty, some people have need for commitment
- also need for flexibility: use early withdrawals to smooth out financial consequences of life events
- preliminary model results suggest advantage of state-contingent policies

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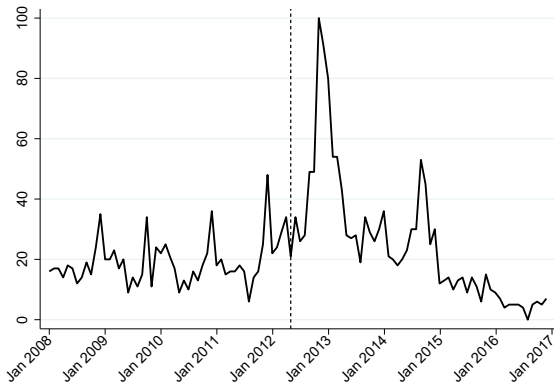
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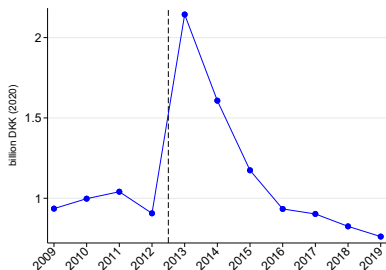
Were Danes aware of the reform?



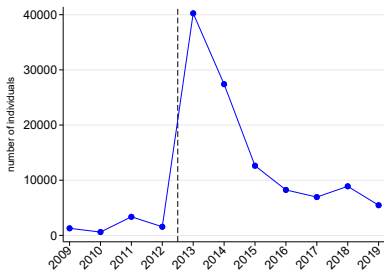
- searches from Google Trends for term “kapitalpension”
- dashed line marks first announcement of reform
- peak when tax rebate on EW became available in 2013

Did Danes react to the reform?

Total amount of EWs (post-tax)

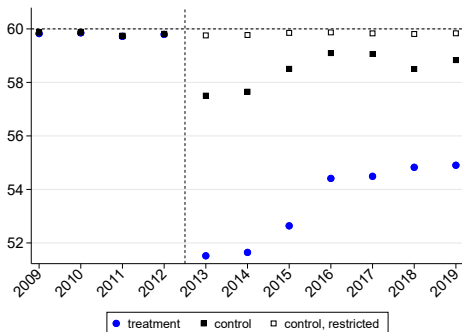


EWs with below-regular tax rate



- EW of private capital pension holders 2013-15: mean 75,000 DKK (2020; around 11,500 USD) / median 32,500 DKK (2020; around 5,000 USD)

How well does assignment work? – Tax rates in T and C



- restriction (only for illustration): exclude individuals who paid into occup. capital pension + had reduced tax penalty from C
- note: one can withdraw from different accounts at same time

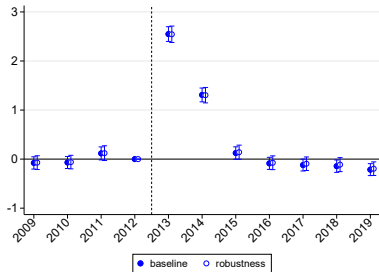
Summary statistics (2012)

	Control	Treatment	No pri. pen.
age	44.20	45.58	39.04
cum. pri. AN cont.	143.41	68.95	0
cum. pri. LS cont.	0	91.72	0
debt	1124.52	859.32	593.22
disp. income	290.31	240.31	205.74
fin. assets	268.40	180.49	115.57
homeownership	0.82	0.77	0.51
no. of children	1.02	0.84	0.86
share female	0.42	0.49	0.53
share married	0.65	0.62	0.48
N	179,129	680,243	1,288,159

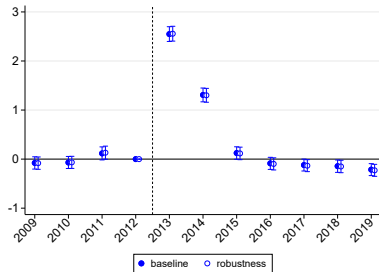
Real amounts are stated in units of 1,000 DKK at 2020 prices.

IPW and only annuity savers

Inverse propensity score weighting

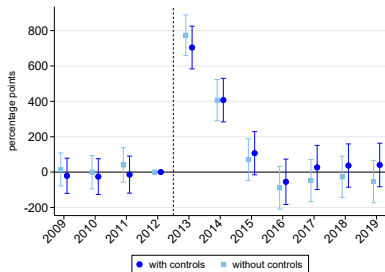


Only annuity savers

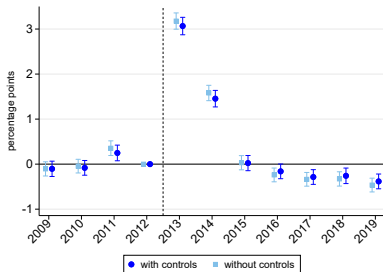


Levels and family aggregation

Post-tax early withdrawals

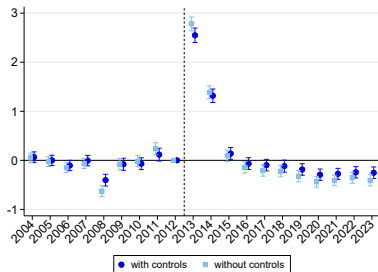


Family-level propensity

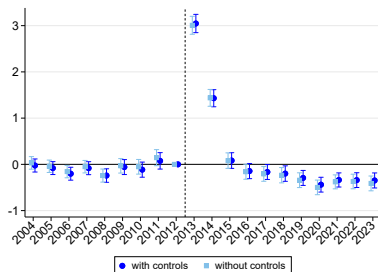


Longer sample

Longer sample



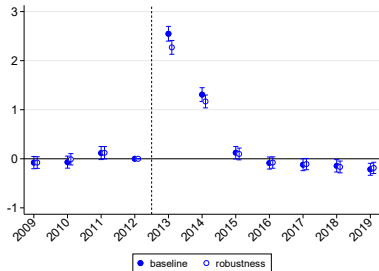
Longer sample, w/o top 25%



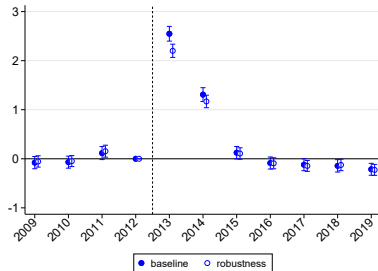
- flat pre-trend apart from outlier in 2008
- driven by top 25% of income distribution (maybe automatic cash-outs of capital losses not captured by minimum EW threshold)

Minimum contribution and last before 2003

No minimum contribution

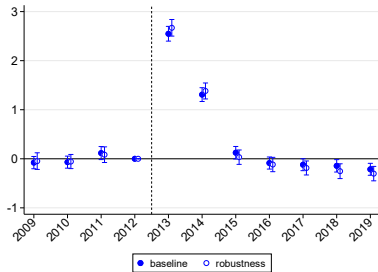


Last contribution before 2003

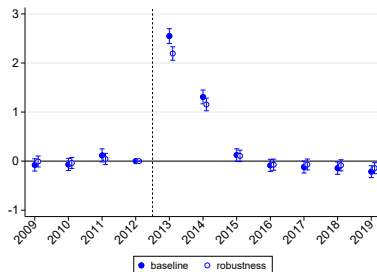


Minimum withdrawal threshold

No threshold

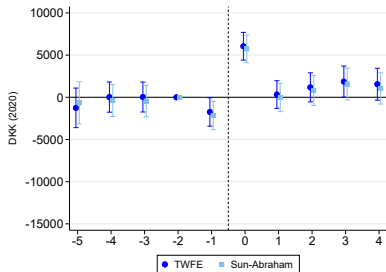


Higher threshold of 10,000 DKK

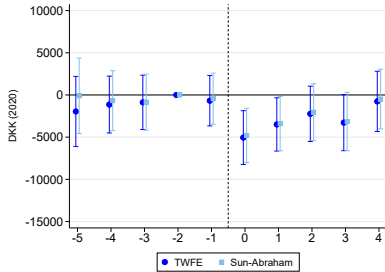


Event study: deposits and debt around early withdrawal

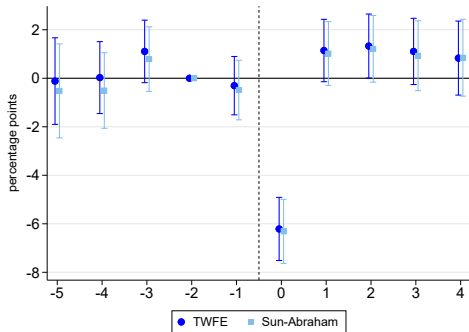
Bank deposits



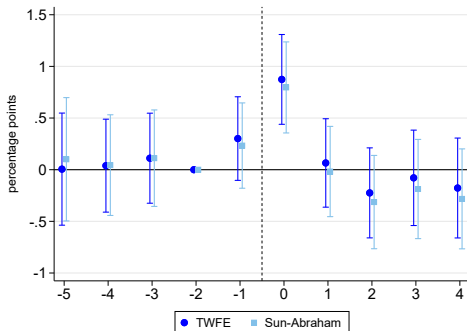
Debt



Savings-to-income ratio



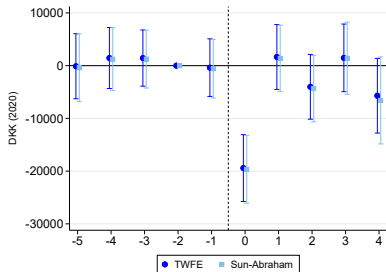
Do people use the money to buy houses?



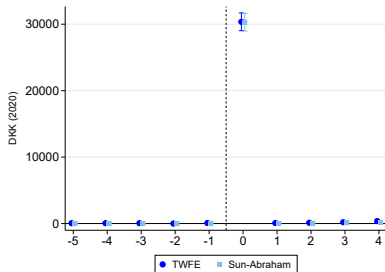
- baseline savings measure excludes years of housing transactions for any HH member (cf. Crawley and Kuchler 2023)
- indeed find an increase in propensity to buy a home
- however, yet 95% don't trade houses

Event study: dissaving around EW, only C group post-2012

Active financial savings

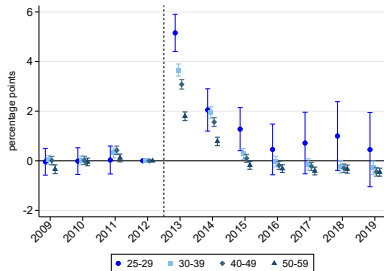


Post-tax early withdrawals

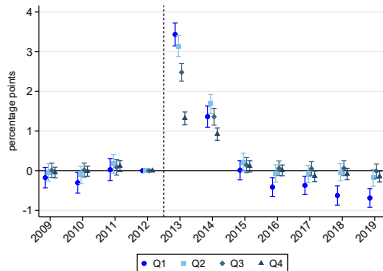


Heterogeneity: age and income

By age

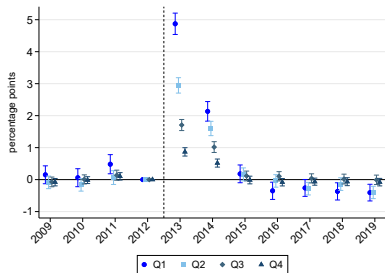


By income

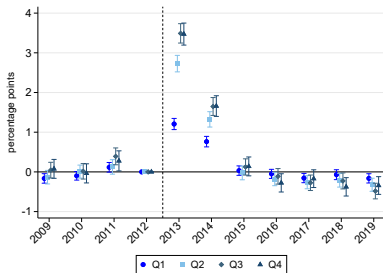


Heterogeneity: financial assets and bank debt

By financial assets/income

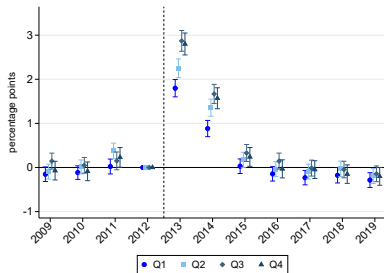


By bank debt/income

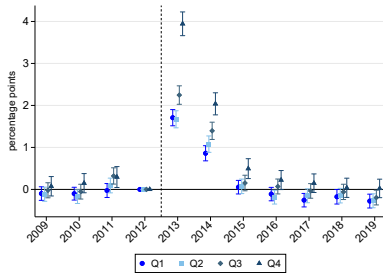


Heterogeneity: housing debt

By mortgage debt/income



By LTV

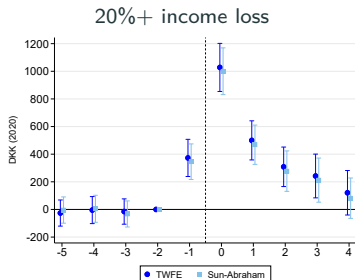
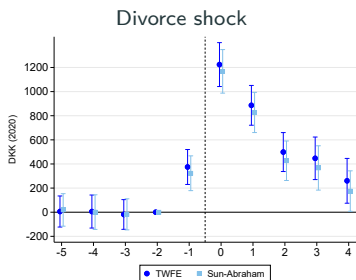
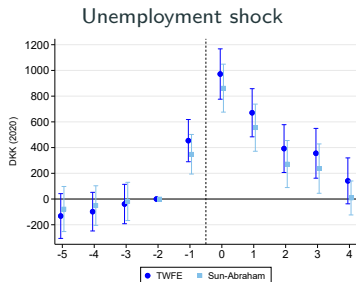


Heterogeneity: all at once

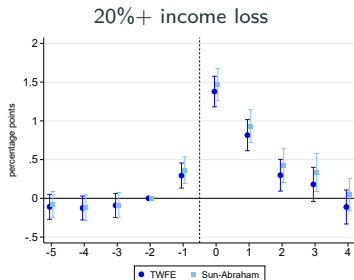
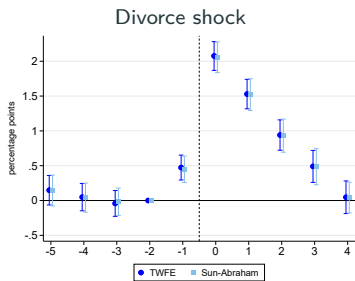
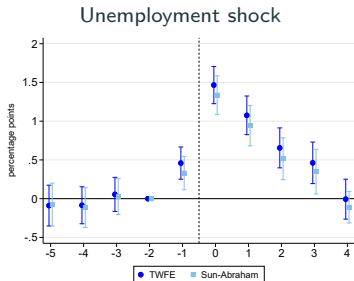
treated × 2013 × age 25-29	2.099***	(0.413)
treated × 2013 × age 30-39	0.897***	(0.152)
treated × 2013 × age 40-49	0.763***	(0.122)
treated × 2013 × income Q1	0.890***	(0.188)
treated × 2013 × income Q2	0.827***	(0.158)
treated × 2013 × income Q3	0.636***	(0.133)
treated × 2013 × FATI Q1	2.438***	(0.191)
treated × 2013 × FATI Q2	1.228***	(0.147)
treated × 2013 × FATI Q3	0.548***	(0.114)
treated × 2013 × PDTI Q2	0.212*	(0.129)
treated × 2013 × PDTI Q3	0.682***	(0.140)
treated × 2013 × PDTI Q4	1.174***	(0.156)
treated × 2013 × HDTI Q2	0.131	(0.141)
treated × 2013 × HDTI Q3	0.374**	(0.154)
treated × 2013 × HDTI Q4	0.394**	(0.159)

Obs.	7,189,609
Clusters	912,227

EW response to negative life events – levels (post-tax)

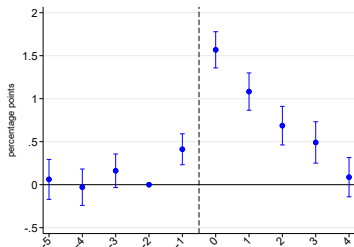


EW response to negative life events – *w/o controls*

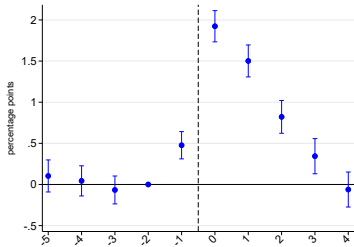


Multiple events

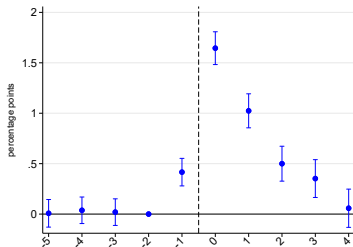
Unemployment shock



Divorce shock

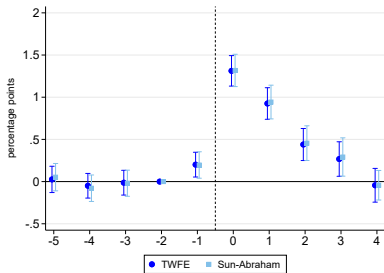


20%+ income loss

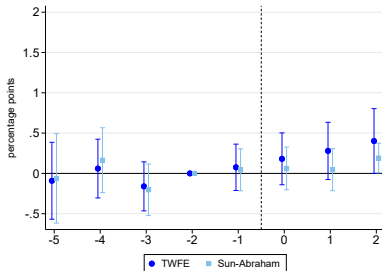


Further robustness

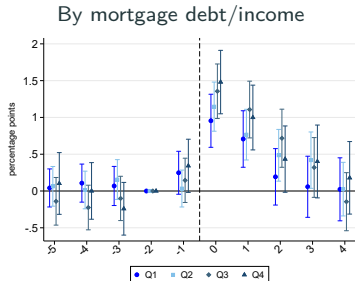
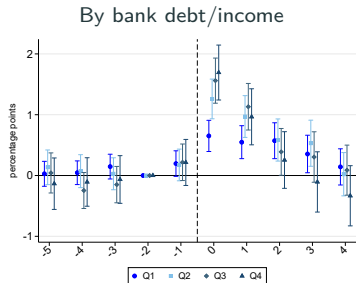
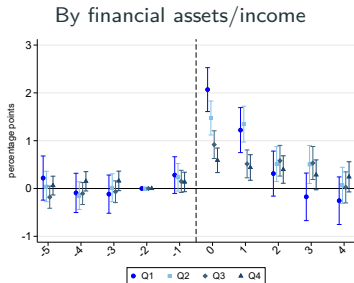
All events combined



Above-median-length hospitalization



Heterogeneity (TWFE)



Model: Preferences

individuals optimize:

$$\mathbb{E}_0 \sum_{t=0}^T \beta^t U(c_t, \tilde{c}_t)$$

- c_t : consumption
- \tilde{c}_t : most tempting alternative (can affect utility w/o being chosen)

Utility function:

$$U(c_t, \tilde{c}_t) = u(c_t) - \underbrace{\lambda [u(\tilde{c}_t) - u(c_t)]}_{\text{utility cost of self-control}}$$

- $\lambda \geq 0$: degree of temptation
- $\tilde{c}_t = \operatorname{argmax}_{c_t} u(c_t)$ s.t. current-period BC

$$a_{t+1} = (1 + r_a)a_t + y_t - \tau_t(y_t, s_t) - c_t - s_t$$

$$b_{t+1} = (1 + r_b)b_t + s_t$$

- $r_a = (1 - \tau_a) \cdot r$: post-tax return on liquid asset a_t
- $r_b = (1 - \tau_b) \cdot r$: post-tax return on retirement account b_t
- y_t : stochastic income
- $\tau_t(\cdot)$: nonlinear tax function (cf. Keane and Wasi 2016)
- s_t : retirement contributions/withdrawals
- $a_t \geq \underline{a}$, $b_t \geq 0$

$$\tilde{y}_{i,t} = g_t + z_{i,t} + \epsilon_{i,t} \quad (1)$$

$$z_{i,t} = \rho_{t-1} z_{i,t-1} + \xi_{i,t}$$

$$z_{i,1} \sim N(0, \sigma_{z_1}^2)$$

$$\xi_{i,t} \sim N(0, \sigma_{\xi,t}^2) \quad \forall t > 1$$

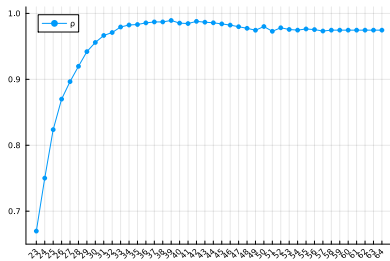
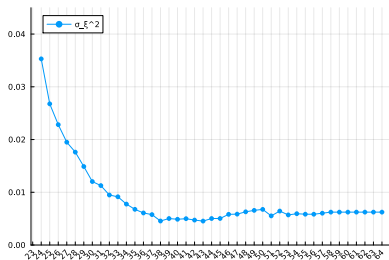
$$\epsilon_{i,t} \sim N(0, \sigma_{\epsilon,t}^2) \quad \forall t$$

- g_t : deterministic age polynomial; $z_{i,t}$: individual productivity; ρ_t : persistence of income shocks; $\xi_{i,t}$: i.i.d. shocks
- employment e_t follows 1st-order Markov process with $\pi_{e_t|e_{t-1}}$
- unemployment benefits $b^u(z_{i,t})$
- retirement income from government-provided social security + private pension savings

$$\begin{aligned}\tau(y_t, s_t) &= \tau_y(y_t, s_t) + \tau_b(s_t) \\ &= \tau_y(y_t, s_t) + (\tau_{rw} + \tau_{ew} \cdot \mathbb{I}_{t < Tr}) \cdot |s_t| \cdot \mathbb{I}_{s_t < 0} \\ &\quad + f_{ew} \cdot \mathbb{I}_{t < Tr} \cdot \mathbb{I}_{s_t < 0}\end{aligned}$$

- τ_1, τ_2 : progressivity parameters
- τ_d : income tax deduction
- τ_w : tax rate on regular pension withdrawals
- τ_{ew} : EW penalty
- $\mathbb{I}_{t < Tr}$: indicator for working age
- f_{ew} : fix cost

Income process parameters

 ρ  $\sigma_{\xi,t}^2$  $\sigma_{\epsilon,t}^2$ 