The price of leverage: learning from the effect of LTV constraints on job search and wages

Gazi Kabas
Tilburg University

Kasper Roszbach
Norges Bank

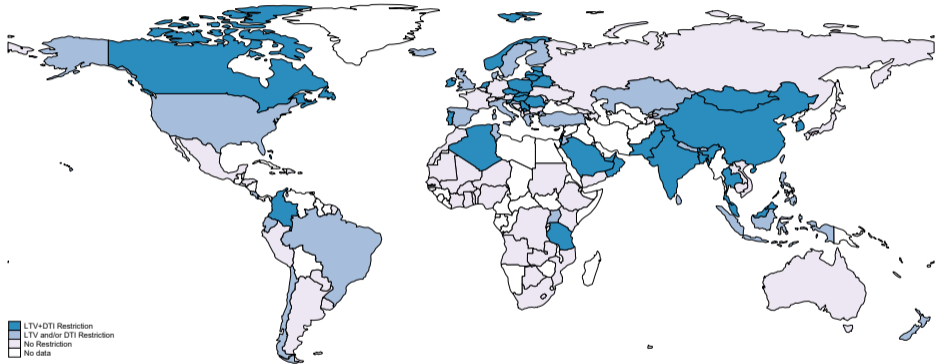Does **household leverage** affect job search, matching in **the labor market** and wages?

- **Household borrowing** is of great importance to the economy, with **benefits** and **costs**
- GFC experience made role of household leverage and job displacement for economy salient
  - Credit growth is a robust predictor of financial crises (Schularick and Taylor, 2012)
  - Rising household debt/GDP presages lower GDP growth (Mian and Sufi, 2017)
  - Scarcity leads to attentional shifts that can explain overborrowing, which can reinforce the conditions of poverty (Shah et al., 2012)
  - Job loss shortens life expectancy by 1.0-1.5 years, and larger earnings losses associated with greater reductions (Sullivan and Von Wachter, 2009)
- These insights contributed to many countries introducing policies to prevent costly build-up of HH debt
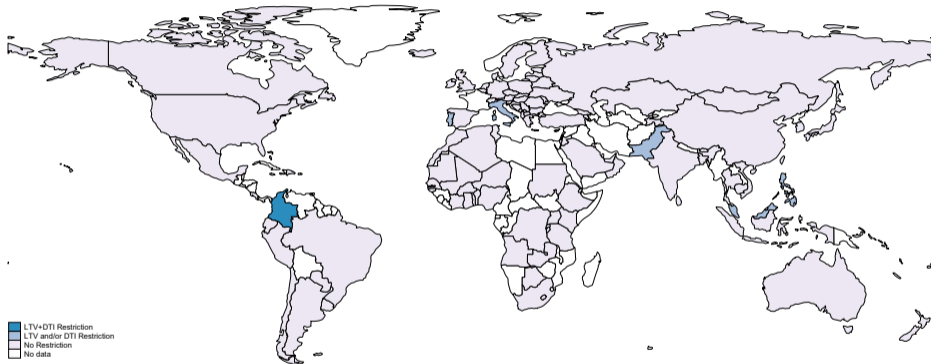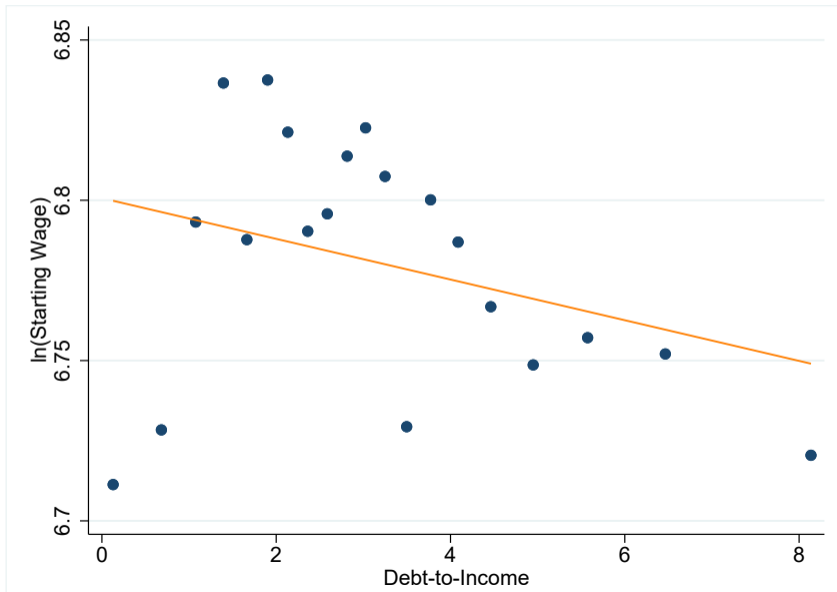
Few countries had macroprudential policies for household leverage in 2000

Many advanced and emerging economies implemented macroprudential policies after the GFC

Take new perspective on macropru and labor market: Does **household leverage** affect **wages** through its influence on **job search**?

- **The costs and benefits of macroprudential policies**
  - Can curb credit booms and improve financial stability [Cerutti et al. (2017), DeFusco et al. (2020), Araujo et al. (2019), Peydró et al. (2020)]
  - But can also generate adverse side effects, e.g., reduce access to housing or liquidity [Tzur-Ilan (2020), Aastveit et al. (2020), Acharya et al. (2019), Van Bekkum et al. (2019),]
- **Interaction btw HH debt & credit access affects labor mrkt via demand channel**
  - HH leverage has detrimental effect on credit availability via financial stability or collateral values, triggering HH deleveraging, a drop in spending and a rise in unemployment [Reinhart and Rogoff (2008); Schularick and Taylor (2012); Corbae and Quintin (2015); Adelino et al. (2016); Eggertsson and Krugman (2012); Mian et al. (2013); Guerrieri and Lorenzoni (2017)]
- **The effects of household balance sheets on job search**
  - Negative home equity limits labor mobility, impairs labor supply; access to credit enables workers to have better job search [Bernstein and Struyven (2017); Brown and Matsa (2019); Gopalan et al. (2020); Bernstein (2020); Herkenhoff (2019); He and le Maire (2020); Kumar and Liang (2018); Chetty (2008); Chetty and Szeidl (2007); Zator (2019)]

Does **household leverage** affect **wages** through its influence on **job search**?

Findings can potentially:

- Inform **calibration** of macroprudential policy: how to trade off costs of restricting lending in good times against the benefits of a smaller bust in bad times
- Improve understanding of how policies that restrict credit mitigate consequences of high household leverage
  - Provide new insights into effects of household leverage on economy through a **supply channel**
  - Understand how household **balance sheet** can affect economy through job search

- We find that a **reduction in household leverage improves wages**
  $\rightarrow$ 25% decline in debt-to-income ratio improves wages by 3.3 pp

- Lower leverage enables workers to **search longer for jobs**

- Displaced workers with lower leverage find jobs at **better paying firms**

- Displaced workers with lower leverage are more likely to assume a **different occupation**
  with their new employer and switch to a **different industry**

- Effect is stronger for **young**, **more educated**, and displaced workers with **shorter tenure**
  with their previous employer

Main ingredients

Theory gives **opposing predictions** for the effect of **household leverage on wages**

- **Household leverage increases wages** → Debt overhang ⇒ Willingness to work ⇓ ⇒ Workers demand higher wages to be incentivized (Donaldson et al., 2019)

- **Household leverage decreases wages**
  → Liquidity constraints ⇒ Default probability ⇑ ⇒ Take earlier but certain offers to later offers with possibly higher wages (Chetty and Szeidl, 2007; Ji, 2021)

Makes it an **empirical question**

To estimate the causal effect of household leverage on labor market outcomes, we need

1. Exogenous variation in household leverage
2. Job search behavior not triggered by individual characteristics

To investigate how household leverage influences job search and wages, we use the introduction of an LTV constraint in Norway as a shock to the leverage of workers who recently bought a home before losing their jobs

→ **Shock: Introduction of LTV constraint**

→ **Sample: Displaced workers** who recently bought a house

→ **Data:** Individual level **labor market**, **balance sheet**, and **housing transaction** data

- Due to strong growth in house prices and household debt levels, FSA introduces LTV constraint in 2011

- **LTV constraint** imposes a **85%** cap on mortgage amounts relative to home value
  $\rightarrow$ Covers all loans to the same property

- Some workers have **smaller mortgages** due to this restriction

- **Unobserved individual characteristics** might trigger a job switch
  $\rightarrow$ LTV restriction can interact with individual characteristics

- Limiting us to workers laid off in **mass layoffs** avoids selection bias, i.e., job search is not triggered by individual characteristics
  $\rightarrow$ Mass layoff: when a firm reduces staffing by at least 30% in a year, or stops existing

Displaced workers + LTV constraint $\Rightarrow$ **Address both challenges**

Policy only affects home-buyers; changes in wealth that occur while LTV is introduced could dilute the measurable effect of policy
$\rightarrow$ Restricting ourselves to displaced workers who bought a home <12M before losing their job avoids build-up of unobservable home-equity

Home Purchase
(DTI Ratio)

Job Search
(Wage, duration)

Time

Next Job

Job Loss
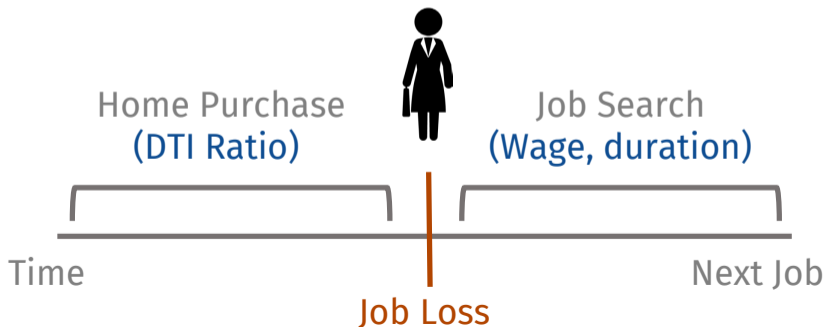
Empirical strategy

- LTV constraint is applied to **all new homebuyers**
  $\rightarrow$ We do not have a variable that tells which workers are affected by this restriction
  $\rightarrow$ Before the restriction, 1/3 of the sample has LTV ratios below the threshold

- How can we **distinguish affected workers from unaffected ones**?

- Exploit data on workers who bought houses **before the LTV constraint was introduced**

- **Predict which workers** in the regression sample would have obtained high/low LTV in absence of the policy

- Use **Random Forest** for this assignment; estimated on the pre-policy data, correctly classifies 82 percent of pre-policy observations

- Then use the model to assign **post-policy** observations to treated or control group

Treated — Workers matched to homebuyers who have high LTV

Control — Workers matched to homebuyers who have low LTV

Before — After

Assignment to T/C is a classical prediction task

- Use a method developed for such prediction tasks
- **Random Forest** algorithm
  - → is non-parametric, and
  - → maximizes out-of-sample matching accuracy

- **Rich set of variables**

  → Household balance sheet variables (income, wage, deposits, debt, unemployment benefits, business income), age, education, location, immigration status, parents balance sheet information (income, wealth, deposits, debt), parents' education and immigration status, macroeconomic variables (GDP, inflation, unemployment rate, policy rate, regional house prices)

- Estimate a **Difference-in-Differences** model

  $y_{it} = \boldsymbol{\beta} \, d(\widehat{LTV} > 0.85)_i \times Post_t + \gamma \, d(\widehat{LTV} > 0.85)_i + \delta \, Post_t + controls + \epsilon_{it}$

  $\rightarrow$ Measure debt at household level
  $\rightarrow$ Wage growth between job that worker is displaced from and next job she finds

- Standard errors are double clustered at location and industry level since mass layoffs can occur due to location and/or industry specific shocks

- Murphy-Topel adjusted standard errors to deal with predicted regressors

- Estimate a **Difference-in-Differences** model

  $y_{it} = \beta \; d(\widehat{LTV} > 0.85)_i \times Post_t + \gamma \; d(\widehat{LTV} > 0.85)_i + \delta \; Post_t + controls + \epsilon_{it}$

  $\rightarrow$ Measure debt at household level
  $\rightarrow$ Wage growth between job that worker is displaced from and next job she finds

- Standard errors are double clustered at location and industry level since mass layoffs can occur due to location and/or industry specific shocks

- Murphy-Topel adjusted standard errors to deal with predicted regressors

- **Identifying assumptions:**
  $\rightarrow$ Treatment and control groups have different characteristics. Their effects on labor market outcomes must not change as LTV is introduced
  $\rightarrow$ Without the LTV, the difference between T and C group would have been the same in the post period

- Investigate trend differences in pre-treatment period by estimating D-i-D model $Post_t$ is replaced by **year dummies** D_k

$$y_{ht} = \sum_{k=-4}^{2} \gamma_k \, D_k \times d(\widehat{LTV} > 0.85)_h + \alpha_n controls_{ht} + \epsilon_{ht} \quad (1)$$

- We omit $period = -1$ so γ_k reflects difference between T/C groups in year k relative to the difference in year -1.
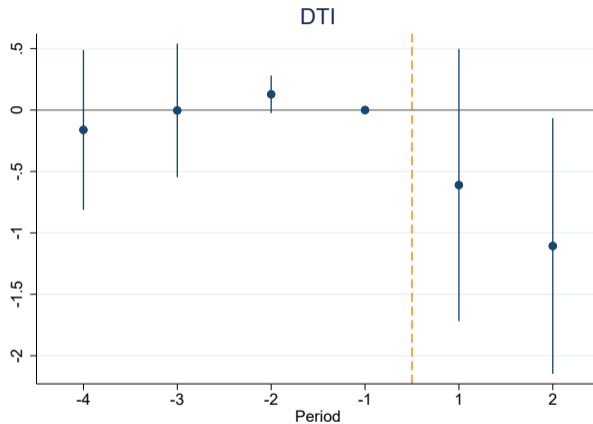
LTV restriction reduces household leverage of affected displaced workers

	$\frac{Debt}{Income}$					
	(1)	(2)	(3)	(4)	(5)	(6)
$d(\widehat{LTV}>0.85) \times$ Post	-1.094***	-1.058***	-1.138***	-1.108***	-1.148***	-1.017**
	(0.372)	(0.348)	(0.394)	(0.358)	(0.353)	(0.401)
$d(\widehat{LTV}>0.85)$	0.895***	0.858***	1.192***	1.206***	1.188***	1.193***
	(0.284)	(0.256)	(0.304)	(0.268)	(0.234)	(0.250)
Fixed Effects:						
Year FE		✓	✓	✓	✓	✓
Education FE			✓	✓	✓	✓
Location FE				✓	✓	
Industry FE					✓	
Location × Industry FE						✓
Obs.	1,876	1,876	1,833	1,833	1,833	1,833
R^2	0.023	0.029	0.163	0.187	0.211	0.265
Mean($\frac{Debt}{Income}$)	4.241					

25 percent reduction in household leverage
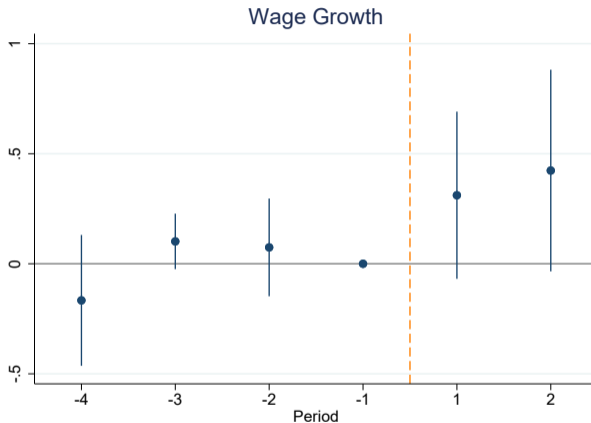
Wage Growth

Leverage reduction improves starting wages of affected displaced workers

	Wage Growth					
	(1)	(2)	(3)	(4)	(5)	(6)
$d(\widehat{LTV}>0.85) \times$ Post	0.335**	0.343**	0.482***	0.495***	0.449**	0.390*
	(0.154)	(0.153)	(0.161)	(0.158)	(0.160)	(0.187)
$d(\widehat{LTV}>0.85)$	-0.102***	-0.109***	-0.129***	-0.125***	-0.123***	-0.120***
	(0.010)	(0.027)	(0.033)	(0.036)	(0.031)	(0.028)
Fixed Effects:						
Year FE		✓	✓	✓	✓	✓
Education FE			✓	✓	✓	✓
Location FE				✓	✓	
Industry FE					✓	
Location × Industry FE						✓
Obs.	1,876	1,876	1,833	1,833	1,833	1,833
R^2	0.008	0.014	0.091	0.107	0.121	0.183
Mean(Wage Growth)	-0.074					

3.3 percentage points lower decline in wages

22

- LTV constraint could create a problem due to **endogenous selection** to housing market
  - → Some of the workers may not be able to afford down payment
  - → **Characteristics of the treatment group can change** due to the restriction

- **Remove workers who cannot afford down payment** from the prerestriction period
  - → Remaining workers in regression sample can afford down-payment ⇒ No selection bias
  - → Results do not change

- Relax the strict sample filters
  - → Use all displaced workers
  - → Extend duration of home ownership
  - → Drop home ownership requirement

1. Different starting years
2. Remove workers who receive inheritance
3. Remove workers who ever earn business income
4. Control for macroeconomic conditions interacting differently with treated and controls
5. Placebo test using two years prior to policy as post-period
6. Remove workers with LTV far from 85% threshold
7. Wage growth differential is persistent 4 years after displacement

- **Unemployment spell**
  → Lower leverage enables displaced workers to wait for later, better job offers

- **Access to credit during unemployment ("liquidity effect")**
  → A reduction in leverage may increase displaced workers' access to credit during unemployment spell
  → Leverage can affect labor market outcomes through its influence on access to credit

- **Characteristics of new employers**
  → By relaxing constraints, displaced workers can find jobs at better paying firms
  → Firm wage premium (AKM, Abowd et al (ECTA-1999))

	ln(Unemp. Spell)		Δ ln(Ex-Post Debt)		Δ ln(Firm Wage Pre.)	
	(1)	(2)	(3)	(4)	(5)	(6)
d($\widehat{LTV}$>0.85) × Post	0.608***	0.567*	-0.067	-0.114	0.004	0.058**
	(0.205)	(0.281)	(0.244)	(0.313)	(0.023)	(0.027)
d($\widehat{LTV}$>0.85)	0.019	0.017	-0.023	-0.063	0.029***	0.009
	(0.091)	(0.110)	(0.024)	(0.057)	(0.007)	(0.008)
Fixed Effects:						
Year FE		✓		✓		✓
Education FE		✓		✓		✓
Location FE		✓		✓		✓
Industry FE		✓		✓		✓
Obs.	1,876	1,833	1,876	1,833	1,672	1,637
R^2	0.006	0.160	0.000	0.096	0.002	0.386
Mean(Dependent Var.)	2.270		0.085		-0.286	

Longer spell, higher paying new employers, no change in debt during spell

- Lowering financial risk can allow workers to take more time for and **more risk** in search
  $\rightarrow$ They may be more willing to broaden their job search

	Diff. Occupation		Diff. Industry		Diff. Job Location	
	(1)	(2)	(3)	(4)	(5)	(6)
d($\widehat{LTV}$>0.85) × Post	0.202**	0.293***	0.155*	0.233**	0.066	0.024
	(0.088)	(0.097)	(0.082)	(0.105)	(0.132)	(0.157)
d($\widehat{LTV}$>0.85)	0.032	0.012	0.038	0.020	0.067	0.065
	(0.025)	(0.025)	(0.024)	(0.023)	(0.043)	(0.044)
Fixed Effects:						
Year FE		✓		✓		✓
Education FE		✓		✓		✓
Location FE		✓		✓		✓
Industry FE		✓		✓		✓
Obs.	1,876	1,833	1,876	1,833	1,876	1,833
R^2	0.009	0.183	0.005	0.222	0.005	0.142
Mean(Different Job)	0.764		0.650		0.448	

More switching to new industries and occupations, no effect on geographical mobility

28

	Wage Volatility					
	(1)	(2)	(3)	(4)	(5)	(6)
$d(\widehat{LTV}>0.85) \times$ Post	-26.274***	-26.846***	-32.215**	-28.707*	-24.719*	-30.496**
	(5.917)	(7.609)	(15.242)	(15.901)	(12.988)	(13.655)
$d(\widehat{LTV}>0.85)$	1.033	1.294	4.282	5.332	5.183*	4.138
	(3.270)	(3.301)	(3.211)	(3.697)	(2.635)	(2.951)
Fixed Effects:						
Year FE		✓	✓	✓	✓	✓
Education FE			✓	✓	✓	✓
Location FE				✓	✓	
Industry FE					✓	
Location × Industry FE						✓
Obs.	1,869	1,869	1,828	1,828	1,828	1,828
R^2	0.008	0.009	0.154	0.165	0.178	0.222
Mean(Wage Volatility)	82.757					

People do not trade off higher wages against increased income volatility

- Reduction in household leverage **relaxes the constraints** that leverage puts on job search

- Effect should be larger for workers who are better able to exploit this opportunity

- Split sample with respect to **age**, **education** or **job tenure** at latest employer
  - $\rightarrow$ Young and highly educated workers can more easily adjust their skills
  - $\rightarrow$ Skills of workers who have longer job tenure can become firm-specific

- Confirmed by split-sample regressions: **young, low-tenure, lower-income but better educated workers drive the results**

- **Household leverage** affects labor market outcomes through its influence on job search

- A reduction in household leverage **improves wages** of displaced workers

- These workers have longer spells between jobs, find jobs in better paying firms, and broaden their job search

- Effect is not associated with a rise in income volatility (job risk)

- **Macroprudential policies** that limit household leverage can have **positive side effects** in the **labor market**, in particular among younger people

- Results help us to **understand how leverage levels influence dynamics** in an economy that faces, for example, a rise in unemployment

- Qualitatively, debt has a similar effect in the broader population

Thank You!

What literature says on credit access and home equity

- **Negative home equity** caused by declining house prices can **reduce labor mobility** and labor supply (Bernstein and Struyven, 2017; Brown and Matsa, 2019; Bernstein, 2020)

- **Increased access to credit** during or after unemployment spells **can reduce labor supply** (Herkenhoff, 2019)

Institutional background for Norway

- Housing market
  - → Above **80%** home ownership ratio
  - → Due to tax advantages

- Labor market
  - → In case of mass layoff, firm gives a notice of dismissal within a 30-day period and without grounds related to the individual employees
  - → **Unemployment insurance covers 62.4% of previous income** (OECD average is 60%)
  - → **No change in unemployment insurance** in our sample period

Comparison of treated and control workers

	d($\widehat{LTV}$<0.85)	d($\widehat{LTV}$ ≥0.85)	Difference	t-stat
Income$_{t-1}$	1120.76	710.29	410.47	8.67
Wage$_{t-1}$	1065.95	687.38	378.57	8.31
Debt-to-Income$_{t-1}$	2.58	1.54	1.04	4.20
Deposits$_{t-1}$	869.19	156.09	713.10	28.61
Business Inc.$_{t-1}$	54.81	22.91	31.90	2.05
Parents' Debt$_{t-1}$	1898.84	1987.59	-88.75	-0.46
Parents' Dep.$_{t-1}$	1458.99	600.92	858.06	10.18
Parents' Wealth$_{t-1}$	1508.78	529.30	979.48	4.82
Age	36.09	32.39	3.70	5.58
Immigrant	0.18	0.20	-0.02	-0.90
Immigrant^{Mot}	0.21	0.24	-0.03	-0.94
Immigrant^{Fat}	0.29	0.30	-0.01	-0.27
College	0.73	0.39	0.34	10.68
College^{Mot}	0.26	0.17	0.09	3.63
College^{Fat}	0.33	0.18	0.15	5.66
Observations	1880			

Distribution of Misclassified Households
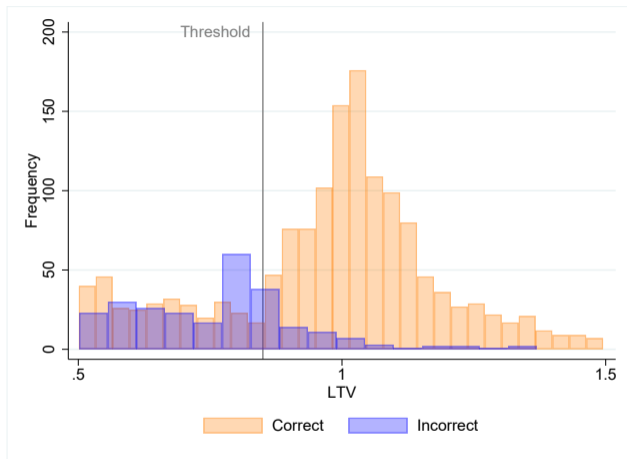
Misclassified observations are clustered around the threshold

National House Prices
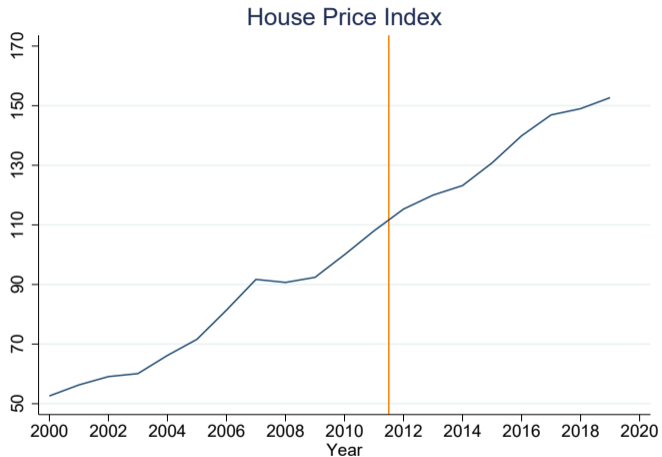
House Price Index

Aggregate house price index is not affected

Random Forest performance
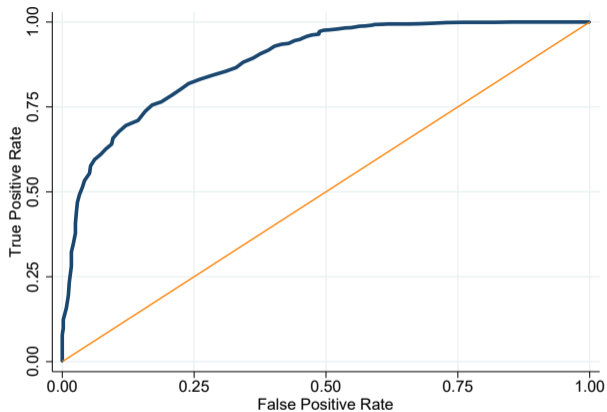
Area under ROC curve is 0.89

Variable importance
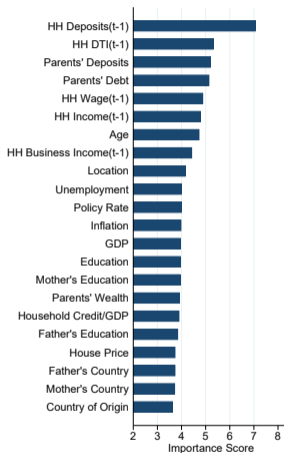
No single variable dominates the model

Regional House Prices

● Before LTV Restriction ● After LTV Restriction
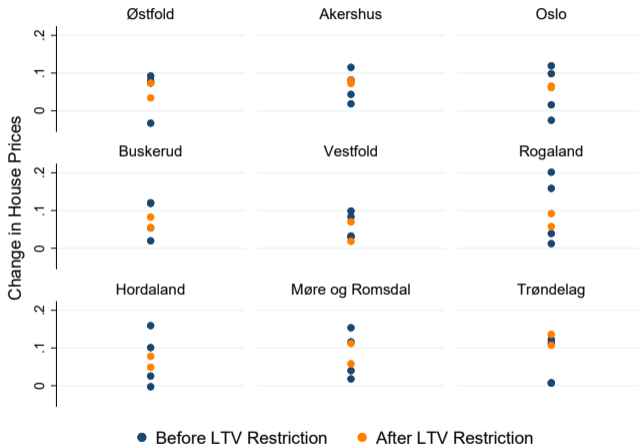
House prices after restriction are in the support of prices before the restriction

Loan-to-Value Ratio

	LTV					
	(1)	(2)	(3)	(4)	(5)	(6)
$d(\widehat{LTV}>0.85) \times$ Post	-0.235***	-0.234***	-0.229***	-0.225***	-0.226***	-0.218***
	(0.021)	(0.021)	(0.021)	(0.017)	(0.018)	(0.030)
$d(\widehat{LTV}>0.85)$	0.234***	0.233***	0.221***	0.216***	0.216***	0.212***
	(0.014)	(0.014)	(0.015)	(0.015)	(0.014)	(0.019)
Fixed Effects:						
Year FE		✓	✓	✓	✓	✓
Education FE			✓	✓	✓	✓
Location FE				✓	✓	
Industry FE					✓	
Location × Industry FE						✓
Obs.	1,876	1,876	1,833	1,833	1,833	1,833
R^2	0.211	0.213	0.278	0.290	0.291	0.343
Mean(LTV)	0.924					

22 percent reduction in LTV ratio

Other Balance Sheet Items

	Mortgage		House Price		Deposits	
	(1)	(2)	(3)	(4)	(5)	(6)
d($\widehat{LTV}$>0.85) × Post	-603.153***	-667.540***	-436.306**	-503.119***	-69.821	-109.932
	(114.309)	(126.417)	(156.551)	(150.137)	(81.675)	(137.884)
d($\widehat{LTV}$>0.85)	-119.832*	90.282	-486.696***	-229.524**	-198.473***	-176.430***
	(65.223)	(61.379)	(93.149)	(81.908)	(12.966)	(45.433)
Fixed Effects:						
Year FE		✓		✓		✓
Education FE		✓		✓		✓
Location FE		✓		✓		✓
Industry FE		✓		✓		✓
Location × Industry FE						✓
Obs.	1,876	1,833	1,876	1,833	1,876	1,833
R^2	0.034	0.256	0.114	0.323	0.096	0.247
Mean(Dependent Var.)	1721.468		1956.405		222.015	

Smaller mortgages, cheaper houses, insignificant decline in deposits

Interest Rate Payments

	Interest Expense					
	(1)	(2)	(3)	(4)	(5)	(6)
d($\widehat{LTV}$>0.85) × Post	-45.875***	-44.626***	-41.265***	-36.504**	-31.523**	-37.456**
	(10.390)	(9.821)	(13.315)	(14.011)	(13.681)	(16.988)
d($\widehat{LTV}$>0.85)	-7.803**	-8.570***	-4.688	-2.726	-2.684	-0.780
	(2.769)	(2.173)	(3.609)	(4.285)	(4.278)	(5.007)
Fixed Effects:						
Year FE		✓	✓	✓	✓	✓
Education FE			✓	✓	✓	✓
Location FE				✓	✓	
Industry FE					✓	
Location × Industry FE						✓
Obs.	1,876	1,876	1,833	1,833	1,833	1,833
R^2	0.014	0.106	0.224	0.249	0.267	0.316
Mean(Interest Expense)	91.489					

Reduction in interest expense

Does policy change characteristics of treated?

Previous	Inc.	Wage	Buss. Inc.	Trans.	Unemp. Ben.	Educ.	Wage Growth	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$d(\widehat{LTV}>0.85) \times$ Post	0.042	0.061	0.183	-0.311	-0.043	0.031	0.289*	0.373*
	(0.191)	(0.195)	(0.141)	(0.426)	(0.243)	(0.071)	(0.156)	(0.213)
$d(\widehat{LTV}>0.85)$	0.064	0.060	-0.050	0.022	0.105**	0.004	-0.055*	-0.056
	(0.055)	(0.055)	(0.055)	(0.085)	(0.047)	(0.019)	(0.031)	(0.048)
Fixed Effects:								
Year FE	✓	✓	✓	✓	✓	✓		✓
Education FE	✓	✓	✓	✓	✓			✓
Location FE	✓	✓	✓	✓	✓	✓		✓
Industry FE	✓	✓	✓	✓	✓	✓		✓
Obs.	1,833	1,833	1,833	1,833	1,833	1,876	941	927
R^2	0.110	0.109	0.080	0.120	0.093	0.083	0.014	0.181
Mean(Dependent Var.)	0.361	0.369	0.092	0.333	0.050	0.777	-0.074	

Controlling for liquidity

	Wage Growth					
	(1)	(2)	(3)	(4)	(5)	(6)
d($\widehat{LTV}$>0.85) × Post	0.265*	0.274*	0.403**	0.397**	0.327*	0.193
	(0.142)	(0.135)	(0.160)	(0.164)	(0.183)	(0.219)
d($\widehat{LTV}$>0.85)	-0.033	-0.041	-0.030	-0.013	-0.013	0.033
	(0.053)	(0.052)	(0.048)	(0.050)	(0.047)	(0.062)
$ln(liq.)_{t-1}$	0.248	0.204	0.287*	0.278*	0.345**	0.124
	(0.163)	(0.161)	(0.158)	(0.151)	(0.152)	(0.144)
$ln(liq.)_{t-1} \times ln(liq.)_{t-1}$	-0.044	-0.037	-0.051*	-0.049*	-0.060**	-0.025
	(0.026)	(0.026)	(0.026)	(0.024)	(0.025)	(0.023)
$ln(liq.)_{t-1} \times ln(liq.)_{t-1} \times ln(liq.)_{t-1}$	0.002*	0.002	0.002**	0.002**	0.003**	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Fixed Effects:						
Year FE		✓	✓	✓	✓	✓
Education FE			✓	✓	✓	✓
Location FE				✓	✓	
Industry FE					✓	
Location × Industry FE						✓
Obs.	941	941	927	927	927	927
R^2	0.018	0.032	0.147	0.165	0.187	0.298
Mean(Wage Growth)	-0.074					

Robustness checks for starting wages

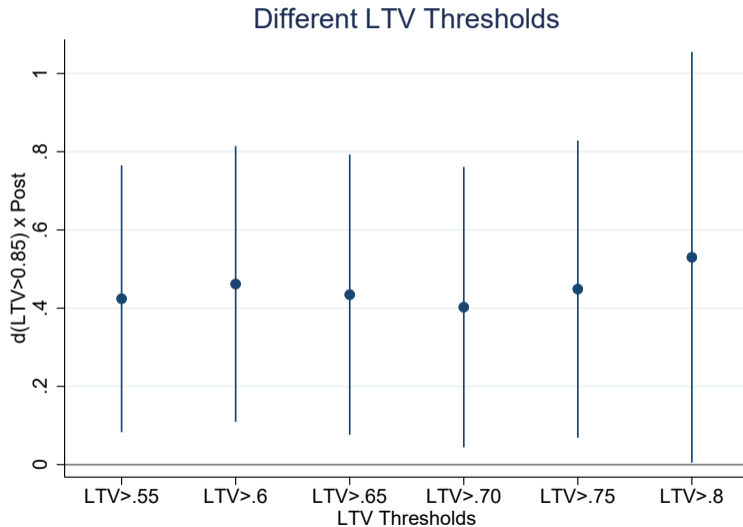|	Wage Growth						
	(1) 2005	(2) 2007	(3) No Transf.	(4) No Bus. Inc.	(5) Macro	(6) Education	(7) Placebo
$d(\widehat{LTV}>0.85) \times$ Post	0.426**	0.449**	0.409**	0.430**	0.983***	0.423*	
	(0.183)	(0.186)	(0.180)	(0.183)	(0.329)	(0.205)	
$d(\widehat{LTV}>0.85) \times$ Placebo							-0.039
							(0.131)
$d(\widehat{LTV}>0.85)$	-0.108**	-0.096***	-0.088**	-0.126***	-5.076	0.703***	0.027
	(0.040)	(0.033)	(0.038)	(0.037)	(3.510)	(0.184)	(0.117)
Fixed Effects:							
Year FE	✓	✓	✓	✓	✓	✓	✓
Education FE	✓	✓	✓	✓	✓	✓	✓
Location FE	✓	✓	✓	✓	✓	✓	✓
Industry FE	✓	✓	✓	✓	✓	✓	✓
Treated $\times$ Macro Var.					✓		
Treated $\times$ Education FE						✓	
Obs.	2,016	1,614	1,649	1,737	1,833	1,833	1,029
R^2	0.124	0.124	0.138	0.122	0.124	0.171	0.169
Mean(Wage Growth)	-0.074						

Placebo test

	Wage Growth					
	(1)	(2)	(3)	(4)	(5)	(6)
d($\widehat{LTV}$>0.85) × Placebo	0.014	0.017	-0.015	-0.033	-0.039	-0.152
	(0.111)	(0.106)	(0.128)	(0.136)	(0.131)	(0.168)
Placebo	0.016	-0.000	0.041	0.034	0.027	0.045
	(0.072)	(0.067)	(0.077)	(0.092)	(0.117)	(0.137)
Year FE		✓	✓	✓	✓	✓
Education FE			✓	✓	✓	✓
Location FE				✓	✓	
Industry FE					✓	
Location × Industry FE						✓
Obs.	1,050	1,050	1,029	1,029	1,029	1,029
R^2	0.000	0.002	0.099	0.114	0.169	0.259
Mean(Wage Growth)	-0.074					

Evidence for parallel trends

Narrow the sample from below

Different LTV Thresholds

Interactions with Macro variables

	Wage Growth					
	(1)	(2)	(3)	(4)	(5)	(6)
d($\widehat{LTV}$>0.85) × Post	0.744***	0.744***	1.030***	1.053***	0.983***	1.025*
	(0.154)	(0.154)	(0.325)	(0.284)	(0.329)	(0.555)
d($\widehat{LTV}$>0.85) × Inflation	-0.300**	-0.300**	-0.462	-0.476*	-0.478*	-0.589
	(0.142)	(0.142)	(0.272)	(0.249)	(0.269)	(0.522)
d($\widehat{LTV}$>0.85) × Unemployment	0.833	0.833	1.421	1.419	1.429	1.808
	(0.541)	(0.541)	(1.032)	(0.931)	(1.018)	(1.975)
d($\widehat{LTV}$>0.85) × GDP	-0.185**	-0.185**	-0.278*	-0.287*	-0.280*	-0.343
	(0.081)	(0.081)	(0.159)	(0.144)	(0.160)	(0.294)
d($\widehat{LTV}$>0.85) × Policy Rate	0.395*	0.395*	0.611	0.616*	0.610	0.754
	(0.193)	(0.193)	(0.378)	(0.335)	(0.372)	(0.692)
d($\widehat{LTV}$>0.85)	-3.074	-3.074	-5.102	-5.073	-5.076	-6.370
	(1.855)	(1.855)	(3.560)	(3.182)	(3.510)	(6.698)
Fixed Effects:						
Year FE		✓	✓	✓	✓	✓
Education FE			✓	✓	✓	✓
Location FE				✓	✓	
Industry FE					✓	
Location × Industry FE						✓
Obs.	1,876	1,876	1,833	1,833	1,833	1,833
R^2	0.017	0.017	0.095	0.111	0.124	0.186
Mean(Wage Growth)	-0.074					

Wages 4 years after displacement

	Wage Growth					
	(1)	(2)	(3)	(4)	(5)	(6)
d($\widehat{LTV}$>0.85) × Post	0.257***	0.259***	0.246**	0.220*	0.182**	0.201*
	(0.061)	(0.066)	(0.113)	(0.116)	(0.080)	(0.106)
d($\widehat{LTV}$>0.85)	0.003	0.002	-0.005	-0.008	-0.006	-0.012
	(0.036)	(0.037)	(0.036)	(0.043)	(0.031)	(0.033)
Fixed Effects:						
Year FE		✓	✓	✓	✓	✓
Education FE			✓	✓	✓	✓
Location FE				✓	✓	
Industry FE					✓	
Location × Industry FE						✓
Obs.	1,856	1,856	1,815	1,815	1,815	1,815
R^2	0.010	0.012	0.092	0.104	0.115	0.189
Mean(Wage Growth)	0.182					

Wage growth differential is persistent

Heterogeneity tests: income and Gender

Wage Growth	Income			Gender	
	(1) Low	(2) Medium	(3) High	(4) Male	(5) Female
d($\widehat{LTV}$>0.85) × Post	0.833*	0.268	0.193	0.233	0.735*
	(0.475)	(0.264)	(0.244)	(0.152)	(0.384)
d($\widehat{LTV}$>0.85)	-0.209***	-0.102*	-0.044	-0.119*	-0.122*
	(0.061)	(0.052)	(0.058)	(0.059)	(0.064)
Fixed Effects:					
Year FE	✓	✓	✓	✓	✓
Education FE	✓	✓	✓	✓	✓
Location FE	✓	✓	✓	✓	✓
Industry FE	✓	✓	✓	✓	✓
Obs.	432	911	490	1,022	811
R^2	0.312	0.176	0.261	0.156	0.228
Mean(Wage Growth)	-0.074				

Effect is stronger for low income workers and females

Heterogeneity tests: age, tenure and education

Wage Growth	Age		Tenure		Education	
	(1) Low	(2) High	(3) Low	(4) High	(5) Low	(6) High
d($\widehat{LTV}$>0.85) × Post	0.700***	0.126	0.609**	0.433	0.101	0.402**
	(0.210)	(0.277)	(0.227)	(0.423)	(0.260)	(0.173)
d($\widehat{LTV}$>0.85)	-0.195**	-0.024	-0.160**	-0.054	-0.161***	-0.026
	(0.069)	(0.049)	(0.072)	(0.040)	(0.036)	(0.030)
Fixed Effects:						
Year FE	✓	✓	✓	✓	✓	✓
Education FE	✓	✓	✓	✓		
Location FE	✓	✓	✓	✓	✓	✓
Industry FE	✓	✓	✓	✓	✓	✓
Obs.	1,044	789	866	967	419	882
R^2	0.170	0.219	0.159	0.195	0.096	0.062
Mean(Wage Growth)	-0.074					

Effect is stronger for young, highly educated workers with lower tenure

External validity: expanding sample

Wage Growth	Full	Unemployed	Displaced	≤4y	Spell		Tenure
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
					< 500days	<2 years	<5 years
$\ln(\text{debt})_{t-1}$	-0.026***	-0.052***	-0.019***				
	(0.0001)	(0.0003)	(0.001)				
$d(\widehat{LTV}>0.85) \times$ Post				0.415***	0.539***	0.494**	0.362*
				(0.228)	(0.172)	(0.178)	(0.189)
$d(\widehat{LTV}>0.85)$				-0.125***	-0.129***	-0.131***	-0.152***
				(0.0178)	(0.0374)	(0.0374)	(0.0509)
Fixed Effects:							
Individual FE	✓						
Wage bins FE	✓	✓	✓				
Year FE	✓	✓	✓	✓			
Education FE					✓	✓	✓
Location FE					✓	✓	✓
Industry FE					✓	✓	✓
Obs.	33,421,099	1,880,454	148,875	8,361	1,700	1,756	1,453
R^2	0.360	0.376	0.116	0.015	0.132	0.124	0.133

Qualitative effect on wages robust to expanding, effect size varies substantially

References

Aastveit, Knut Are, Ragnar Juelsrud, and Ella Getz Wold (2020) "Mortgage regulation and financial vulnerability at the household level".

Acharya, Viral V, Tim Eisert, Christian Eufinger, and Christian Hirsch (2019) "Whatever it takes: The real effects of unconventional monetary policy", *The Review of Financial Studies*, 32 (9), pp. 3366–3411.

Adelino, Manuel, Antoinette Schoar, and Felipe Severino (2016) "Loan originations and defaults in the mortgage crisis: The role of the middle class", *The Review of Financial Studies*, 29 (7), pp. 1635–1670.

de Araujo, Douglas Kiarelly Godoy, Joao Barata Ribeiro Blanco Barroso, and Rodrigo Barbone Gonzalez (2019) "Loan-to-value policy and housing finance: effects on constrained borrowers", *Journal of Financial Intermediation*, p. 100830.

Bernstein, Asaf (2020) "Negative home equity and household labor supply", *Journal of Finance*.

Bernstein, Asaf and Daan Struyven (2017) "Housing lock: Dutch evidence on the impact of negative home equity on household mobility", *Available at SSRN 3090675*.

Brown, Jennifer and David A Matsa (2019) "Locked in by leverage: Job search during the housing crisis", *Journal of Financial Economics*.

Cerutti, Eugenio, Stijn Claessens, and Luc Laeven (2017) "The use and effectiveness of macroprudential policies: New evidence", *Journal of Financial Stability*, 28, pp. 203–224.

Chetty, Raj (2008) "Moral hazard versus liquidity and optimal unemployment insurance", *Journal of political Economy*, 116 (2), pp. 173–234.

Chetty, Raj and Adam Szeidl (2007) "Consumption commitments and risk preferences", *The Quarterly Journal of Economics*, 122 (2), pp. 831–877.

Corbae, Dean and Erwan Quintin (2015) "Leverage and the foreclosure crisis", *Journal of Political Economy*, 123 (1), pp. 1–65.

DeFusco, Anthony A, Stephanie Johnson, and John Mondragon (2020) "Regulating household leverage", *The Review of Economic Studies*, 87 (2), pp. 914–958.

Donaldson, Jason Roderick, Giorgia Piacentino, and Anjan Thakor (2019) "Household debt overhang and unemployment", *The Journal of Finance*, 74 (3), pp. 1473–1502.

Eggertsson, Gauti B and Paul Krugman (2012) "Debt, deleveraging, and the liquidity trap: A fisher-minsky-koo approach", *The Quarterly Journal of Economics*, 127 (3), pp. 1469–1513.

Gopalan, Radhakrishnan, Barton H Hamilton, Ankit Kalda, and David Sovich (2020) "Home equity and labor income: The role of constrained mobility", *The Review of Financial Studies*.

Guerrieri, Veronica and Guido Lorenzoni (2017) "Credit crises, precautionary savings, and the liquidity trap", *The Quarterly Journal of Economics*, 132 (3), pp. 1427–1467.

He, Alex Xi and Daniel le Maire (2020) "How does liquidity constraint affect employment and wages? evidence from danish mortgage reform".

Herkenhoff, Kyle F (2019) "The impact of consumer credit access on unemployment", *The Review of Economic Studies*, 86 (6), pp. 2605–2642.

Ji, Yan (2021) "Job search under debt: Aggregate implications of student loans", *Journal of Monetary Economics*, 117, pp. 741–759.

Kumar, Anil and Che-Yuan Liang (2018) "Labor market effects of credit constraints: Evidence from a natural experiment".

Mian, Atif, Kamalesh Rao, and Amir Sufi (2013) "Household balance sheets, consumption, and the economic slump", *The Quarterly Journal of Economics*, 128 (4), pp. 1687–1726.

Mian, Atif and Amir Sufi (2017) "Household debt and defaults from 2000 to 2010: The credit supply view", *Evidence and Innovation in Housing Law and Policy*, pp. 257–288.

Peydró, José-Luis, Francesc Rodriguez Tous, Jagdish Tripathy, and Arzu Uluc (2020) "Macroprudential policy, mortgage cycles and distributional effects: Evidence from the uk".

Reinhart, Carmen M and Kenneth S Rogoff (2008) "This time is different: A panoramic view of eight centuries of financial crises", Technical report, National Bureau of Economic Research.

Schularick, Moritz and Alan M Taylor (2012) "Credit booms gone bust: Monetary policy, leverage cycles, and financial crises, 1870-2008", *American Economic Review*, 102 (2), pp. 1029–61.

Shah, Anuj K., Sendhil Mullainathan, and Eldar Shafir (2012) "Some consequences of having too little", *Science*, 338 (6107), pp. 682–685.

Sullivan, Daniel and Till Von Wachter (2009) "Job displacement and mortality: an analysis using administrative data", *The Quarterly Journal of Economics*, 124 (3), pp. 1265–1306.

Tzur-Ilan, Nitzan (2020) "The real consequences of ltv limits on housing choices", Technical report.

Van Bekkum, Sjoerd, Marc Gabarro, Rustom M Irani, José-Luis Peydró et al. (2019) "Take it to the limit? the effects of household leverage caps", Technical report.

Zator, Michal (2019) "Working more to pay the mortgage: Household debt, consumption commitments and labor supply".