

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

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The views expressed here are those of the authors, and not necessarily those of the Norges Bank.

- **Household leverage** is crucial for the economy  
→ With **benefits**

The New York Times

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IN THE NATION

## *IN THE NATION; Why Owning a Home Is the American Dream*

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By Anthony Depalma

OCT 12, 09:55

### UN chief calls for easier credit to offset rising inequality

William Langley in Hong Kong

The UN secretary-general has called on global institutions to ease the flow of credit to poorer countries to offset rising inequality caused by the coronavirus pandemic.

António Guterres told the IMF that the pandemic had forced 100m people into poverty at a time when 4bn had little to no income support, healthcare or social benefits.

He called on international institutions to expand liquidity in poorer countries by reallocating unused special drawing rights, expand and extend a World Bank scheme to suspend debt servicing costs for low-income countries, and roll out an international framework for public and private debt relief.

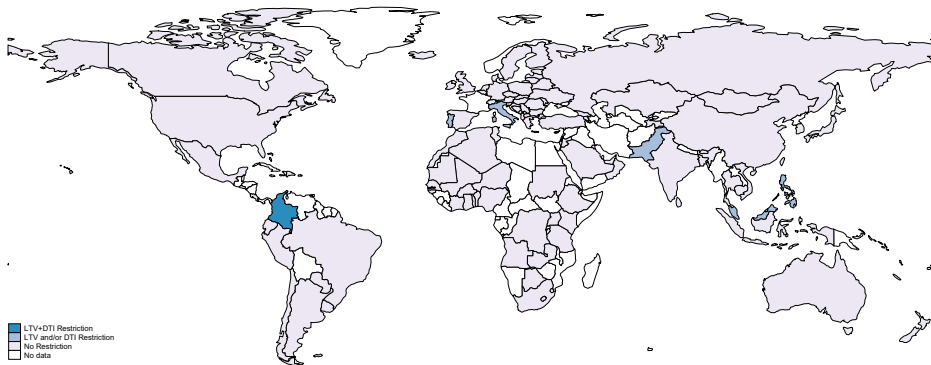
Guterres said that access to liquidity was preventing some countries from bouncing back, noting that advanced economies were investing 28 per cent of their gross domestic product in economic recovery, while least developed countries were investing

# Background

- **Household leverage** is crucial for the economy  
→ With **benefits** and **costs**

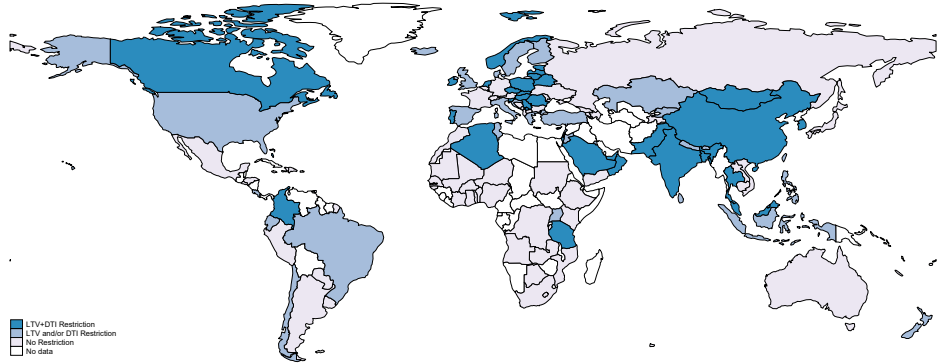


## Countries with macroprudential policies for household leverage until 2000



Only few countries had macroprudential policies for household leverage in 2000

## Countries with macroprudential policies for household leverage until 2018



Many advanced and emerging countries have implemented macroprudential policies recently

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

→ New insights into effects of household leverage

→ Useful for developing better tools to cope with consequences of high household leverage

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

## Household leverage

- **Increases wages**

→ Debt overhang  $\Rightarrow$  Willingness to work  $\Downarrow \Rightarrow$  Workers demand higher wages to be incentivized (Donaldson, Piacentino, Thakor (JF-2019))

- **Decreases wages**

→ Liquidity constraints  $\Rightarrow$  Default probability  $\Uparrow \Rightarrow$  Earlier but certain offers to later offers with possibly higher wages (Chetty & Szeidl (QJE-2007), Ji (JME-2020))

To investigate how household leverage influences job search and wages, this paper uses

→ **Data:** Individual level **labor market** and **balance sheet** data from Norway

→ **Shock:** **LTV ratio restriction**

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



- We find that a **decrease in household leverage improves wages**  
→ 25% decline in debt-to-income ratio improves wages by 3.3 pp
- Leverage forces displaced workers to accept earlier job offers → **Lower leverage enables workers to stay unemployed longer**
- Displaced workers with lower leverage find jobs in **better paying firms**
- Displaced workers with lower leverage are more likely to do a **different occupation** with their new employer and switch to a **different industry**

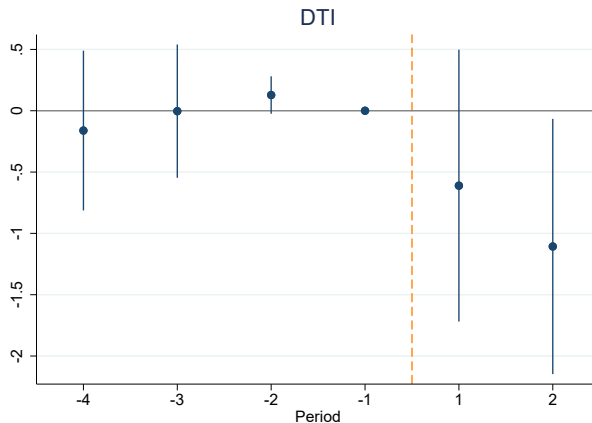
## LTV ratio restriction

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- Due to strong growth in house prices and household debt levels, LTV ratio restriction is introduced in 2011
- **LTV restriction** puts a cap on mortgage amounts relative to home value
  - **85%**
  - Covers all loans to the same property
- Some workers have **smaller mortgages** due to this restriction
- LTV ratio restriction is applied to **all new homebuyers**
  - Before the restriction, 1/3 of the sample has LTV ratios below the threshold
  - How can we **distinguish affected workers from unaffected ones**?
  - We do not have a variable that tells which workers are affected by this restriction

- Homebuyers before the restriction
- **Match workers** in the regression sample to homebuyers before the restriction using individual characteristics
  - **Random Forest** algorithm with rich set of variables
- Sample: **Displaced workers**
  - Workers who lost their jobs due to a mass layoff and recently bought a house
  - Job search is not related with individual unobservables
- Estimate a **Difference-in-Differences** model
$$y_{it} = \beta d(\widehat{LTV} > 0.85)_i \times Post_t + \gamma d(\widehat{LTV} > 0.85)_i + controls + \epsilon_{it}$$
  - Debt-to-income ratio at household level, Wage growth

## Debt-to-Income ratio



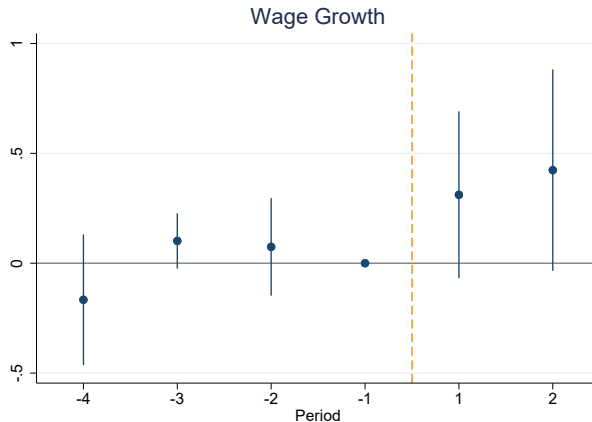
**LTV restriction reduces HH leverage of affected displaced workers**

## Debt-to-Income ratio

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

**25 percent reduction in HH leverage**

## Wage growth between two jobs



**LTV restriction improves the starting wages of affected displaced workers**

## Wage growth between two jobs

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

1. **Selection into housing market**

→ Characteristics do not change, remove workers who cannot afford the down payment

2. Different starting years

3. Remove workers who receive inheritance

4. Remove workers who ever earn business income

5. Control for macroeconomic conditions

6. Placebo test

7. Remove low LTV ratio observations far from LTV threshold



## Through what mechanism does leverage affect wages?

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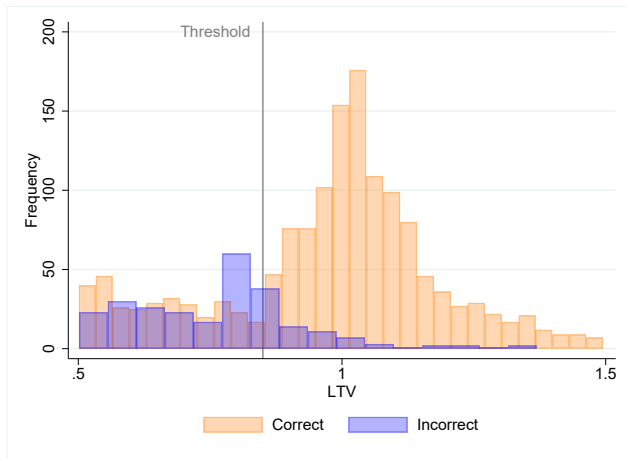
Workers with lower leverage

- Have **longer unemployment spell**
- Find jobs in **better paying firms**
  - Firm wage premium (Abowd et al (ECTA-1999)), explains 20% of the effect
- Have **broader job search**
  - More likely to do a different occupation type in a new industry
- Labor mobility, credit use during unemployment, and changes in education cannot explain the results
- Effect is stronger for young, highly educated workers with shorter tenure

- **Household leverage** affects labor market outcomes through its influence on job search
- A reduction in household leverage **improves wages** of displaced workers
- Workers with lower leverage have longer unemployment spells, find jobs in better paying firms, and broaden their job search
- **Macroprudential policies** that limit household leverage can have **positive side effects** to the **labor market**
- Results help us to **understand the nature of an economy** that enters into a recession with **high household leverage**

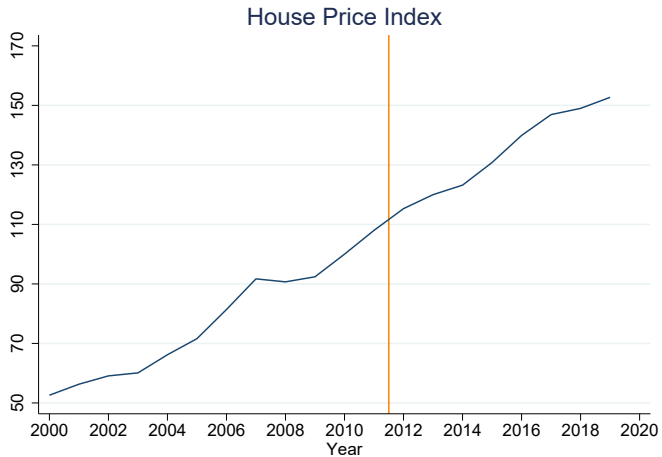
**Thank You!**

## Distribution of Misclassified Households



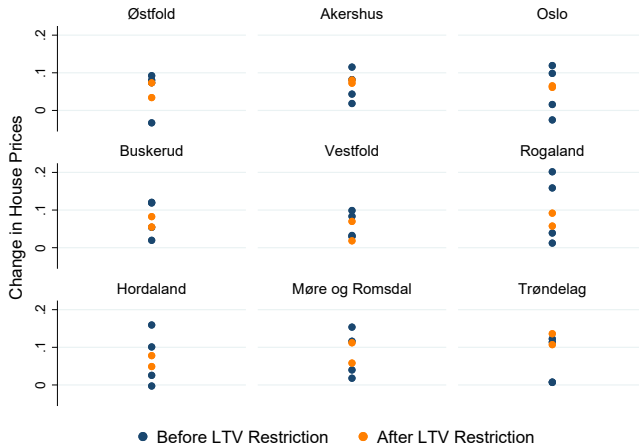
**Misclassified observations are clustered around the threshold**

# National House Prices



**Aggregate house price index is not affected**

# Regional House Prices



House prices after restriction are in the support of prices before the restriction

## Loan-to-Value Ratio

	LTV					
	(1)	(2)	(3)	(4)	(5)	(6)
$d(\widehat{LTV} > 0.85) \times \text{Post}$	-0.235*** (0.021)	-0.234*** (0.021)	-0.229*** (0.021)	-0.225*** (0.017)	-0.226*** (0.018)	-0.218*** (0.030)
$d(\widehat{LTV} > 0.85)$	0.234*** (0.014)	0.233*** (0.014)	0.221*** (0.015)	0.216*** (0.015)	0.216*** (0.014)	0.212*** (0.019)
<i>Fixed Effects:</i>						
Year FE		✓	✓	✓	✓	✓
Education FE			✓	✓	✓	✓
Location FE				✓	✓	
Industry FE					✓	
Location $\times$ Industry FE						✓
Obs.	1,876	1,876	1,833	1,833	1,833	1,833
R <sup>2</sup>	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)
$d(\widehat{LTV} > 0.85) \times \text{Post}$	-603.153*** (114.309)	-667.540*** (126.417)	-436.306** (156.551)	-503.119*** (150.137)	-69.821 (81.675)	-109.932 (137.884)
$d(\widehat{LTV} > 0.85)$	-119.832* (65.223)	90.282 (61.379)	-486.696*** (93.149)	-229.524** (81.908)	-198.473*** (12.966)	-176.430*** (45.433)
<i>Fixed Effects:</i>						
Year FE		✓		✓		✓
Education FE		✓		✓		✓
Location FE		✓		✓		✓
Industry FE		✓		✓		✓
Location $\times$ Industry FE						✓
Obs.	1,876	1,833	1,876	1,833	1,876	1,833
R <sup>2</sup>	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)
$d(\widehat{LTV} > 0.85) \times \text{Post}$	-45.875*** (10.390)	-44.626*** (9.821)	-41.265*** (13.315)	-36.504** (14.011)	-31.523** (13.681)	-37.456** (16.988)
$d(\widehat{LTV} > 0.85)$	-7.803** (2.769)	-8.570*** (2.173)	-4.688 (3.609)	-2.726 (4.285)	-2.684 (4.278)	-0.780 (5.007)
<i>Fixed Effects:</i>						
Year FE		✓	✓	✓	✓	✓
Education FE			✓	✓	✓	✓
Location FE				✓	✓	
Industry FE					✓	
Location $\times$ Industry FE						✓
Obs.	1,876	1,876	1,833	1,833	1,833	1,833
R <sup>2</sup>	0.014	0.106	0.224	0.249	0.267	0.316
Mean(Interest Expense)	91.489					

**Reduction in interest expense**

# Controlling for liquidity

	Wage Growth					
	(1)	(2)	(3)	(4)	(5)	(6)
$d(\widehat{LTV} > 0.85) \times \text{Post}$	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)
$\ln(\text{liq.})_{t-1}$	0.248	0.204	0.287*	0.278*	0.345**	0.124
	(0.163)	(0.161)	(0.158)	(0.151)	(0.152)	(0.144)
$\ln(\text{liq.})_{t-1} \times \ln(\text{liq.})_{t-1}$	-0.044	-0.037	-0.051*	-0.049*	-0.060**	-0.025
	(0.026)	(0.026)	(0.026)	(0.024)	(0.025)	(0.023)
$\ln(\text{liq.})_{t-1} \times \ln(\text{liq.})_{t-1} \times \ln(\text{liq.})_{t-1}$	0.002*	0.002	0.002**	0.002**	0.003**	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
<u>Fixed Effects:</u>						
Year FE		✓	✓	✓	✓	✓
Education FE			✓	✓	✓	✓
Location FE				✓	✓	
Industry FE					✓	
Location $\times$ Industry FE						✓
Obs.	941	941	927	927	927	927
R <sup>2</sup>	0.018	0.032	0.147	0.165	0.187	0.298
Mean(Wage Growth)	-0.074					

## Robustness checks for starting wages

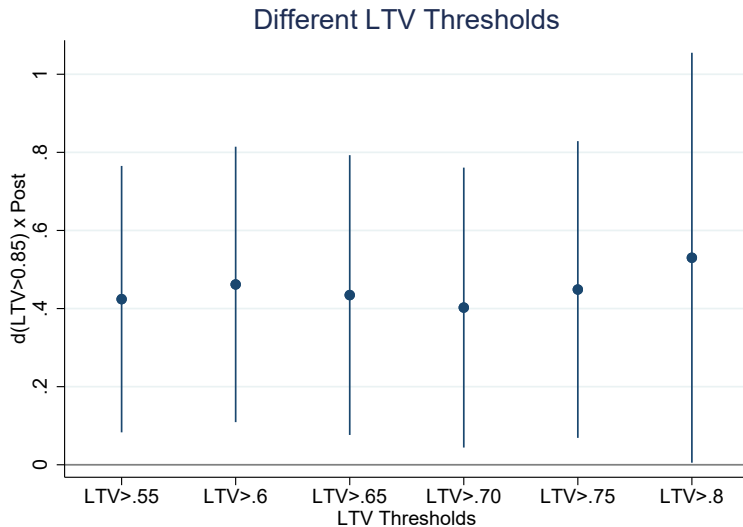
	Wage Growth						
	(1) 2005	(2) 2007	(3) No Transf.	(4) No Bus. Inc.	(5) Macro	(6) Education	(7) Placebo
$d(\widehat{LTV} > 0.85) \times \text{Post}$	0.426** (0.183)	0.449** (0.186)	0.409** (0.180)	0.430** (0.183)	0.983*** (0.329)	0.423* (0.205)	
$d(\widehat{LTV} > 0.85) \times \text{Placebo}$							-0.039 (0.131)
$d(\widehat{LTV} > 0.85)$	-0.108** (0.040)	-0.096*** (0.033)	-0.088** (0.038)	-0.126*** (0.037)	-5.076 (3.510)	0.703*** (0.184)	0.027 (0.117)
<u>Fixed Effects:</u>							
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 <sup>2</sup>	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)
$d(\widehat{LTV} > 0.85) \times \text{Placebo}$	0.014 (0.111)	0.017 (0.106)	-0.015 (0.128)	-0.033 (0.136)	-0.039 (0.131)	-0.152 (0.168)
Placebo	0.016 (0.072)	-0.000 (0.067)	0.041 (0.077)	0.034 (0.092)	0.027 (0.117)	0.045 (0.137)
Year FE		✓	✓	✓	✓	✓
Education FE			✓	✓	✓	✓
Location FE				✓	✓	
Industry FE					✓	
Location $\times$ Industry FE						✓
Obs.	1,050	1,050	1,029	1,029	1,029	1,029
R <sup>2</sup>	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



# Interactions with Macro variables

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

## Wages 4 Years After

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

**Wage is still higher 4 years after the restriction**

# Wage Volatility

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

Wage volatility is lower