

# The long-run earnings effects of a credit market disruption

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*The views expressed herein are those of the authors and should not be attributed to the Bank of Italy or to the Eurosystem.*

# How does the labour market adjust to a major credit event?

- ▶ The global financial crisis had big consequences on the real economy.
- ▶ Persistent effects on labour markets ("jobless recovery", Jaimovich and Siu 2012; hysteresis; wages remained low, Draghi 2017).
- ▶ Growing literature on the real effect of the credit crunch on investment and employment at the firm and LLM level
- ▶ What is the effect in the long and short term of credit shocks on workers' earnings? Are these effects heterogeneous across workers?

# What we already know

Two strands of literature:

1. Real negative effects of credit shocks on **firm-level** or local level outcomes
  - ▶ Benmelech et al. 2015; Bentolila et al. 2017; Berton et al. 2018; Chodorow-Reich 2014; Cingano et al. 2016; Popov and Rocholl 2016; Greenstone et al. 2014; Caggese et al. 2017; Sforza, 2018; Barbosa et al. 2017; Acabbi 2019; Moser 2018.

Less is known on **wages** at the worker level **and long term effects**

2. Persistent losses in workers' earnings after job displacement
  - ▶ Mass lay-offs: Jacobson et al. 1993; Lachowska et al. 2019; Schmieder et al. 2019.
  - ▶ Trade shocks at the sector level: Autor et al. 2014.

# This paper

- ▶ We use matched administrative bank-employer-employee data for the period 2001-2016.
- ▶ We construct a **firm-specific shock**: firms that in 2006 used to borrow relatively more from banks more exposed to the interbank market (Iyer et al. 2014; Paravisini et al. 2015).
- ▶ We follow workers for **9 years after the shock**: we look at labour earnings, days worked and daily wages

# Advantages of our setting

- ▶ We study both **displaced workers and stayers**
  - insurance within the firm?
  - Who bears the largest cost?
    - ▶ different from mass lay-offs (only displaced).
- ▶ Shock fully **exogenous to workers' characteristics**
  - which workers do firms displace?
    - ▶ different to trade shocks (lower cost input mostly substitute low skilled workers).
- ▶ Allows to assess **how the effect of the firm-level shock depends on external (local labour market) conditions**

## Preview of Results (1)

- ▶ Firms borrowing from banks more exposed to interbank market: **persistent reduction in credit.**
- ▶ Firms with limited access to credit shrink more and pay on average lower wages than less affected firms.
- ▶ **Highly persistent earnings losses for workers employed in more exposed firms, mainly due to a persistent drop in days worked.**

## Preview of Results (2)

- ▶ **High type workers experience more persistent earning losses**
  - ▶ **They are less likely to find a new job** (some evidence of labour supply response) → inequality decreases
- ▶ Substantial heterogeneity depending on LLM conditions:
  - ▶ Good LLM conditions: firms hoard good type workers and displace low-type workers.
  - ▶ Bad LLM conditions: firm fire both low- and (especially) high-type workers, who experience persistent loss in days worked and in wages → **Selection in displacement**
- ▶ Reallocation of workers mostly towards better firms ( $\neq$  from Schmieder et al. 2019) but incomplete ( $\neq$  from Lachowska et al. 2019).

# Data and Identification



# Data

We use a matched Bank-Employer-Employee dataset for the period 2001-2016.

1. Banks: Balance sheet data from Supervisory Reports + Credit at the bank-firm level from the Credit Register.
2. Employers: Universe of firms in the private sector with at least one employee (INPS): info on firm size, sector of activity and average wage paid by the firm.
3. Employees: entire working history of 6.5 per cent of social security records (INPS): representative, random sample, based on 24 days of birth in any given year. Contains info on employment spells, daily wages, occupation, and type of contract (permanent/temporary).

# Sample

- ▶ Banks: All banks.
- ▶ Employers: incorporated companies existing in 2006 (base year) who were borrowing at least 75,000 euro from some bank.
- ▶ Employees: all individuals aged 25-50 in 2006, who worked in any of these firms in 2006 and have at least 3 years of experience (had worked in the same firm of 2006 for at least 200 days per year in 2003-2005).

# Construction of the shock: bank exposure to the financial shock

- ▶ As a measure of bank exposure to the Global financial crisis we use their **2002-2006** reliance on interbank (wholesale) funding
  - ▶ Liquidity drought in interbank market, increase banks' external finance premium  $\rightarrow$  reduction in credit granted (Brunnermeier 2009, Iyer et al. 2013, Cingano et al. 2016).
- ▶ Collapsed at the firm level exploiting existing credit relationships in 2006: we weight by share of 2006 credit granted by each bank  $b$  to firm  $f$  (Cingano et al. 2016)
  - ▶ Bank-firm lending relationships are usually long lasting  $\rightarrow$  we use banks-firms relationships in 2006 (Chodorow-Reich 2014)

# Firm-level exposure to the interbank market

$$interb_{06,f} = \sum_b w_{06,f,b} * interb_{06,b}$$

where:

- ▶  $w_{06,f,b}$  is the share of credit granted by each bank  $b$  to firm  $f$  on 31/12/2006
- ▶  $interb_{06,b}$  is bank  $b$  exposure to the shock, its interbank funding-to-assets ratio (2002-2006)

Extensively used in the literature as a measure of exogenous credit restriction. Conceptually similar to the measure used by Chodorow-Reich 2014.

Arguably exogenous. Possible correlation with borrower characteristics (see below on this).

# Threats to identification

- ▶ Before 2006 no endogenous sorting of banks relying heavily on the interbank market to firms (i.e. riskier firms, were not systematically expanding credit) [Go](#)
- ▶ Interpretation of the credit shock. Sovereign debt crisis in 2011 does not systematically affect more 2006 interbank-exposed banks
  - ▶ Negative correlation with sovereign bonds holdings and other bank characteristics [Go](#)

# A difference-in-differences framework: firm level analysis

First, evidence at the firm-level

- ▶ Test on total effect on credit

$$\Delta \log credit_{ft} = \theta interb_{06,f} * post06_t + \alpha_f + \gamma_{pt} + \eta_{ft}$$

- ▶ Test on employment and average wage at the firm-level

$$y_{ft} = \beta interb_{06,f} * post06_t + \alpha_f + \gamma_{pt} + \epsilon_{ft}$$

where  $y_{f,t}$  is employment or average (monthly) wage at the firm level and  $interb_{06,j}$  is interbank exposure of firm  $f$

## A difference-in-differences framework: worker-level

Next, we estimate the following equation at the worker level for all workers employed in firm  $f$  in 2006 with at least 3 years of tenure:

$$y_{ift} = \beta_1 interb_{06,f} * post06_t + \delta_{pt} + \delta_i + \epsilon_{ift}$$

where:

- ▶  $y_{ijt}$  is number of days worked per year, daily wages (normalized=1 in 2006), and labour earnings in year  $t$  of worker  $i$  employed in 2006 in firm  $f$
- ▶  $interb_{06,j}$  is interbank exposure of firm  $f$
- ▶  $\delta_{pt}$  are province-time fixed effects and  $\delta_i$  are individual fixed effects

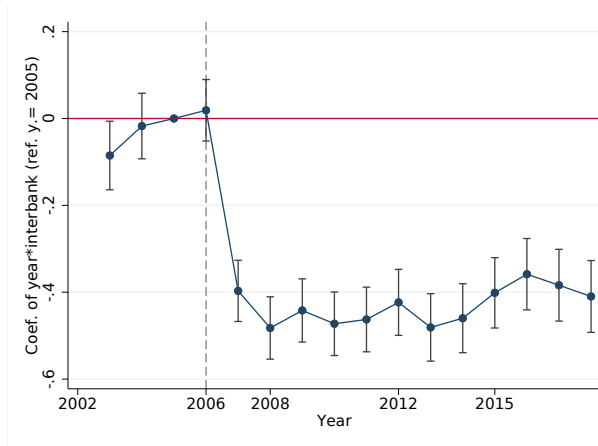
We match individuals in more exposed firms (top 33 pct. exposure) in the same sector to otherwise identical individuals in less exposed firms.

Summary stat.

# Firm level results



# Persistent reduction in credit



**Note** The graph plots the difference in the outcome between more or less exposed firms, and the corresponding 95% confidence intervals, clustered at the individual level. Omitted category: 2005.

## Negative effect on credit, size and average wage

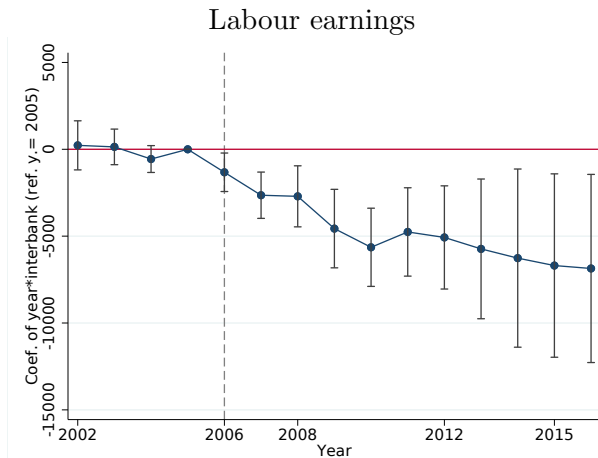
Dep var:	Credit growth [1]	Size growth [2]	Av. wage growth [3]
interb*p2006	-0.542*** (0.021)	-0.074*** (0.020)	-0.018*** (0.006)
<i>st</i> and <i>pt</i> FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
N	1232208	1463070	1463070

**Note:** standard errors clustered at the firm level.

If interbank exposure is 10 ppt higher: credit growth shrinks by 6.4% of a s.d.; size shrinks by 1.2% of a s.d., average wage by 0.7% of a s.d.

# Worker level results

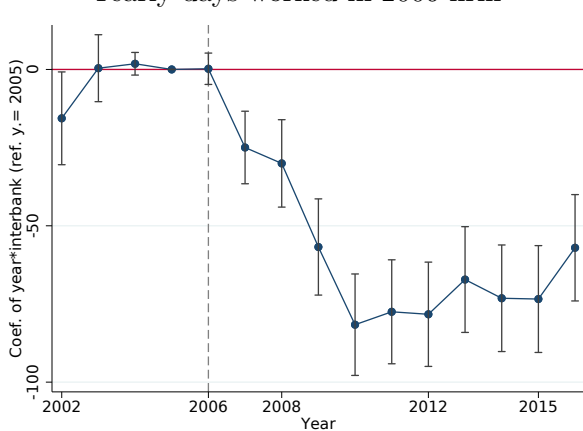
# Persistent reduction in labour earnings



**Note** The graph plots the difference in the outcome between workers employed in 2006 in more or less exposed firms, and the corresponding 95% confidence intervals, clustered at the individual level. Omitted category: 2005.

# Mainly due to job losses: workers more likely to leave the 2006 firm

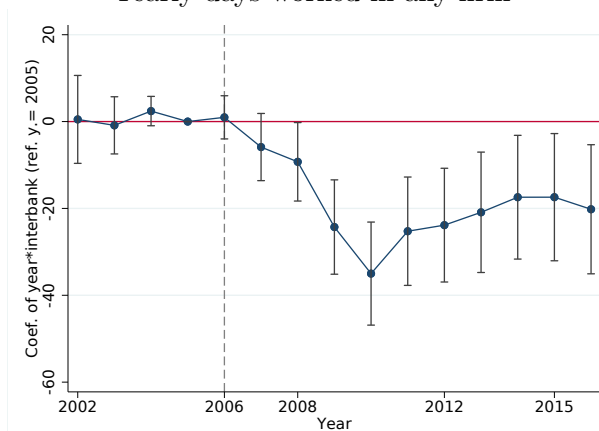
## Yearly days worked in 2006 firm



**Note** The graph plots the difference in the outcome between workers employed in 2006 in more or less exposed firms, and the corresponding 95% confidence intervals, clustered at the individual level. Omitted category: 2001.

# Some manage to find a new job but days worked do not fully recover

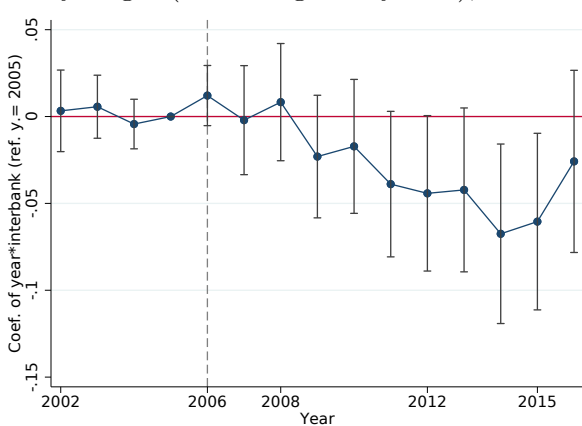
## Yearly days worked in any firm



**Note** The graph plots the difference in the outcome between workers employed in 2006 in more or less exposed firms, and the corresponding 95% confidence intervals, clustered at the individual level. Omitted category: 2001.

Also wages decrease persistently (mainly for dismissed workers)

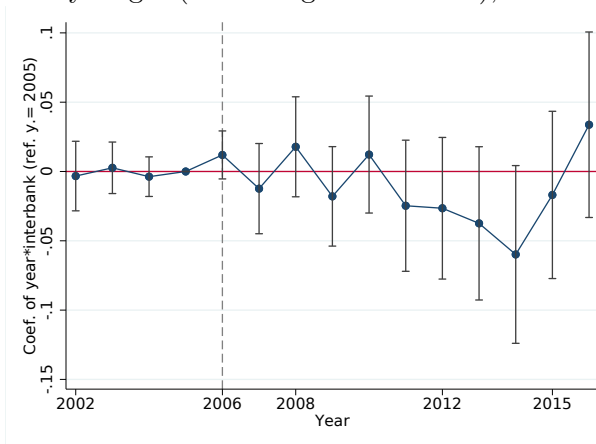
Daily wages (if working in any firm), 2006=1



**Note** The graph plots the difference in the outcome between workers employed in 2006 in more or less exposed firms, and the corresponding 95% confidence intervals, clustered at the individual level. Omitted category: 2001.

# No significant decrease in wages of stayers

Daily wages (if working in 2006 firm), 2006=1



**Note** The graph plots the difference in the outcome between workers employed in 2006 in more or less exposed firms, and the corresponding 95% confidence intervals, clustered at the individual level. Omitted category: 2001.



## Economic significance

- ▶ Workers employed in 2006 in firms with 10 pp higher exposure earn on average 480 euros less per year (over 9 years).
- ▶ This is a drop of around 2.4% in average yearly labour earnings.
- ▶ Effects on earnings are persistent: still there in 2016 (no recovery).
- ▶ **These are average effects on all workers, not only on displaced workers.**
- ▶ As in mass lay-off papers: reduction in earnings about 20% for displaced workers.

# Inspecting the mechanism

# High/low-type workers and local labor market conditions

To uncover the underlying mechanisms:

- ▶ We study separately **high- and low-type workers**
  - ▶ Workers with wage above/below the median in 2006 (net of age, gender, part time contract, tenure, firm size, province and sector fixed effects).
- ▶ We look at the differential effect of local labour market conditions (**high/low unemployment provinces**).
- ▶ We assess whether loss in wages due to labour market conditions or to changes in type of firms workers find a new job

# Earnings losses are concentrated among high-type workers

Dep var:	Earnings	N days empl		Daily wage	
		2006 firm (0 if moving)	any firm	any firm	if they stay (. if moving)
	[1]	[2]	[3]	[4]	[5]
<i>High type workers in 2006</i>					
interb.*p2006	-7621.987*** (2555.657)	-61.506*** (9.580)	-26.250*** (6.705)	-0.021 (0.020)	-0.005 (0.017)
N	846330	846330	846330	781568	628336
<i>Low type workers in 2006</i>					
interb.*p2006	-1703.319*** (609.047)	-54.205*** (8.773)	-14.990** (6.951)	-0.040* (0.022)	-0.018 (0.015)
N	770415	770415	770415	689878	564878
Worker FE	Yes	Yes	Yes	Yes	Yes
pt FE	Yes	Yes	Yes	Yes	Yes

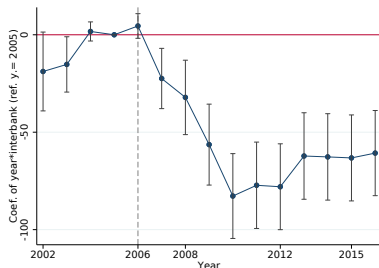
**Note:** standard errors clustered at the worker level.

Differently from findings on trade shocks (Autor et al. 2014, Utar 2018), **inequality decreases.**

# While high- and low-type workers are similarly separated...

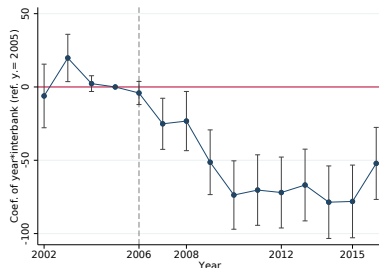
## Low-type workers

Yearly days worked in 2006 firm



## High-type workers

Yearly days worked in 2006 firm

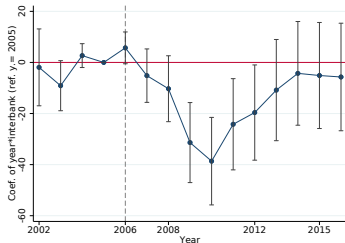


**Note:** interactions of exposure to interbank of the firms where the worker was employed in 2006 with year dummies. Vertical bars represent 95% confidence intervals. Standard errors clustered at the worker level. Additional controls: province (of the firm in 2006) times year fixed effects, sector (1 digit, of the firm in 2006) times year fixed effects.

# ... high-type workers do not find another job

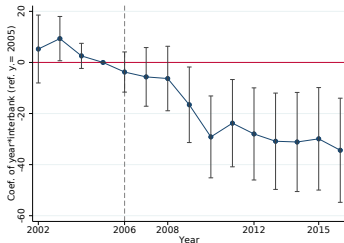
## Low-type workers

Yearly days worked



## High-type workers

Yearly days worked



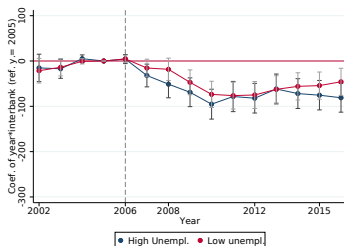
**Note:** interactions of exposure to interbank of the firms where the worker was employed in 2006 with year dummies. Vertical bars represent 95% confidence intervals. Standard errors clustered at the worker level. Additional controls: province (of the firm in 2006) times year fixed effects, worker FE.

# Does it depend on LLM? Selection into displacement

High-type workers displaced only if LLM in bad economic conditions

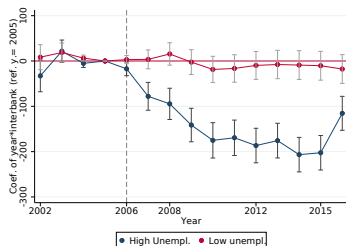
## Low-type workers

Yearly days worked in 2006 firm



## High-type workers

Yearly days worked in 2006 firm



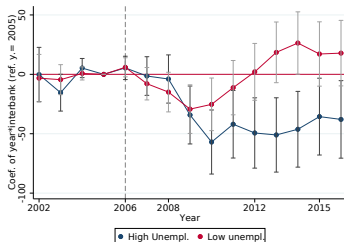
**Note:** High unempl: average unemployment rate at the province level greater than the median. interactions of exposure to interbank of the firms where the worker was employed in 2006 with year dummies. Vertical bars represent 95% confidence intervals.

In good economic conditions: firms fire low-type workers (labour hoarding); in bad conditions: firms fire both types of workers.

# Persistent employment losses in high-unemployment provinces

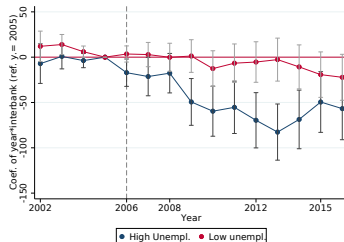
## Low-type workers

Yearly days worked in any firm



## High-type workers

Yearly days worked in any firm



**Note:** interactions of exposure to interbank of the firms where the worker was employed in 2006 with year dummies. Vertical bars represent 95% confidence intervals.

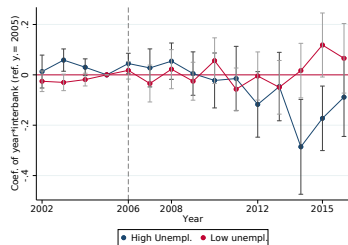


# Even though wages decrease in provinces with high unemployment

Wages react to labour market slack

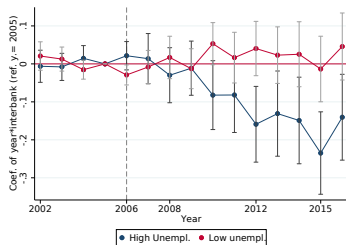
## Low-type workers

Daily wages in 2006 firm (2006=1)



## High-type workers

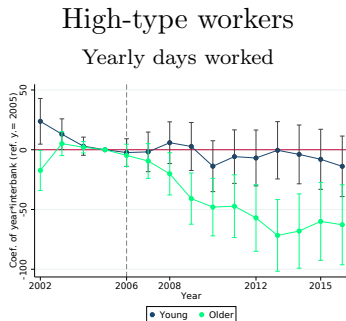
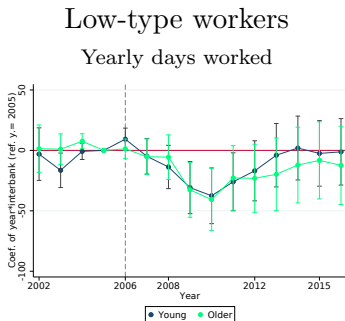
Daily wages in any firm (2006=1)



**Note:** interactions of exposure to interbank of the firms where the worker was employed in 2006 with year dummies. Vertical bars represent 95% confidence intervals.

# Why do high type workers experience persistent loss in days worked?

Persistent loss only among high type-old workers: supply effect?



**Note:** Young workers: aged 25-40 in 2006. Old workers: aged 40-50 in 2006. interactions of exposure to interbank of the firms where the worker was employed in 2006 with year dummies. Vertical bars represent 95% confidence intervals.

Perm. exit

Early retirement

By tenure

# Robustness: Is the wage effect a matter of (new) firm quality?

- ▶ Do workers who lose their job move to worse firms?
- ▶ We define high/low type firms as those with average wage below/above the 50th percentile in 2006 (net of firm size, province and sector fixed effects).
- ▶ We decompose the total effect on days worked into three components
  1. in the 2006 firm
  2. days found in new firms of higher type
  3. days found in new firms of lower or equal type

variation shock unempl.

by firm type

# Decomposition of days worked

Workers move mainly towards better firms

Dep var:	Days worked			
	Any firm	2006 firm [1]	in better firms [2]	in worse (or =) firms [3]
<i>High-type workers in 2006:</i>				
interb.*post2006	-26.250*** (6.705)	-61.506*** (9.580)	23.036*** (6.406)	12.270** (6.052)
N	846330	846330	846330	846330
<i>Low-type workers in 2006:</i>				
interb.*post2006	-14.990** (6.951)	-54.205*** (8.773)	25.496*** (5.588)	13.739*** (5.296)
N	770415	770415	770415	770415
Worker FE	Yes	Yes	Yes	Yes
pt FE	Yes	Yes	Yes	Yes

**Note:** worker level analysis, additional controls: province (of the firm in 2006) times year fixed effects, sector (1 digit, of the firm in 2006) times year fixed effects. Standard errors clustered at the worker level.

Wage losses not due to the type of firms workers are moving to.  
Consistent with wage reaction to labour market slack.

# Conclusions

- ▶ We use bank-employer-employee matched data to study the long term consequences of a credit shock on workers' earnings.
- ▶ We find that:
  - ▶ Workers experience persistent and sizable earnings losses.
  - ▶ Earnings losses are stronger for high type workers in high unemployment areas.
  - ▶ Possibly also due to supply effects: older high type workers exit the labour market.
  - ▶ Selection into dismissal: some firms hoard labour, other do not.
  - ▶ Wages react to local labour market conditions (wage losses not due to worse reallocation: reallocation is positive).

Thank you

# EXTRA TABLES

## Share of firm-level credit from banks more exposed to the interbank market in 2006

Dep var:	Delta % credit 2005-2000	
	[1]	[2]
interbank06 <sub>b</sub>	0.001 (0.000)	0.001 (0.003)
Share of credit in 2000		-1.009*** (0.006)
N	538169	538169
Firm FE	Yes	Yes

**Note:** Regression at the bank-firm level, it shows whether the change in the pre-crisis share of credit of different banks lending to firm  $f$  is correlated to the banks' exposure to interbank markets in 2006. Robust standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .



# First stage: Change in firm-level credit to firms more exposed to the interbank market in 2006

Back

	Delta cred 2010-2006 [1]	Delta cred 2015-2011 [2]	Delta cred [3]
interbank06	-0.285*** (0.0268)	-0.155*** (0.0277)	
l.delta cred	-0.101*** (0.00389)	-0.0795*** (0.00440)	
interbank06*post 2011			-0.0269 (0.0370)
post 2011			-30.55*** (0.475)
l.delta cred			0.0810*** (0.00349)
l.delta cred*post 2011			-1.164*** (0.00742)
Observations	223263	246548	340438
Firm FE	No	No	Yes

**Note:** Regression at the firm level, it shows whether the change in credit (2015 and 2010) of different firms is correlated to the banks' exposure to interbank markets in 2006, after controlling for the drop in credit observed between 2010 and 2006. Robust standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

## Correlation between bank characteristics as of 2010-2011 and interbank exposure as of 2006 at the bank level

	[1] capital/assets	[2] tier1/assets	[3] capital/rwa	[4] roa	[5] govt/assets
interb <sub>06,b</sub>	-0.0221 (0.0169)	-0.0116 (0.0173)	-0.0217 (0.0388)	-0.000242 (0.00467)	-0.162*** (0.0509)
Observations	469	469	469	469	469
R <sup>2</sup>	0.192	0.252	0.132	0.017	0.151

**Note:** The table shows correlations between interbank funding to total assets as of 2006 of each banks and measures of capital, profitability, and exposure to the sovereign debt crisis. These measures are averages between June 2010 and June 2011. All regressions include dummies for deciles of bank assets. Data are from the Supervisory Reports. Robust standard errors in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

## Change in bank's average cost of funding

	(1)	(2)
	06-10	11-15
interb <sub>06,b</sub>	0.0484** (0.0238)	0.000735 (0.0130)
initial cost of funding (level)	-1.285** (0.521)	-0.388** (0.166)
Observations	448	443
$R^2$	0.119	0.085

**Note:** The table shows correlations between interbank funding to total assets as of 2006 of each banks and the change in the average cost of funding between 2006 and 2010 in column 1 and 2011-2015 in column 2. All regressions include dummies for deciles of bank assets. Data are from the Supervisory Reports. Robust standard errors in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

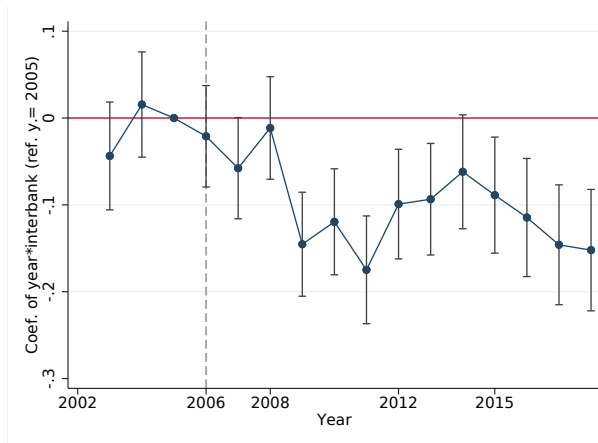
Back

## Threats to identification - II: Correlation with firm and/or worker characteristics

	Most treated Unweighted top 33 <sup>th</sup> exp. [1]	Least treated others [2]	Most treated Weighted (PSM) top33 <sup>th</sup> exp. [3]	Least treated others [4]
<i>Firm level variables (characteristics in 2006 of 2006 firms )</i>				
Interbank exp.	17.083 (5.755)	10.954 (2.838)	17.323 (6.071)	11.360 (2.669)
size	5.454 (2.384)	4.547 (2.042)	5.193 (2.161)	4.811 (2.024)
Av. wage	7.623 (0.369)	7.549 (0.346)	7.627 (0.368)	7.602 (0.354)
Firm age	18.255 (12.373)	20.216 (12.816)	18.557 (12.548)	19.678 (12.704)
<i>Worker level variables (in 2006)</i>				
age	39.271 (6.953)	39.096 (7.006)	39.205 (6.949)	39.206 (6.967)
female	0.315 (0.465)	0.332 (0.471)	0.308 (0.462)	0.322 (0.467)
blue coll	0.529 (0.499)	0.577 (0.494)	0.541 (0.498)	0.551 (0.497)
temporary	0.014 (0.116)	0.013 (0.115)	0.014 (0.117)	0.014 (0.119)
Observations	893415	1812105	679890	648510

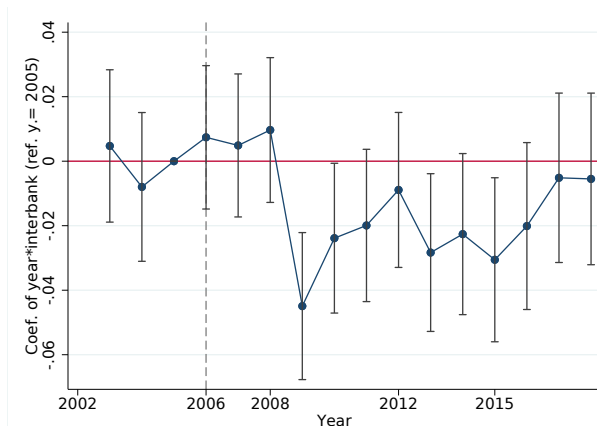
**Note:** standard deviation in parenthesis. Treated and control are the treatment and control groups, after having matched the workers working in most exposed firms with the workers working in least exposed firms.

## Effect on firm size



**Note** The graph plots the difference in firm average size growth (relative to 2005) for firms whose banks in 2006 were more or less exposed to the interbank market (95 confidence interval). controls: firm and year fixed effects.

# Effect on firm average wage growth



**Note** The graph plots the difference in firm average wage growth (relative to 2005) for firms whose banks in 2006 were more or less exposed to the interbank market (95 confidence interval). controls: firm and year fixed effects.

Back

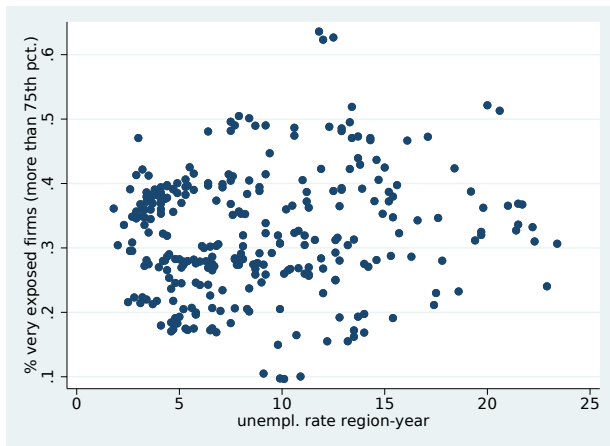
## Quantifying the effect on earnings

Dep var:	Earnings	N days empl		Daily wage	
		2006 firm (0 if moving)	any firm	any firm	if they stay (. if moving)
	[1]	[2]	[3]	[4]	[5]
interb.*post2006	-4790.253*** (1730.178)	-59.365*** (6.625)	-20.548*** (4.882)	-0.032** (0.015)	-0.014 (0.012)
N	1616745	1616745	1616745	1471446	1193214
Worker FE	Yes	Yes	Yes	Yes	Yes
st and pt FE	Yes	Yes	Yes	Yes	Yes

**Note:** standard errors clustered at the worker level.

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# Large variation in firm level shocks in regions with different UR



**Note:** Unemployment rate at the region year level (2002-2015) and share of firms highly exposed to the interbank market (above the 75<sup>th</sup> percentile in 2006) in the same region-year.

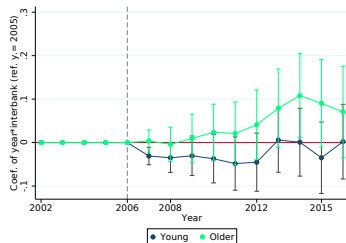


# Additional outcomes by worker's age

Increased probability of permanent exit among high-type old workers

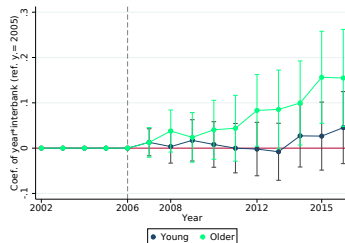
## Low-type workers

Prob permanent exit



## High-type workers

Prob permanent exit



**Note:** young workers: aged 25-40 in 2006. old workers: aged 40-50 in 2006.

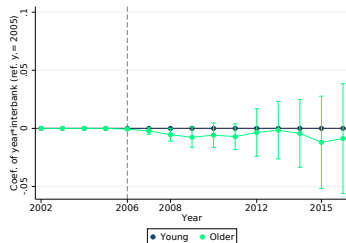
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# Additional outcomes by worker's age

Increased probability of early retirement among high-type old workers

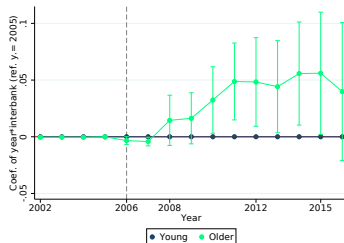
## Low-type workers

Prob early retirement



## High-type workers

Prob early retirement

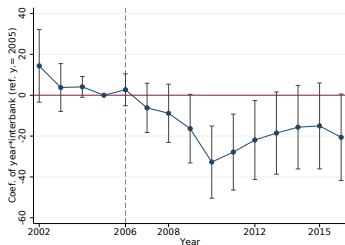


**Note:** young workers: aged 25-40 in 2006. old workers: aged 40-50 in 2006.

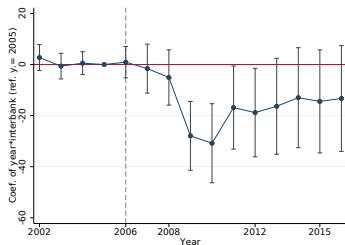
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# Firm specific human capital accumulation unlikely to explain the persistent job losses

Workers with short tenure  
Yearly days worked



Workers with long tenure  
Yearly days worked

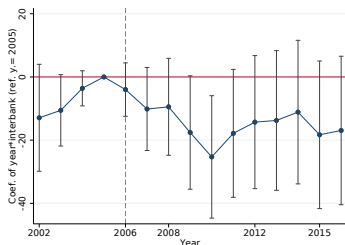


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# No differences by firm type

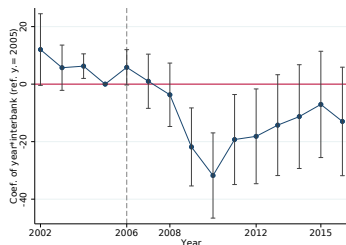
Low-type firms

Yearly days worked



High-type firms

Yearly days worked



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