Institute for Employment Research
The Research Institute of the Federal Employment Agency
IAB

Short-Time Work in Germany during the Great Recession: A Quantitative Investigation

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Contents

Introduction

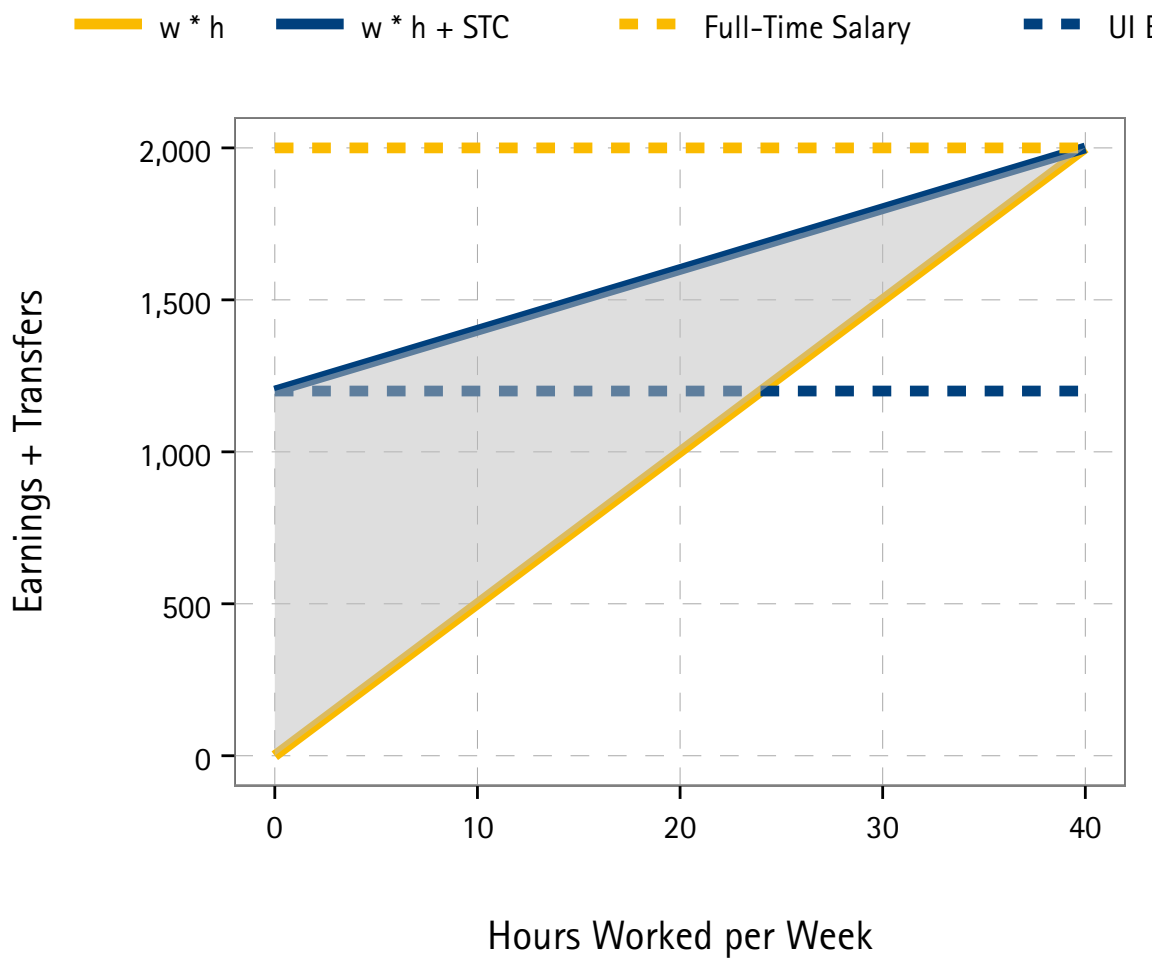
Motivation

- Main policy instrument to address extensive job loss during recessions: unemployment insurance
- Alternative: Some countries use short-time work (workers who work reduced hours receive partial unemployment insurance benefits)

Why short-time work?

- Encourage intensive margin response instead of layoffs
- Prevent human capital loss
- Spread the burden of a recession across more workers
- Speed up recovery

Policy Illustration



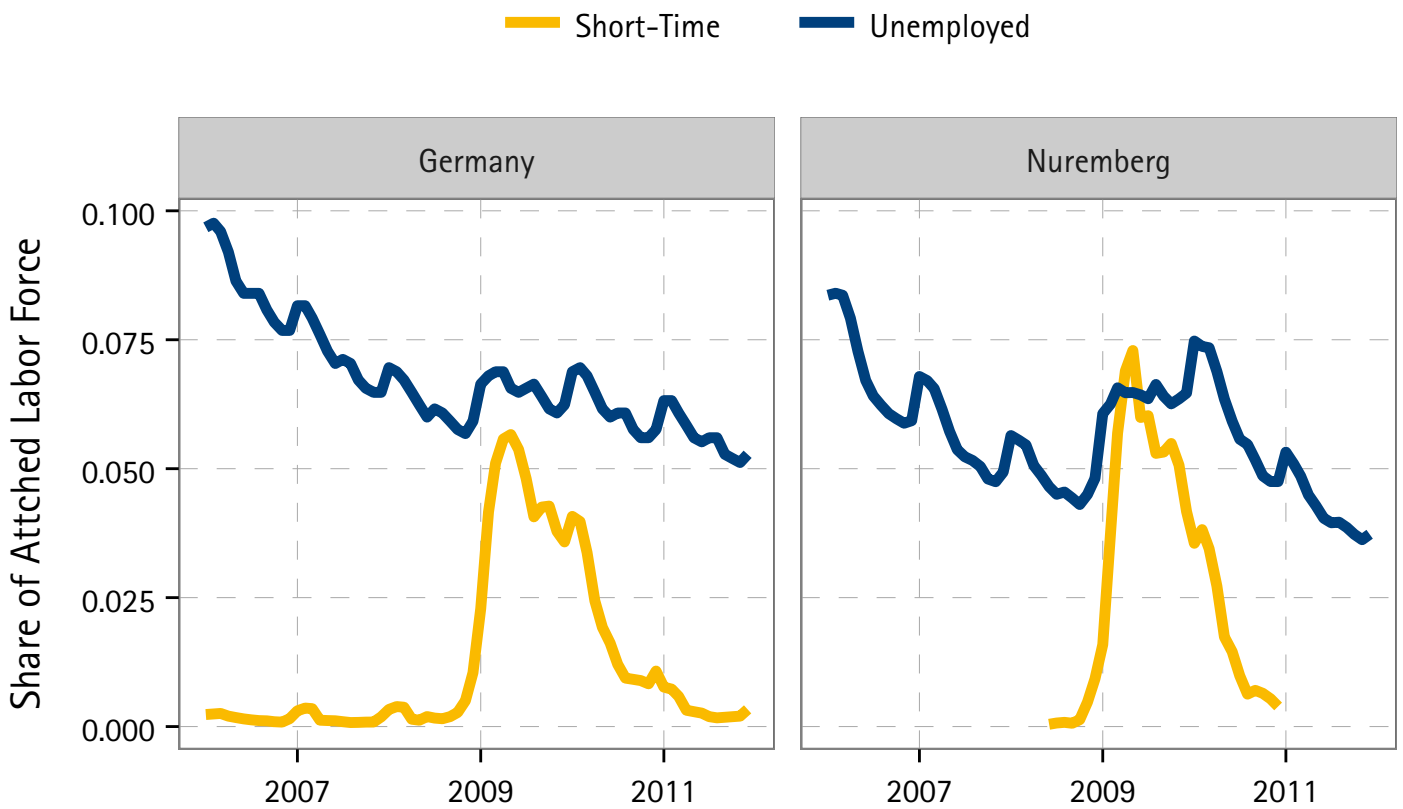
Data

Data Sources

- Short-time workers appear as full-time employees in the usual German administrative data sources
- Employers must report short-time workers' hours to the Federal Employment Agency on a monthly basis to receive payments
- These mostly type-written reports were digitized for the Nuremberg metro area between June 2008 and December 2010
- These reports were merged with employment biographies for all workers in Nuremberg between 2000 and 2014 (IEB-Sample)
- optional: Merge with firm-level short-time data to ensure accuracy and Establishment History Panel data (BHP)

$\Rightarrow$ The only German data source with worker-level short-time data

Unemployment and short-time rates: Germany vs. Nuremberg



Data

Summary Statistics: Germany vs. Nuremberg

	Germany (SIAB)	Nuremberg
Unemployment rate	0.07	0.06
Share female	0.36	0.38
Mean age	41.60	40.97
Mean monthly wage	2765.86	2964.12
Share manufacturing	0.26	0.29

Summary Statistics

	Mean	SD	N
Short-Time Duration	4.29	3.71	13,810
Unemployment Duration	9.66	9.79	177,470
Short-Time Hours	0.27	0.77	14,015
Monthly Earnings	2,949.55	1,362.75	2,817,802
... of Short-Time Workers	2,979.88	1,067.75	2,058
Age	40.18	11.28	2,989,980
Experience	13.50	9.47	2,989,980
Tenure	7.07	7.38	2,651,813

Data

Summary Statistics

	Mean	N
No Degree	0.11	37,673
Vocational Training	0.70	37,673
College Degree	0.19	37,673
Female	0.43	37,673
Manufacturing	0.28	253,359

Data

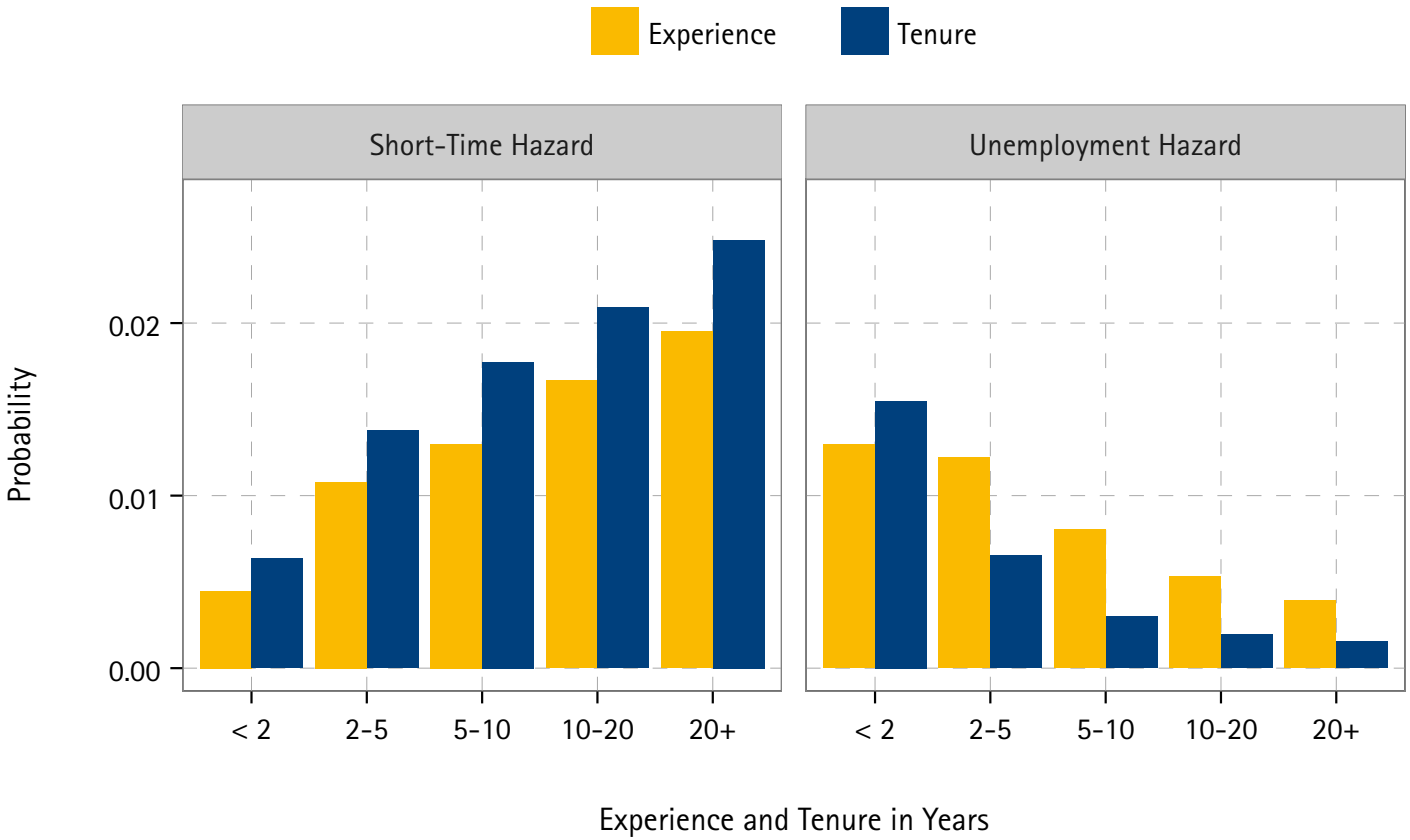
Short-Time Uptake across Industries

	Number	Industry
1	149,114	Installation of industrial machinery and equipment
2	8,185	Casting of light metals
3	7,852	Repair of electronic and optical equipment
4	7,359	Manufacture of other parts and accessories for motor vehicle...
5	4,910	Manufacture of other electrical equipment
6	4,380	Activities of head offices
7	4,246	Other transportation support activities
8	3,577	Repair of other equipment
9	3,128	Other non-ferrous metal production
10	2,789	Manufacture of fasteners and screw machine products
11	81,711	Other

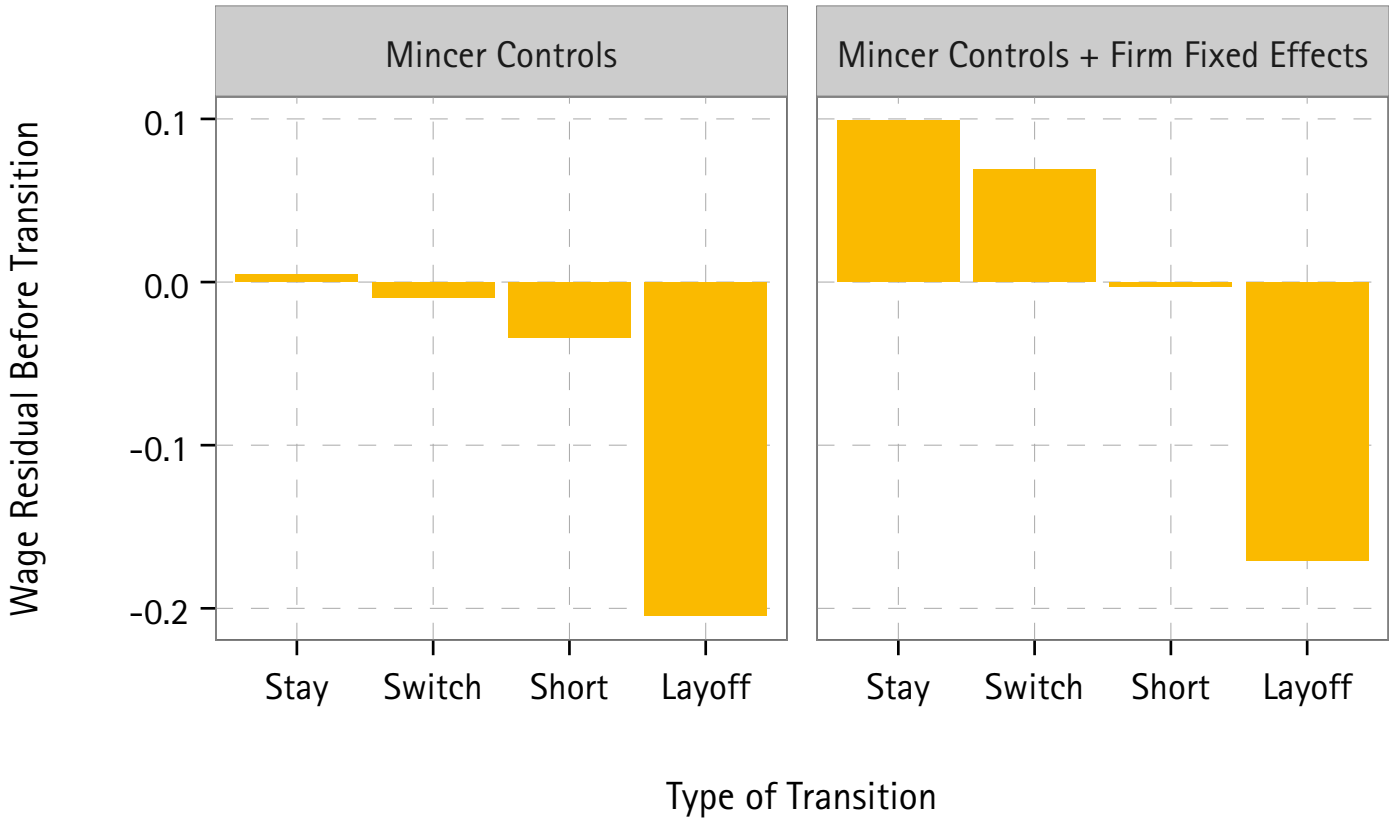
Short-Time Uptake across Occupations

	Number	Occupation
1	42,966	Occupations in machine-building ...
2	37,868	Occupations in metalworking
3	35,780	Office clerks and secretaries
4	20,046	Occupations in electrical engine...
5	14,330	Occupations in technical researc...
6	14,291	Occupations in warehousing and l...
7	11,297	Technical occupations in product...
8	10,829	Occupations in precision mechani...
9	8,333	Technical occupations in the aut...
10	6,141	Occupations in plastic- and rubb...
11	70,679	Other

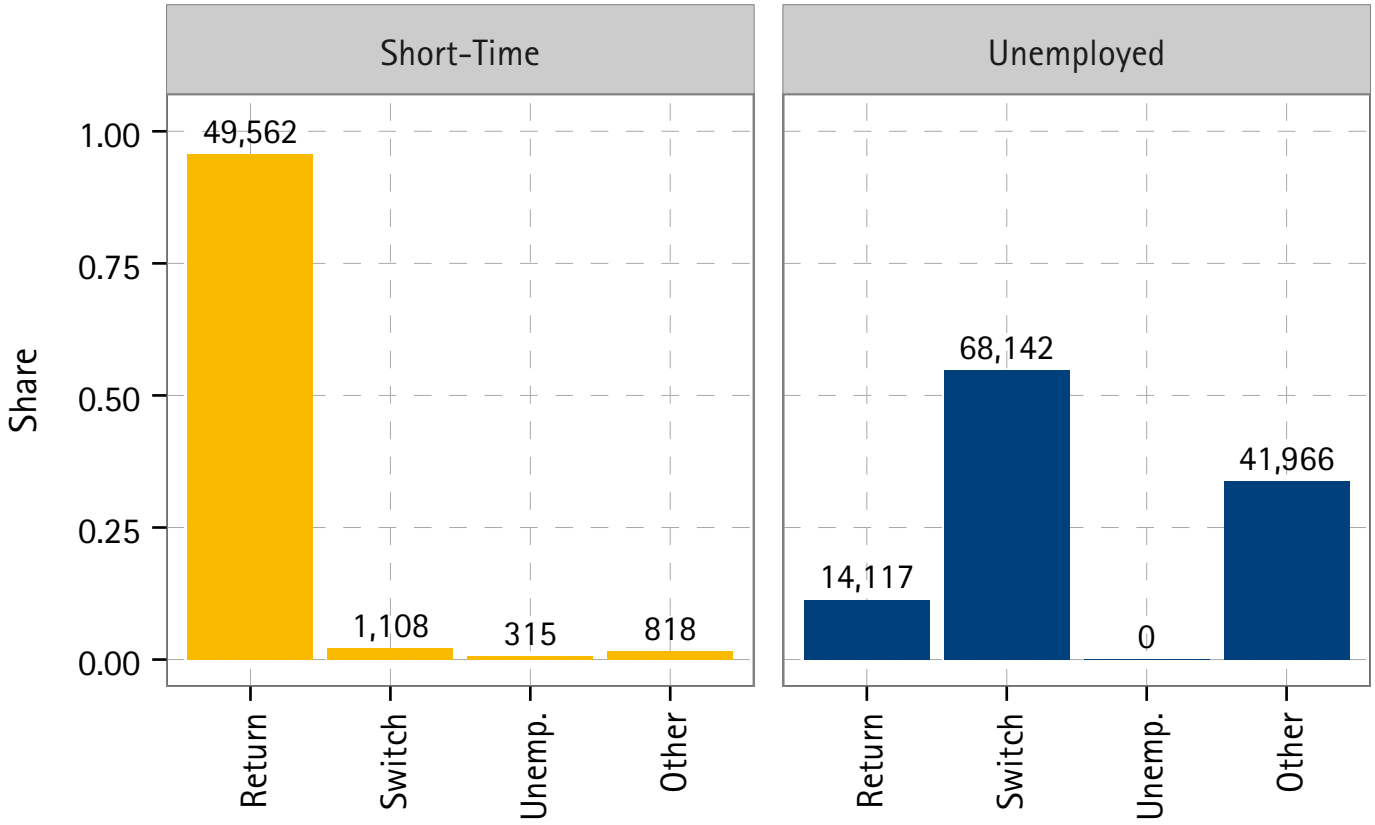
Hazard rates by work experience and tenure



Wage residual by labor market transition



Where do short-time workers end up?



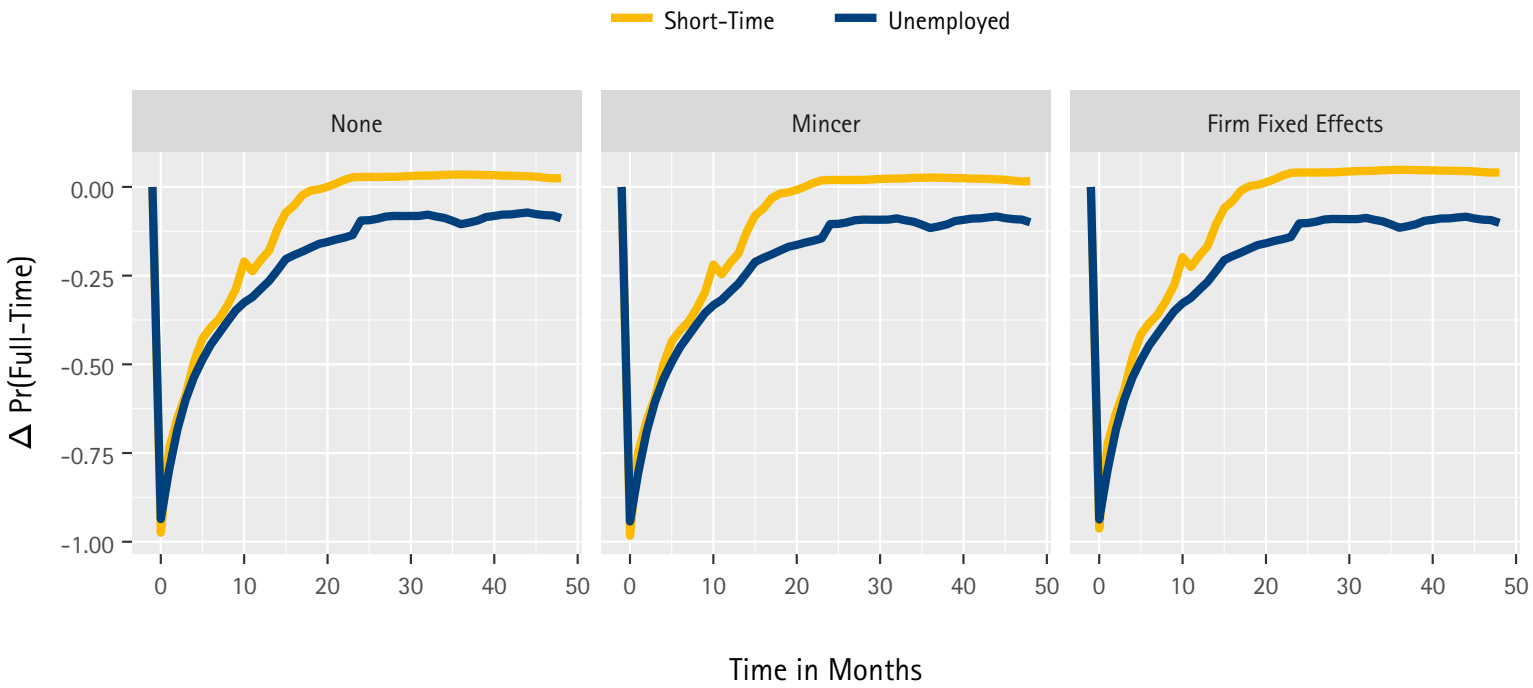


Figure: Long-run effects on Full-Time Employment

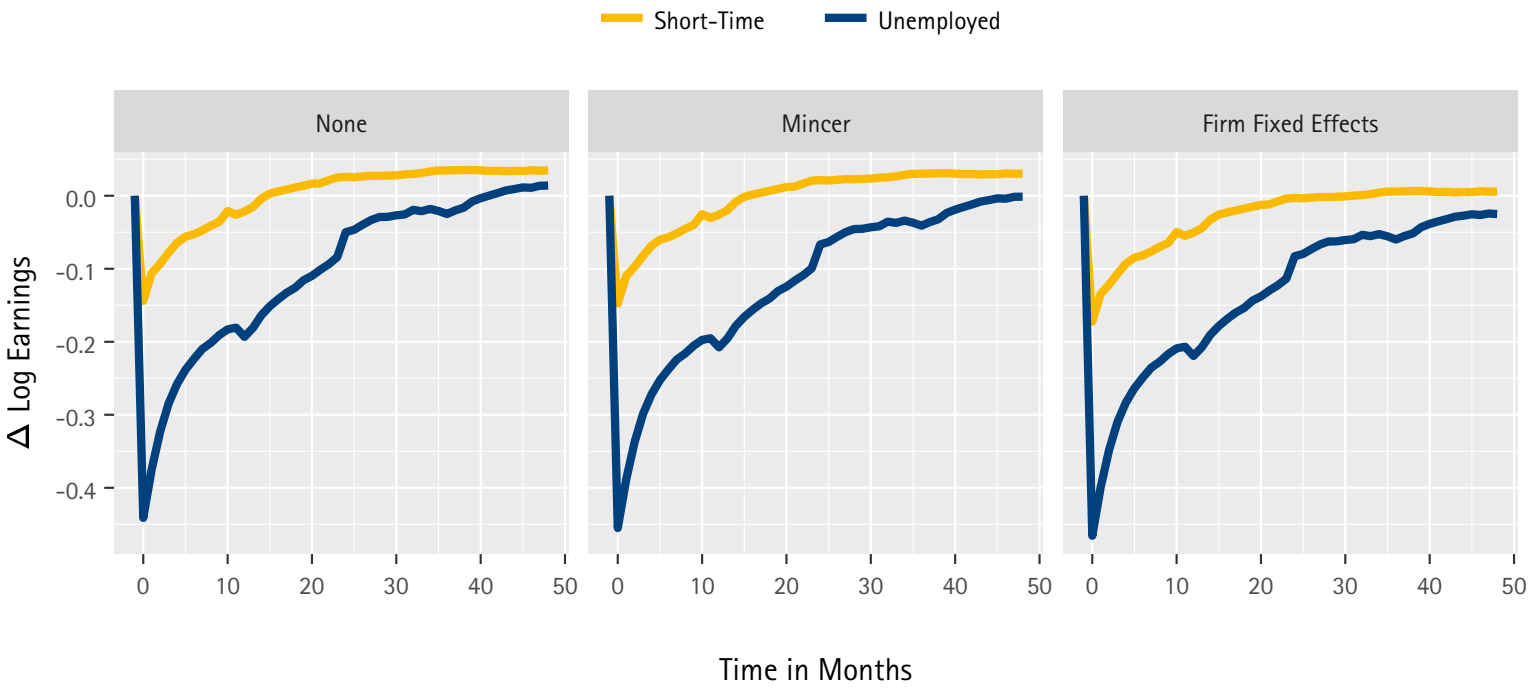


Figure: Long-run effects on Earnings

Model

Objective of Model

- Capture the key aspects of the data
- Explain what drives the uptake of short-time work
- Assess welfare effects and study optimal policy

Key Features

- Mortensen/Pissarides (1994) style model with hours choice
- Aggregate shocks
- General and firm-specific human capital
- Temporary unemployment (as in Fujita/Moscarini (2013))
- Search on- and off-the-job
- Vacancy creation

Model

Workers

- Unit measure
- Preferences: $u(c, h)$, discount factor β u(consumption, hours)
- Denote worker's **general human capital** by x
- x follows a discrete ladder with stochastic transitions; accumulate human capital by working, lose it by not working
- Retire with prob. ρ (absorbed in discount factor)
- Workers who retire are replaced by young workers (at the bottom rung of the experience ladder)
- Workers make search decisions on- and off-the-job; matches are experience goods (as in e.g. Menzio/Shi (2011))

Model

Firms

- Positive measure of firms
- Maximize expected profits, discount factor β
- Aggregate state of economy $z \in \{\underline{z}, \bar{z}\}$
- Technology: $f(\mathbf{y}, x, h)$ f(match type, worker type, hours)
- Match productivity $\mathbf{y} = [\mu, \varepsilon]$
  - μ is firm-specific human capital, discrete ladder
  - ε is cost shock, $\varepsilon \sim \Gamma(\varepsilon|z)$
  - Every period, draw new ε with probability $\lambda(z)$
- Match productivity evolves as long as worker is in contact
- Firms can post vacancies in submarket x at cost $c_V(x)$

Model

Worker's lifetime utility from working

$$W(\mathbf{y}, x, z, w, h) = \max_{e} u(w + s(x, z, h), h) - e\xi$$
$$+\beta[1 - ep_h(\theta(x, z))]\mathbb{E}_h \left[\overline{W}(\mathbf{y}', x', z') \mid \mathbf{y}, x, z\right]$$
$$+\beta ep_h(\theta(x, z))\ \mathbb{E}_0 \left[\overline{W}(\mathbf{y}^*, x', z') \mid x, z\right]$$

where

- e is search effort, $e\xi$ is the cost from search
- $ep_h(\theta(x, z))$ is probability that worker meets a firm
- $\overline{W}(\mathbf{y}', x', z')$ is value from entering period attached to firm y'

Model

Worker's lifetime utility from unemployment when **attached**

$$
\begin{aligned}
W_0(\mathbf{y}, x, z) = \max_e \; & u(b(x,z), 0) - e\xi \\
& + \beta(1-\delta_0)[1 - ep_0(\theta(x,z))]\mathbb{E}_0\left[\overline{W}(\mathbf{y}', x', z') \mid \mathbf{y}, x, z\right] \\
& + \beta\delta_0[1 - ep_0(\theta(x,z))]\mathbb{E}_0\left[U(x', z') \mid x, z\right] \\
& + \beta ep_0(\theta(x,z))\, \mathbb{E}_0\left[\overline{W}(\mathbf{y}^*, x', z') \mid x, z\right]
\end{aligned}
$$

where

- $\overline{W}(\mathbf{y}', x', z')$ is value from entering period attached to firm y'
- $ep_0(\theta(x,z))$ is probability that worker meets a firm
- δ_0 is probability that worker and firm lose contact
- $U(x', z')$ is value from entering period unattached

Model

Worker's lifetime utility from unemployment when **unattached**

$$
\begin{aligned}
U(x,z) = \max_{e} \; & u(b(x,z),0) - e\xi \\
& + \beta[1 - ep_0(\theta(x,z))]\mathbb{E}_0\left[U(x',z') \mid x,z\right] \\
& + \beta ep_0(\theta(x,z))\; \mathbb{E}_0\left[\overline{W}(\mathbf{y}^*,x',z') \mid x,z\right]
\end{aligned}
$$

where

- $\overline{W}(\mathbf{y}',x',z')$ is value from entering period attached to firm y'
- $ep_0(\theta(x,z))$ is probability that worker meets a firm
- $U(x',z')$ is value from entering period unattached

Model

Firm's discounted stream of profits from employment

$$J(\mathbf{y}, x, z, w, h) = f(\mathbf{y}, x, h) - \tau_0 - (1 + \tau_1)w \\ +\beta[1 - ep_h(\theta(x, z))]\mathbb{E}_h\left[\bar{J}(\mathbf{y}', x', z') \mid \mathbf{y}, x, z\right]$$

Firm's discounted stream of profits from laying a worker off

$$J_0(\mathbf{y}, x, z) = \beta(1 - \delta_0)[1 - ep_0(\theta(x, z))]\mathbb{E}_0\left[\bar{J}(\mathbf{y}', x', z') \mid \mathbf{y}, x, z\right]$$

where

- e is the worker's search effort

Model

Firm's value from opening a vacancy

$$V(z) = \max_{x} -c_V(x) + q(\theta(x,z))\beta\mathbb{E}_0\left[\bar{J}(\mathbf{y}^*, x', z)|x, z\right]$$

where

- $q(\theta(x,z))$ is the probability that firm meets worker
- Need not keep track of the entire distribution of workers, because we assumed that matches are experience goods
- Conditional on searching, workers will accept any offer

Model

Wages, hours, search decisions

- Wages and hours are determined using Nash bargaining; threat point is the value from a layoff with recall option

$$(w(\mathbf{y}, x, z), h(\mathbf{y}, x, z)) \in \underset{w,h}{\operatorname{argmax}} \left[W(\mathbf{y}, x, z, w, h) - W_0(\mathbf{y}, x, z)\right]^{\alpha} \times \left[J(\mathbf{y}, x, z, w, h) - J_0(\mathbf{y}, x, z)\right]^{1-\alpha}$$

- Workers unilaterally decide whether to search for outside offers

Model

Equilibrium

The equilibrium consists of

- market tightness $\theta(z, x)$
- wage and hours functions $w(\mathbf{y}, x, z)$ and $h(\mathbf{y}, x, z)$
- search policy on-the-job $e(\mathbf{y}, x, z)$ and off-the-job $e(x, z)$
- workers' and firms' value functions W, W_0, U, J, J_0

such that

- the worker's and firm's Bellman equations are satisfied
- wages and hours decisions maximize the Nash product
- search decisions are individually rational

Model

Key Decision

Full-time	**Short-time**	**Unemployment**
produce output	some benefits/output	receive benefits
human capital $\uparrow$	human capital $\sim$	human capital $\downarrow$
keep contact $\sim$	keep contact $\sim$	keep contact $\downarrow$
leisure $\downarrow$	leisure $\sim$	leisure $\uparrow$
time to search $\downarrow$	time to search $\sim$	time to search $\uparrow$

Workers with more experience and tenure have a higher value from staying in their particular match $\Rightarrow$ more short-time uptake

Estimation

Indirect Inference

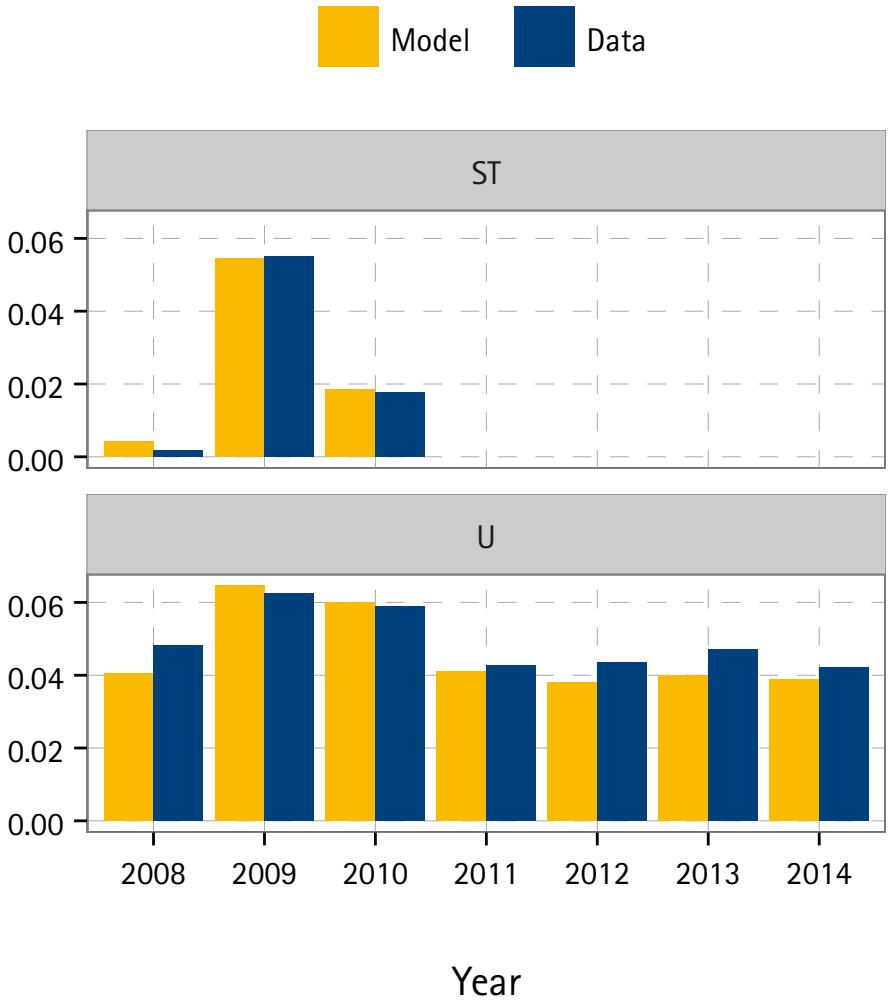
- We estimate the model using indirect inference
- We estimate a stochastic process for recessions using German GDP data starting in 1960
- We then simulate our model for the time period 1960-2014
- Introduction of short-time work policy is a surprise in 2009
- Address measurement error issues in short-time reporting
- Set UI benefits and short-time compensation to 60% of mean wage by human capital

Estimation

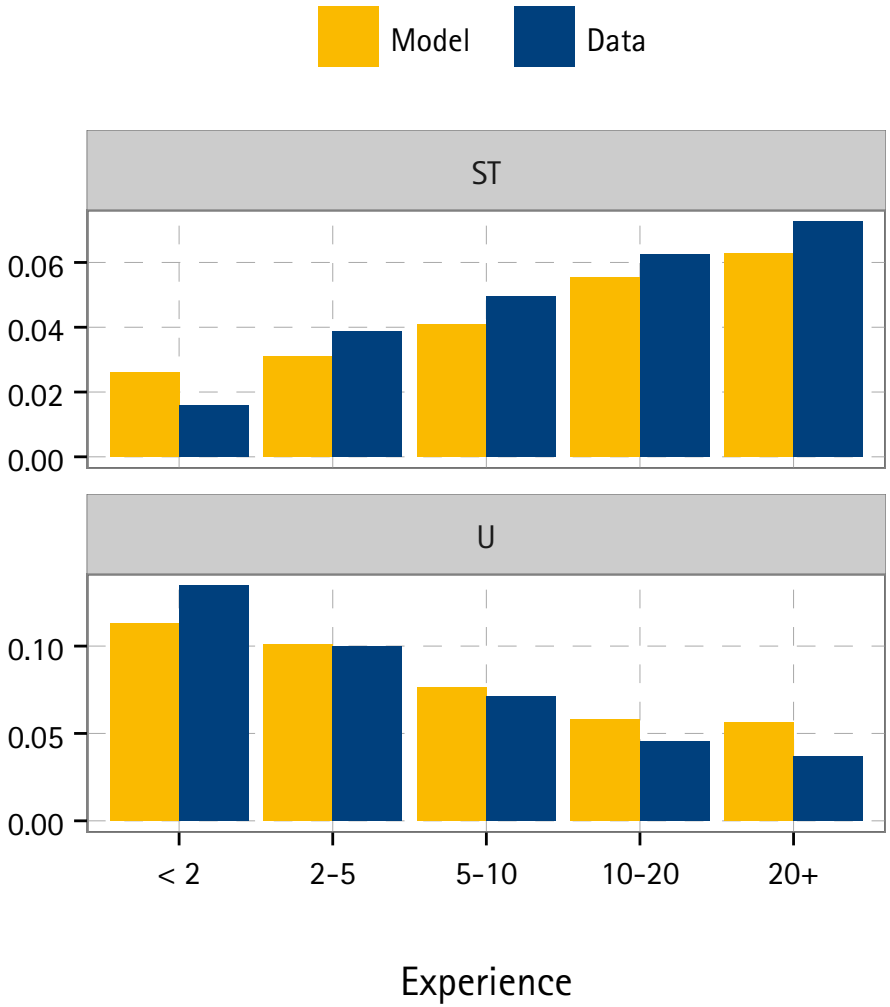
Moments

- Employment shares (FT, ST, U) by year, experience, tenure
- Mean wage growth and its variance both on- and off-the-job by experience and tenure
- Earnings loss associated with unemployment by duration of spell, experience, and tenure
- Duration of unemployment, incidence of recall
- Duration and hours reduction of short-time work

Model fit


Model
Data
ST
U
0.06
0.04
0.02
0.00
2008
2009
2010
2011
2012
2013
2014
Year

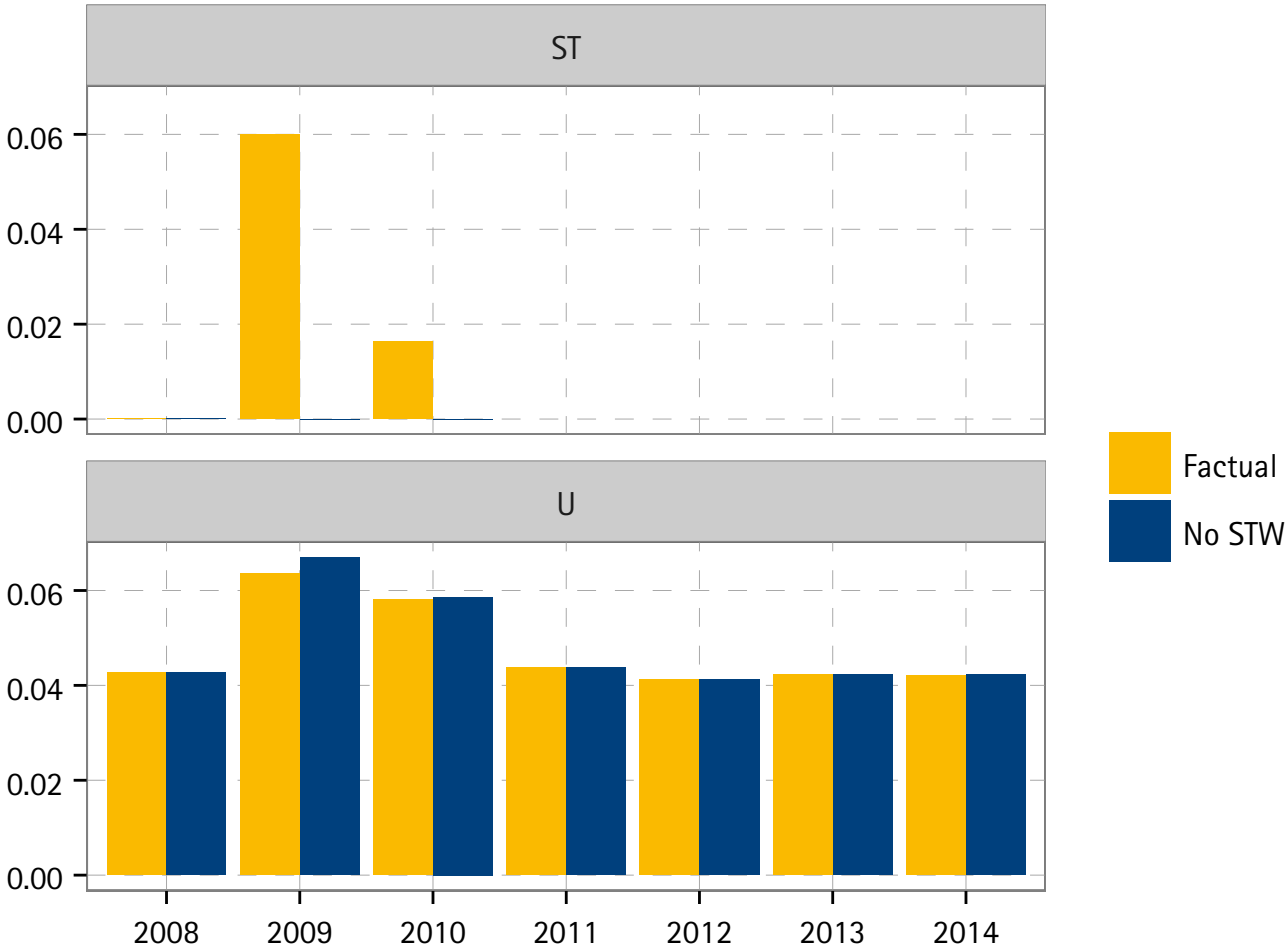
Model fit


Model
Data
ST
0.06
0.04
0.02
0.00
U
0.10
0.05
0.00
< 2
2-5
5-10
10-20
20+
Experience

Model fit

	Data	Model
Short-Time Duration (Months)	3.95	4.03
Unemployment Duration (Months)	5.94	5.67
Short-Time Hours (Share of Full-Time)	0.27	0.25

What would have happened without short-time work?



Results

Where would short-time workers have ended up?

- Counterfactual employment state by experience

	FT	ST	U
<2 years	0.37	0.00	0.63
2-5 years	0.59	0.00	0.41
5-10 years	0.70	0.00	0.30
10+ years	0.89	0.00	0.11

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