The Employment and Output Effects of Short-Time Work in Germany

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Motivation

- 2008 recession in Germany entailed:
  - Large negative effect on GDP & total hours worked
  - Small effect on unemployment
  - Stark contrast with other OECD economies
  - 'German Labor Market Miracle'
- One Leading Explanation: Short-Time Work (STW)
- Our question:
  - Can STW save jobs?
  - And if yes, at what cost?

GDP Growth (year-to-year)
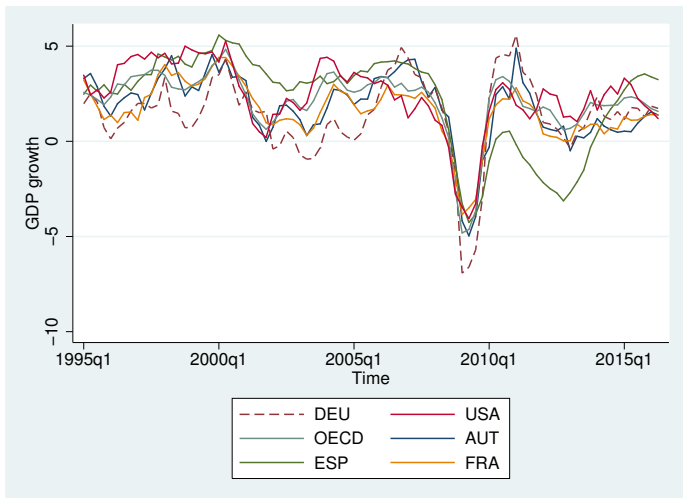
Unemployment Rate
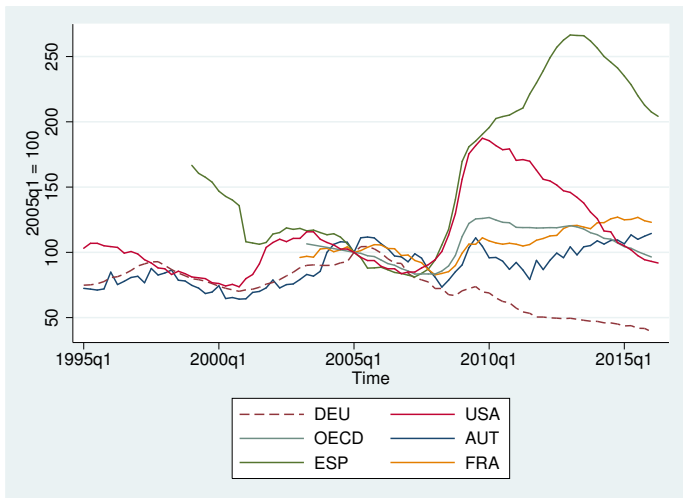
What is Short-Time Work (STW)?

- Labor market policy instrument
  - Goal: Mitigating cyclical shocks
  - Change labor demand via intensive margin (hours vs. workers)
  - UI compensates workers for lost income (60-67%)
  - Absent STW, unilateral reductions in hours worked are illegal
  - Use of STW is subject to strict set of legal requirements Details
- The 'STW policy': 2009 - 2010
  - Gov't dramatically reduced eligibility criteria & burden of proof
  - Maximum duration increased from six to 18, and then 24 months
  - June 2009: Around 60,000 establishments and 1,500,000 workers Graph

Summary of Results

- Can STW save jobs?
  - Economic press, Government, Unions
  - $\rightarrow$ We find a positive effect on employment
- What are the costs?
  - Reduced form vs. structural model
  - 'Reallocation channel'
    - $\rightarrow$ STW prevents reallocation of labor
   - $\rightarrow$ adverse effect on GDP

Literature

- **Work Sharing:** Burdett & Wright (1989), Hunt (1998, 1999), Marimon & Zilibotti (2000), Kudoh & Sasaki (2011)
- **German Labor Market:** Krause & Uhlig (2011), Burda & Hunt (2011), Cahuc & Carcillo (2011), Balleer et al. (2016)
- **Factor allocation:** Hsieh & Klenow (2007), Bartelsman et. al (2013)
- **Multi-worker firms:** Cooper, Haltiwanger, & Willis (2007), Elsby & Michaels (2013), Stole & Zwiebel (1996)

Data

- *Afid-Panel Indusriebetriebe* from German Statistical Office
- Universe of manufacturing plants, annual panel 1995-2010
- Up to 68,000 observations, use $\approx$ 39,000
- Variables: Revenue, Employment, Hours Worked, ... Sumstats
- Advantages
    - June 2009: 80.4% (41%) of workers (firms) using STW were located in manufacturing
    - Heavy concentrating of employment in *Mittelstand*
    - No sampling bias
- Disadvantages
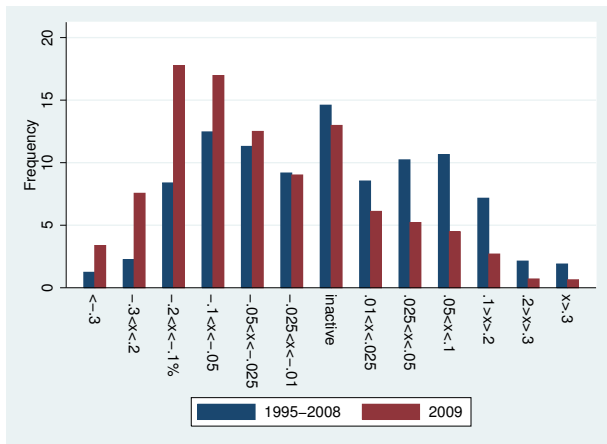   - No direct information on STW

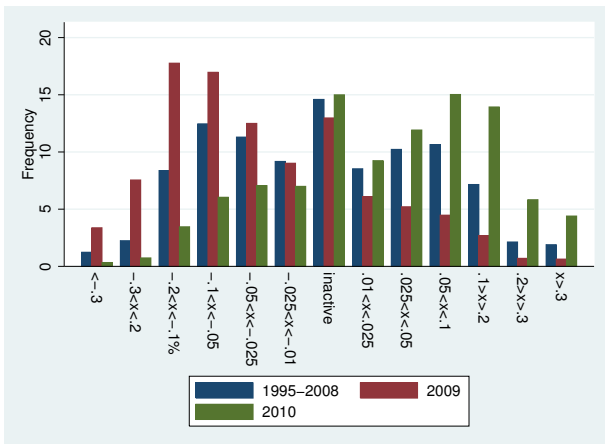# Changes in Total Hours: Extensive and Intensive Margins
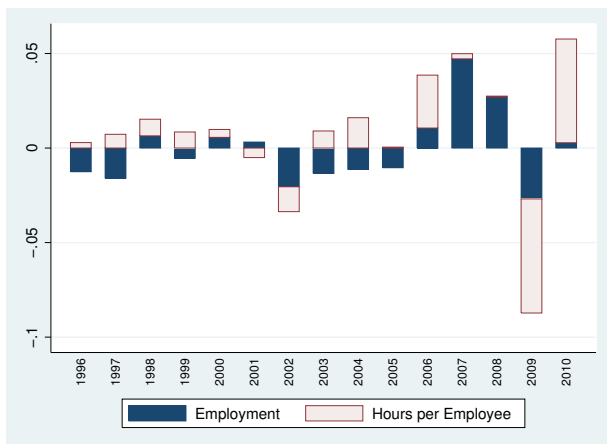
Distribution of changes in annual hours per worker: 1995-2008
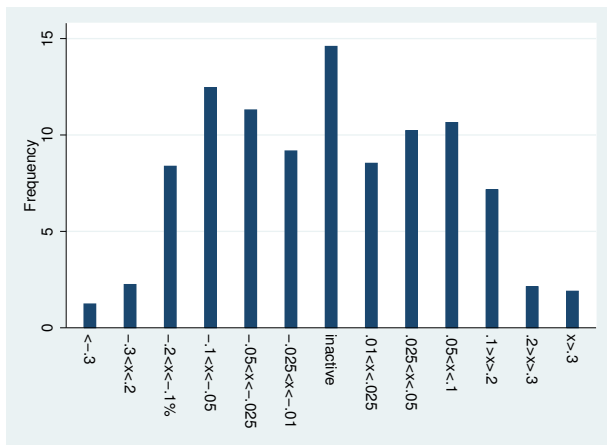
Distribution of changes in annual hours per worker: 1995-2009

Distribution of changes in annual hours per worker: 1995-2010

Model - Overview

- Basic Model
- Hours Contraints & STW
- Aggregate Shocks
- Quantitative Results: Counterfactuals

Model - Ingredients

- Workers and multi-worker Firms
- Firms face idiosyncratic productivity shocks ε
- Decreasing returns to scale in production
- Total labor input $L = h \cdot n$
- Frictional labor market produces rents
  - Nash-Bargaining
  - Matching Function $M = m(U, V)$, CRS
  - Labor Market Tightness $\theta = \frac{V}{U}$
  - Vacancy-filling probability $q = \frac{M}{V}$
- Distribution of firms over (ε, n)

Model - Timing

- Firm enters period with n_{-1} workers and productivity ε
- Choose n workers and average hours h
- Negotiate wage with n workers
- Produce output

Model - Firm's Problem

$$V(\varepsilon, n_{-1}) = \max_{h,n} \left\{ \varepsilon F(h \cdot n) - \omega(h, n, \varepsilon) \cdot h \cdot n \quad - \right.$$

$$\left. \frac{c_v}{q}(n - n_{-1})\mathbb{1}^+ + \beta \int V(\varepsilon', n)dG(\varepsilon'|\varepsilon) \right\},$$

- $\omega(\cdot)$ is a wage schedule
- c_v is a linear vacancy creation cost
- $\mathbb{1}^+$ is an indicator for when a firm is hiring
- q is the vacancy filling rate, determined in equilibrium

Model - Firm's Problem

- FOC Hours

$$\varepsilon F_L(h \cdot n) - \omega(h, n, \varepsilon) - \omega_h(h, n, \varepsilon) \cdot h = 0$$

Model - Firm's Problem

- FOC Hours

$$\varepsilon F_L(h \cdot n) - \omega(h, n, \varepsilon) - \omega_h(h, n, \varepsilon) \cdot h = 0$$

- FOC Employment (if $\Delta n \neq 0$)

$$\varepsilon h F_L(h \cdot n) - \omega(h, n, \varepsilon) \cdot h - \omega_n(h, n, \varepsilon) \cdot nh - \frac{c_v}{q} \mathbb{1}^+ + \beta D(\varepsilon, n) = 0,$$

- where $D(\varepsilon, n) \equiv \int V_n(\varepsilon', n) dG(\varepsilon'|\varepsilon)$

Model - Worker's Problem

$$W^e(\varepsilon, n) = \omega(h, \varepsilon, n) \cdot h - \xi(h) + \beta \mathbb{E}_{\varepsilon'|\varepsilon} \left[s W^u + (1-s) W^e(\varepsilon', n') \right].$$

$$W^u = b + \beta \mathbb{E}_{(\varepsilon', n')} \left[(1-\phi) W^u + \phi W^e(\varepsilon', n') \right].$$

- value of employment conditional on the state of a firm: used for negotiation
- s endogenous separation rate

Model - Wages

- Workers and Firm share surplus of match
  - Decreasing return to scale $\rightarrow$ surplus changes for each worker
  - Nash bargaining over *marginal* surplus (Stole & Zwiebel (1996))
- Firm's marginal surplus for matching with a worker:

$$S(\varepsilon, n) = \varepsilon h F_L(h \cdot n) - \omega(h, n, \varepsilon)h - \omega_n(h, n, \varepsilon)hn + \beta D(\varepsilon, n)$$

- Surplus is shared according to

$$W^e(\varepsilon, n) - W^u = \frac{\eta}{1 - \eta} S(\varepsilon, n).$$

Model - Wages

- Appendix B: Wage solves differential equation

$$\omega(h, \varepsilon, n) \cdot h = (1 - \eta)\left[b + \xi(h)\right] +$$
$$\eta\left[\varepsilon h F_L(h \cdot n) + \phi\frac{c_v}{q} - \omega_n(h, n, \varepsilon) \cdot h \cdot n\right]$$

- Assume $F(L) = L^\alpha = (n \cdot h)^\alpha$

$$\omega(h, \varepsilon, n) \cdot h = (1 - \eta)\left[b + \xi(h)\right] + \eta\left[\frac{\varepsilon\alpha h^\alpha n^{\alpha-1}}{1 - \eta(1 - \alpha)} + \phi\frac{c_v}{q}\right]$$

- Alternative Interpretation of Bargain:
  - Negotiated at $t = 0$
  - Covers many workers/firm pairs

Model - Optimal Labor Demand

- Combine wage with FOCs to get $\mathcal{H}(\varepsilon, n)$ and $\mathcal{N}(\varepsilon, n_{-1})$.
- The optimal hours choice:

$$\mathcal{H}(\varepsilon, n) = \left[\frac{\varepsilon \alpha n^{\alpha-1}}{\xi'(h)\left(1 - \eta(1-\alpha)\right)} \right]^{\frac{1}{1-\alpha}}$$

- The optimal employment choice:

$$\mathcal{N}(\varepsilon, n_{-1}) = \begin{cases} \psi_v^{-1}(\varepsilon) & \text{if } \varepsilon > \psi_v(n_{-1}), \\ n_{-1} & \text{if } \varepsilon \in \left[\psi(n_{-1}), \psi_v(n_{-1})\right], \\ \psi^{-1}(\varepsilon) & \text{if } \varepsilon < \psi(n_{-1}), \end{cases}$$

Graph

Introducing Hours Constraint and STW

- Standard hours $= \underline{h}$. Generally, firm cannot set $h < \underline{h}$
- STW
    - $\Xi \in [0, \underline{h}]$
    - Constraint changes to $\underline{h} - \Xi$
    - Workers compensated for income loss
    - STW use has to be approved by gov't
- The optimal hours policy function becomes

$$\mathcal{H}(\varepsilon, n) = \max \left\{ \underline{h} - \Xi, \left[\frac{\varepsilon \alpha n^{\alpha-1}}{\xi'(h)\left(1 - \eta(1-\alpha)\right)} \right]^{\frac{1}{1-\alpha}} \right\}.$$

- extensive margin
    - impacts firm demand for workers
    - equilibrium effect on vacancy filing rate
- NO effects on wage function

Model - Calibration ($\Xi = 0$)

Parameter	Meaning	Value	Reason
β	Discount factor	.9967	Annual $r = 4\%$
γ	Matching elasticity	.6	Petrongolo & Pissarides (2001)
μ	Matching efficiency	.1622	$\theta = 0.091$
α	$F(L) = L^{\alpha}$	.65	Cooper et al. (2007)
$\bar{\varepsilon}$	Mean of ε	1	Normalization
b	Unemployment benefit	.024	Average employment $= 98.5$
ξ_0	Disutility of work (scale)	.124	Average hours $= 1$
η	Worker bargaining power	.413	Labor share 0.76

Table: Calibrated Parameters

Model - Estimation ($\Xi = 0$)

Moment	Data	Model
$\frac{L-N}{L} = \frac{\delta}{\phi+\delta}$	.09	.09
$\Delta h < \lvert 5\% \rvert$ (annual)	.538	.542
$\Delta n < \lvert 5\% \rvert$ (annual)	.476	.440
$cv(n)/cv(h)$	5.63	5.66
Distance $L(\Theta)$	-	0.001382

Table: Moments for Estimation

Parameter	Meaning	Value
ξ_1	Disutility of work	4.42
c_v	Vacancy cost	.065
ρ_ε	Persistence of ε	.983
σ_ε	Std. dev. of ε	.037

Table: Estimated Parameters

Steady state results - no policy

- Match inactivity regions of Hours and Employment changes
- Match the relative variability of hours and employment
- Value of leisure $= 13.24\%$ of average wages
- Firms spend on average 1.07% of monthly wage bill on recruiting costs
- Labor market tightness $\theta = \frac{V}{U} = 0.091$
- Monthly job-finding rate of 6.22%
  - US $\approx 30\%$ (Hall (2006))

Steady state results - Hourly wage
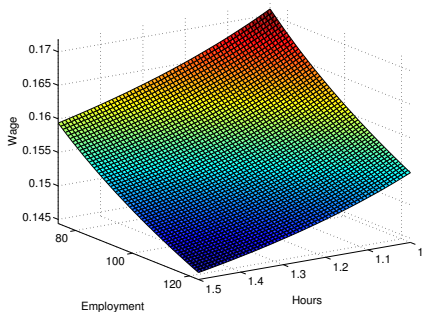
- Wage is decreasing in n and h
  - Effect via marginal product of labor & disutility
- More productive firms are large
  - Positive relationship between size and wages

Steady state results - The Hours Constraint $\underline{h} = 1$
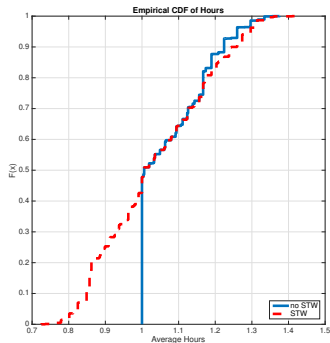
- Constraint can be binding in steady state
- $\underline{h}$ prevents hours reductions, firms use extensive margin

Aggregate Shocks

$$\Pi = \begin{array}{c} \\ A^{\text{high}} \\ A^{\text{low}} \\ A^{\Xi} \end{array} \begin{array}{ccc} A^{\text{high}} & A^{\text{low}} & A^{\Xi} \\ \left[\begin{array}{ccc} \rho & 1-\rho & 0 \\ 1-\rho & \rho & 0 \\ 1-\rho & \rho-\pi & \pi \end{array} \right] \end{array}$$

- Average duration of STW is six months: π
- Solve similarly to Krusell & Smith (1998)
  - Firms need to forecast q' which depends on the cross-sectional distribution
  - summarized by inclusion of lagged q

Effect of STW

- Simulation of economy
- Let STW policy become active in period $t = 200$
- no negative productivity shocks

IRF - Effect of STW
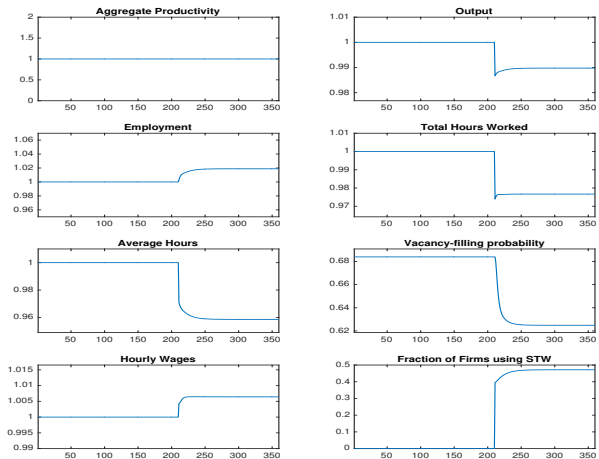
Effect of STW

- Simulation of economy
- Let STW policy become active in period $t = 200$
- no negative productivity shocks
- Partial Equilibrium: Keep q fixed

IRF - Effect of STW - PE
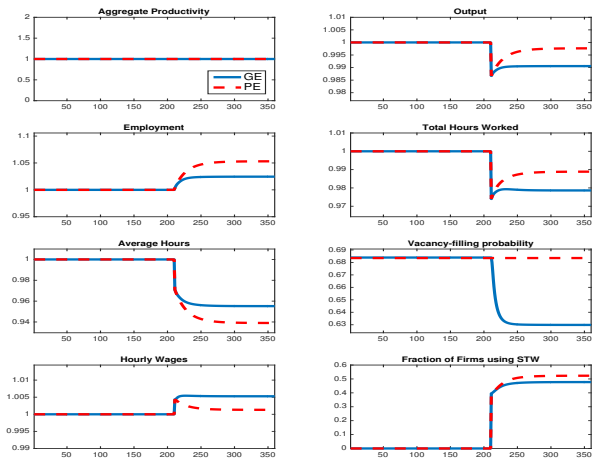
Effect of STW

- STW increases employment but has a negative effect on output.
- Key: endogeneity of q
- Positive employment response more than twice as large in PE
- Output falls by almost 1%
- Heterogeneous effect on firms

IRF - Recession without STW
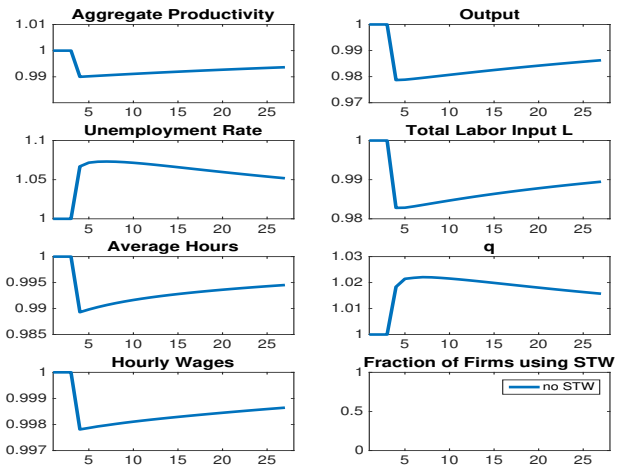
IRF - Recession with STW

Productivity Effects

Correlation of Employment and Productivity
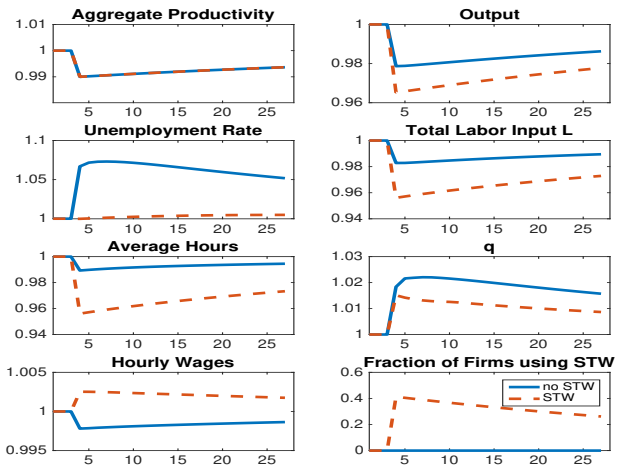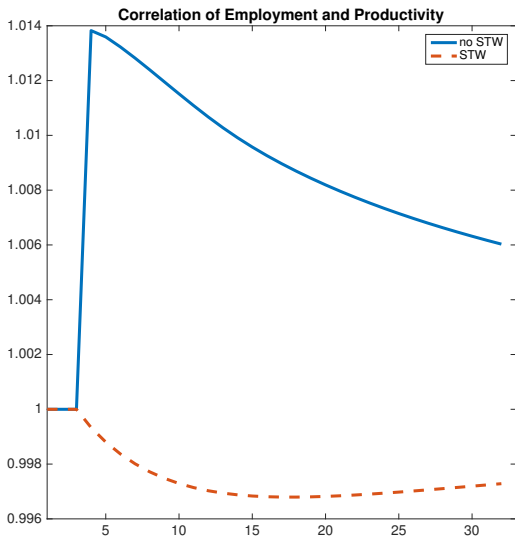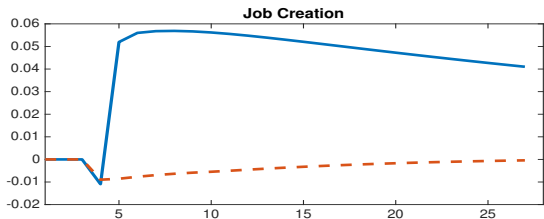
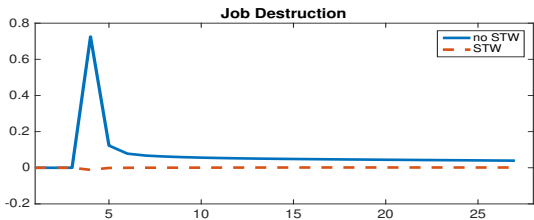# Employment Effects for firms with $\Delta\varepsilon < 0$
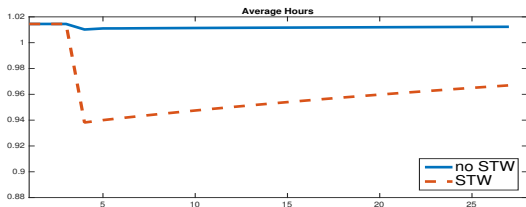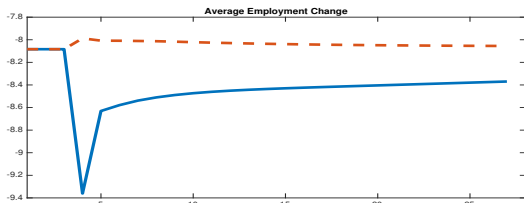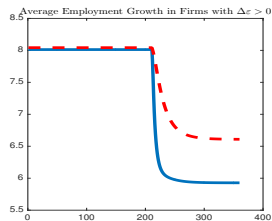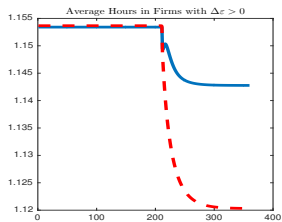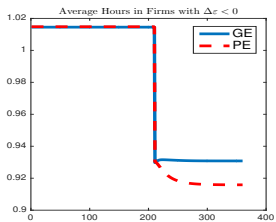
Figure: Average Hours and Employment Change by $\Delta\varepsilon$.

Job Creation and Job Destruction

Robustness

- Role of parameters (see paper)
- Role of labor market institutions
  - Flexibility, $\underline{h} < 1$
- Alternative: Hiring Credits
  - cheaper, but less effective
  - Large initial effect on U via JD

Model Predictions

- Germany 2009:
  - labor productivity per worker -4.9%
  - labor productivity per hour -2.2%
  - Less job creation in sectors with more STW Graph
  - in line with model prediction

Conclusion

- Can STW save jobs?
  - Economic press, Government, Unions
  - $\rightarrow$ We find a positive on employment
- What are the costs?
  - Reduced form vs. structural model
  - 'Reallocation channel'
  - $\rightarrow$ STW prevents reallocation of labor
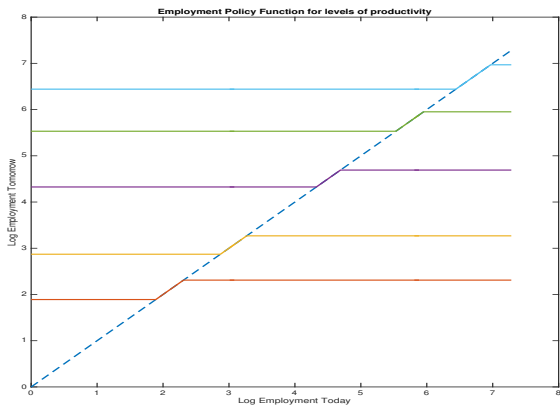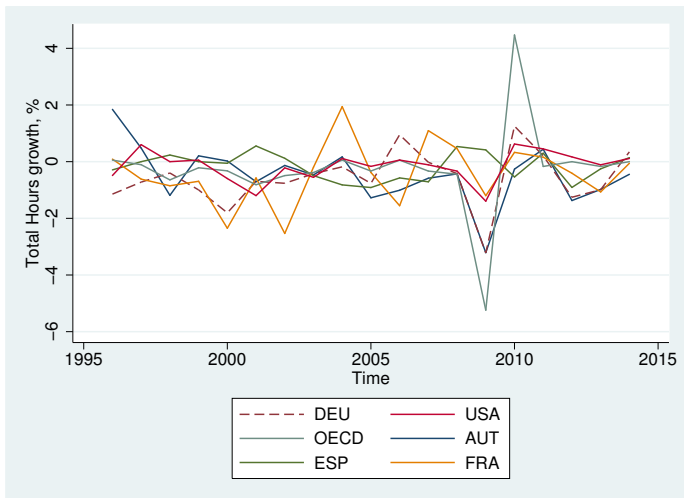 - $\rightarrow$ negative effect on GDP of around 1%

Employment Policy

Figure: Firm's Employment Policy $\mathcal{N}(\varepsilon, n_{-1})$ as a function of productivity.

Change in Total Hours Worked

Summary Statistics

	Count	Mean	SD	IQR	p10	p50	p90
N	38,839	98.5	142.6	73.8	19.4	48.2	228.0
H	33,617	156,300	20,576	11,694	3,578	8,366	35,107
H/N	34,303	135.8	35.7	31.6	104.5	134.0	167.9
PY	39,180	1,531,785	3,106,538	1,116,285	101,242	474,343	3,766,944

Table: Summary Statistics

Note: Summary statistics for Employment N, Hours H, Hours per Employee H/N, and Revenues PY. The table shows average values over all years. Revenues are deflated to 2005 Euros.
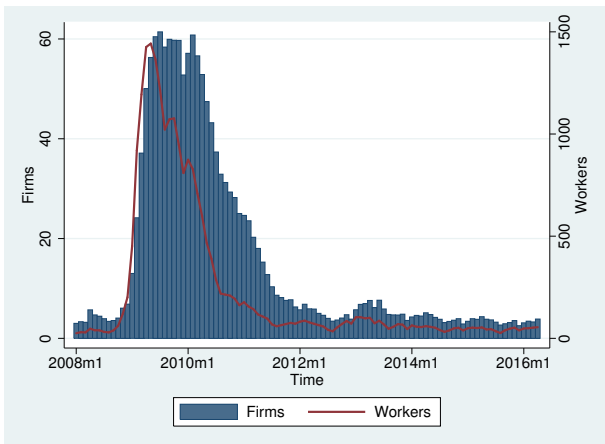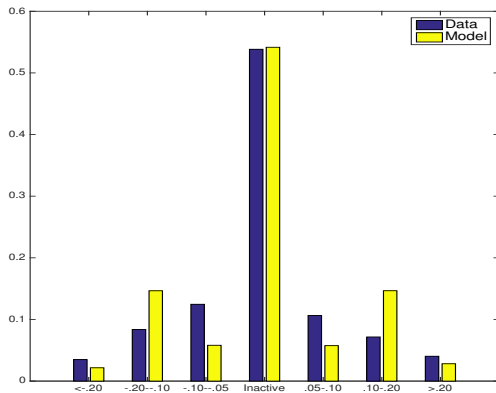
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Rules for STW

1. Hours reduction must not be preventable (overtime, holidays)
2. The firm must be unable to compensate the work stoppage with permissible variations in intra-firm working hours
3. At least a third of the firm's workforce must suffer an earnings loss of at least 10%.
4. Reduction in working time must be *temporary*. The maximum duration of STW is six months. After this time full-time employment should be restored.

- Hours worked will be paid as usual
- Remanence costs for the firm
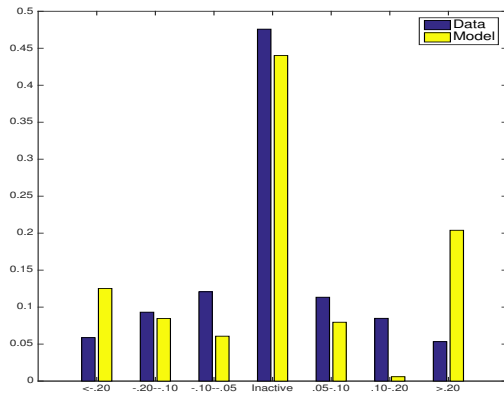- The gov't will compensate workers for 60% (67%) of earnings loss

STW use by Workers and Firms

Hours Change Distribution

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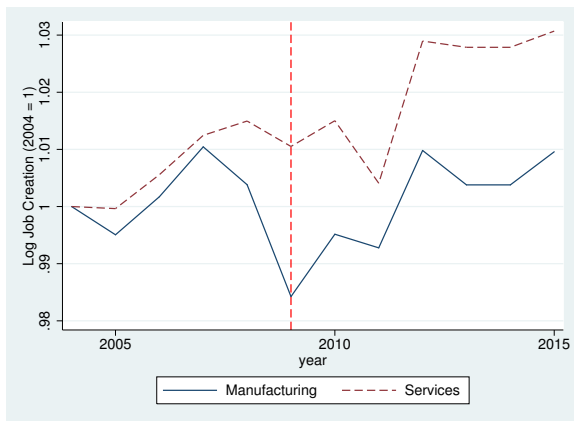# Employment Change Distribution

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Job Creation

Figure: Job Creation, in logs, normalized to 2004 values. Source: German Employment Agency.