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

Russell Cooper\textsuperscript{1}  Moritz Meyer \textsuperscript{2}  Immo Schott \textsuperscript{3}

\textsuperscript{1}Penn State  \textsuperscript{2}The World Bank  \textsuperscript{3}Université de Montréal

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Motivation

- In Germany the 2008 recession led to:
  - Large negative effect on GDP & total hours worked
  - Small effect on unemployment
  - Stark contrast with other OECD economies
  - ‘German Labor Market Miracle’

- Possible 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

- 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
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
  - \( \rightarrow \) negative effect on GDP
Literature

- **Factor allocation:** Hsieh & Klenow (2007), Bartelsman et. al (2013)
Data

- Afid-Panel *Industriebetriebe* from German Statistical Office
- Universe of manufacturing plants, annual panel 1995-2010
- Up to 68’000 observations, of which we use ≈ 39’000
- Variables: Revenue, Employment, Hours Worked, . . .

**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

The graph shows the distribution of changes in annual hours per worker from 1995 to 2009. The x-axis represents the range of percentage changes, while the y-axis represents the frequency of occurrence. The changes are categorized into different intervals, and the data is presented for the years 1995-2008 and 2009.
Distribution of changes in annual hours per worker: 1995-2010
Model - Overview

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

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

- Firm enters period with $n_{-1}$ workers and productivity $\varepsilon$
- Choose $n$ workers and average hours $h$
- Negotiate wage with $n$ workers
- Produce output
Model - Firm’s Problem

\[ V(\varepsilon, n_{-1}) = \max_{h, n} \left\{ \varepsilon F(h \cdot n) - \omega(h, n, \varepsilon) \cdot h \cdot n - \frac{c_v}{q} (n - n_{-1}) \mathbb{1}^+ + \beta \int V(\varepsilon', n) dG(\varepsilon' | \varepsilon) \right\}, \]

- \( \omega(\cdot) \) is a wage schedule
- \( c_v \) is a linear vacancy creation cost
- \( \mathbb{1}^+ \) is an indicator for when a firm is hiring
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 \( \Delta n \neq 0 \))

\[ \varepsilon hF_L(h \cdot n) - \omega(h, n, \varepsilon) \cdot h - \omega_n(h, n, \varepsilon) \cdot nh - \frac{c_v}{q} + \beta D(\varepsilon, n) = 0, \]

where \( D(\varepsilon, n) \equiv \int V_n(\varepsilon', n) dG(\varepsilon' | \varepsilon) \)
Model - Worker’s Problem

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

\[ W^u = b + \beta \mathbb{E}_{(\varepsilon', n')} \left[ (1 - \phi)W'^u + \phi W^e(\varepsilon', n') \right]. \]
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:
  
  \[
  S(\varepsilon, n) = \varepsilon h F_L(h \cdot n) - \omega(h, n, \varepsilon) h - \omega_n(h, n, \varepsilon) h n + \beta D(\varepsilon, n)
  \]

- Surplus is shared according to
  \[
  W^e(\varepsilon, n) - W^u = \frac{\eta}{1 - \eta} S(\varepsilon, n).
  \]
Model - Wages

- Wage solves differential equation

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

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

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

- Negotiated at \( t = 0 \)
Model - Optimal Labor Demand

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

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

- The optimal employment choice:

$$N(\varepsilon, n_{-1}) = \begin{cases} 
\psi^{-1}_v(\varepsilon) & \text{if } \varepsilon > \psi_v(n_{-1}), \\
n_{-1} & \text{if } \varepsilon \in [\psi(n_{-1}), \psi_v(n_{-1})], \\
\psi^{-1}(\varepsilon) & \text{if } \varepsilon < \psi(n_{-1}),
\end{cases}$$
Hours Constraint and STW

- Standard hours = $h$. Firm cannot set $h < h$
- Policy parameter for STW: $\Xi$
  - $\Xi \in [0, h]$
  - Constraint changes to $h - \Xi$
- The optimal hours policy function becomes

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

- STW use has to be approved by gov’t
## Model - Calibration ($\Xi = 0$)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Meaning</th>
<th>Value</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>Discount factor</td>
<td>.9967</td>
<td>Annual $r = 4%$</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>Matching elasticity</td>
<td>.6</td>
<td>Petrongolo &amp; Pissarides (2001)</td>
</tr>
<tr>
<td>$\mu$</td>
<td>Matching efficiency</td>
<td>.1622</td>
<td>$\theta = 0.091$</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>$F(L) = L^\alpha$</td>
<td>.65</td>
<td>Cooper et al. (2007)</td>
</tr>
<tr>
<td>$\bar{\varepsilon}$</td>
<td>Mean of $\varepsilon$</td>
<td>1</td>
<td>Normalization</td>
</tr>
<tr>
<td>$b$</td>
<td>Unemployment benefit</td>
<td>.024</td>
<td>Average employment $= 98.5$</td>
</tr>
<tr>
<td>$\xi_0$</td>
<td>Disutility of work (scale)</td>
<td>.124</td>
<td>Average hours $= 1$</td>
</tr>
<tr>
<td>$\eta$</td>
<td>Worker bargaining power</td>
<td>.413</td>
<td>Labor share 0.76</td>
</tr>
</tbody>
</table>

*Table: Model Parameters.*
Model - Estimation ($\Xi = 0$)

<table>
<thead>
<tr>
<th>Moment</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{L-N}{L} = \frac{\delta}{\phi+\delta}$</td>
<td>.09</td>
<td>.09</td>
</tr>
<tr>
<td>$\Delta h &lt; 5%$ (annual)</td>
<td>.538</td>
<td>.542</td>
</tr>
<tr>
<td>$\Delta n &lt; 5%$ (annual)</td>
<td>.476</td>
<td>.440</td>
</tr>
<tr>
<td>$cv(n)/cv(h)$</td>
<td>5.63</td>
<td>5.66</td>
</tr>
<tr>
<td>Distance $L(\Theta)$</td>
<td>-</td>
<td>0.001382</td>
</tr>
</tbody>
</table>

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 costs of posting vacancies are 32.66% of the average monthly worker wage
- Labor market tightness $\theta = \frac{V}{U} = 0.091$
- Monthly job-finding rate of 6.22%
  - US $\approx$ 30% (Hall (2006))
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 $h = 1$

- Constraint can be binding in steady state
- $h$ prevents hours reductions, firms use extensive margin
Aggregate Shocks

\[ \Pi = \begin{bmatrix} A^{\text{high}} & A^{\text{low}} & A^{\Xi} \\ A^{\text{high}} & \rho & 1 - \rho & 0 \\ A^{\text{low}} & 1 - \rho & \rho & 0 \\ A^{\Xi} & 1 - \rho & \rho - \pi & \pi \end{bmatrix} \]

- Average duration of STW is six months: \( \pi \)
- Solve similarly to Krusell & Smith (1998)
  - Firms need to forecast \( q' \) which depends on the cross-sectional distribution
Effect of STW

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

- **Aggregate Productivity**
- **Output**
- **Employment**
- **Total Hours Worked**
- **Average Hours**
- **Vacancy-filling probability**
- **Hourly Wages**
- **Fraction of Firms using 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

- Aggregate Productivity
- Output
- Employment
- Total Hours Worked
- Average Hours
- Vacancy-filling probability
- Hourly Wages
- Fraction of Firms using STW
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

- **Aggregate Productivity**
- **Output**
- **Unemployment Rate**
- **Total Labor Input L**
- **Average Hours**
- **q**
- **Hourly Wages**
- **Fraction of Firms using STW**

Graphs showing the impact of recession with STW on various economic indicators.
Productivity Effects

Correlation of Employment and Productivity

Figure: Cross-sectional correlation between productivity and employment
Employment Effects for firms with $\Delta \varepsilon < 0$

![Average Employment Change](chart1)

![Average Hours](chart2)

- No STW
- STW
Job Creation and Job Destruction

![Graph of Job Destruction](image1)

![Graph of Job Creation](image2)
Robustness

- Role of parameters (see paper)
- Role of labor market institutions
  - Flexibility, $h < 1$
- 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
  - in line with model prediction
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
- $\rightarrow$ negative effect on GDP of around 1%
Thank you
Figure: Firm’s Employment Policy $\mathcal{N}(\varepsilon, n_{-1})$ as a function of productivity.
Change in Total Hours Worked

-6 -4 -2 0 2 4
Total Hours growth, %
Time
DEU USA
OECD AUT
ESP FRA
Summary Statistics

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

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.
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

![Graph showing the distribution of hours change.]
Job Creation

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