Wage Rigidity and Job Creation

Christian Haefke
IHS Vienna

Marcus Sonntag
University of Bonn

Thijs van Rens
CREI and Universitat Pompeu Fabra

NBB, KUL, ULB, UCL
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1 Wage Rigidity and Job Creation

- Job Creation
  - Unemployment volatility puzzle (Shimer 2005; Costain and Reiter 2006)
  - Wage rigidity often suggested as an explanation (Shimer 2005; Hall 2005; Rudanko 2006; Gertler and Trigari 2006; Blanchard and Gali 2006; Braun 2006; ...)

- Wage rigidity
  - Wage less volatile than models predict
  - Micro-evidence (Bils 1985; Beaudry and DiNardo 1991; Solon, Barsky and Parker 1994)
2 Wage Rigidity and Job Creation

- Job Creation
  - Unemployment volatility puzzle (Shimer 2005; Costain and Reiter 2006)
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- Wage rigidity
  - Wage less volatile than models predict
    - Micro-evidence (Bils 1985; Beaudry and DiNardo 1991; Solon, Barsky and Parker 1994)

- This paper:
  - Wage newly hired workers is flexible
    - Rigid wage models not consistent with the data
3 Our argument

- Response wage to changes in labor productivity
  - New hires: \( \frac{d \log w}{d \log y} \approx 1 \)
  - Workers in ongoing jobs: \( \frac{d \log w}{d \log y} \approx 0.25 << 1 \)

- To match these facts, model needs:
  - Search frictions
  - Wage rigidity in ongoing matches
  - Flexible wage setting at start of match

- Implication
  - Job creation not affected by observed wage rigidity
  - Wage rigidity cannot explain the unemployment volatility puzzle
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5 Data

“There is little statistical data on the pay of new hires. And the data that do exist show little downward flexibility.” (Bewley 1999)

- Large, representative sample of wage data @ quarterly frequency
  - Wage = usual weekly earnings / usual weekly hours

- Panel data to identify newly hired workers
  - Match individual workers to three proceeding months ⇒ 1 quarter employment history
  - New hire = unemployed at least once in previous 3 months
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- Sample sizes (per quarter)
  - Workers in private non-farm business sector: 35 000
  - Correctly matched workers: 28 000
  - New hires: 1 500
7 Data

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- Sample sizes (per quarter)
  
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<thead>
<tr>
<th>Category</th>
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<tr>
<td>Correctly matched workers</td>
<td>28 000</td>
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</table>
  | New hires                             | 1 500   | (cf PSID: 5% of 3200/4 = 40)
8 Data: replicating the aggregate wage

- Aggregate wage: hourly compensation in the private, non-farm business sector

- Adjustments to the CPS wages
  - Correcting individual wages
    * Impute topcoded earnings
    * Impute ‘varying’ hours worked
    * No correction for overtime, tips and commissions
  - Correcting sample
    * Exclude public sector and armed forces
    * Exclude agriculture (industry)
    * Exclude supervisory workers (occupation)
    * Exclude workers < 25 and > 60 years old
  - Aggregation
    * Use median instead of mean or trim outliers in hours worked
    * Weight median/mean by hours worked (and sampling weights)
9 Data: replicating the aggregate wage

- Business cycle statistics (HP filtered, $10^5$)

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<tr>
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- Statistics corrected for sampling error (i.i.d. with known variance)

- Similar for various detrending methods
10 Data: newly hired workers

- Descriptive statistics (2005)

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<thead>
<tr>
<th></th>
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<th>New hires</th>
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<tr>
<td>Education (years)</td>
<td>13.6</td>
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<td>Experience (years)</td>
<td>21.9</td>
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<tr>
<td>Female (%)</td>
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<td>Black (%)</td>
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<td>Hispanic (%)</td>
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<td>Married (%)</td>
<td>62.4</td>
<td>53.6</td>
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11 Wage of new hires
12 Wage of new hires

Wage for newly hired workers and all workers, BP 3206
13 Wage of new hires

- Business cycle statistics (HP filtered, $10^5$)

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14 **Wage response to productivity shocks**

- Two-step procedure
  - 1) Regress wage on (controls and) time dummies
  - 2) Regress $\Delta$ coefficients on $\Delta$ productivity

\[
\Delta \log w_{it} = \alpha + \xi \Delta \log y_t + \varepsilon_t
\]
15 Wage response to productivity shocks

• Two-step procedure
  – 1) Regress wage on (controls and) time dummies
  – 2) Regress $\Delta$ coefficients on $\Delta$ productivity

$$\Delta \log w_{it} = \alpha + \xi \Delta \log y_t + \varepsilon_t$$

• Existing micro-studies (all workers, job stayers, job changers)
  – 1) Regress $\Delta$ wage on (controls and) time dummies
  – 2) Regress coefficients on $\Delta$ unemployment

$$\Delta \log w_{it} = \tilde{\alpha} + \tilde{\xi} \Delta u_t + \tilde{\varepsilon}_t$$

  – Cannot do this for new hires (out of non-employment)

• Estimation issues
  – Composition bias
  – Endogeneity
# Wage response to productivity shocks

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17 Composition bias

- Worker heterogeneity
  - New hires not representative for workforce
  - Relatively more high skilled workers hired in recession (Solon, Barsky and Parker 1994)
18 Fraction of female workers

![Graph showing the fraction of female workers over time from 1980 to 2005. The graph indicates fluctuations and trends in the percentage of female workers in the workforce.]
19 Fraction of black workers
20 Fraction of hispanic workers
21 Fraction of married workers
22 Average years of schooling
23 Average years of experience
24 Composition bias

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  - Control for wage fluctuations due to fluctuations in (observable) skill
26 Composition bias

- Worker heterogeneity
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  - Control for wage fluctuations due to fluctuations in (observable) skill

- Elasticity wrt unemployment from the PSID (Devereux 2001)

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# 27 Wage response to productivity shocks

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## 29 Wage response - composition bias

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## 30 Wage response - robustness

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31 Exogenous changes in productivity

- Diminishing returns to employment
  - \( \text{LP} = \log Y_t - \log L_t \)
  - \( \text{TFP} = \log Y_t - \alpha \log K_t - (1 - \alpha) \log L_t = \text{LP} - \alpha \log K_t + \alpha \log L_t \)

- Identified technology shocks
  - SVAR with long run restriction
  - Technology shocks only shocks that affect labor productivity in the long run (Gali 1999)

- Total Factor Productivity (Basu, Fernald and Kimball 2006; Fernald 2007)
# Wage response - exogenous productivity shocks

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- Response wage to changes in labor productivity → Data & Results
  - New hires: $d \log w / d \log y \simeq 1$
  - Workers in ongoing jobs: $d \log w / d \log y \simeq 0.25 << 1$

- To match these facts, model needs: → Model & Conclusions
  - Search frictions
  - Wage rigidity in ongoing matches
  - Flexible wage setting at start of match

- Implication
  - Job creation not affected by observed wage rigidity
  - Wage rigidity cannot explain the unemployment volatility puzzle


34 Model

- Standard search and matching model (Pissarides 1985, 2000)
  - Continuum of identical, risk-neutral workers and firms (entrepreneurs)
  - Random search, CRTS, Cobb-Douglas matching technology
    * Probability vacancy is filled $q(\theta_t)$, where $\theta_t = v_t / u_t$
    * Probability worker finds job $p(\theta_t) = \theta_t q(\theta_t)$
  - Exogenous (constant) separation probability $\delta$

- Stochastic labor productivity (Shimer 2005)

- Equilibrium $(\theta_t, w_t)$
  - Job creation (‘labor demand’)
  - Wage curve (‘labor supply’ + wage determination)
35 Job creation

- Free entry drives profits vacancy to zero

\[
\frac{c}{q(\theta_t)} = \frac{\bar{y}_t - \bar{w}_t}{r + \delta}
\]

ENPV costs of opening vacancy \quad \text{ENPV profits from filled job}

where

\[
\bar{y}_t - \bar{w}_t = \frac{r + \delta}{1 + r} \sum_{\tau=1}^{\infty} \left( \frac{1 - \delta}{1 + r} \right)^\tau E_t \left[ y_{t+\tau} - w_{t+\tau} \right]
\]

- Only ‘permanent’ wage is allocative
  - cf. user cost of labor (Kudlyak 2007)
36 Job creation

- Free entry drives profits vacancy to zero

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\frac{c}{q(\theta_t)} = \frac{\bar{y}_t - \bar{w}_t}{r + \delta}
\]

ENPV costs of opening vacancy \hspace{1cm} ENPV profits from filled job

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\bar{y}_t - \bar{w}_t = \frac{r + \delta}{1 + r} \sum_{\tau=1}^{\infty} \left( \frac{1 - \delta}{1 + r} \right)^\tau E_t [y_{t+\tau} - w_{t+\tau}]
\]

- Only ‘permanent’ wage is allocative
  - cf. user cost of labor (Kudlyak 2007)

- Rigidity in permanent wage
  - Makes ENPV profits more responsive to productivity shocks
  - Therefore, vacancy creation is more volatile
  - Therefore, unemployment is more volatile
37 Flexible wages

- Job creation
  \[
  \frac{c}{q(\theta_t)} = \frac{\bar{y}_t - \bar{w}_t}{r + \delta}
  \]

- Wage determination
  - Nash bargaining every period
  - Wage curve
    \[
    \bar{w}_t = (1 - \beta) b + \beta \bar{y}_t + \beta c \bar{\theta}_t
    \]
38 Flexible wages

- Job creation

\[
\frac{c}{q (\theta_t)} = \frac{\bar{y}_t - \bar{w}_t}{r + \delta}
\]

- Wage determination
  - Nash bargaining every period
  - Wage curve

\[
\bar{w}_t = (1 - \beta) b + \beta \bar{y}_t + \beta c \bar{\theta}_t
\]

- In this model:
  - Unique period wage for all workers
  - Wage responds almost one-to-one to productivity, \( d \log w_t / d \log y_t \approx 1 \)
# 39 Flexible wages: elasticities

<table>
<thead>
<tr>
<th>Flexible wages</th>
<th>$b$</th>
<th>$\beta$</th>
<th>$\frac{d \log w_t}{d \log \bar{y}_t}$</th>
<th>$\frac{d \log w_t}{d \log y_t}$</th>
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<tbody>
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<td>0.991</td>
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</table>

New hires: stayers: all
40 Flexible wages: elasticities
41 Wage rigidity

- Need wage rigidity in ongoing jobs

- Theoretical justification
  - Implicit contracts (Beaudry and DiNardo 1991; Rudanko 2006)
  - Unions
  - Motivational concerns (Bewley 1999)

- Empirical evidence (Bils 1985; Solon, Barsky and Parker 1994; Beaudry and DiNardo 1991)
  - Vast majority workers are in ongoing job relationships
  - Wages of job movers much more cyclical (Bils 1985; Barlevy 2001; Devereux and Hart 2005; Pissarides 2007)
### Wage rigidity: elasticities

<table>
<thead>
<tr>
<th></th>
<th>$b$</th>
<th>$\beta$</th>
<th>$\frac{d \log w_t}{d \log y_t}$</th>
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<th>$\frac{d \log y_t}{d \log y_t}$</th>
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<td></td>
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<td>stayers</td>
<td>all</td>
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<td>0.050</td>
<td>0.592</td>
<td>0.598</td>
<td>$=$</td>
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43 Wage rigidity: elasticities
44 Wage rigidity

- Wage rigidity in ongoing jobs consistent with wage data
  - Completely rigid, full commitment: $\frac{d \log w_t^0}{d \log y_t} = 0.16 < 0.25$
  - Intermediate cases: adaptive, occasional rebargaining, ...
45 Wage rigidity

- Wage rigidity in ongoing jobs consistent with wage data
  - Completely rigid, full commitment: \( \frac{d \log w_t^0}{d \log y_t} = 0.16 < 0.25 \)
  - Intermediate cases: adaptive, occasional rebargaining, ...

- Implied rigidity permanent wage

\[
\frac{d \log \bar{w}_t}{d \log \bar{y}_t} = \frac{d \log \bar{w}_t / d \log w_t^0}{d \log \bar{y}_t / d \log y_t} \frac{d \log w_t^0}{d \log y_t}
\]

  - Elasticity of interest
  - Persistence ratio
  - Observed elasticity

- Flexible wages: \( \frac{d \log \bar{w}_t}{d \log \bar{y}_t} \approx \frac{d \log w_t^0}{d \log y_t} \)

- Rigid wages in ongoing jobs: \( \frac{d \log \bar{w}_t}{d \log \bar{y}_t} \geq \frac{d \log w_t^0}{d \log y_t} \)
## Wage rigidity: elasticities

<table>
<thead>
<tr>
<th></th>
<th>$b$</th>
<th>$\beta$</th>
<th>(\frac{d \log w_t}{d \log y_t}) (new hires)</th>
<th>(\frac{d \log w_t}{d \log y_t}) (stayers)</th>
<th>(\frac{d \log w_t}{d \log y_t}) (all)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible wages</td>
<td>0.400</td>
<td>0.050</td>
<td>0.592</td>
<td>0.598</td>
<td>=</td>
</tr>
</tbody>
</table>
| Rigid wages ongoing jobs | 0.400| 0.700   | 0.984                            | 0.648                            | 0.159                         | 0.163                         | 1.646
47 Wage rigidity and job creation

- Job Creation

\[
\frac{c}{q(\theta_t)} = \frac{\bar{y}_t - \bar{w}_t}{r + \delta}
\]

ENPV costs of opening vacancy

ENPV profits from filled job

- Response job finding rate to productivity shocks

\[
\frac{d \log p(\theta_t)}{d \log \bar{y}_t} = \frac{1 - \eta}{\eta} \left[ \frac{\bar{y}_t}{\bar{y}_t - \bar{w}_t} - \frac{\bar{w}_t}{\bar{y}_t - \bar{w}_t} \frac{d \log \bar{w}_t}{d \log \bar{y}_t} \right] = \begin{cases} 
\frac{1 - \eta}{\eta} \frac{\bar{y}_t}{\bar{y}_t - \bar{w}_t} & \text{if } \frac{d \log \bar{w}_t}{d \log \bar{y}_t} = 0 \\
\frac{1 - \eta}{\eta} & \text{if } \frac{d \log \bar{w}_t}{d \log \bar{y}_t} = 1
\end{cases}
\]

- \( \eta > 0.5 \) (Petrongolo and Pissarides 2001) \( \Rightarrow \frac{d \log p(\theta_t)}{d \log \bar{y}_t} < 1 \) (Data: \( \sigma_{p(\theta)}/\sigma_y = 5.9 \))
48 Wage rigidity and job creation

- **Job Creation**
  \[
  \frac{c}{q(t)} \quad \text{ENPV costs of opening vacancy}
  \]
  \[
  \frac{\tilde{y}_t - \tilde{w}_t}{r + \delta} \quad \text{ENPV profits from filled job}
  \]

- **Response job finding rate to productivity shocks**
  \[
  \frac{d \log p(\theta_t)}{d \log \tilde{y}_t} = \frac{1 - \eta}{\eta} \left[ \frac{\tilde{y}_t - \tilde{w}_t}{\tilde{y}_t - \tilde{w}_t} - \frac{\bar{w}_t}{\bar{y}_t - \bar{w}_t} d \log \bar{w}_t \right] = \begin{cases} 
  \frac{1 - \eta}{\eta} \frac{\bar{y}_t}{\bar{y}_t - \bar{w}_t} & \text{if } \frac{d \log \bar{w}_t}{d \log \bar{y}_t} = 0 \\
  \frac{1 - \eta}{\eta} & \text{if } \frac{d \log \bar{w}_t}{d \log \bar{y}_t} = 1
  \end{cases}
  \]

- \( \eta > 0.5 \) (Petrongolo and Pissarides 2001) \( \Rightarrow \frac{d \log p(\theta_t)}{d \log \tilde{y}_t} < 1 \) (Data: \( \sigma_{p(\theta)} / \sigma_y = 5.9 \))

- **Unemployment volatility and job destruction**
  \[
  u_{t+1} = u_t + \delta (1 - u_t) - p(\theta_t) u_t
  \]
49 Conclusions

- New data on wage new hires out of non-employment:
  - New hires: $d \log w / d \log y \approx 1$
  - Workers in ongoing jobs: $d \log w / d \log y \approx 0.25 << 1$

- To match these facts, model needs:
  - Wage rigidity in ongoing matches
  - Flexible wage setting at start of match

- Implications for the unemployment volatility puzzle
  - No rigidity in permanent wage
  - No effect on job creation
  - No effect on unemployment fluctuations