The Vanishing Procyclicality of Labor Productivity

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![Graph showing labor productivity with bandpass filter over time from 1950 to 2005.]

J. Galí and T. van Rens (CREI)
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Correl prod with output (blue) and hours (red), cntrd 6-yr rolling window, bp
### The Vanishing Procyclicality of Labor Productivity

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<th>Pre-84</th>
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<td>Corr prod with output</td>
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- **BP, 1949-2007**
  - prod = output / worker
  - labor input = employment

- Robustness
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### Changes in Labor Market Dynamics

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- **Robustness**
Changes in Labor Market Dynamics

1. Procyclicality labor productivity ‘vanished’
   - Correlation with output: less procyclical
   - Correlation with labor input: countercyclical

2. Relative volatility labor input increased

3. Relative volatility wages increased

4. Volatility output decreased (Great Moderation)
Did the labor market become more flexible?

- A reduction in labor market frictions can explain all of these facts.
Did the labor market become more flexible?

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- Production requires employment $n_t$ and effort $e_t$

$$y_t = a_t + (1 - \alpha) \left( n_t + \psi e_t \right)$$
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- Effort provides intensive margin to adjust labor input
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- Effort provides intensive margin to adjust labor input
- Search frictions ↓ ⇒ volatility employment ↑ ⇒ volatility effort ↓
  - Relative volatility employment (with respect to output) increases
  - Labor productivity becomes less procyclical (countercyclical)
    \[
y_t - n_t = a_t - \alpha n_t + (1 - \alpha) \psi e_t
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Did the labor market become more flexible?

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- Production requires employment $n_t$ and effort $e_t$

  $$y_t = a_t + (1 - \alpha) (n_t + \psi e_t)$$

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  - Relative volatility employment (with respect to output) increases

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    $$y_t - n_t = a_t - \alpha n_t + (1 - \alpha) \psi e_t$$

  - Wages *endogenously* become more flexible
Outline

- Facts
- Model
- Results I
- Endogenous wage rigidity
- Results II
- Discussion
Model

- RBC model with labor market frictions (adjustment costs)
  - No capital
  - No other frictions or market imperfections
- Intensive margin for labor input (effort)
- Two types of shocks
  - Technology shocks (TFP)
  - Non-technology shocks (preference shocks)
Firms

Choose vacancies and labor demand to maximize

$$E_0 \sum_{t=0}^{\infty} Q_{0,t} \left[ Y_t - W_t N_t - g(V_t) \right]$$

subject to

$$N_t = (1 - \delta) N_{t-1} + qV_t$$

Output

$$Y_t = A_t \left( \int_0^{N_t} \mathcal{E}_{it} \psi dt \right)^{1-\alpha} = A_t \left( \mathcal{E}_t^\psi N_t \right)^{1-\alpha}$$
Households

- Choose consumption and labor supply to maximize

$$E_0 \sum_{t=0}^{\infty} \beta^t [Z_t u(C_t) - \gamma L_t]$$

subject to (given new hires $qV_t$)

$$C_t = W_t N_t$$

$$N_t = (1 - \delta) N_{t-1} + qV_t$$

- Total effective labor supply

$$L_t = \int_0^{N_t} \frac{1 + \zeta \mathcal{E}_{it}^{1+\phi}}{1 + \zeta} \, di = \frac{1 + \zeta \mathcal{E}_t^{1+\phi}}{1 + \zeta} N_t$$
Effort and Wages

- Effort is set to maximize match surplus \((\text{MDU} = \text{MP})\)

\[
\mathcal{E}_{it}^{1+\phi} = \mathcal{E}_t^{1+\phi} = \frac{\psi}{1 + \phi} \frac{1 + \zeta}{\zeta} \frac{Z_t u'(C_t)}{\gamma} (1 - \alpha) Y_t N_t
\]

- Effort increases with preference shocks and technology shocks

- Effort decreases with employment \(N_t\) (substitutes)

- Wages are set to share surplus equally (Nash bargaining)

\[
W_t = \frac{1}{2} \left( W_t^{UB} + W_t^{LB} \right)
\]

where \(S_t^H = W_t - W_t^{LB}\) and \(S_t^F = W_t^{UB} - W_t\)
Equilibrium

- Efficiency condition for effort

- Job creation equation

\[
\frac{g'(V_t)}{q} = W_t^{UB} - W_t \\
= E_t \sum_{s=0}^{\infty} (1 - \delta)^s Q_{t,t+s} \left[ (1 - \Psi_F) \frac{(1 - \alpha) Y_{t+s}}{N_{t+s}} - W_{t+s} \right]
\]

- Nash bargaining over wages

- Good market clearing

\[ Y_t = C_t + g(V_t) \]
Preview of the Results

- Infinite matching frictions $\Rightarrow$ Employment is constant

$$
e_t = (1 - \eta) a_t + z_t$$
$$y_t = (1 + \phi) a_t + (1 - \alpha) \psi z_t$$
$$y_t - n_t = y_t$$

- Frictionless labor market $\Rightarrow$ Effort is constant

$$
n_t = (1 - \eta) a_t + z_t$$
$$y_t = a_t + (1 - \alpha) z_t$$
$$y_t - n_t = \eta a_t - \alpha z_t$$
Calibration

- Standard parameters

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- Non-standard parameters

  - Relative variance preference shocks
    $\Rightarrow$ match relative volatility employment
  
  - Labor market frictions: $0 - 3\%$ of output
    (Silva-Toledo 2007: $1 - 1.4\%$)

- Free parameter

  - Importance of effort, $\phi + \psi$
## Results I

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Endogenous wage rigidity

- With flexible wages, wage proportional to MP of labor

- Search frictions allow for equilibrium wage rigidity (Hall 2005)

- Endogenizing wage rigidity
  - Wages are rigid within the bargaining set
  - The width of the bargaining set is determined by search frictions

- Reduction in labor market frictions makes wages more flexible
Endogenous wage rigidity
Endogenous wage rigidity
Wage Rule

- Wages are rigid within the bargaining set
  \[ W_t = R_t W_{t-1} + (1 - R_t) \frac{1}{2} \left( W_t^{UB} + W_t^{LB} \right) \]

- The width of the bargaining set is determined by search frictions

- Degree of rigidity \( R_t \in [0, 1] \) is endogenous
  \[ R_t = \tilde{R} \left[ 1 - \left( \frac{W_t - \frac{1}{2} \left( W_t^{UB} + W_t^{LB} \right)}{\frac{1}{2} (W_t^{UB} - W_t^{LB})} \right)^{2\rho} \right] \]

- Guarantees that \( W_t \in \left( W_t^{LB}, W_t^{UB} \right) \)

- Need non-linear solution method: 2nd order approximation
Calibration

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    (Silva-Toledo 2007: 1 – 1.4%)

- Free parameters

  - Importance of effort, $\phi + \psi$
  
  - Maximum wage rigidity, $\bar{R}$
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<td>0.56</td>
<td>-0.35</td>
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<td>0.87</td>
<td>1.01</td>
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<tr>
<td><strong>Endog wage rigidity</strong></td>
<td></td>
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<tr>
<td>frictions 3%</td>
<td>0.57</td>
<td>0.75</td>
<td>0.17</td>
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<td>0.69</td>
<td>1.00</td>
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<td>0.68</td>
<td>0.05</td>
<td>0.72</td>
<td>0.69</td>
<td>1.00</td>
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<tr>
<td>frictions 1%</td>
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<td>-0.05</td>
<td>0.76</td>
<td>0.70</td>
<td>1.02</td>
</tr>
<tr>
<td>frictionless</td>
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<td>0.62</td>
<td>-0.14</td>
<td>0.78</td>
<td>0.74</td>
<td>0.99</td>
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More Flexible Labor Markets and the Great Moderation

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J. Galí and T. van Rens (CREI)
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  - The rising relative volatility of employment and hours
  - Potentially: The rising relative volatility of wages
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