The Vanishing Procyclicality of Labor Productivity

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Labor productivity (bandpass filter)

1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005

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Correl prod with output (blue) and hours (red), cntrd 6-yr rolling window, bp
The Vanishing Procyclicality of Labor Productivity

|                                | Pre-84 | Post-84 | Change |
|--------------------------------|--------|---------|--------|
| Corr prod with output         | 0.78   | 0.60    | −0.18  |
|                                | [0.04] | [0.05]  | [0.06] |
| Corr prod with labor input    | 0.31   | −0.15   | −0.47  |
|                                | [0.08] | [0.10]  | [0.13] |

- BP, 1949-2007
  - prod = output / worker
  - labor input = employment

- Robustness
Changes in Labor Market Dynamics

|                          | Pre-84 | Post-84 | Ratio |
|--------------------------|--------|---------|-------|
| Std.dev. employment      | 1.57   | 0.91    | 0.58  |
|                          | [0.08] | [0.05]  | [0.04]|
| Relative std.dev. empl   | 0.66   | 0.81    | 1.23  |
|                          | [0.03] | [0.05]  | [0.09]|

Vanishing Procyclicality Labor Productivity
### Changes in Labor Market Dynamics

|                          | Pre-84 | Post-84 | Ratio |
|--------------------------|--------|---------|-------|
| **Std.dev. employment**  | 1.57   | 0.91    | 0.58  |
|                          | [0.08] | [0.05]  | [0.04]|
| **Relative std.dev. empl** | 0.66   | 0.81    | 1.23  |
|                          | [0.03] | [0.05]  | [0.09]|
| **Std.dev. wages**       | 0.71   | 0.99    | 1.38  |
|                          | [0.05] | [0.06]  | [0.12]|
| **Relative std.dev. wages** | 0.30   | 0.88    | 2.93  |
|                          | [0.02] | [0.07]  | [0.31]|

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

$$y_t = a_t + (1 - \alpha) (n_t + \psi e_t)$$
Did the labor market become more flexible?

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

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

- Adjusting employment subject to search frictions.
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- Effort provides intensive margin to adjust labor input
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- Search frictions ↓ ⇒ volatility employment ↑ ⇒ volatility effort ↓
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- Relative volatility employment (with respect to output) increases
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Search frictions ↓ ⇒ volatility employment ↑ ⇒ volatility effort ↓

- Relative volatility employment (with respect to output) increases
- Labor productivity becomes less procyclical (countercyclical)

$$y_t - n_t = a_t - \alpha n_t + (1 - \alpha) \psi e_t$$
Did the labor market become more flexible?

- A reduction in labor market frictions can explain all of these facts

- 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

  - Labor productivity becomes less procyclical (countercyclical)
    
    $$y_t - n_t = a_t - \alpha n_t + (1 - \alpha) \psi e_t$$

  - 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

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

subject to

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

- Output

\[ Y_t = A_t \left( \int_0^{N_t} \mathcal{E}_{i t}^\psi di \right)^{1-\alpha} = A_t \left( \mathcal{E}_t^\psi N_t \right)^{1-\alpha} \]
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

\[ L_t = \int_0^{N_t} \frac{1 + \zeta E_{it}^{1+\phi}}{1 + \zeta} di = \frac{1 + \zeta E_t^{1+\phi}}{1 + \zeta} N_t \]
Effort and Wages

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

  \[ \mathcal{E}_{it}^{1+\phi} = \mathcal{E}_{t}^{1+\phi} = \frac{\psi}{1 + \phi} \frac{1 + \zeta Z_t u'(C_t)}{\gamma} (1 - \alpha) Y_t \]

  - 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

\[
g' (V_t) \frac{q}{W} = W_{t}^{UB} - W_t
\]

\[
= E_t \sum_{s=0}^{\infty} (1 - \delta)^s Q_{t,t+s} \left[ (1 - \Psi_F) \frac{(1 - \alpha) Y_{t+s}}{N_{t+s}} - W_{t+s} \right]
\]

- 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**

| $\alpha$ | $\beta$ | $u(C_t)$ | $\gamma$ | $\delta$ |
|----------|---------|----------|----------|----------|
| $1/3$    | 0.99   | $\log C_t$ | $\bar{N} = 0.7$ | 6%/qrt  |

- **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

|       | $\tilde{N}$ | $\rho(p, y)$ | $\rho(p, n)$ | $\frac{sd(n)}{sd(y)}$ | $\frac{sd(w)}{sd(y)}$ |
|-------|-------------|--------------|--------------|------------------------|------------------------|
| **Data** |             |              |              |                        |                        |
| Pre-84 |             | 0.78         | 0.31         | 0.66                   | 0.30                   |
| Post-84|             | 0.60         | -0.15        | 0.81                   | 0.88                   |
| **Model** |            |              |              |                        |                        |
| frictions 3% | 0.57 |              |              |                        | 0.66                   |
| frictions 2% | 0.61 |              |              |                        |                        |
| frictions 1% | 0.66 |              |              |                        |                        |
| frictionless | 0.70 |              |              |                        |                        |
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| Model |          |             |             |                       |                       |
| frictions 3% | | 0.57       | 0.75       | -0.04                 | 0.66                  | 0.87                  |
| frictions 2% | | 0.61       | 0.69       | -0.14                 | 0.73                  | 0.86                  |
| frictions 1% | | 0.66       | 0.63       | -0.24                 | 0.79                  | 0.86                  |
| frictionless | | 0.70       | 0.56       | -0.35                 | 0.88                  | 0.87                  |
## Results 1

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| **Model** |         |              |              |                                 |                                 |               |
| frictions 3% | 0.57     | 0.75         | -0.04        | 0.66                            | 0.87                            | 1.00          |
| frictions 2% | 0.61     | 0.69         | -0.14        | 0.73                            | 0.86                            | 1.00          |
| frictions 1% | 0.66     | 0.63         | -0.24        | 0.79                            | 0.86                            | 1.00          |
| frictionless | 0.70    | 0.56         | -0.35        | 0.88                            | 0.87                            | 1.01          |
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
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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

\[ R_t = \bar{R} \left[ 1 - \left( \frac{W_t - \frac{1}{2} (W_t^{UB} + W_t^{LB})}{\frac{1}{2} (W_t^{UB} - W_t^{LB})} \right)^{2\rho} \right] \]

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

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

- **Standard parameters**

| $\alpha$ | $\beta$ | $u(C_t)$ | $\gamma$ | $\delta$ |
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| $1/3$   | $0.99$  | $\log C_t$ | $\bar{N} = 0.7$ | $6\% / \text{qrt}$ |

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

- **Free parameters**
  - Importance of effort, $\phi + \psi$
  - Maximum wage rigidity, $\bar{R}$
## Results II

|       | $\bar{N}$ | $\rho(p, y)$ | $\rho(p, n)$ | $\frac{\text{sd}(n)}{\text{sd}(y)}$ | $\frac{\text{sd}(w)}{\text{sd}(y)}$ | $\text{sd}(y)$ |
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| frictions 1% | 0.66 | 0.63         | -0.24        | 0.79                             | 0.86                             | 1.00         |
| frictionless | 0.70 | 0.56         | -0.35        | 0.88                             | 0.87                             | 1.01         |
| **Endog wage rigidity** |           |              |              |                                   |                                   |              |
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| **Endog wage rigidity** |           |               |               |                                     |                                     |               |
| frictions 3% | 0.57 | 0.75          | 0.17          | 0.66                                | 0.69                                | 1.00          |
| frictions 2% | 0.61 | 0.68          | 0.05          | 0.72                                | 0.69                                | 1.00          |
| frictions 1% | 0.66 | 0.64          | $-0.05$       | 0.76                                | 0.70                                | 1.02          |
| frictionless | 0.70 | 0.62          | $-0.14$       | 0.78                                | 0.74                                | 0.99          |
Can a reduction in labor market frictions explain the increase in wage volatility?
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Can a reduction in labor market frictions explain the Great Moderation?

Only if increase wage volatility large enough (direct effect makes output more volatile)
If wage rigidity is extended to newly hired workers (Haefke-Sonntag-van Rens 2008)
If fluctuations driven largely by labor demand (technology) shocks
More Flexible Labor Markets and the Great Moderation

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Conclusions

- More flexible labor markets (lower hiring costs) can explain
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2. The rising relative volatility of employment and hours
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- What caused the reduction in search frictions?
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What caused the reduction in search frictions?

- Internet-based job search (monster.com)
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Share of THS (NATSS) in nonfarm employment
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