The Vanishing Procyclicality of Labor Productivity and the Great Moderation

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Changes in U.S. labor market dynamics: Three observations

- The procyclicality of labor productivity has vanished

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- To assess the hypothesis of a possible common source: A decline in labor market frictions
- To understand their connection (if any) to the Great Moderation

The Potential Role of Declining Labor Market Frictions: Some Intuition

- Assume two margins of adjustment of effective labor input: (observed) employment/hours vs. (unobserved) effort

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

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

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- Effects of labor market frictions (large costs of adjusting n_t):

$\Rightarrow$ smaller fluctuations in employment, larger fluctuations in effort
$\Rightarrow$ low volatility of employment relative to output
$\Rightarrow$ procyclical labor productivity conditional on non-technology shocks
$\Rightarrow$ room for wage rigidity $\Longrightarrow$ more volatility in response to technology shocks

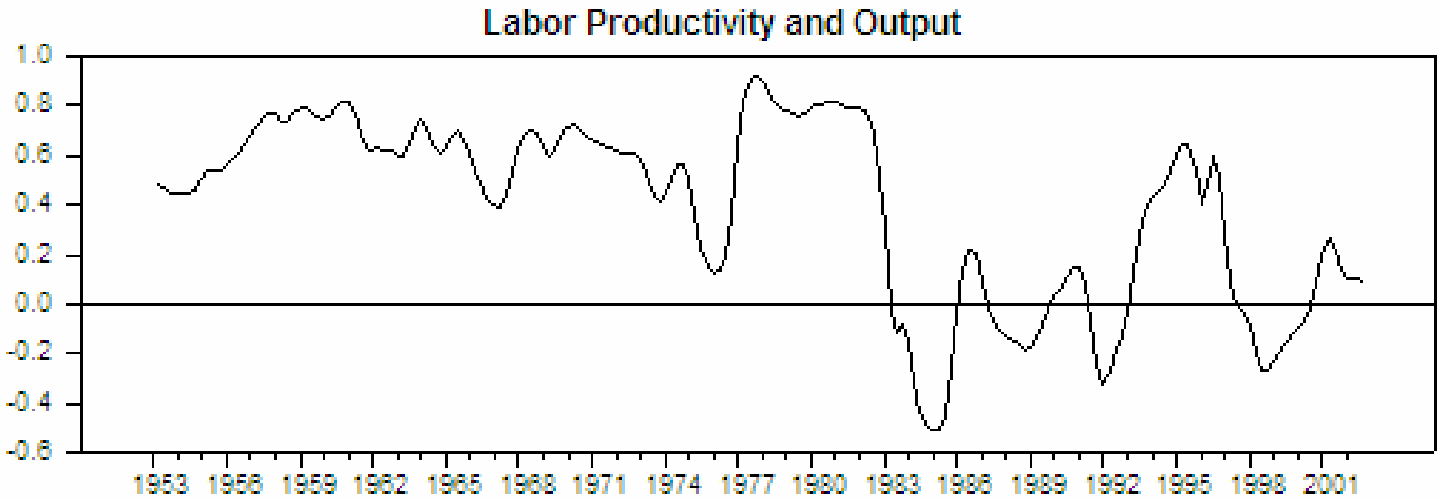
Observation #1: *The Procyclicality of Labor Productivity has Vanished*

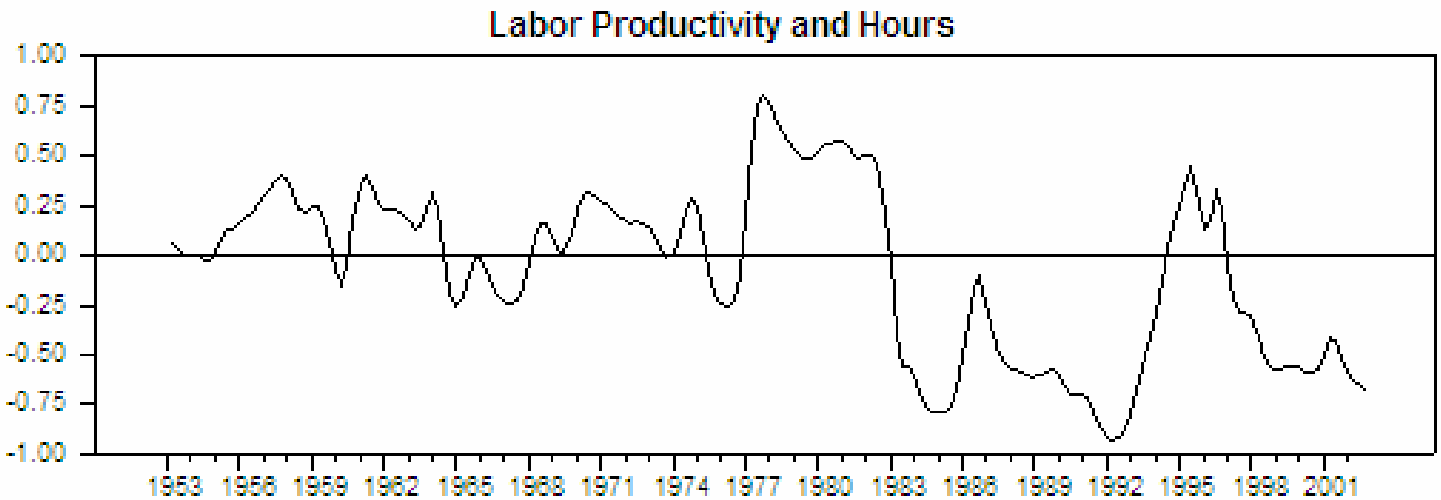
Table 1. Cyclical Behavior of Labor Productivity

	Correlation with Output			*Correlation with Labor Input*		
	Pre-84	Post-84	Change	Pre-84	Post-84	Change
Nonfarm Business						
BP	0.61 (0.04)	−0.01 (0.09)	−0.62* (0.10)	0.18 (0.07)	−0.53 (0.07)	−0.72* (0.10)
4D	0.66 (0.05)	0.07 (0.09)	−0.58* (0.10)	0.20 (0.07)	−0.49 (0.09)	−0.69* (0.11)
Total (hours)						
BP	0.45 (0.06)	0.03 (0.08)	−0.42* (0.11)	0.03 (0.08)	−0.51 (0.07)	−0.54* (0.11)
4D	0.57 (0.06)	0.11 (0.08)	−0.46* (0.10)	0.05 (0.08)	−0.46 (0.08)	−0.51* (0.11)
Total (employment)						
BP	0.84 (0.02)	0.74 (0.04)	−0.10* (0.04)	0.41 (0.07)	0.18 (0.09)	−0.22* (0.11)
4D	0.87 (0.02)	0.72 (0.04)	−0.14* (0.04)	0.32 (0.07)	0.20 (0.10)	−0.12 (0.12)

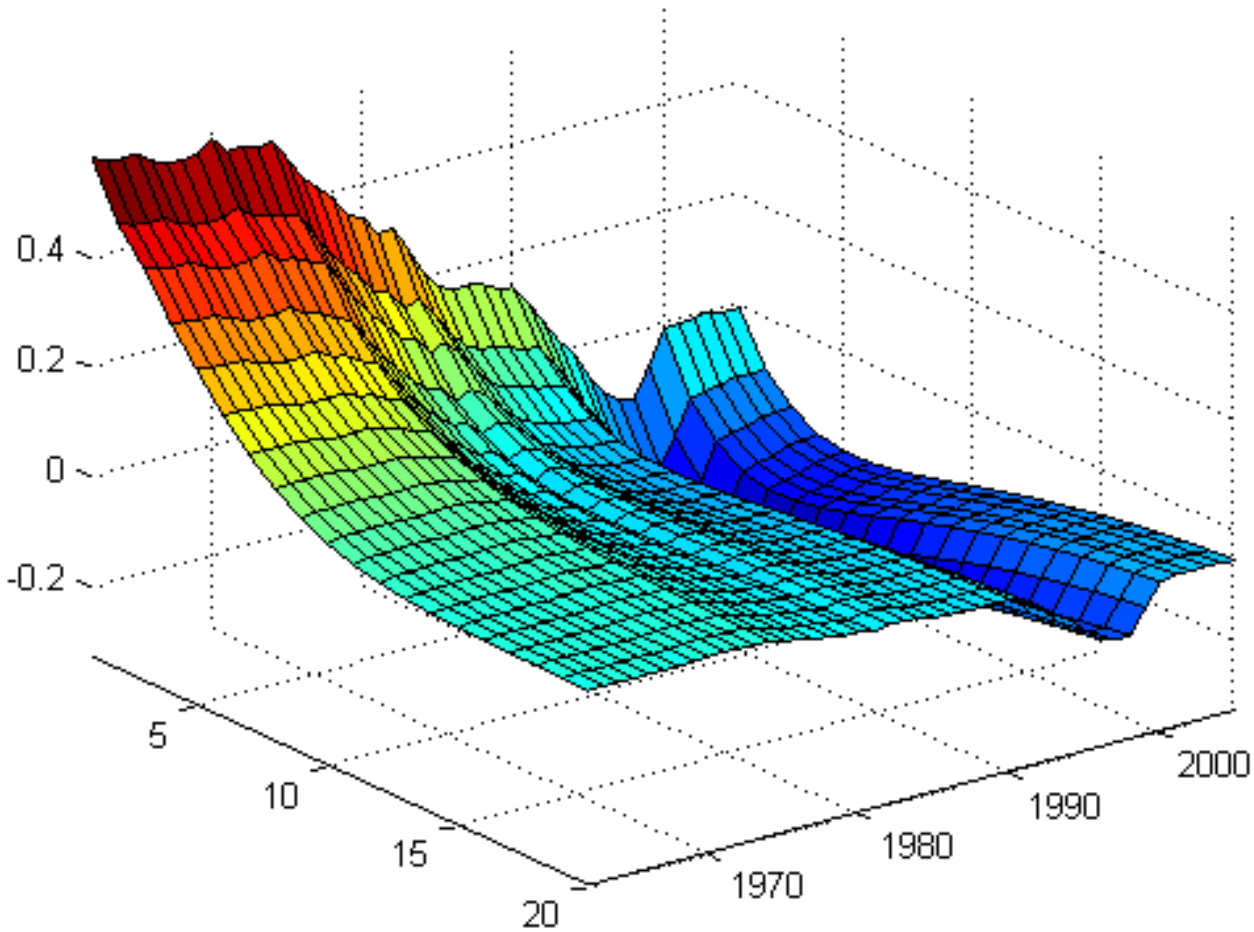
See also: Barnichon (2007), Stiroh (2008), Galí-Gambetti (2008)

Rolling Correlations (BP filter)





Time-Varying Response of Labor Productivity to Non-Technology Shocks



Source: Galí and Gambetti (2008)

Observation #2 : *The Relative Volatility of (Measured) Labor Input has Risen*

Table 2. Labor Input Volatility

	Absolute			*Relative to Output*		
	Pre-84	Post-84	Ratio	Pre-84	Post-84	Ratio
Hours (NFB)						
BP	2.07 (0.10)	1.35 (0.08)	0.65* (0.05)	0.80 (0.03)	1.18 (0.06)	1.46* (0.09)
4D	3.07 (0.18)	2.17 (0.16)	0.70* (0.06)	0.76 (0.03)	1.14 (0.07)	1.50* (0.11)
Hours (Total)						
BP	1.78 (0.09)	1.02 (0.06)	0.57* (0.04)	0.89 (0.03)	1.16 (0.06)	1.30* (0.08)
4D	2.62 (0.17)	1.69 (0.11)	0.64* (0.06)	0.82 (0.04)	1.12 (0.06)	1.36* (0.10)
Employment						
BP	1.17 (0.06)	0.60 (0.04)	0.51* (0.04)	0.58 (0.03)	0.68 (0.04)	1.16* (0.08)
4D	1.66 (0.09)	1.06 (0.09)	0.64* (0.06)	0.52 (0.03)	0.71 (0.03)	1.36* (0.10)
Hours per worker						
BP	0.73 (0.06)	0.49 (0.03)	0.64* (0.06)	0.38 (0.03)	0.56 (0.03)	1.45* (0.13)
4D	1.32 (0.12)	0.83 (0.05)	0.62* (0.06)	0.41 (0.03)	0.55 (0.05)	1.33* (0.16)

See also: Hall (2007), Galí-Gambetti (2009)

Observation #3: *The Volatility of the Real Wage has Risen*

Table 3. Wage Volatility

	Absolute			*Relative to Output*			*Relative to Hours*		
	Pre-84	Post-84	Ratio	Pre-84	Post-84	Ratio	Pre-84	Post-84	Ratio
P-Wage									
BP	0.70 (0.07)	0.99 (0.06)	1.40* (0.16)	0.27 (0.02)	0.86 (0.08)	3.15* (0.40)	0.34 (0.03)	0.73 (0.05)	2.15* (0.25)
4D	1.24 (0.09)	1.60 (0.11)	1.29* (0.03)	0.31 (0.02)	0.85 (0.11)	2.74* (0.42)	0.40 (0.03)	0.73 (0.08)	1.82* (0.25)
C-Wage									
BP	0.89 (0.05)	0.98 (0.06)	1.10 (0.09)	0.34 (0.03)	0.85 (0.08)	2.47* (0.29)	0.43 (0.03)	0.72 (0.06)	1.68* (0.18)
4D	1.71 (0.11)	1.64 (0.10)	0.95 (0.09)	0.42 (0.03)	0.86 (0.11)	2.03* (0.30)	0.56 (0.05)	0.75 (0.08)	1.35* (0.18)

Table 4. The Product Wage and Labor Productivity						
	Relative Volatility			*Correlation*		
	Pre-84	Post-84	Ratio	Pre-84	Post-84	Change
BP	0.59 (0.06)	1.40 (0.10)	2.35* (0.28)	0.42 (0.07)	0.62 (0.06)	0.20* (0.09)
4D	0.60 (0.05)	1.31 (0.11)	2.17* (0.25)	0.48 (0.07)	0.62 (0.05)	0.14* (0.08)

A Stylized Model of Economic Fluctuations with Labor Market Frictions

Households

Preferences

$$E_0 \sum_{t=0}^{\infty} \beta^t \; U(C_t, N_t, \{\mathcal{E}_{it}\}, Z_t)$$

where

$$U(C_t, N_t, \{\mathcal{E}_{it}\}) \equiv Z_t \; \log C_t - \int_0^{N_t} \left(b + \frac{\mathcal{E}_{it}^{1+\varphi}}{1+\varphi} \right) \; di$$

Constraints

$$C_t = \int_0^{N_t} W_{it} \; di + \Pi_t$$

$$N_t = (1-\delta) \; N_{t-1} + x_t \; U_t$$

$$0 \leq N_t \leq 1$$

where $U_t \equiv 1 - (1-\delta) N_{t-1}$.

Firms

Objective

$$\max E_0 \sum_{t=0}^{\infty} Q_{0,t} \left(Y_{jt} - W_{jt} N_{jt} - G_t H_{jt} \right)$$

where $Q_{0,t} = Q_{0,1} Q_{1,2} ... Q_{t-1,t}$ and $Q_{t,t+1} \equiv \beta \frac{C_t}{C_{t+1}} \frac{Z_{t+1}}{Z_t}$.

Cost per hire G_t taken as given.

Constraints:

$$Y_{jt} = A_t \left(\int_0^{N_{jt}} \mathcal{E}_{jit}^{\theta} \, di \right)^{1-\alpha}$$

$$N_{jt} = (1 - \delta) \, N_{j,t-1} + H_{jt}$$

Labor Market Frictions

Cost per hire:

$$G_t = \Gamma A_t \; x_t^{\eta}$$

where

$$x_t \equiv \frac{H_t}{U_t} \in [0, 1]$$

The Firm-Worker Relationship

Once employed, individual effort chosen efficiently:

$$\frac{C_t}{Z_t}\ \mathcal{E}_{jit}^{\ \varphi} = (1-\alpha)\theta\ \frac{Y_{jt}}{N_{jt}\mathcal{E}_{jt}^{\theta}}\ \mathcal{E}_{jit}^{\ -(1-\theta)}$$

Symmetric equilibrium:

$$\mathcal{E}_{jt}^{1+\varphi} = (1-\alpha)\theta\ \frac{Y_{jt}}{N_{jt}}\ \frac{Z_t}{C_t}$$

$$Y_{jt} = A_t\ \left(N_{jt}\ \mathcal{E}_{jt}^{\theta}\right)^{1-\alpha}$$

implying:

$$\mathcal{E}_{jt} = \left((1-\alpha)\theta\ A_t N_{jt}^{\ -\alpha}\ \frac{Z_t}{C_t}\right)^{\frac{1}{1-\theta(1-\alpha)+\varphi}}$$

Marginal Product of Labor:

$$\begin{aligned}\frac{dY_{jt}}{dN_{jt}} &= \frac{\partial Y_{jt}}{\partial N_{jt}} + \frac{\partial Y_{jt}}{\partial \mathcal{E}_{jt}} \frac{\partial \mathcal{E}_{jt}}{\partial N_{jt}} \\ &= (1-\Theta)\ \frac{Y_{jt}}{N_{jt}}\end{aligned}$$

where $1-\Theta = (1-\alpha)\left(1 - \frac{\alpha\theta}{1-\theta(1-\alpha)+\varphi}\right)$

Optimal hiring policy:

$$G_t = (1-\Theta)\ \frac{Y_{jt}}{N_{jt}} - W_{jt} + (1-\delta)\ E_t\{Q_{t,t+1}\ G_{t+1}\}$$

Firm surplus from marginal worker employed: $S_t^F = G_t$

Household surplus from marginal worker employed:

$$V_t^N = W_t - \frac{C_t}{Z_t}\, b - \frac{(1-\alpha)\theta}{1+\varphi}\, \frac{Y_t}{N_t} + E_t\{Q_{t,t+1}\,[(1-\delta(1-x_{t+1}))\, V_{t+1}^N + \delta(1-x_{t+1})\, V_{t+1}^U]\}$$

$$V_t^U = E_t\{Q_{t,t+1}[(1-x_{t+1})\, V_{t+1}^N + x_{t+1}\, V_{t+1}^U]\}$$

Letting $S_t^H \equiv V_t^N - V_t^U$,

$$S_t^H = W_t - \frac{C_t}{Z_t}\, b - \frac{(1-\alpha)\theta}{1+\varphi}\, \frac{Y_t}{N_t} + (1-\delta)\, E_t\{Q_{t,t+1}(1-x_{t+1})\, S_{t+1}^H\}$$

Bargaining Set

$$W_t \in [W_t^L,\ W_t^U]$$

where

$$W_t^L = \frac{C_t}{Z_t}\ b + \frac{(1-\alpha)\theta}{1+\varphi}\ \frac{Y_t}{N_t} - (1-\delta)\ E_t\{Q_{t,t+1}(1-x_{t+1})\ S_{t+1}^H\}$$

$$W_t^U = (1-\Theta)\ \frac{Y_t}{N_t} + (1-\delta)\ E_t\{Q_{t,t+1}\ G_{t+1}\}$$

Nash Bargaining

$$\xi\ S_t^H = (1-\xi)\ S_t^F$$

Nash Wage

$$W_t = \xi\ W_t^L + (1-\xi)\ W_t^U$$

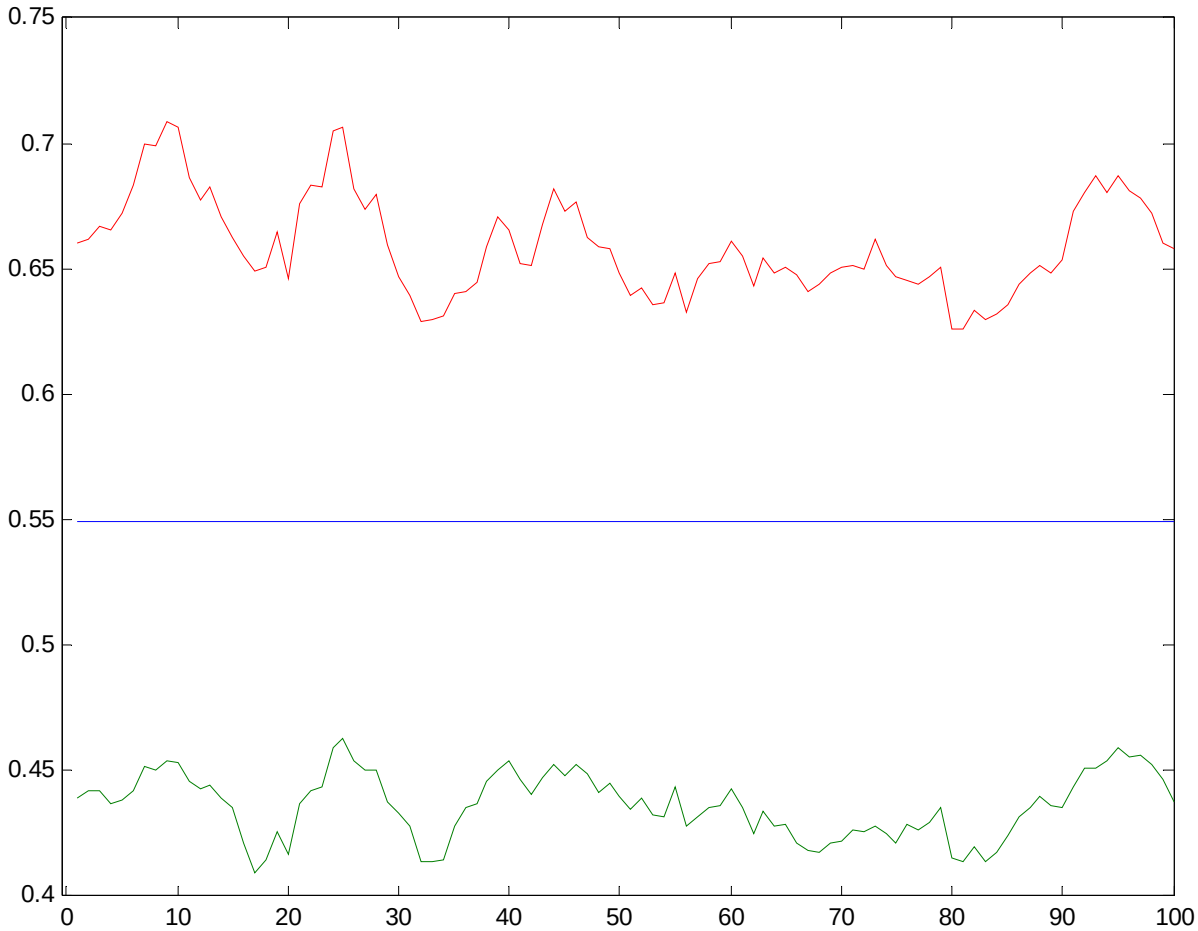
Rigid Wage

$$W_t = \xi\ W^L + (1-\xi)\ W^U$$

Size of bargaining set:

$$\Delta_t = W_t^U - W_t^L = \frac{1}{\xi}\ G_t$$

The Bargaining Set and the Rigid Wage



The Frictionless Case ($\Gamma = 0 \Longrightarrow \ G_t = 0$, all t)

$$(1-\Phi)\ \frac{Y_t}{N_t} = \frac{C_t}{Z_t}\ b$$

$$Y_t = C_t$$

implying

$$N_t = \frac{1-\Phi}{b}\ Z_t$$

$$\mathcal{E}_t^{1+\varphi} = (1-\alpha)\theta\ \frac{Y_t}{N_t}\ \frac{Z_t}{C_t} = \frac{(1-\alpha)\theta b}{1-\Phi}$$

In logs:

$$n_t = z_t$$

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

$$w_t = y_t - n_t = -\alpha\ z_t + a_t$$

Implications:

$$cov(y_t - n_t, y_t) = -\alpha(1-\alpha)\ var(z_t) + var(a_t)$$

$$cov(y_t - n_t, n_t) = -\alpha\ var(z_t)$$

$$var(y_t) = (1-\alpha)^2 var(z_t) + var(a_t)$$

$$\frac{var(n_t)}{var(y_t)} = \frac{var(z_t)}{(1-\alpha)^2 var(z_t) + var(a_t)}$$

$$\frac{var(w_t)}{var(y_t)} = \frac{\alpha^2\ var(z_t) + var(a_t)}{(1-\alpha)^2 var(z_t) + var(a_t)}$$

Question: How do frictions affect the above statistics?

Calibration

- Preferences: $\beta = 0.99$; $\varphi = 1$
- Technology: $\alpha = 1/3$
- Frictions: $\eta = 2$; Γ so that hiring costs equal 0.1% of output in SS.
- Bargaining: $\xi = 0.5$
- (δ, b) to match $x = 0.7$ and $u = 5.5\%$ in SS
- Wage rigidity: $\gamma = 1$
- Driving forces:

$$a_t = \rho_a \, a_{t-1} + \varepsilon_t^a$$

$$z_t = \rho_z \, z_{t-1} + \varepsilon_t^z$$

where $\rho_a = \rho_z = 0.9$ and (σ_a, σ_z) chosen to match $\sigma(n)$ and $\sigma(y)$ in the post-84 period using the frictionless model.

Simulations

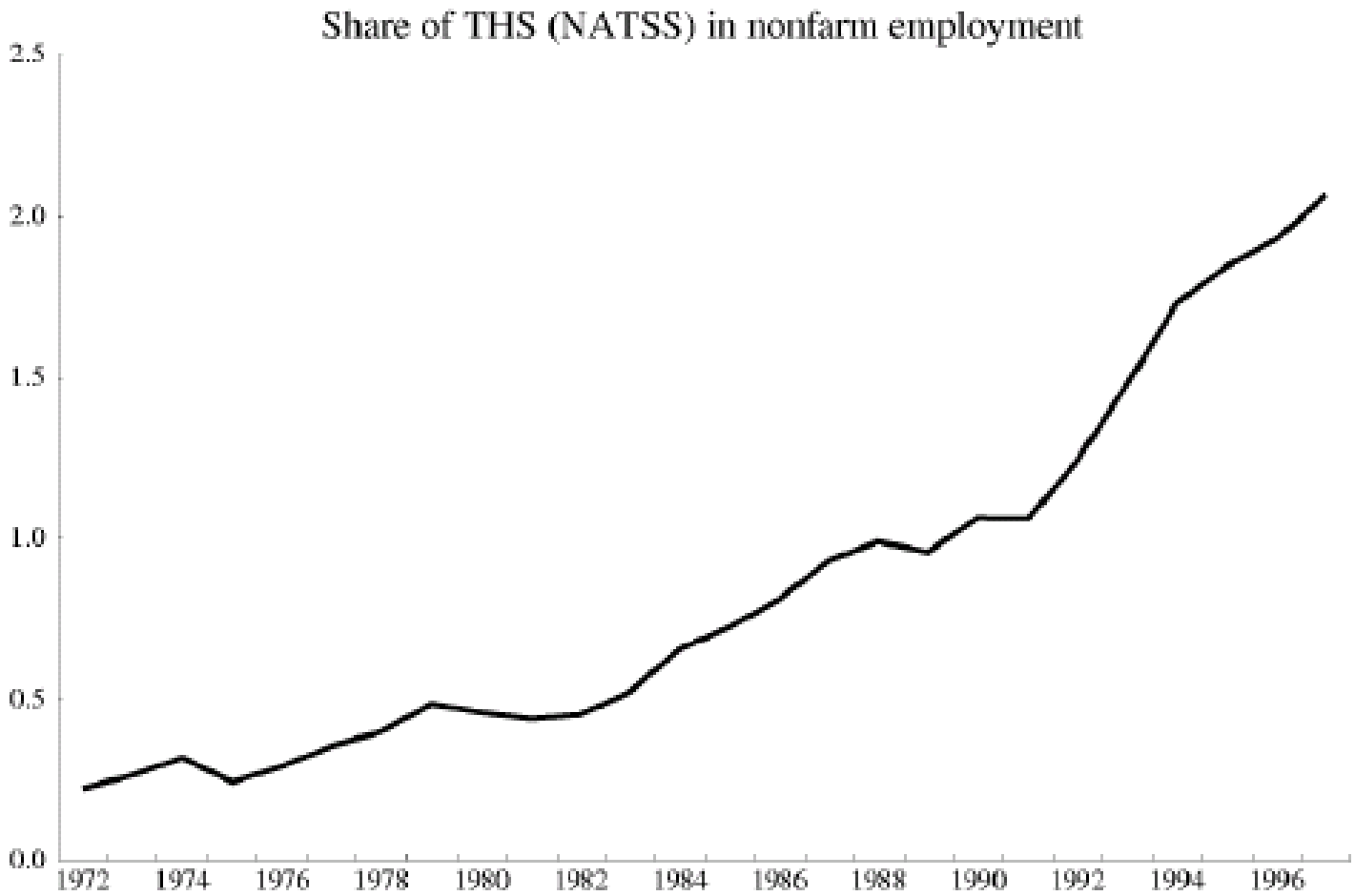
Table 5. Model Simulations

	No Frictions			*Frictions (0.1%)*			*Wage rigidity*		
	Both	Tech	Pref	Both	Tech.	Pref	Both	Tech	Pref
$corr(y-n, y)$	0.11	1.0	-1.0	0.84	1.0	-0.98	0.97	0.97	0.98
$corr(y-n, n)$	-0.53	0.0	-1.0	-0.10	0.0	-0.98	0.96	0.96	0.96
$\frac{\sigma(n)}{\sigma(y)}$	**1.18**	0.0	1.5	0.54	0.0	1.16	0.80	0.81	0.79
$\frac{\sigma(w)}{\sigma(y)}$	0.72	1.0	0.5	0.92	1.0	0.46	0.0	0.0	0.0
$\sigma(y)$	**1.15**	0.70	0.90	0.78	0.70	0.37	1.35	1.33	0.20

To Do List

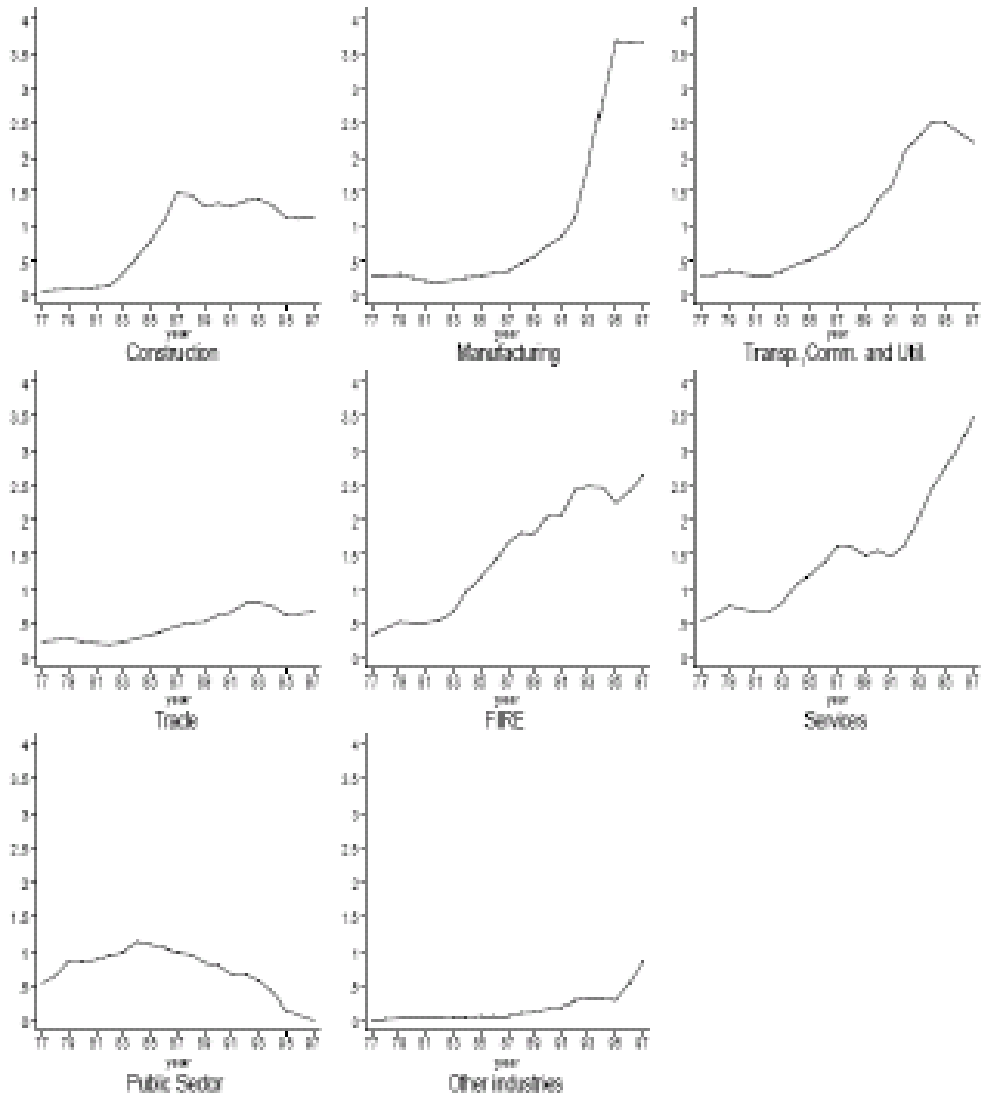
- Analysis of the role of different parameters, more careful calibration
- Endogenize degree of wage rigidity
- Additional shocks
- Nominal rigidities, changes in monetary policy rule
- More direct evidence on declining frictions...

The Rising Share of Temp Workers



Source: Estevao and Lach (1999)

Figure 4
Proportion (%) of THS in each sector's employment



Source: Estevao and Lach (1999)

Decline in unionization rates

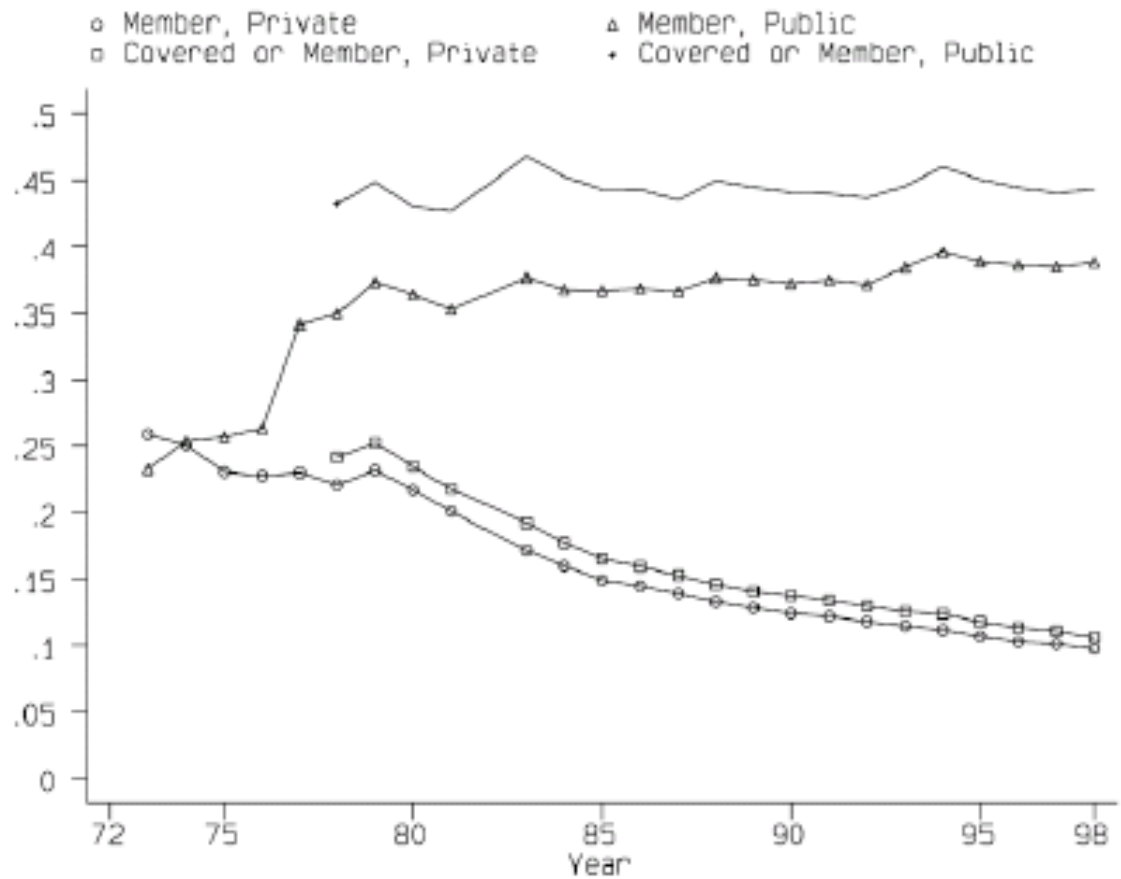
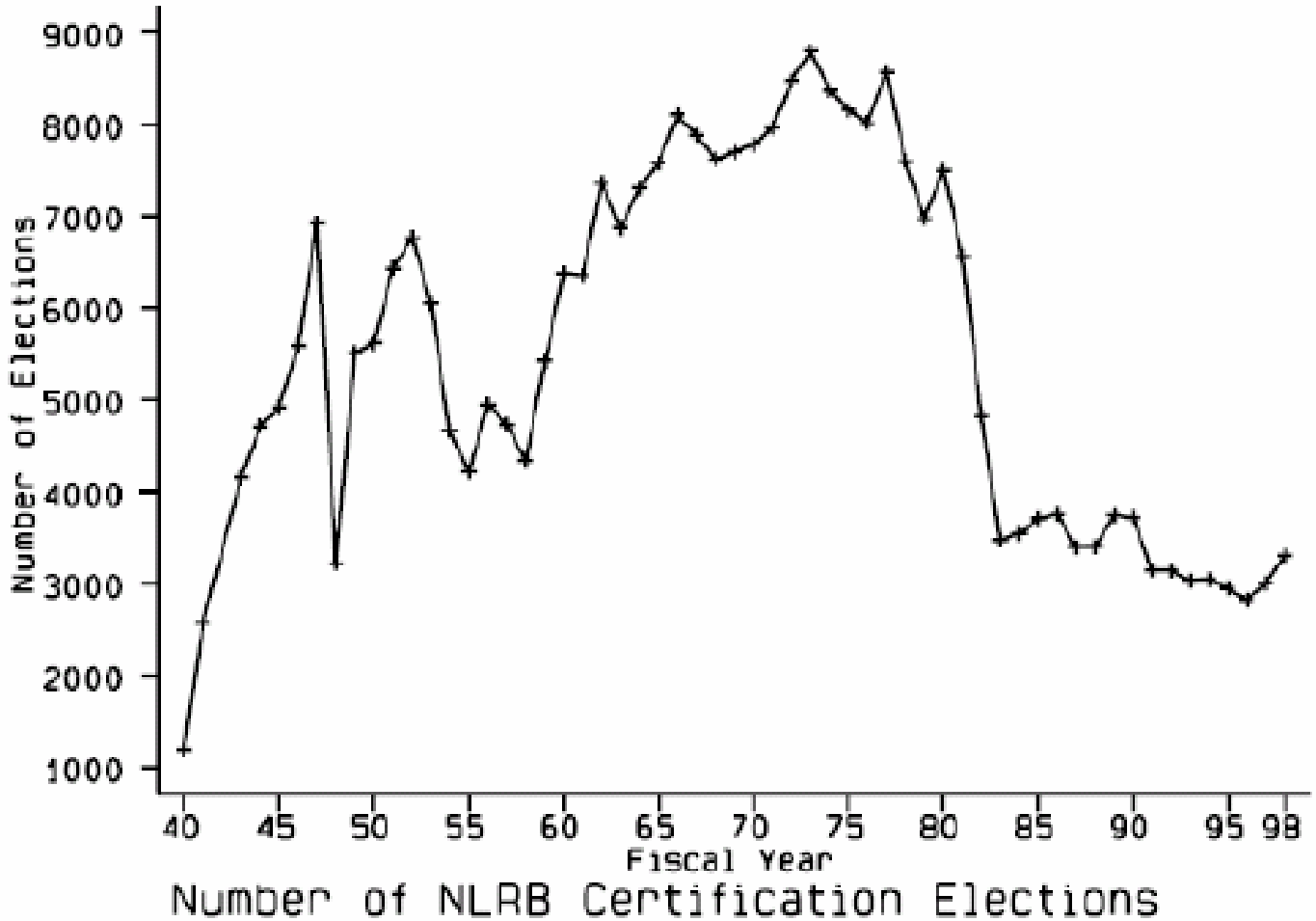


Figure 2: Private and Public Sector Unionization Rates, 1973–1978

Source: Farber and Western (2002)

Changes in “effective” unionization: NLRB elections



Source: Farber and Western (2001)

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The June index reflected a summer slow down in recruitment activity; Retail showed increased labor demand.