How Sticky Wages In Existing Jobs Can Affect Hiring

Mark Bils
University of Rochester
NBER

Yongsung Chang
University of Rochester
Yonsei University

Sun-Bin Kim
Yonsei University

1 Introduction

- Wages arguably sticky–but less so for new matches (Pissarides, 2009)

- Develop a Diamond-Mortensen-Pissarides model with wages flexible for new hires, but sticky within

- Depart from sticky-wage literature by firms/workers bargaining over effort/output

  — Not in wage: effort for hourly, hours or effort for salaried

  — Renders effective wage partly flexible

- In M-P model wage stickiness in existing jobs doesn't matter–Doesn't hold in our model
  - Wage stays high after negative shock; ask more of workers
  - Reduces payoff to hiring–G.E. effect
- Can get wide difference in effort by vintage, impact short-lived
- If constrain workers to have same effort/pace, impact much larger
  - Get considerable wage inertia/unemployment volatility

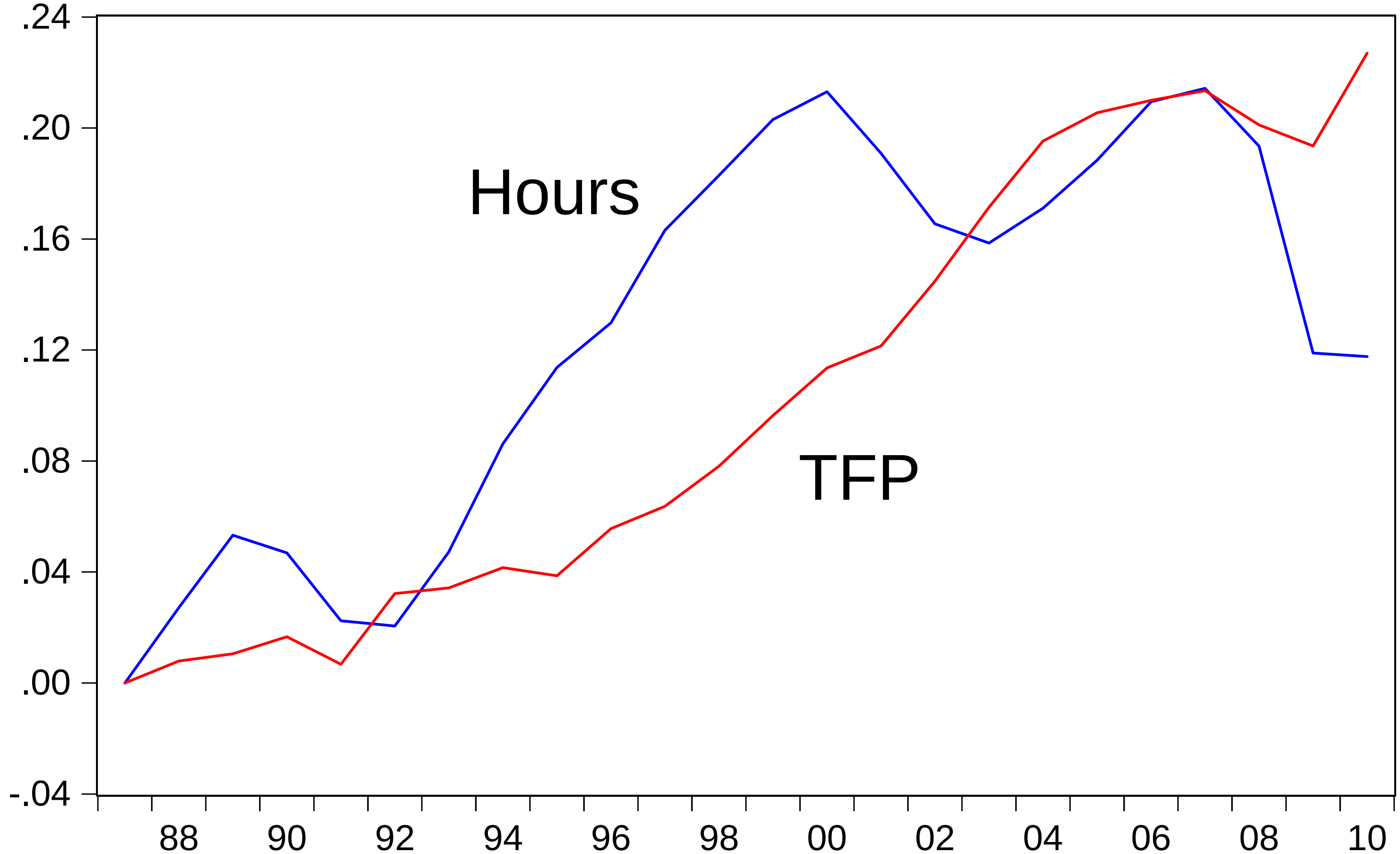
- Difficult to measure cyclicalilty of effort

- Schor (1987) finds modestly procyclical for 131,500 **piece-rate** workers in U.K. for 1970 to 1986.

- Anger (2011) unpaid overtime (extra) hours highly countercyclical for German workers for 1984 to 2004

- Lazear, Shaw, and Stanton (2013) examine productivity of 20,000 workers at services company for June 2006 to May 2010: increase in local unemployment rate of 5 percentage points increases productivity of 3.75%

- Our model consistent with productivity/wage response in great recession
  - 2007 to 2009, 10% decline in hours compared to 6% in output
- Goes part way in rationalizing Shimer puzzle
  - Gives bigger response in employment to productivity shock
  - Makes measured TFP respond much less to that shock
- Examine whether consistent with behavior of TFP across industries
  - Stratify industries by measures of wage stickiness
  - Stickier wages yields countercyclical TFP, more cyclical inputs



Hours
TFP
.24
.20
.16
.12
.08
.04
.00
-.04
88
90
92
94
96
98
00
02
04
06
08
10

Model

- Diamond-Mortensen-Pissarides matching model
- Exogenous Separation
- Staggering Wage Contracts
- Wages Flexible for Newly Matched Workers
- Effort is chosen through Nash Bargaining

Workers' Preferences

$$E_0 \sum_{t=0}^{\infty} \beta^t \left\{ c_t + \psi \frac{(1 - e_t)^{1-\gamma} - 1}{1 - \gamma} \right\},$$

- c: consumption
- e: effort
- $\frac{e}{1-e}\frac{1}{\gamma}$: Frisch elasticity of effort w.r.t. wage

Firms' Production Technology

$$y_t = z_t e_t^{\alpha} (k_t e_t)^{1-\alpha},$$

- z: aggregate productivity
- k: capital per effort, equated over firms
- Aggregate capital fixed over cycle

Matching Technology

$$M(u_t, v_t) = \chi u_t^{1/2} v_t^{1/2},$$

Each period jobs are destroyed with exogenous probability δ.

Free Entry Condition

Vacancies posted until expected value of hire equals cost of vacancy.

Staggered Wage Contract

- When a match is formed, the wage is set according to a Nash bargaining.

- Wage is fixed for T periods.

Choice of Labor Effort

- Effort is determined according to the Nash bargaining.

- We consider three cases:
  - Effort level is fixed
  - Effort level is chosen by worker vintage
  - Common level of effort chosen across vintages

Nash Bargaining over Wages of New Bargains

The wage for new matches, $w^*(z, \mu)$, dictated by Nash bargain between set of workers and firm:

$$w^*(z, \mu) = argmax_w \Big(J_0(w; z, \mu) \Big)^{1/2} \Big(W_0(w; z, \mu) - U(z, \mu) \Big)^{1/2}.$$

First order condition for $w^*(z, \mu)$ gives

$$J_0(w^*; z, \mu) = W_0(w^*; z, \mu) - U(z, \mu).$$

Choice of Effort

Given wage contract w_j, effort dictated by Nash bargain. By worker vintage:

$$e_j^*(w_j, z, \mu) = argmax_{e_j}\Big(J_j(e_j; w_j, z, \mu)\Big)^{1/2}\Big(W_j(e_j; w_j, z, \mu) - U(z, \mu)\Big)^{1/2}$$

First order condition for $e^*(z, \mu)$ gives

$$\psi(1 - e_j)^{-\gamma} J_j(e_j; w_j, z, \mu) = \alpha z k^{1-\alpha}\Big(W_j(e_j; w_j, z, \mu) - U(z, \mu)\Big)$$

For $w_j = w^*(z, \mu)$ have efficient effort

$$\psi(1 - e_j)^{-\gamma} = \alpha z k^{1-\alpha}$$

Model with Common Level of Effort

We also consider the model with common level of effort across workers.

- Maybe unrealistic to operate at varying work rules across employee.
- Complementarity of labor across workers

Bargaining over the Common Level of Effort

The common effort level, $e(z,\mu)$, is determined by Nash bargaining over weighted average of surpluses across worker vintages.

$$e^*(z,\mu) = argmax_e \Big(J\Big)^{1/2} \Big(W - U\Big)^{1/2},$$

$$J = \sum_{j=0}^{T-1} \left(\frac{N_j}{\sum_{j=0}^{T-1} N_j}\right) J_j,$$
$$W - U = \sum_{j=0}^{T-1} \left(\frac{N_j}{\sum_{j=0}^{T-1} N_j}\right) (W_j - U).$$

Calibration: Key Parameters

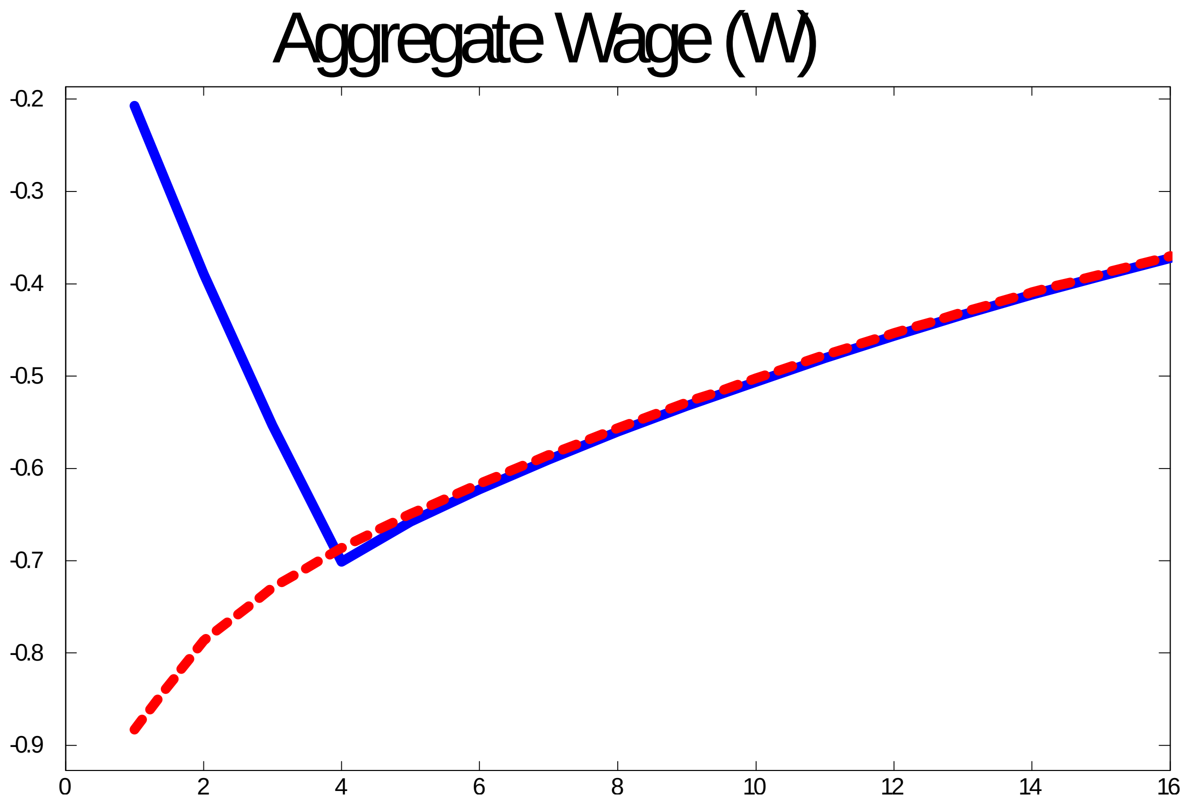
- Contract length: $T = 4$
- Frisch Elasticity of Effort: $\frac{1}{\gamma}\frac{(1-e)}{e} = 1$; ψ so S.S. effort, $e = 1/2$
- Labor elasticity: $\alpha = 0.64$
- Benefit b so replacement rate $b \Big/ \left(w_{ss} + \psi \frac{(1-e)^{1-\gamma} - 1}{1-\gamma} \right) = 75\%$.
- Productivity Shock: $\rho_z = 0.95$

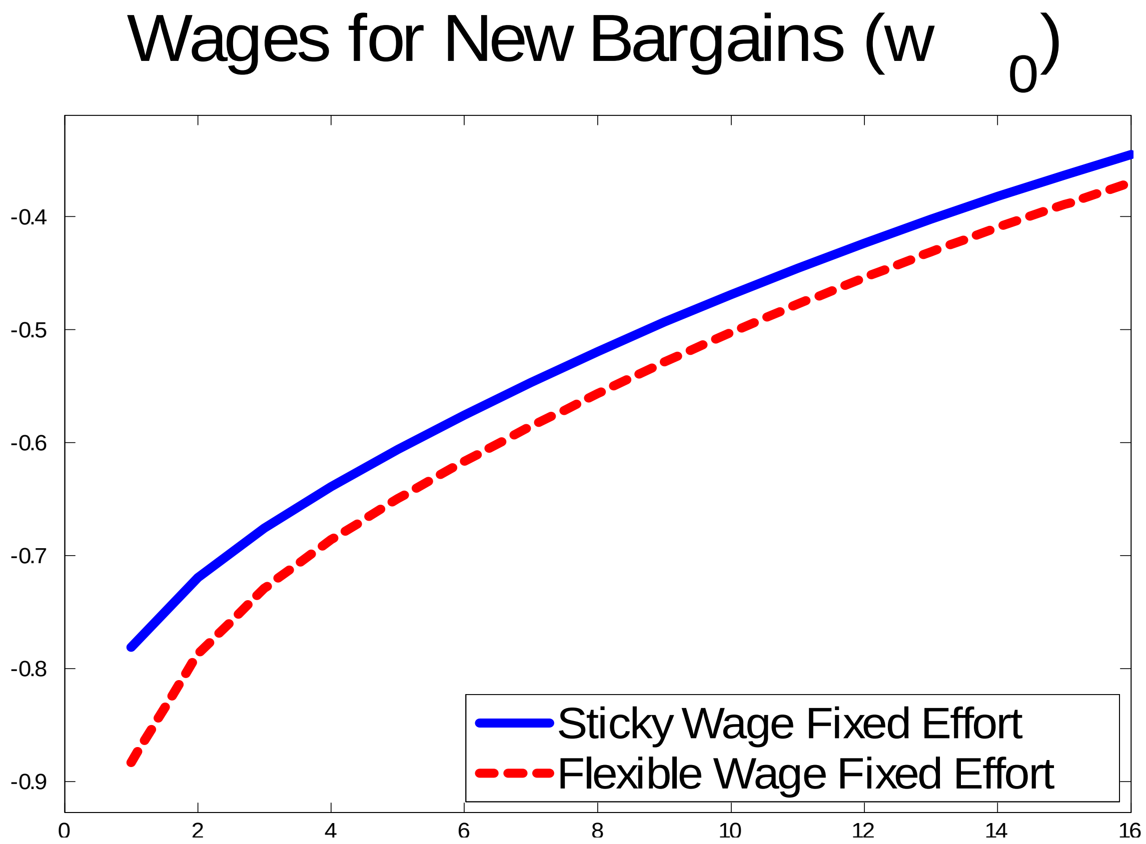
Impulse Responses to a 1% Decrease in Productivity

We will show models with:

- Fixed Effort (Flexible wage and Sticky wage)
- Endogenous Effot
  - Flexible wage
  - Sticky wage with individual effort level
  - Sticky wage with common effort level

Models with Fixed Effort


Aggregate Wage (W)
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
0
2
4
6
8
10
12
14
16



Wages for New Bargains (w_0)
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
0
2
4
6
8
10
12
14
16
Sticky Wage Fixed Effort
Flexible Wage Fixed Effort

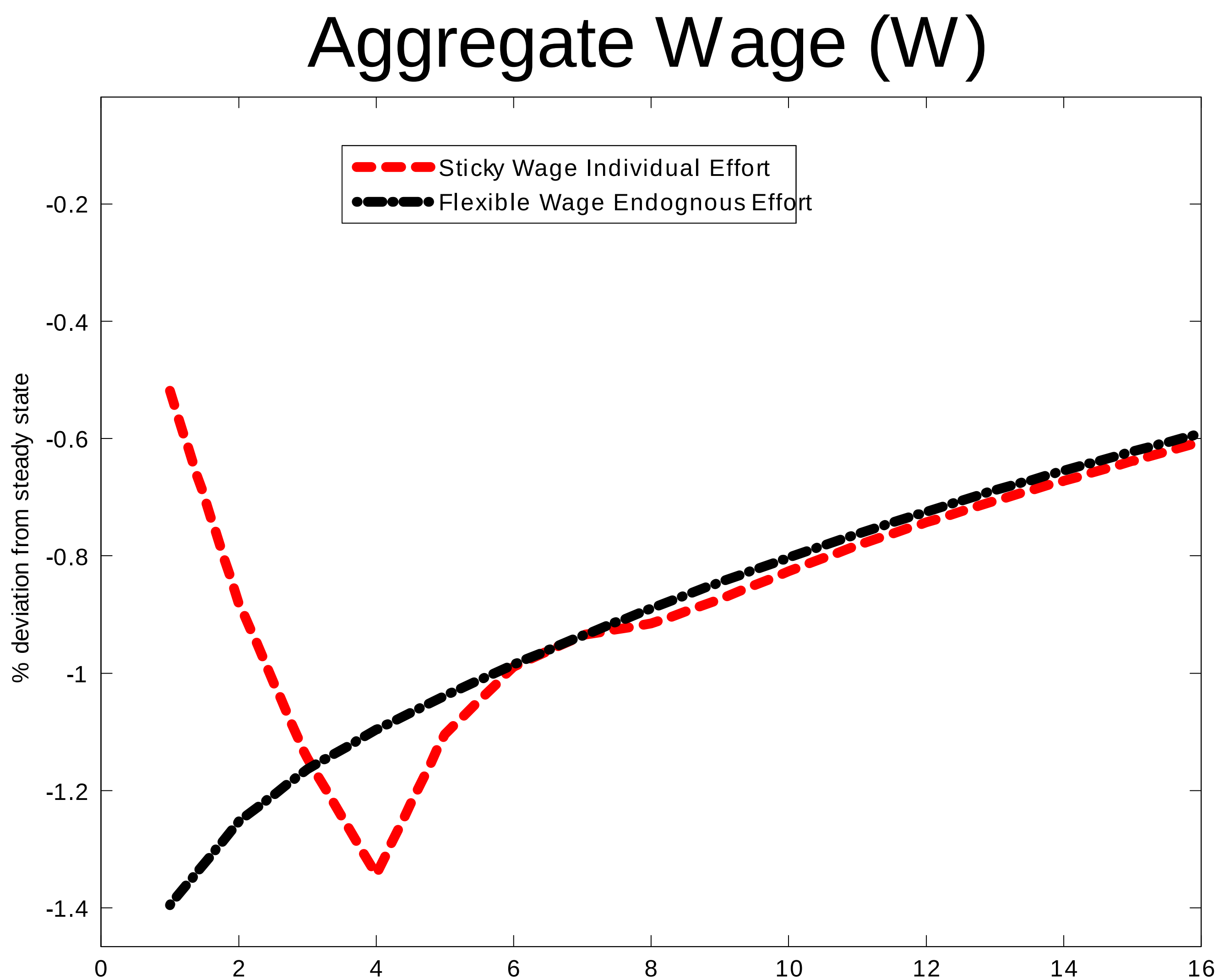

Employment (N)
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
0
2
4
6
8
10
12
14
16

Models with Variable Effort:

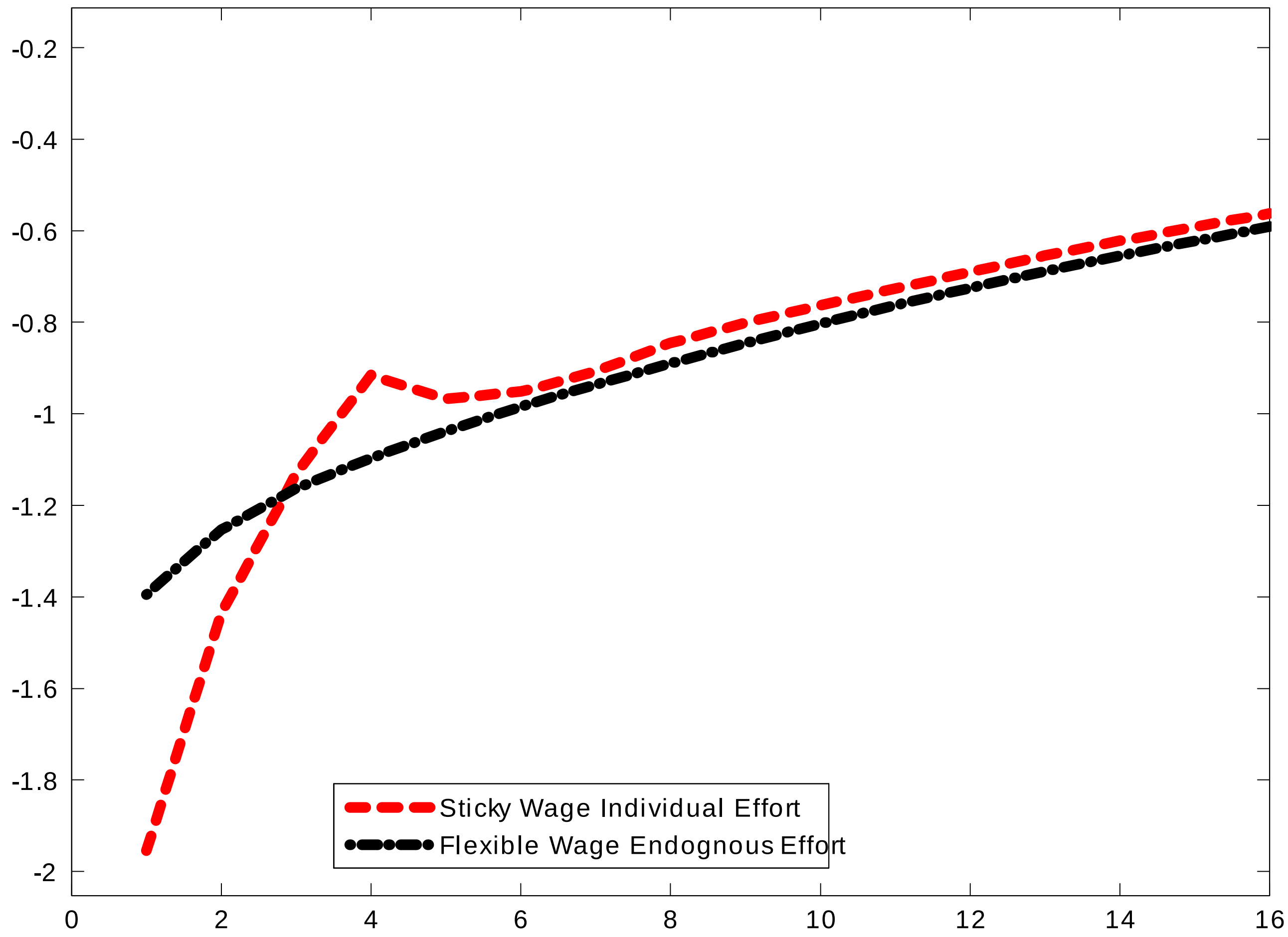
We consider cases with:

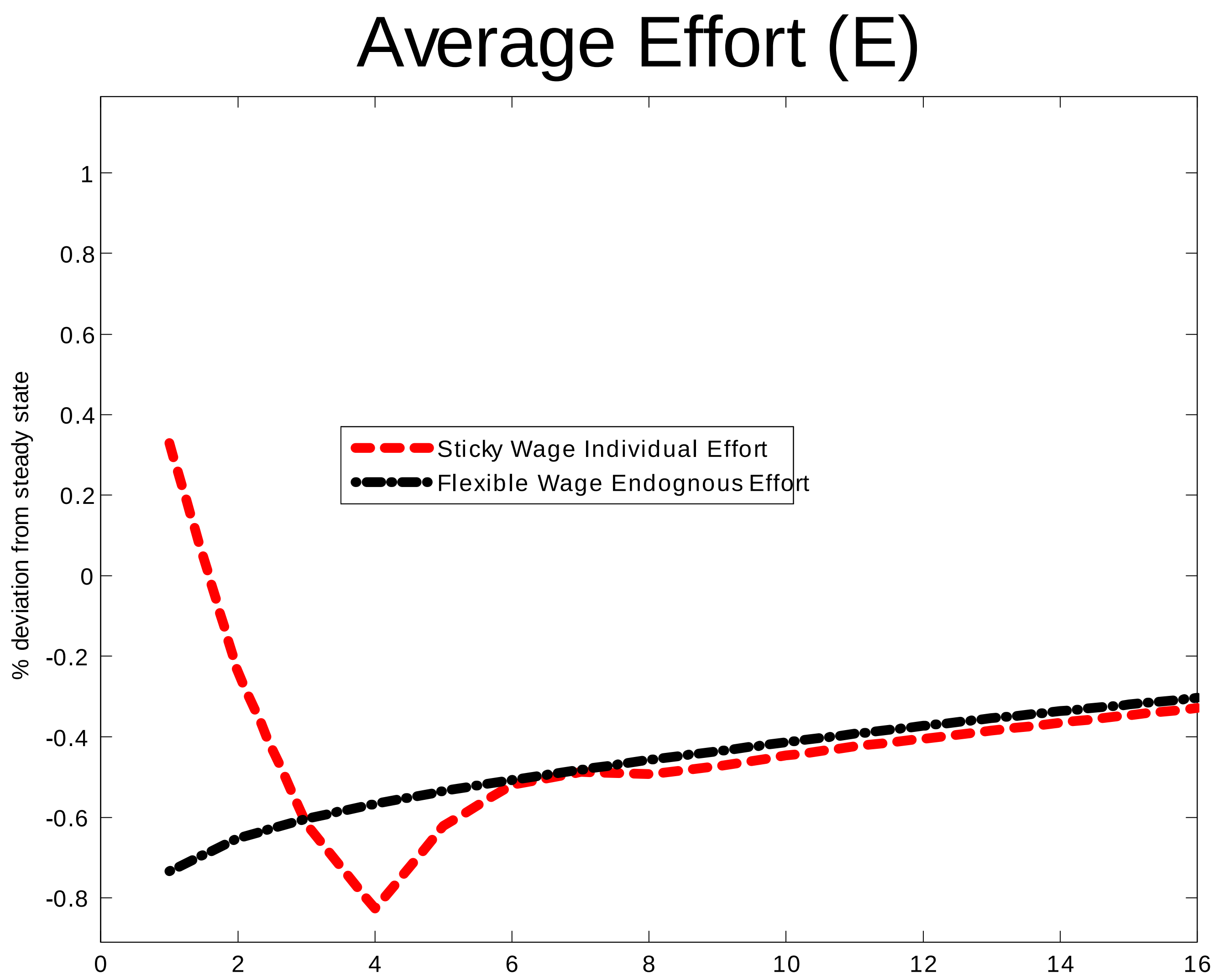
- Benchmark ($T = 4$, $\gamma = 1$, $\alpha = 0.64$)
- Longer Contract Length ($T = 8$)
- Smaller Frisch Elasticity ($\gamma = 2$)
- Smaller Labor Demand Elasticity ($\alpha = 0.28$)

Benchmark ($T = 4$, $\gamma = 1$, $\alpha = 0.64$)

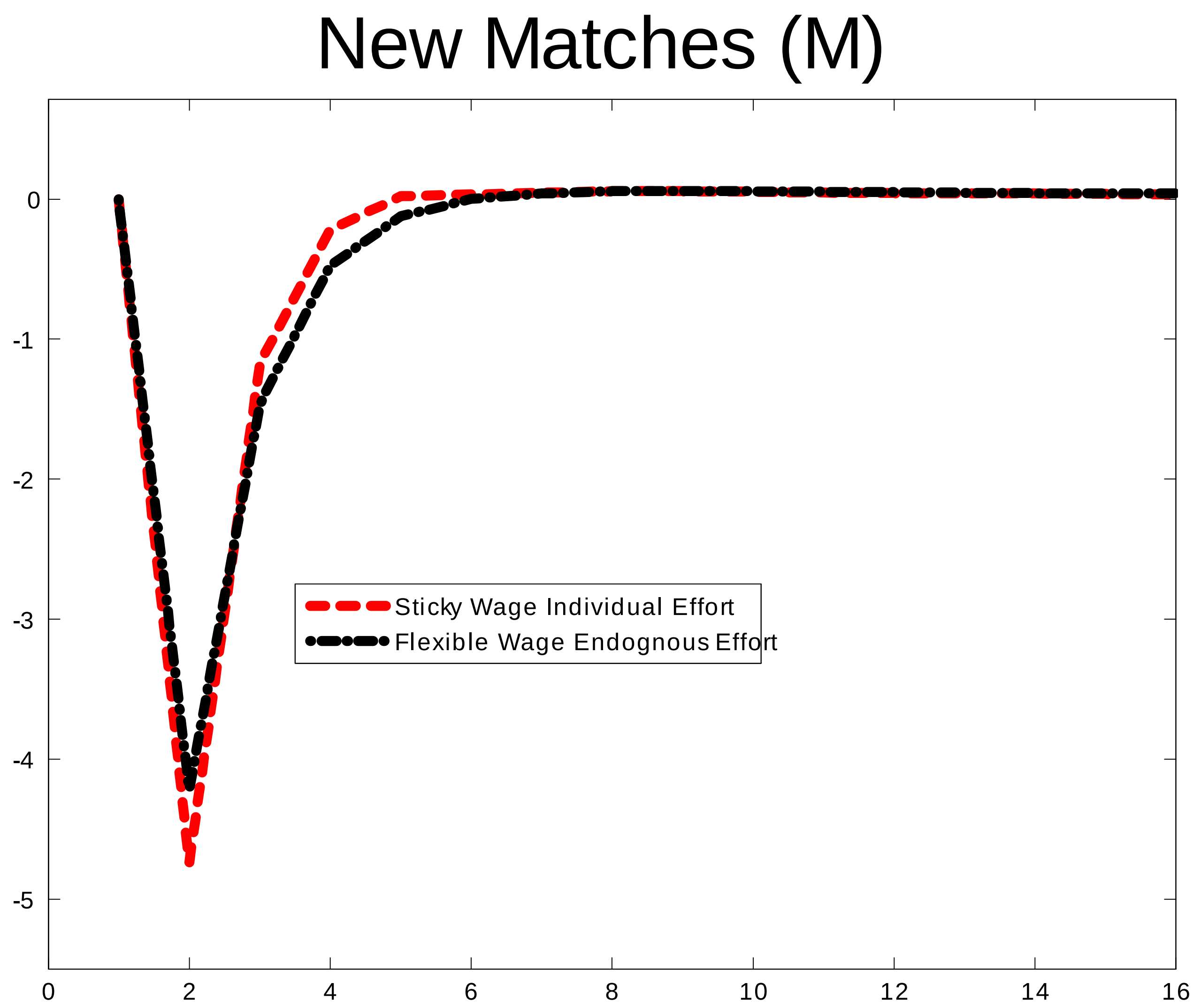

Aggregate Wage (W)
Sticky Wage Individual Effort
Flexible Wage Endognous Effort
% deviation from steady state
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
0
2
4
6
8
10
12
14
16

Wages for New Bargains (w_0)

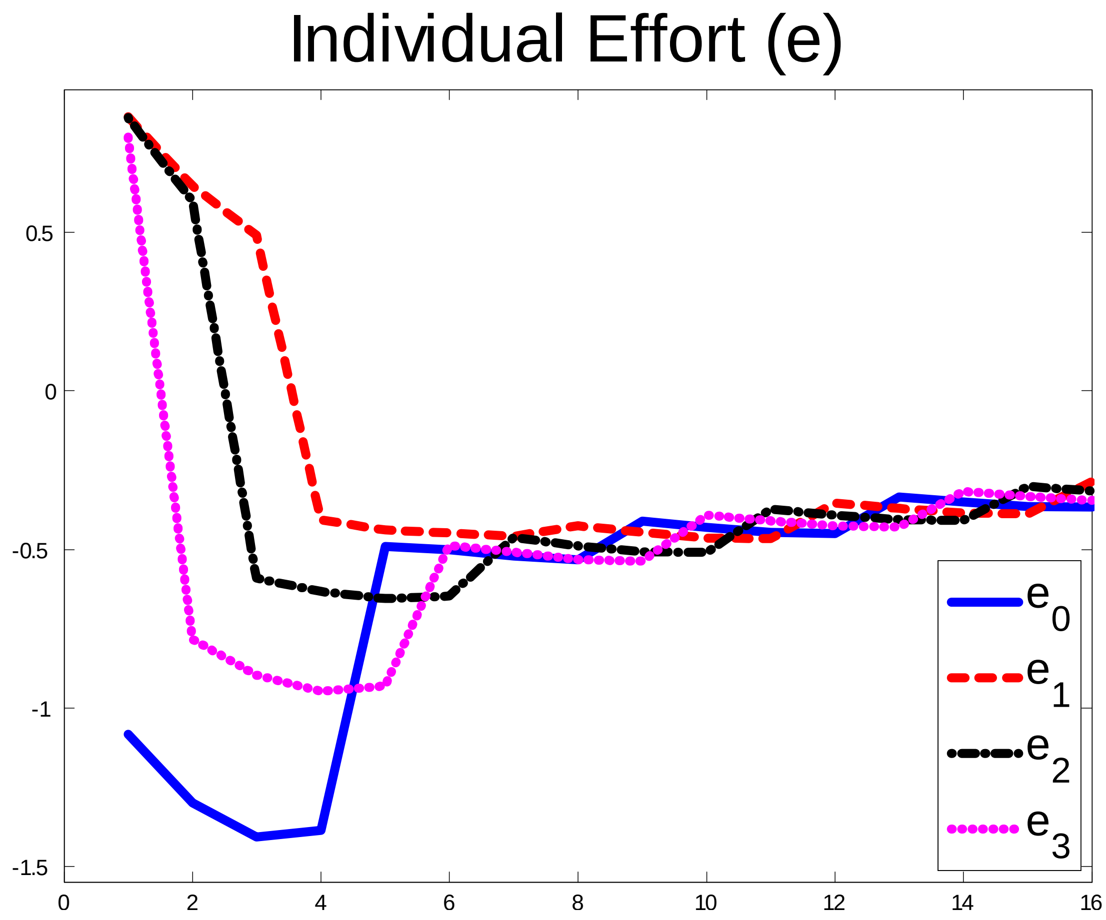




Average Effort (E)
% deviation from steady state
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
2
4
6
8
10
12
14
16
Sticky Wage Individual Effort
Flexible Wage Endognous Effort

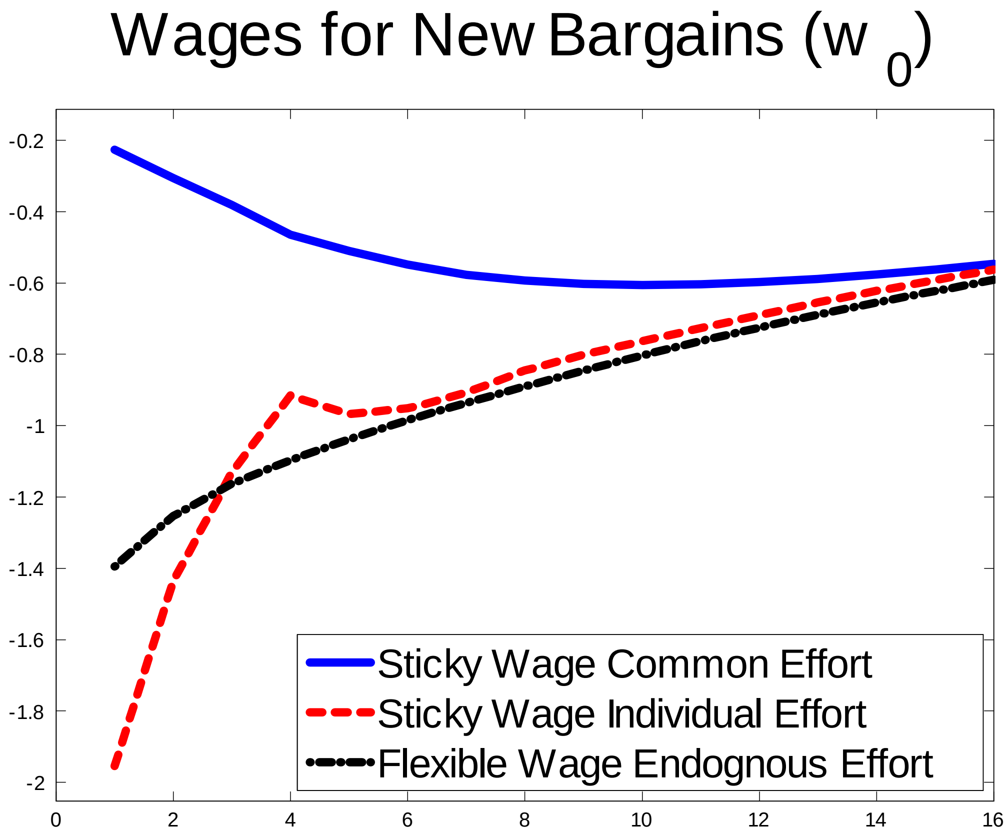


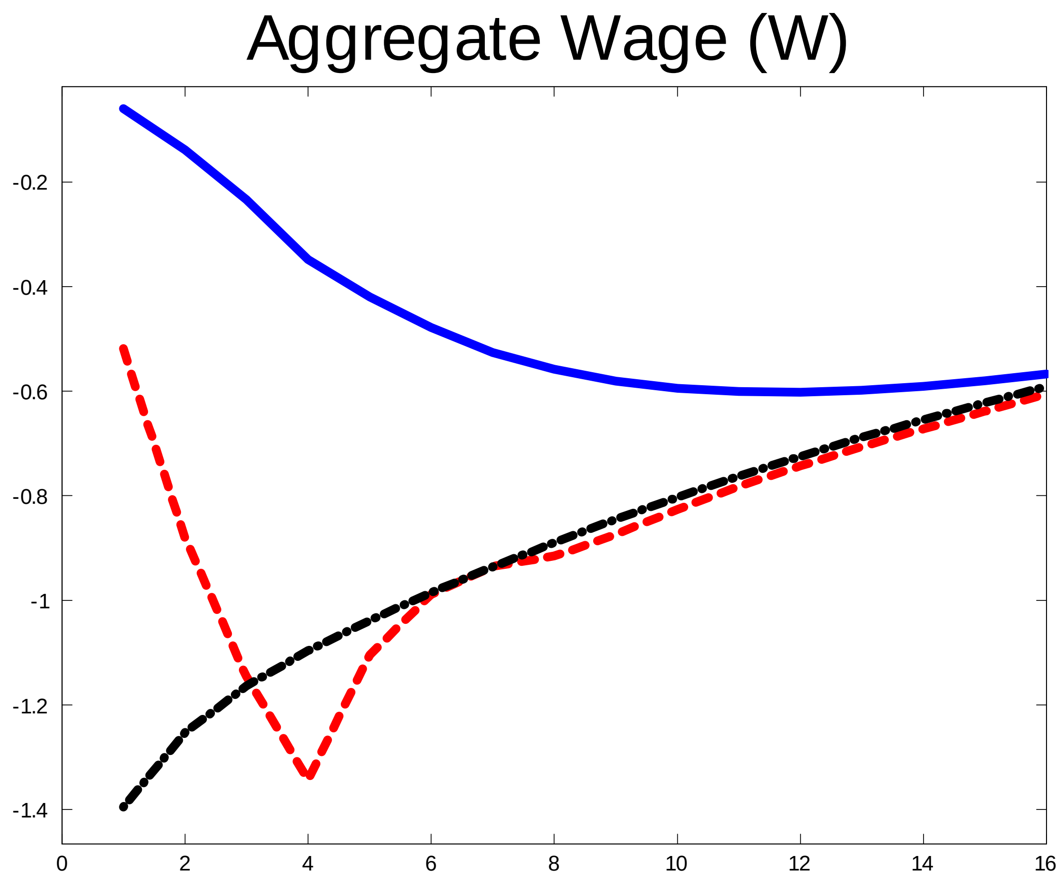
New Matches (M)
0
-1
-2
-3
-4
-5
0
2
4
6
8
10
12
14
16
Sticky Wage Individual Effort
Flexible Wage Endognous Effort



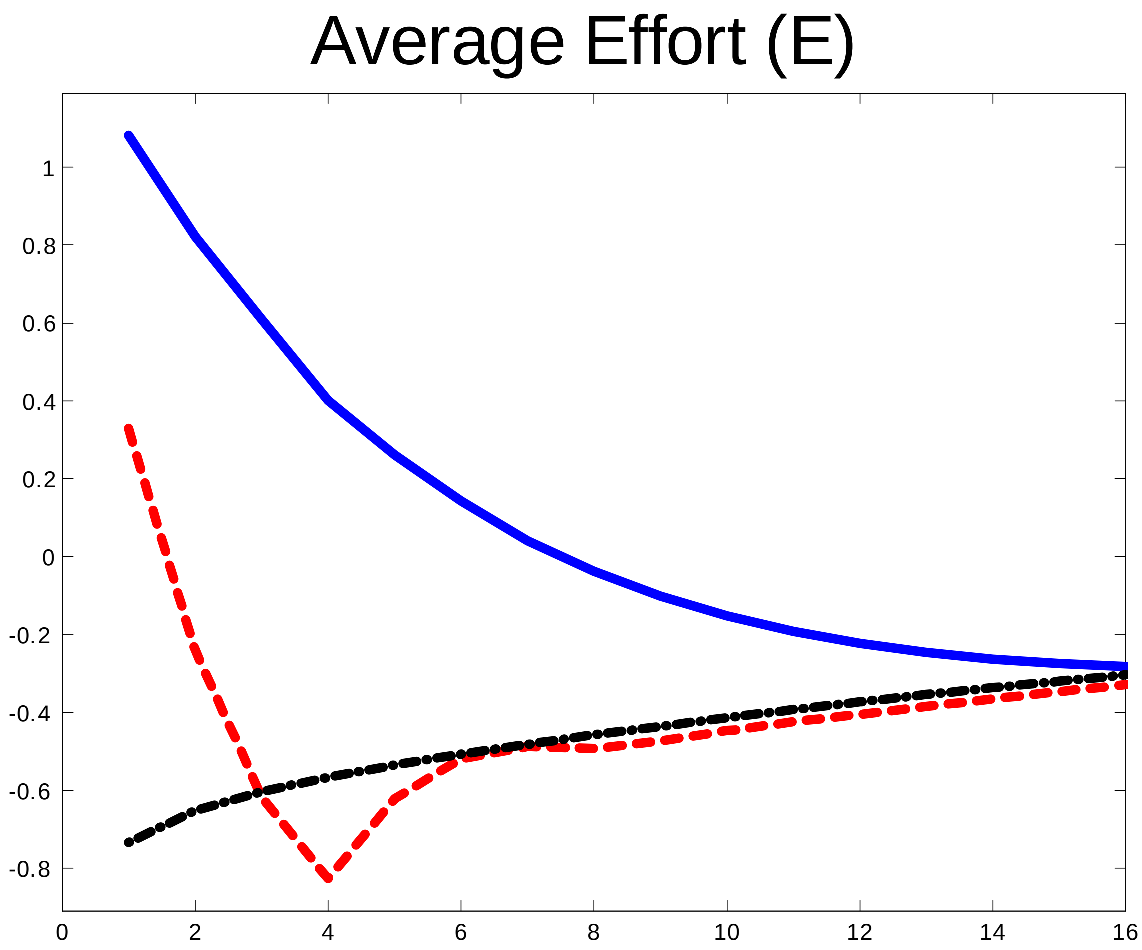
Individual Effort (e)
0.5
0
-0.5
-1
-1.5
0
2
4
6
8
10
12
14
16
e_0
e_1
e_2
e_3

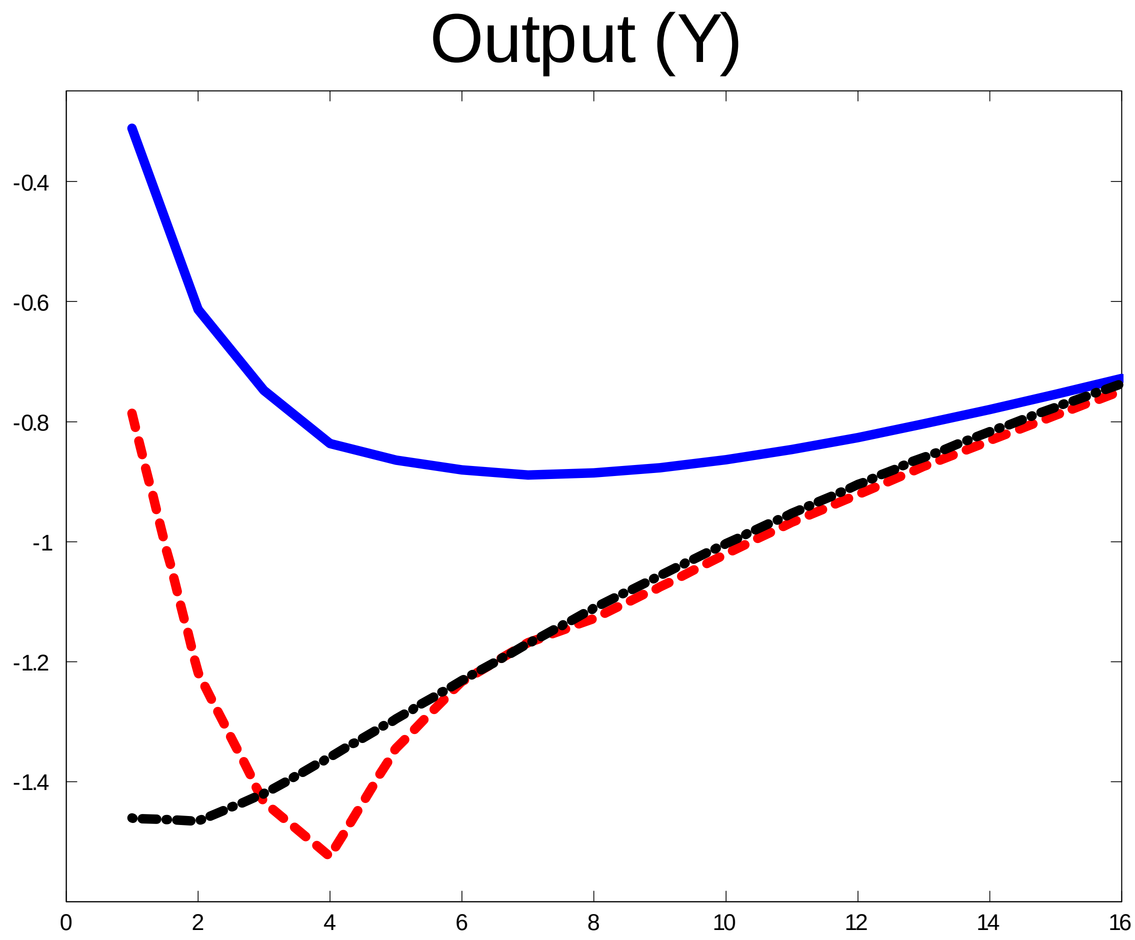
Benchmark ($T = 4$, $\gamma = 1$, $\alpha = 0.64$)



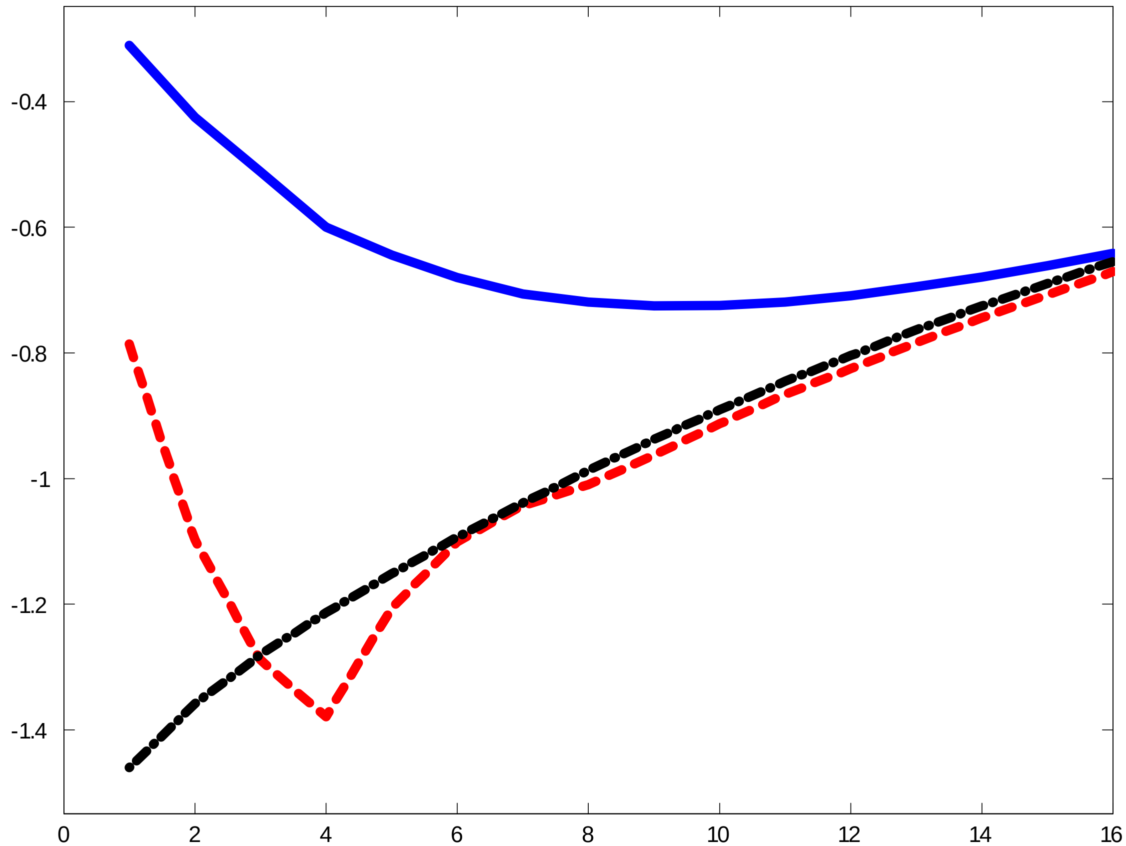


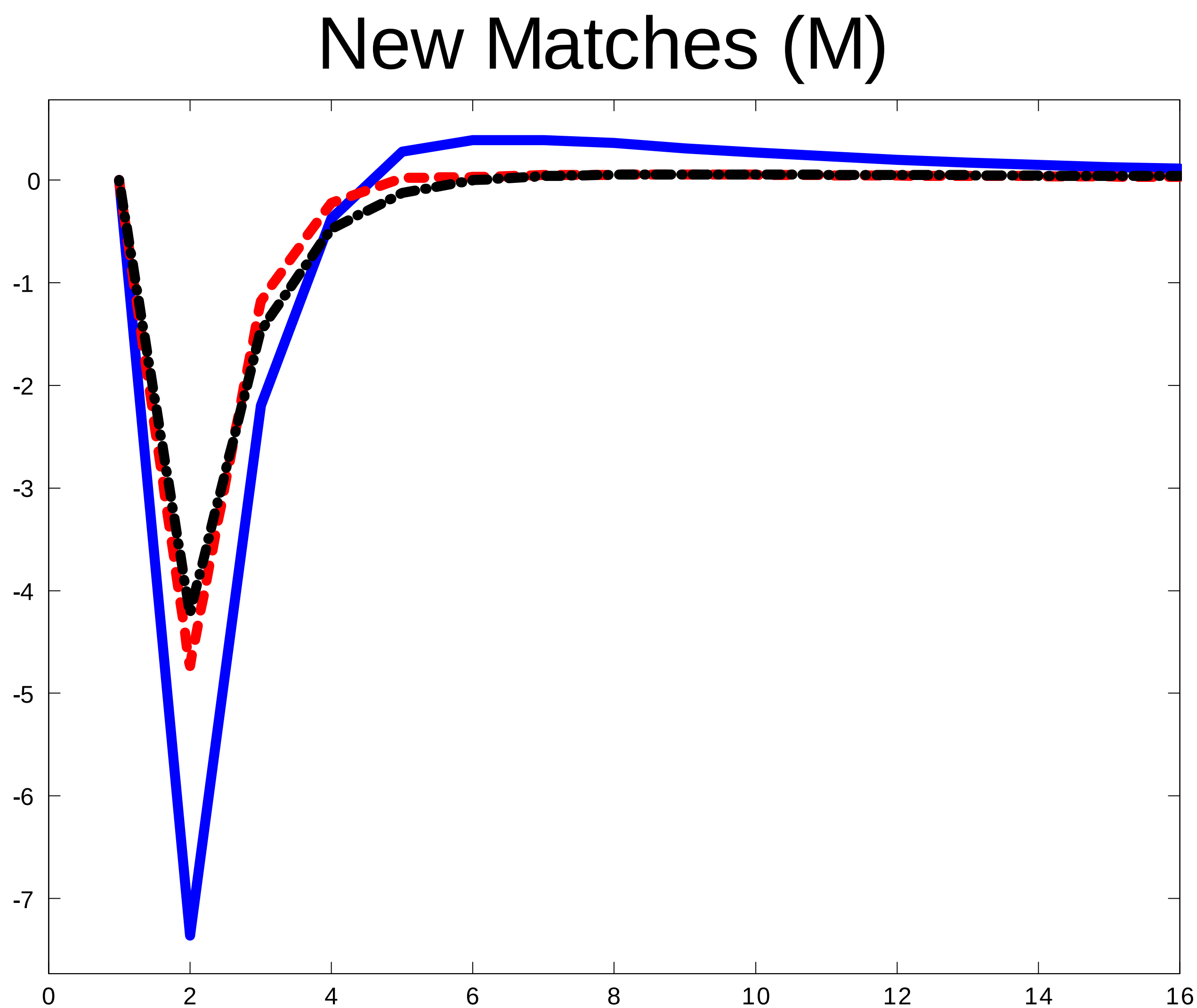
Aggregate Wage (W)
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
0
2
4
6
8
10
12
14
16

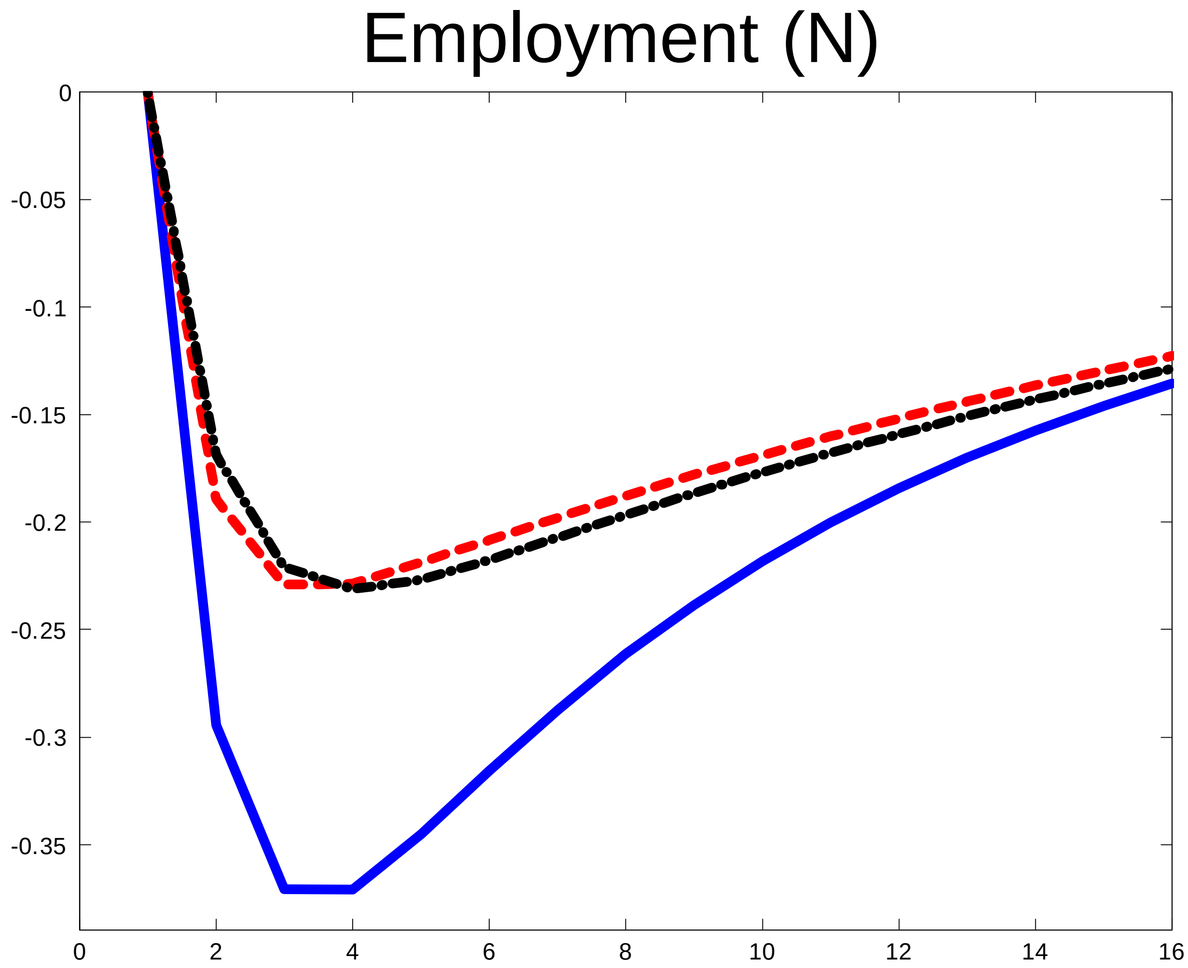

Average Effort (E)
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
2
4
6
8
10
12
14
16


Output (Y)
-0.4
-0.6
-0.8
-1
-1.2
-1.4
0
2
4
6
8
10
12
14
16

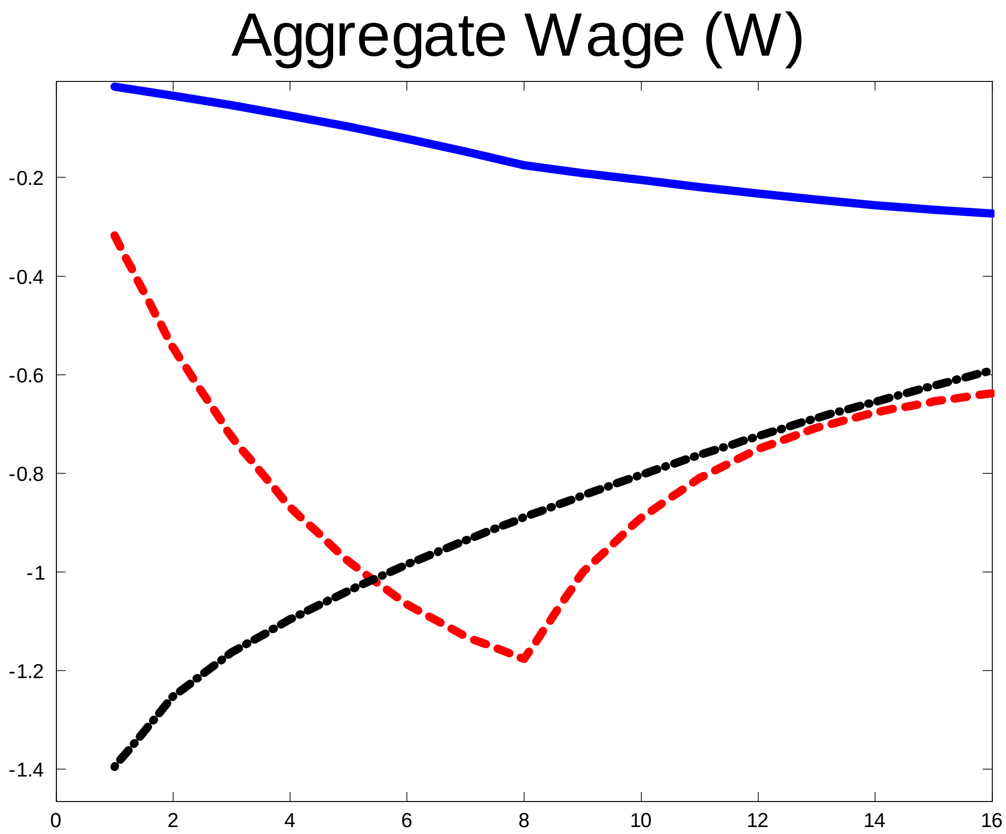
Measured TFP

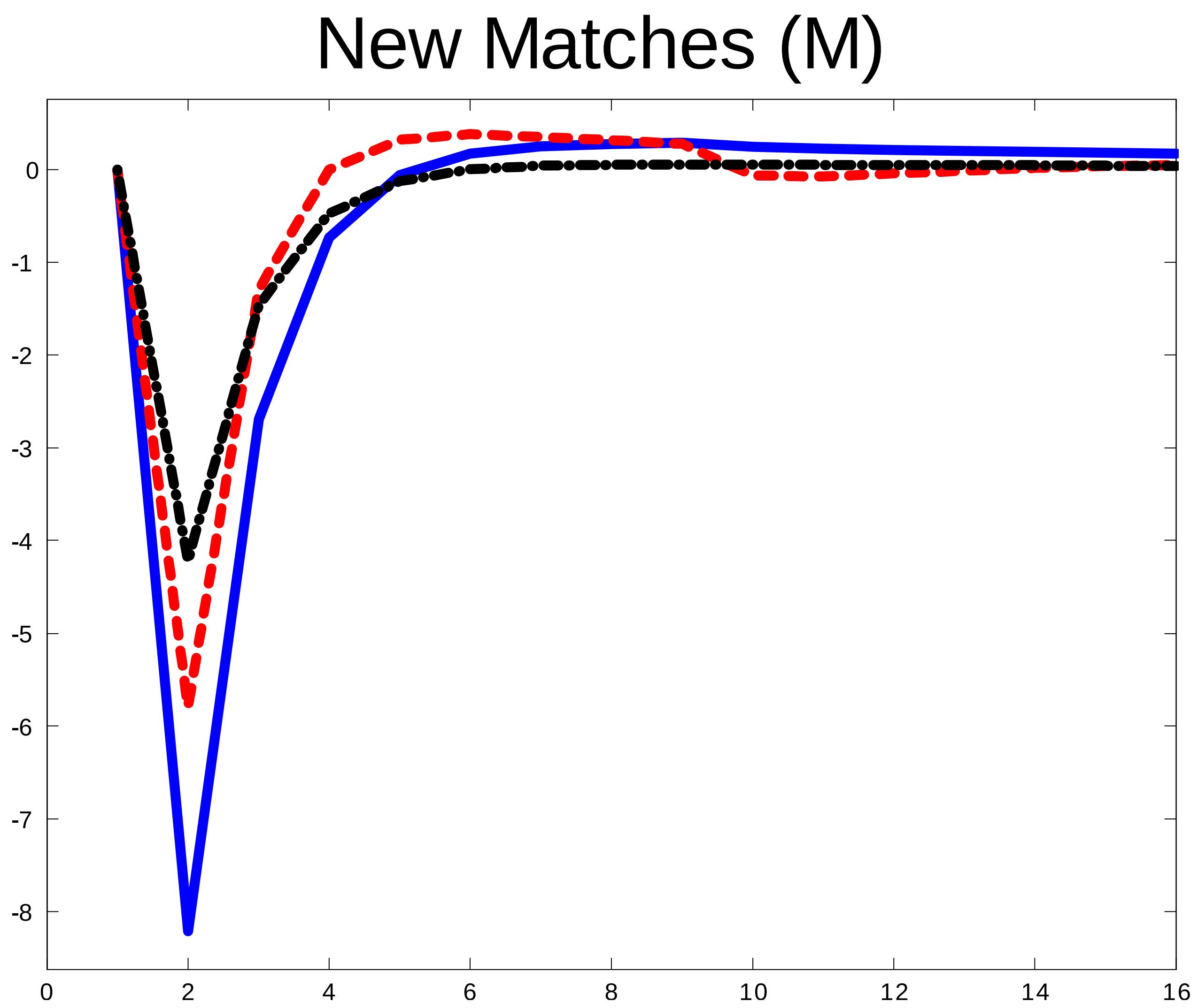





Employment (N)
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
0
2
4
6
8
10
12
14
16

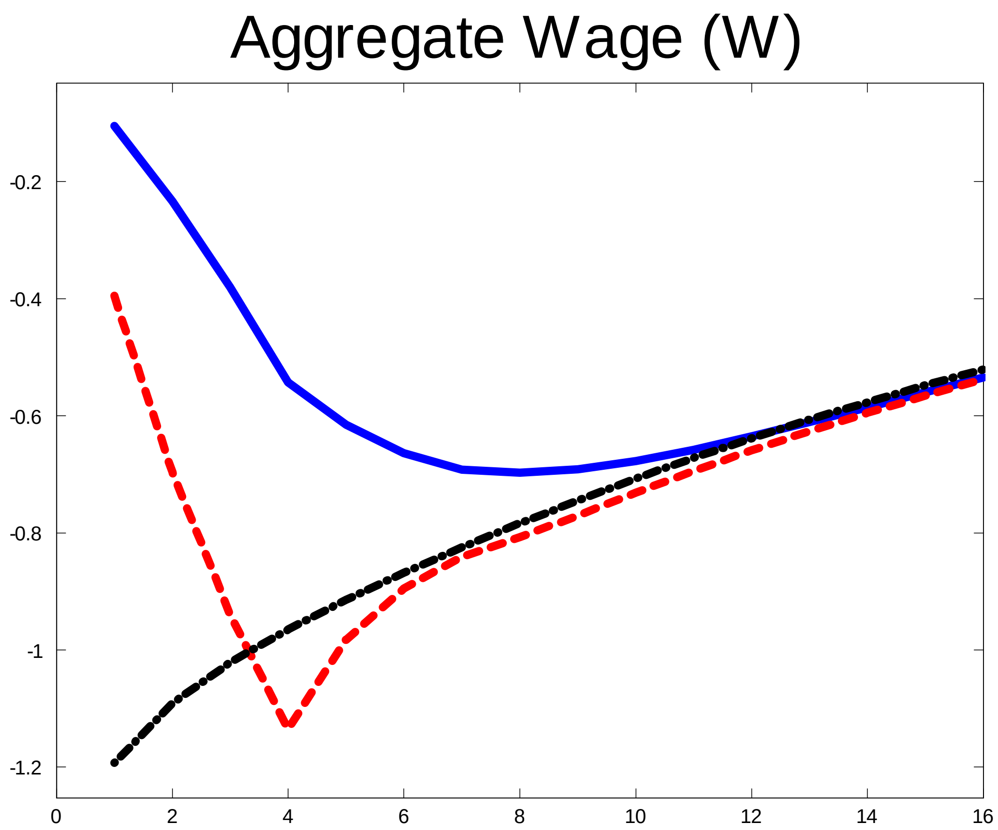
Longer Contract Length ($T = 8$)

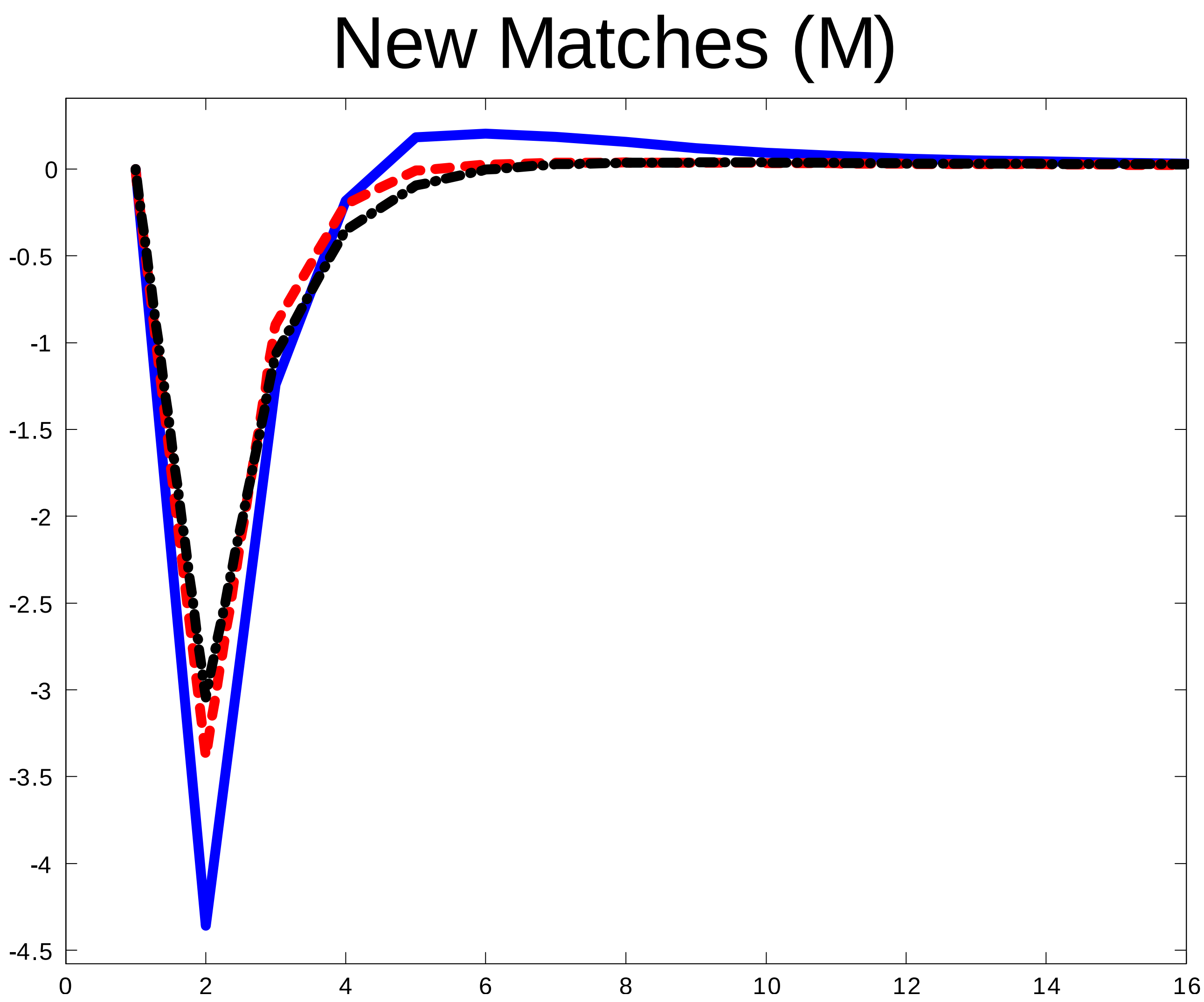




New Matches (M)
0
-1
-2
-3
-4
-5
-6
-7
-8
0
2
4
6
8
10
12
14
16

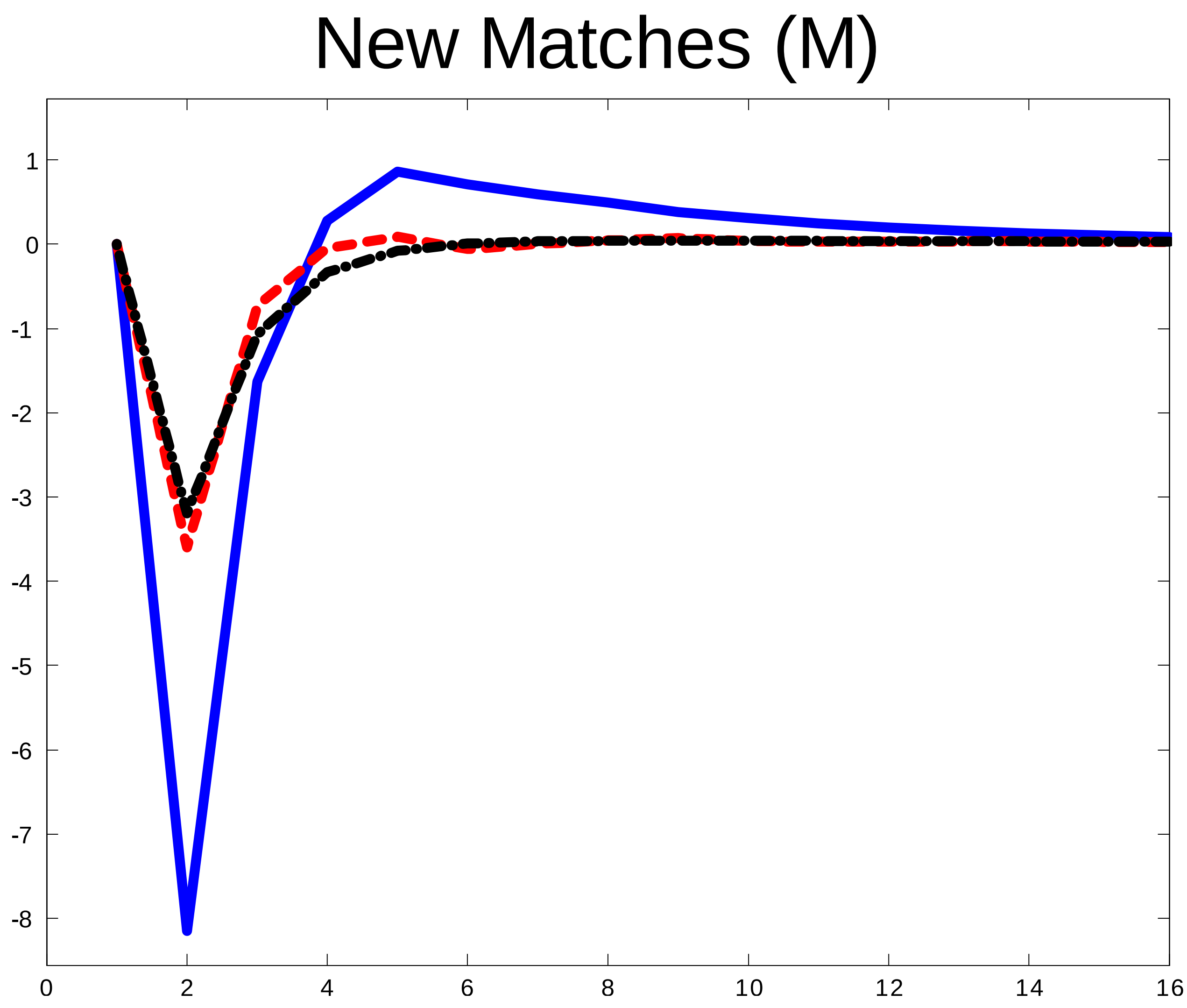
Smaller Frisch Elasticity ($\gamma = 2$)





New Matches (M)
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
0
2
4
6
8
10
12
14
16

Smaller Labor Demand Elasticity ($\alpha = 0.28$)


New Matches (M)
1
0
-1
-2
-3
-4
-5
-6
-7
-8
0
2
4
6
8
10
12
14
16

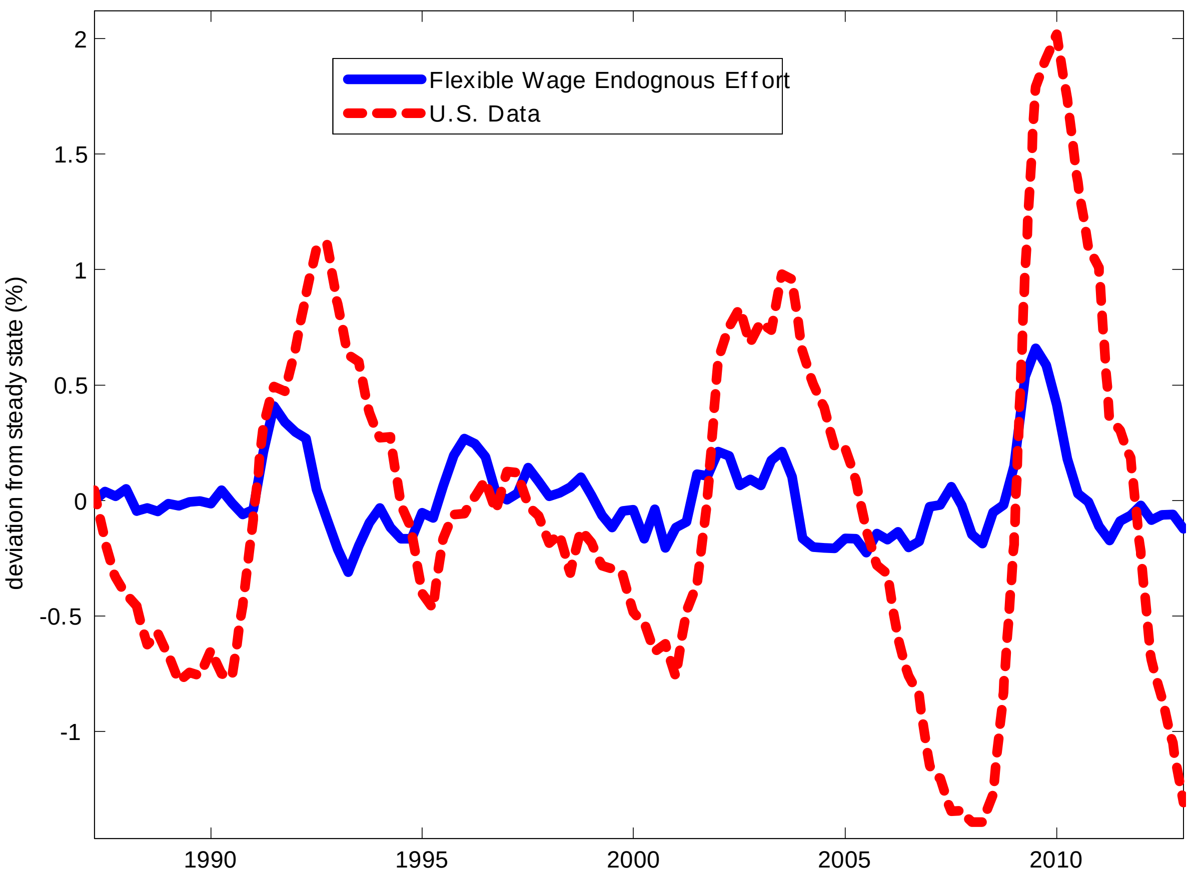
2 Model Helps Explain Volatility of Unemployment for Measured Productivity

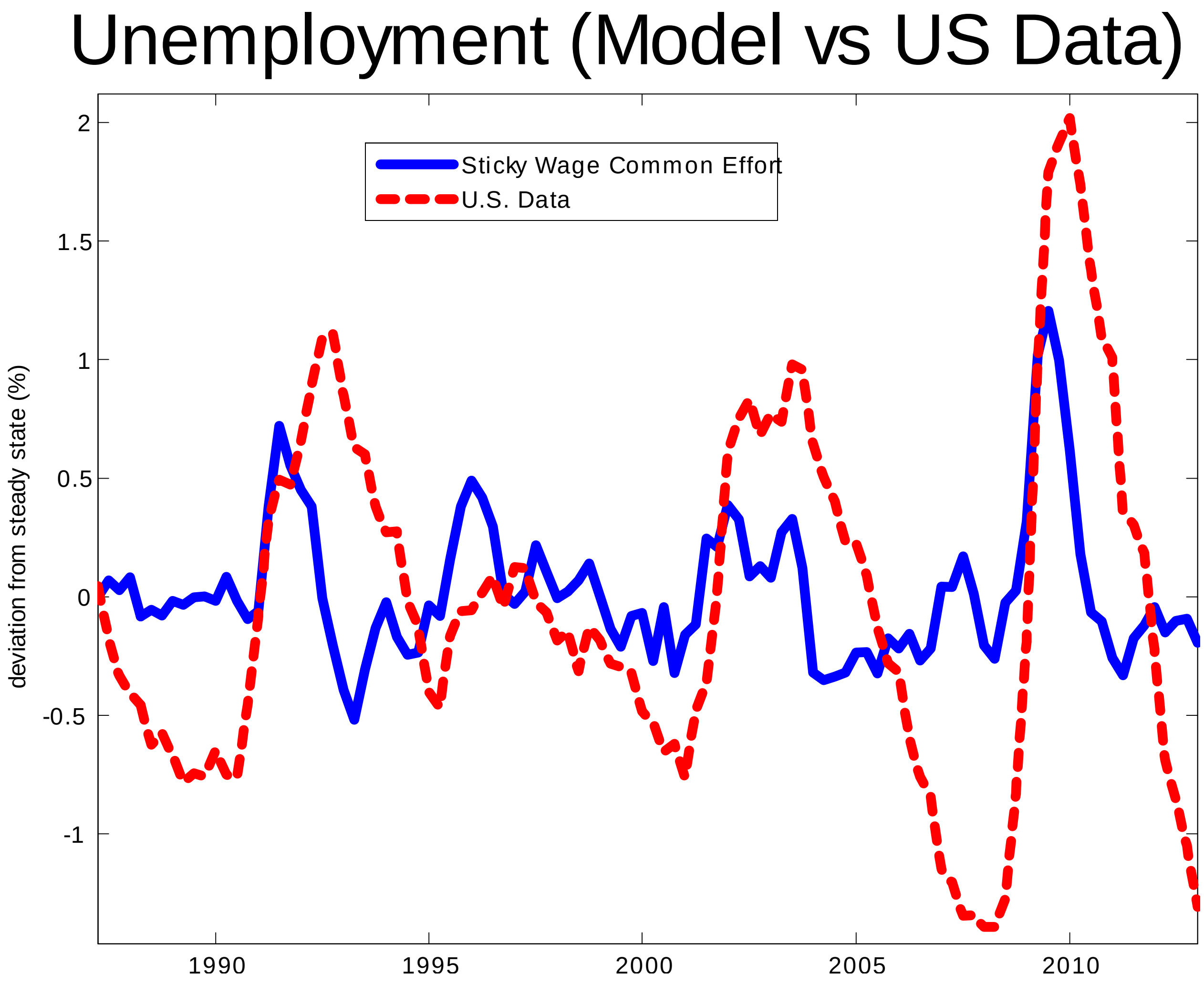
- Partly by making employment respond more

- Partly by making measured productivity less cyclical than shock

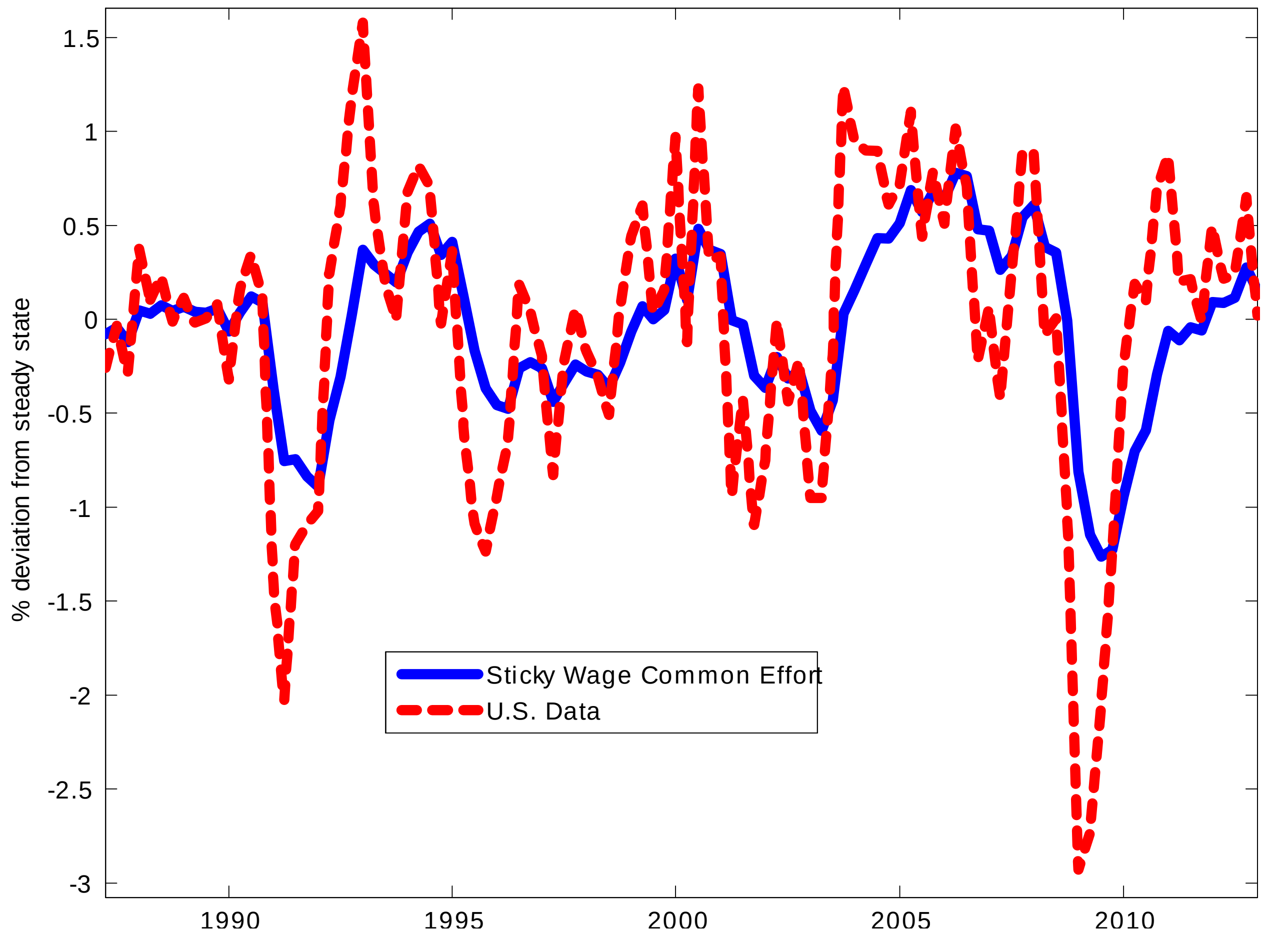
Productivitiy Shock = Measured TFP in US

Unemployment (Model vs US Data)



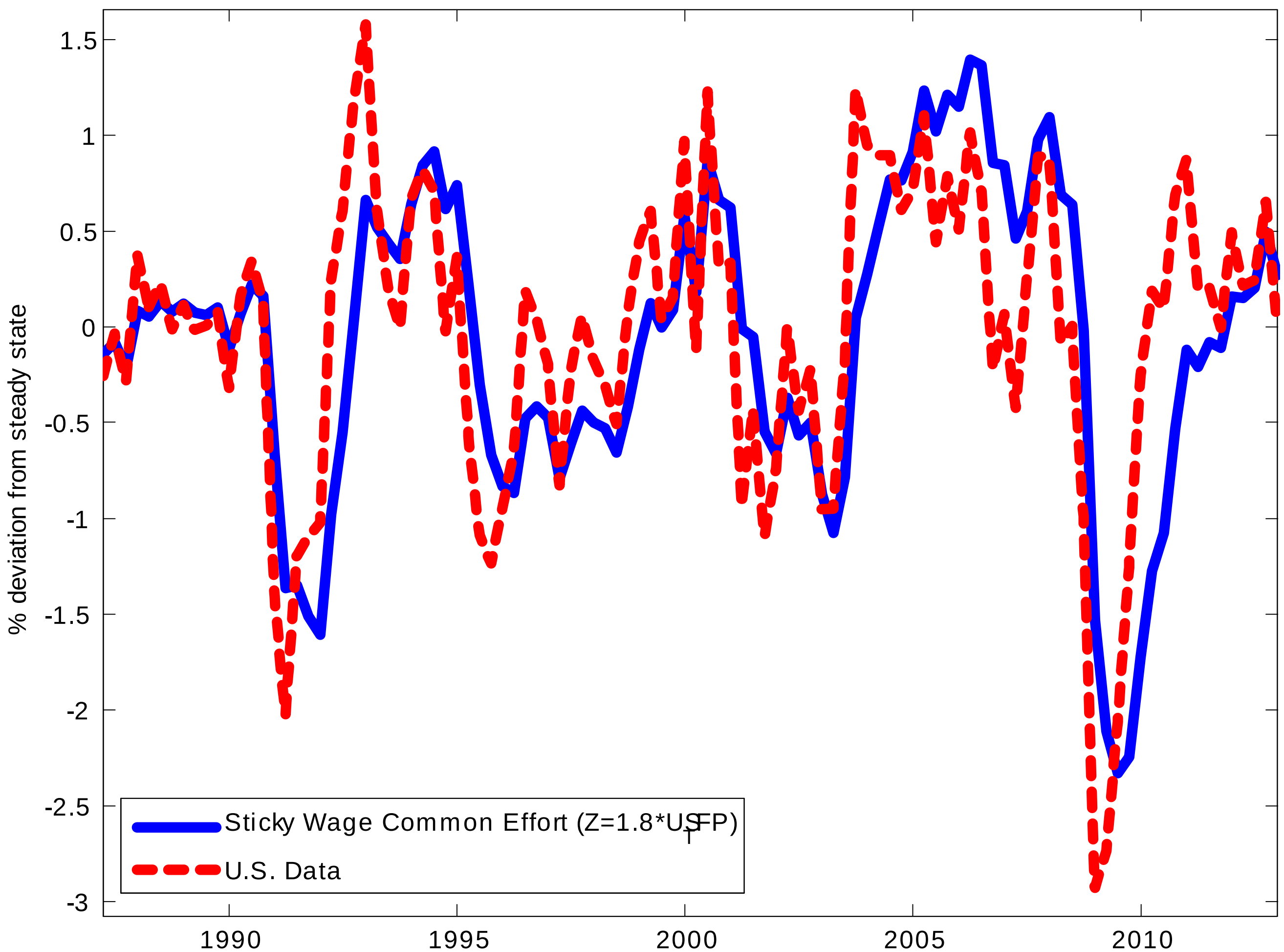

Unemployment (Model vs US Data)
Sticky Wage Common Effort
U.S. Data
deviation from steady state (%)
2
1.5
1
0.5
0
-0.5
-1
1990
1995
2000
2005
2010

Measured TFP (Model vs US Data)

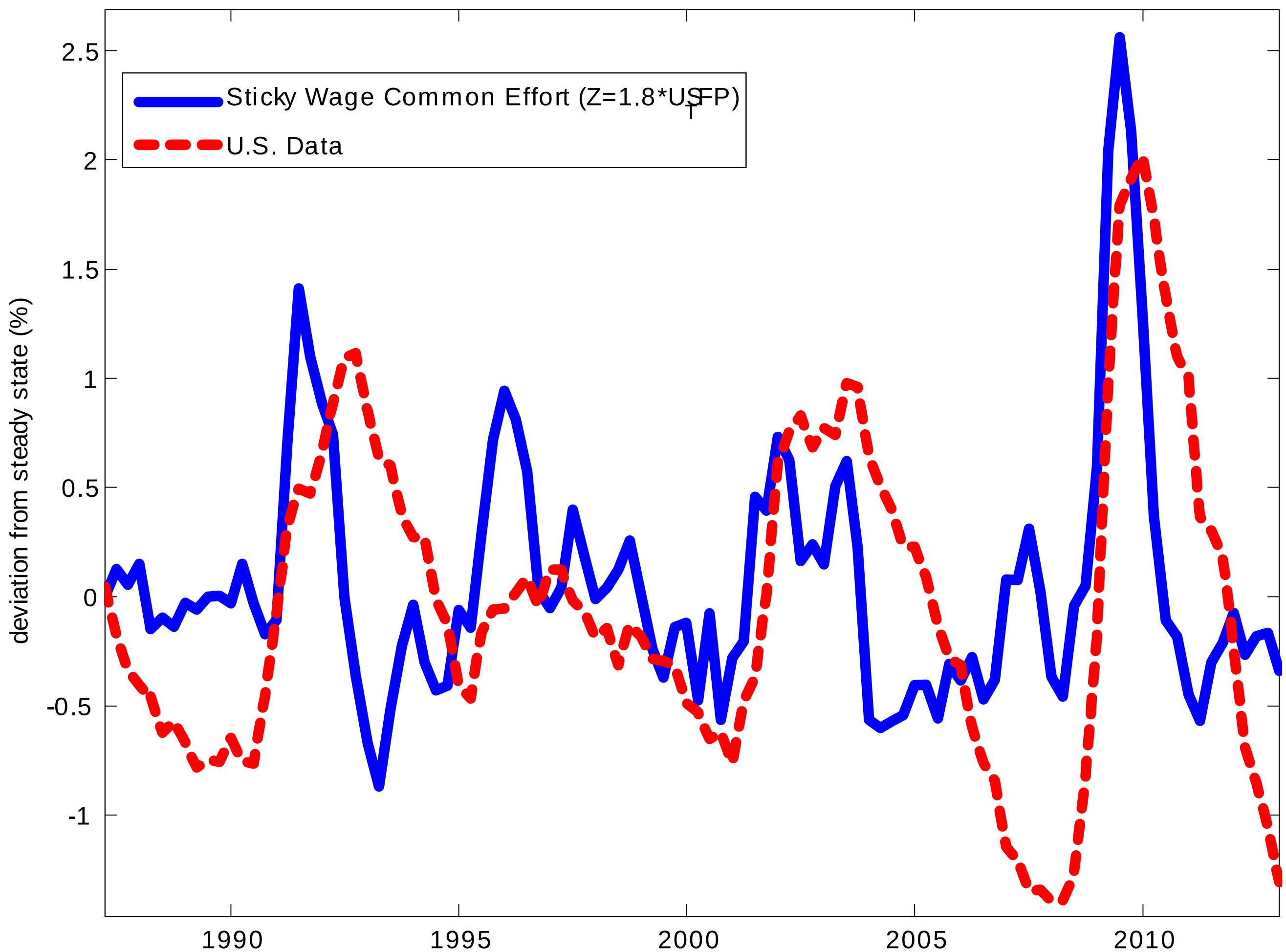


Productivitiy Shock = 1.8* Measured TFP in US

Measured TFP (Model vs US Data)



Unemployment (Model vs US Data)



3 Industry Wage and TFP Patterns

- Examine cyclicality of inputs, TFP, and wages by stickiness

$$\begin{pmatrix} x_{it} \\ y_{it} - x_{it} \\ w_{it} \end{pmatrix} = \alpha Y_t + \beta \left[s_{it} - \overline{s}_{it} \right] Y_t + error_{it}$$

- U.S. KLEMS Data for 60 Industries 1987-2010

- Measure wage stickiness by industry from frequency of wage changes in SIPP data

Correlation Cyclical Relative Wage and TFP

- Highly correlated for (HP) industry cycle

- Only in proportion to labor's share

Industry Wage and TFP Fluctuations

Dependent Variable = TFP for Value Added

Wage	0.54 (0.04)	−0.08 (0.09)
Wage*Labor's Share		1.13 (0.15)

60 industries by 24 years. Regressions include full set of year dummies. Industries weighted by value added.

Measuring Wage Stickiness

- Use 1990 to 2008 SIPP panels

  — Measure 4 and 8-month frequencies of change

- Allow for measurement error–assume change exactly reversed signifies error

  — Do under Calvo or Taylor: $\alpha_C = \dfrac{\Delta_2 - \Delta_1}{1 - \Delta_1}$

Frequency of Wage Changes SIPP, 1990-2011

	4-month	8-month	Error	Calvo	Taylor
1990-93 Panels (1990-95)	0.68	0.76	0.34	0.26	0.20
1996 Panel (1996-99)	0.75	0.85	0.36	0.39	0.28
2001 Panel (2001-04)	0.76	0.84	0.38	0.34	0.25
2004 Panel (2004-07)	0.39	0.55	0.07	0.28	0.22
2008 Panel (2008-11)	0.29	0.40	0.05	0.19	0.16
Average all Panels	0.57	0.69	0.25	0.29	0.22

Cyclicality by Industry Wage Stickiness

RHS variable is Duration(months)*Aggregate Real GDP

	Inputs	TFP	Wage
All 60 Industries	0.17 (.04)	−0.29 (.10)	0.22 (.06)
30 Low-Labor-Share Industries	0.13 (.04)	−0.20 (.15)	0.22 (.09)
30 High-Labor-Share Industries	0.15 (.07)	−0.45 (.14)	0.20 (.08)

Conclusion

- Breaks irrelevance of sticky wage for current workers

- Matters quantatively when tie effort levels–gives a lot of wage inertia
  - Bigger employment response
  - Mutes procyclical productivity

- Industry wage stickiness matters for cyclicality of TFP for industries with important labor share