

Macroeconomic implications of downward wage rigidity

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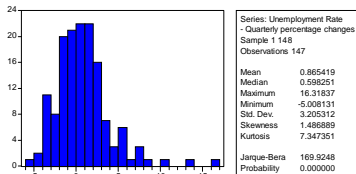
Downward real wage rigidity present in many OECD countries.

What are the macroeconomic implications of downward wage rigidity?

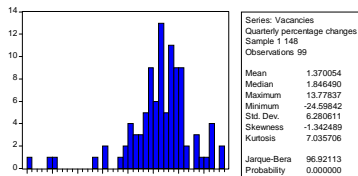
- 1 Asymmetries in labour market responses to shocks
- 2 Implications for duration and intensity of expansions and recessions
- 3 Implications for monetary policy

Evidence: Asymmetries in Economy and Labour Market

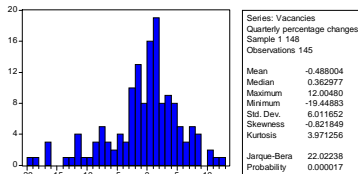
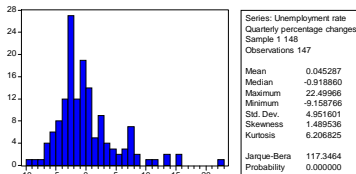
Unemployment



Vacancies



France



US

Evidence: Asymmetries in Economy and Labour Market

Skewness of different variables in first differences

	Δy_t	Δp_t	Δw_t	Δu_t	Δv_t
EA	-0.42	0.64	1.02	1.83	n.a.
US	-0.11	1.09	0.41	1.49	-0.82
FR	-0.22	0.86	0.35	1.49	-1.34
DE	0.64	0.83	-0.32	0.77	-0.49
UK	0.43	1.56	0.21	0.87	-1.09

Business cycles: Turning Point Analysis

Output

	Duration (quarters)			Growth Rates		Cumulative Δ	
	Cycle	Exp.	Rec.	Exp.	Rec.	Exp.	Rec.
EA	35.50	34.00	2.00	0.70	-0.72	23.8	-1.44
US	22.33	19.33	2.75	0.99	-0.86	19.14	-2.36

Table: Analysis obtained with Harding-Pagan algorithm

Employment

	Duration (quarters)			Growth Rates		Cumulative Δ	
	Cycle	Exp.	Rec.	Exp.	Rec.	Exp.	Rec.
EA	19.67	12.50	8.00	0.03	-0.21	0.38	-1.68
US	18.00	10.43	8.00	0.18	-0.33	1.88	-2.64

Table: Analysis obtained with Harding-Pagan algorithm after applying Rotemberg filter for detrending.

Summarizing the empirical regularities

● Moments analysis

- ▶ Unemployment growth rates are positively skewed
- ▶ Vacancy growth rates are negatively skewed
- ▶ Results are ambiguous for output growth

● Turning points

- ▶ Output Cycle and Employment Cycle: long and smooth recessions, but sharp and short recessions

● Possible explanations

- ▶ Lumpy job destruction in recessions
- ▶ Complementarity with capital might exacerbate the effect of this margin
- ▶ Asymmetric adjustment costs (hiring and training costly and timely, firing immediate and often less costly)

● In this paper instead

- ▶ Focus on the job-creation margin
- ▶ Can downward wage rigidity reconcile the stylized facts?

Related studies

• **Downward Wage Rigidity: Empirical Evidence**

- ▶ Worker level: Dickens et al. (2007), International Wage Flex. Project, Wage Dynamics Network
- ▶ Industry level: Holden & Wulfsberg (2007,2008)

• **Downward Wage Rigidity: Theory**

- ▶ Downward nominal wage rigidity: e.g. Elsby (2007), Benigno & Ricci (2008), Fagan and Messina (2008), Fahr & Smets (2008)
- ▶ Downward wage rigidities and employment fluctuations: Costain and Jansen (2006)

• **Asymmetries in the labour market (job destruction)**

- ▶ Job destruction: Davis, Haltiwanger and Shuh (1996)
- ▶ Complementarity with capital: den Haan, Ramey, Watson (2000)

• **Asymmetries of the cycle**

- ▶ Harding & Pagan (2002)
- ▶ McKay & Reis (2008)

● **Asymmetric labour market adjustment:**

- ▶ **Booms:** real wages increase strongly, limiting vacancy posting and employment creation; strong increase in inflation
- ▶ **Recessions:** real wages respond slowly, strong decline in vacancy posting and employment; reaction of inflation is smaller
- ▶ The model replicates skewness of vacancy and unemployment growth and the implications for employment

● **Labour Market Rigidities and Business Cycles:**

- ▶ Labour market rigidities can explain the differences between the US and EA business cycle
- ▶ Downward wage rigidities leads to more pronounced recessions but doesn't affect the length of the cycle

● **Implications for Monetary Policy**

- ▶ Inflation targeting: lowers inflation volatility but expansions become shorter and recessions more violent
- ▶ Including employment stabilization smoothes recessions and lengthens expansions (under EA calibration: from 30 to 44 quarters)

The Model

- Standard New Keynesian model with search and matching for the labor market (Ravenna and Walsh 2008)
- Sticky prices in the retail sector (Rotemberg adjustment costs)
- Downward wage rigidities: Hall's (2005) notion of wage norm
 - ▶ real wage is a linear combination of last period's wage and of the desired Nash bargained one
 - ▶ varying weight on Nash bargained or past period's wage depending on desired wage growth
- Solution method: second order approximation (Dynare)

Supply Side: Wholesalers

- Profit maximization of firms leads to free entry condition (job creation condition)

$$\frac{\kappa_t}{q_t} = \varphi_t A_t (z_t h_t)^\alpha - w_t^R h_t + (1 - \rho) \mathbb{E}_t \left[\beta \frac{\lambda_{t+1}}{\lambda_t} \frac{\kappa_{t+1}}{q_{t+1}} \right]$$

- A_t is permanent productivity level
 z_t is relative productivity to permanent level

$$\ln z_t = \rho_a \ln z_{t-1} + \varepsilon_t^z$$

$$g_{a,t} \equiv \frac{A_t}{A_{t-1}} = (1 - \rho_a) g_a + \rho_a g_{a,t-1} + \varepsilon_t^{g_a}$$

ε_t^z : shock to transitory productivity

$\varepsilon_t^{g_a}$: shock to growth rate of aggregate productivity level

Wage rigidity

- Following Hall (2005) the real wage w_t^R is a weighted average of the Nash bargained wage w_t^N and a wage norm $w_{t-1}^R g_a$ (the wage in the previous, adjusted for productivity growth)

$$w_t^R = \left(w_t^N\right)^{\gamma(\Omega_t)} \left(w_{t-1}^R g_a\right)^{1-\gamma(\Omega_t)}$$

- The index of wage rigidity depends on the state of the economy:

$$\gamma(\Omega_t) = \left(1 + \tau_2 \exp \left[-\tau_1 \left(\frac{w_t^N}{w_{t-1}^R g_a} - 1 \right) \right] \right)^{-1}$$

- Intuition: if $w_t^N > w_{t-1}^R g_a$ (wage growth) large weight is given to the desired wage;
if $w_t^N < w_{t-1}^R g_a$ (wage cuts) more weight is given to past wages / wage norm

Wage adjustment

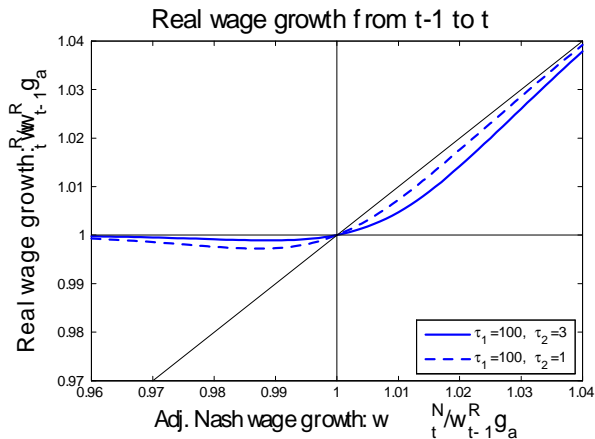


Figure: Real wage growth as function of adjusted Nash wage growth.

Monetary policy

- The model is closed with a specification for monetary policy:

$$r_t = (r_{t-1})^{\omega_r} \left[\left(\frac{P_t}{P_{t-1}} \right)^{\omega_\pi} \left(\frac{N_t}{\bar{N}} \right)^{\omega_n} \right]^{1-\omega_r} \varepsilon_t^m$$

- Baseline calibration: $\omega_r = 0.85$, $\omega_\pi = 1.5$, $\omega_n = 0$ (inflation targeting)
- Alternative specifications:
 - ▶ stricter inflation targeting ($\omega_\pi = 5$)
 - ▶ employment stabilisation ($\omega_\pi = 1.5$, $\omega_n = 0.25$).

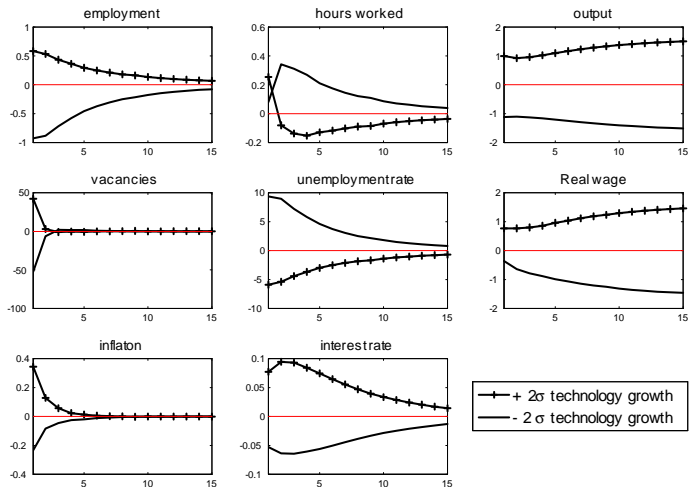
Calibration: key parameters

Param	Value	Calibration
η	0.5	Worker's bargaining power
ϑ	0.5	Search elast. matching fct.
ρ	0.033/0.12	Exog. job separation rate (EU/US)
s	0.25/0.7	Job-finding rate (EU/US)
b	0.6	Unemployment benefits, Replacement rate
τ_1	1	Wage rigidity in steady state, implies $\gamma = 0.5$
τ_2	0/100	Degree of asymmetry
g	0.5%	Quarterly growth rate of productivity
ρ_a	0.85	Persistence of permanent technology shock
ρ_z	0.95	Persistence of transitory technology shock
σ_a	0.12%	Std. dev. permanent shock
σ_z	0.5%	Std. dev. transitory shock
σ_m	0.1%	Std. dev. monetary shock

Permanent productivity shock

Permanent effects on the productivity level

2 σ technology growth shock: asymmetric wage adjustments



Observations and implications of DRWR: Dynamics

- A fundamental asymmetry appears in the response to positive and negative productivity shocks:
 - ▶ Positive: real wages and inflation increase strongly, limiting vacancy posting and employment creation
 - ▶ Negative: shocks are mainly absorbed through a strong decline in vacancy posting and employment, while reaction of wages and inflation is smaller
- Employment and hours worked have opposite dynamics: Effects on output are dampened, part of the asymmetry is absorbed.

Asymmetries in the Labor Market: Moments

Skewness of different variables in growth rates

	Δy_t	Δh_t	Δw_t	Δu_t	Δv_t
Model: No DRWR	0.02	-0.01	0.00	-0.06	-0.01
Model: With DRWR	-0.27	0.28	1.12	0.79	-0.25
EA data	-0.42	0,64	1.02	1.83	n.a.

Asymmetries in the Labor Market: Employment Cycle

Turning Point Analysis for Euro Area

	Duration			Growth Rates		Cumulative Δ	
	Cycle	Exp.	Rec.	Exp.	Rec.	Exp.	Rec.
Model: No DRWR	14.55	7.29	7.25	0.32	-0.40	2.34	-2.88
Model: DRWR	14.70	8.15	6.55	0.30	-0.47	2.42	-3.11
EA Data	19.67	12.50	8.00	0.03	-0.21	0.38	-1.68

Labour Market Rigidities and the Business Cycle

- How do different labor market structures affect the length and intensity of expansions and recessions?
- 5 calibration:
 - 1 US
 - 2 EU
 - 3 Strong wage rigidity
 - 4 Downward wage rigidity
 - 5 Strong price rigidity

Labour Market Rigidities and the Business Cycle

	Duration		
	Cycle	Exp.	Rec.
US calib. $\bar{u} = 5\%, \bar{s} = 0.7$ $\gamma = 0.5$	24.59	20.35	4.24
EU Calib. $\bar{u} = 9\%, \bar{s} = 0.25$ $\gamma = 0.5$	29.50	24.77	4.73
High RWR EU, $\gamma = 0.25$	23.30	19.01	4.29
DRWR $\gamma = 0.5, \tau_2 = 100$	29.15	24.90	4.25
High Price stick. $\gamma = 0.5, \tau_2 = 100$ $\psi = 100$	29.50	25.12	4.38

Labour Market Rigidities and the Business Cycle

	Duration			Growth Rates		
	Cycle	Exp.	Rec.		Exp.	Rec.
US calib. $\bar{u} = 5\%, \bar{s} = 0.7$ $\gamma = 0.5$	24.59	20.35	4.24	y_t	0.77	-0.61
				n_t	0.18	-0.93
				h_t	-0.08	0.49
EU Calib. $\bar{u} = 9\%, \bar{s} = 0.25$ $\gamma = 0.5$	29.50	24.77	4.73	y_t	0.67	-0.24
				n_t	0.07	-0.49
				h_t	-0.03	0.17
High RWR EU, $\gamma = 0.25$	23.30	19.01	4.29	y_t	0.73	-0.46
				n_t	0.13	-0.70
				h_t	-0.05	0.31
DRWR $\gamma = 0.5, \tau_2 = 100$	29.15	24.90	4.25	y_t	0.69	-0.60
				n_t	0.08	-0.76
				h_t	-0.03	0.33
High Price stick. $\gamma = 0.5, \tau_2 = 100$ $\psi = 100$	29.50	25.12	4.38	y_t	0.69	-0.30
				n_t	0.08	-0.55
				h_t	-0.03	0.22

Labour Market Rigidities and the Business Cycle: Results

- Rigid labour markets (lower job-finding and separation rates):
⇒ cycle longer and smoother
- Rigid wages
⇒ cycle shorter and more intense
- Downward wage rigidity:
⇒ no effect on length of cycle,
⇒ but recessions are more violent

(cumulative output loss: from -1.14 to -2.56)

Implications of Monetary Policy on business cycle

Mon. pol.	Duration			Growth Rates		
	Cycle	Exp.	Rec.		Exp.	Rec.
Baseline $\omega_\pi = 1.5, \omega_n = 0$	29.39	25.37	4.02	y_t	0.67	-0.42
				n_t	0.06	-0.60
				h_t	-0.03	0.28
Strict Inflation target $\omega_\pi = 5, \omega_n = 0$	26.23	22.39	4.01	y_t	0.69	-0.59
				n_t	0.10	-0.71
				h_t	-0.05	0.34
Employment stab. $\omega_\pi = 1.5, \omega_n = 0.25$	44.06	39.67	4.39	y_t	0.60	-0.36
				n_t	0.03	-0.52
				h_t	-0.01	0.14

Monetary Policy and Inflation and Growth Volatility

- Effects of Monetary policy on business cycle:
 - ▶ Strict IT shortens expansionary phase, recessions more violent
 - ▶ Employment stabilization lengthens and smoothens the cycle, but higher inflation volatility
- Intuition:
 - ▶ In the presence of real wage rigidities a trade-off of monetary policy arises (Blanchard and Galì 2007)
 - ▶ When wages are downwardly rigid, this trade-off is felt more intensively exactly when it hurts more: during a recessions
- Employment stabilization reduces the asymmetric response of unemployment and wages and shifts the asymmetry to inflation.

Conclusion

- Downward real wage rigidities introduce a fundamental asymmetry in the labor market response to shocks:
 - ▶ vacancies are negatively skewed
 - ▶ unemployment positively skewed
 - ▶ skewness of output is small
- Recessions are brief and more violent when wages are downwardly rigid
- Monetary policy implications: some recessions may be avoided if the central bank puts a (mild) weight to employment stabilization
- Important: welfare implications still need to be evaluated

APPENDIX

Summarizing the empirical regularities

● Moments analysis

- ▶ Unemployment growth rates are positively skewed
- ▶ Vacancy growth rates are negatively skewed
- ▶ Results are ambiguous for output growth

● Turning points

- ▶ Output Cycle and Employment Cycle: long and smooth recessions, but sharp and short recessions

● Possible explanations

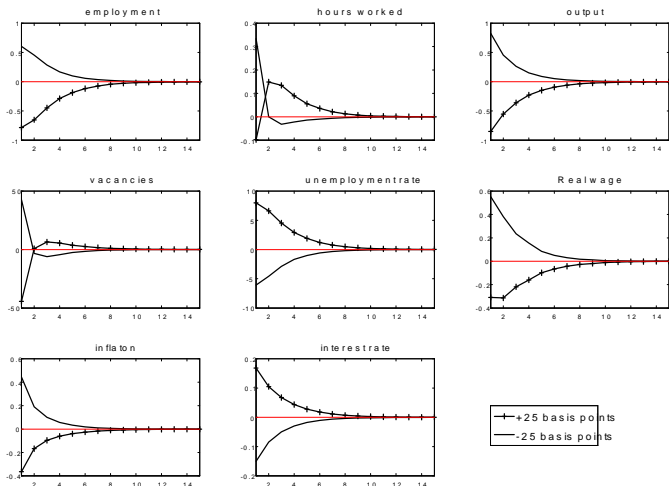
- ▶ Lumpy job destruction in recessions
- ▶ Complementarity with capital might exacerbate the effect of this margin
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● In this paper instead

- ▶ Focus on the job-creation margin
- ▶ Can downward wage rigidity reconcile the stylized facts?

Monetary policy shock

Monetary shock by 25 basis points: asymmetric wage adjustment



Monetary Policy and Inflation and Growth Volatility

Std. Dev. of different variables in growth rates

	Δy_t	Δp_t	Δu_t	Δw_t	Δi_t
Baseline	0.92	0.28	0.55	0.50	0.05
Strict Inflation target	1.00	0.09	0.61	0.53	0.07
Employment stab.	0.59	0.95	0.36	0.36	0.14

Skewness of different variables in growth rates

	Δy_t	Δp_t	Δu_t	Δw_t	Δi_t
$\omega_\pi = 1.5, \omega_n = 0$	-0.24	0.15	0.70	1.22	0.08
$\omega_\pi = 5, \omega_n = 0$	-0.47	0.02	0.97	1.09	0.02
$\omega_\pi = 1.5, \omega_n = 0.25$	-0.03	0.79	0.46	0.75	0.31

Business cycles: Turning Point Analysis

Output

	Duration			Growth Rates		Cumulative Δ	
	Cycle	Exp.	Rec.	Exp.	Rec.	Exp.	Rec.
EA	35.50	34.00	2.00	0.70	-0.72	23.8	-1.44
US	22.33	19.33	2.75	0.99	-0.86	19.14	-2.36
France	72.00	70.00	3.00	0.61	-0.63	42.70	-1.89
Germany	28.50	25.00	3.00	0.92	-0.50	23.00	-1.50
UK	34.00	29.00	5.00	0.72	-0.90	20.88	-4.50

Employment

	Duration			Growth Rates		Cumulative Δ	
	Cycle	Exp.	Rec.	Exp.	Rec.	Exp.	Rec.
EA	19.67	12.50	8.00	0.03	-0.21	0.38	-1.68
US	18.00	10.43	8.00	0.18	-0.33	1.88	-2.64
France	15.00	9.00	6.22	0.08	-0.28	0.72	-1.74
Germany	22.00	12.40	10.67	0.10	-0.26	1.24	-2.77
UK	15.63	8.22	7.25	0.12	-0.23	0.99	-1.66

Values of

γ

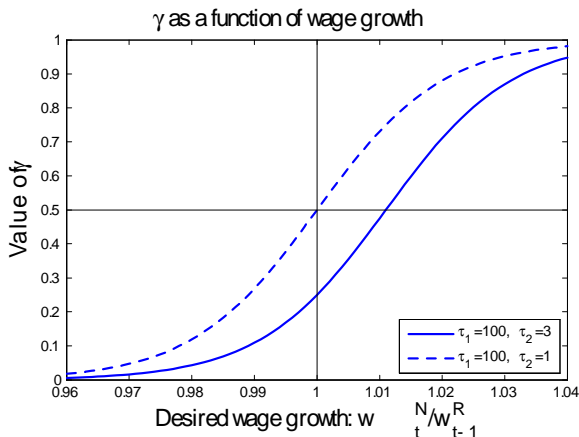


Figure: The parameter for wage rigidity as a function of bargained real wage growth. Higher wage growth implies higher levels for γ implying lower wage rigidity. Potential wage cuts lead to lower levels of γ and thereby stronger wage rigidity. The functional form follows a logistic function. Two parameterisations

Steady state results

Steady state results

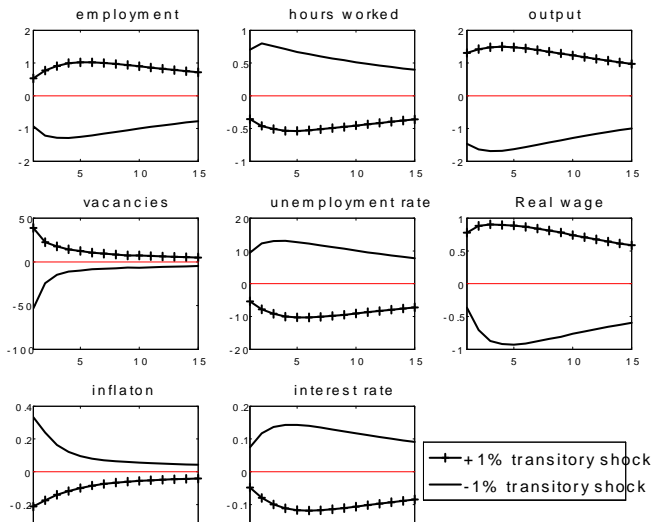
Impulse response functions for three shocks

Questions:

Transitory productivity shock

Adjustment back to Balanced growth path

1% transitory technology shock: asymmetric wage adjustments

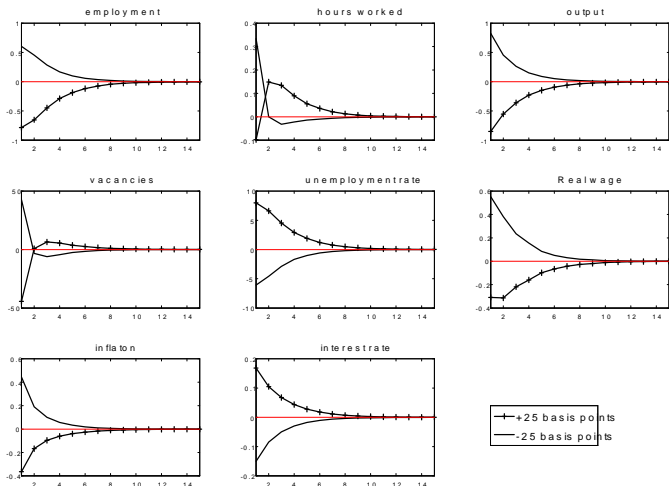


Effects of these three shocks

- Common features
- Transitory productivity shock
- Permanent productivity shock
- Monetary policy shock

Monetary policy shock

Monetary shock by 25 basis points: asymmetric wage adjustment



Evidence: Asymmetries in Cycles and Labour Markets

- Evidence for EA,US,DE,FR,UK using two measures of asymmetry
 - ① Skewness of growth rates of selected variables
 - ★ Vacancy, unemployment, output, wages, prices
 - ② Turning point analysis
 - ★ Harding and Pagan (2002) adaptation of the Bry-Boschan algorithm to identify expansions and recessions
 - ★ McKay and Reis (2008)

Household problem

- Household maximisation

$$\max \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{C_t^{1-\sigma}}{1-\sigma} - \chi \frac{h_t^{1+\phi}}{1+\phi} n_t \right]$$

s.t. standard budget constraint and the law of motion of labour market

$$\begin{aligned} n_t &= (1 - \rho) n_{t-1} + m_t \\ m_t &= \bar{m} u_t^\vartheta v_t^{1-\vartheta} \end{aligned}$$

where $u_t = 1 - (1 - \rho) n_{t-1}$ are *searching workers* at beginning of period t

Supply Side: Retailers

- Two sectors of production: retailers (monopolistic) and wholesaler (matching)
- Monopolistic Retailers with price adjustment costs:

$$\max_{P_t(z)} E_0 \sum_{t=0}^{\infty} \beta^t \frac{\lambda_t}{\lambda_0} \left[\frac{P_t(z) - P_t \varphi_t}{P_t} - \Gamma_t \right] Y_t(z)$$

where φ_t is the relative price of the intermediate good and Γ_t are convex adjustment costs (Rotemberg) for price changes.

Profit maximization:

$$\Gamma'_t \Pi_t = \epsilon_t (\varphi_t + \Gamma_t) - (\epsilon_t - 1) + \beta \mathbb{E}_t \left[\left(\frac{C_{t+1}}{C_t} \right)^{-\sigma} \frac{Y_{t+1}}{Y_t} \Gamma'_{t+1} \Pi_{t+1} \right]$$

Wage negotiations

- Wages and hours are jointly determined according to the maximization of the following Nash criterion

$$\arg \max_{\{w_t, h_t\}} \left[J_t^{1-\eta} (W_t - U_t)^\eta \right]$$

- The FOC give a condition for hours and a condition for the Nash wage

$$\frac{\chi}{\lambda_t} h_t^\phi = \alpha \varphi_t A_t z_t^\alpha h_t^{\alpha-1}$$

$$w_t^N h_t = b_t + \frac{\chi}{\lambda_t} \frac{h_t^{1+\phi}}{1+\phi}$$

$$+ \frac{\eta}{1-\eta} \left\{ \frac{\kappa_t}{q_t} - \beta (1-\rho) \mathbb{E}_t \left[\frac{\lambda_{t+1}}{\lambda_t} (1-s_{t+1}) \frac{\kappa_{t+1}}{q_{t+1}} \right] \right\}$$

Stabilization with monetary policy

- **Monetary policy:**

$$r_t = (r_{t-1})^{\omega_r} \left[\left(\frac{P_t}{P_{t-1}} \right)^{\omega_\pi} \left(\frac{N_t}{\bar{N}} \right)^{\omega_n} \right]^{1-\omega_r} \varepsilon_t^m$$

- Baseline calibration: $\omega_r = 0.85$, $\omega_\pi = 1.5$, $\omega_n = 0$
- 2 alternatives:
 - ① Strict Inflation Targeting: $\omega_\pi = 5$, $\omega_n = 0$
 - ② Mild reaction to employment: $\omega_\pi = 1.5$, $\omega_n = 0.25$