Lecture 7: Labour Economics and Wage-Setting Theory

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Litterature: Calmfors, L. and Larsson, A. (2013) "Pattern Bargaining and Wage Leadership in A Small Open Economy", Scandinavian Journal of Economics 115, 109-140

Background

- Conventional wisdom - Scandinavian model of wage formation: under fixed exchange rates, international competition promotes wage restraint in the tradables sector, which spreads to the rest of the economy.
- Pattern bargaining key feature of wage bargaining in many European countries. The tradables (manufacturing) sector typically acts as wage leader.
- Especially service sector employers have started to question the wage leadership role of manufacturing.
  - not due account of interests of service sector.
  - the service sector is larger than manufacturing.

Issues

How do macroeconomic outcomes depend on the choice of wage leader?

How do the consequences of different choices of wage leadership differ between monetary regimes

- flexible exchange rate and inflation targeting
- fixed exchange rate (monetary union)

How does the size of the wage leader affect outcomes?

Why do subsequent wage bargains tend to mimic the leader's bargain?

Or should one expect the leader's bargain to set a floor for subsequent bargains?

Model set-up

Wage leadership analysed as Stackelberg game.

- comparisons with Nash game (uncoordinated bargaining).

First part: standard trade union utility functions

- trade unions try to maximise rents from unionisation.

Second part: norm setting on the part of the leader

- wage comparisons matter for utility of follower trade union.
- Kahneman-Tversky loss aversion.

Main results

1. **No (or very weak) support for the conventional wisdom that wage leadership for the tradables sector promotes wage moderation and employment**

   under inflation targeting and standard union utility functions the choice of wage leader does not matter.

   under monetary union and standard union utility functions leadership for the **non-tradables sector** promotes employment.

2. **Comparison thinking and loss aversion may promote employment**

   if it causes the follower to mimic the wage of the leader.

   this can only happen if the smaller sector is wage leader and the follower is sufficiently loss averse.

The model

- A tradables and a non-tradables sector.
- Perfectly competitive firms in each sector.
- Given foreign-currency price of tradables from the world market.
- Domestic market clearing determines the price of non-tradables.
- Wage bargaining between one trade union and one employers' association in each sector.

Timing

- Wages are set.
- Monetary policy (exchange rate) is determined.
- Production, employment, consumption and prices are determined.

The model is solved through backward induction.

Stage 3: Individual choices and market clearing

Firms

Profit maximisation of firms

$$\max_{N_i} \Pi_i = \left(P_i Y_i - W_i N_i \right) / P$$

Production function

$$Y_i = \frac{1}{\theta_i} N_i^{\theta_i}$$

Sectoral employment function

$$N_i = \left(\frac{W_i}{P_i} \right)^{-\eta_i},$$

where $\eta_i = (1 - \theta_i)^{-1} > 1$.

Stage 3: Individual choices and market clearing cont.

Firms cont.

Supply function

$$Y_i = \frac{1}{\theta_i} \left(\frac{W_i}{P_i} \right)^{-\sigma_i},$$

where $\sigma_i = \theta_i / (1 - \theta_i)$.

Profit function

$$\Pi_i = \frac{1}{\eta_i - 1} \frac{W_i}{P} \left(\frac{W_i}{P_i} \right)^{-\eta_i}$$

Stage 3: Individual choices and market clearing

Households

Households spend all their income

$$\max_{C_N, C_T} C_N^{\gamma} C_T^{1-\gamma}$$

Goods demand functions

$$\begin{aligned} C_N &= \gamma \frac{I}{P_N} \\ C_T &= (1-\gamma) \frac{I}{P_T}. \end{aligned}$$

CPI

$$P = P_N^{\gamma} P_T^{1-\gamma},$$

where γ is the budget share of non-tradables.

Stage 3: Individual choices and market clearing

Market Clearing

Market clearing for non-tradables, aggregate budget constraint and assumption of same production technology

$$\frac{P_N}{P_T} = \left(\frac{\gamma}{1-\gamma}\right)^{1-\theta} \left(\frac{W_N}{W_T}\right)^{\theta}$$

P_N / P_T is uniquely determined by W_N / W_T.

Increase in W_N / W_T gives less than proportional increase in P_N / P_T.

Stage 3: Individual choices and market clearing

Employment in each sector depends negatively on real consumption wages in both sectors

$$\begin{aligned} N_N &= w_N^{-\eta} \left(\frac{w_N}{w_T}\right)^{(1-\gamma)\sigma} \left(\frac{\gamma}{1-\gamma}\right)^{(1-\gamma)} \\ N_T &= w_T^{-\eta} \left(\frac{w_T}{w_N}\right)^{\gamma\sigma} \left(\frac{\gamma}{1-\gamma}\right)^{-\gamma}. \end{aligned}$$

$$w_i = \frac{W_i}{P}$$

Aggregate employment

$$\overline{N} = \left(\frac{w_N}{w_T}\right)^{(1-\gamma)\sigma} \left(\frac{\gamma}{1-\gamma}\right)^{(1-\gamma)} w_N^{-\eta} + \left(\frac{w_T}{w_N}\right)^{\gamma\sigma} \left(\frac{\gamma}{1-\gamma}\right)^{-\gamma} w_T^{-\eta}$$

Stage 2: Monetary Policy

- Independent central bank sets the nominal exchange rate in order to attain the monetary target.
- Inflation target: $d \ln P = 0$.
- Monetary Union: $d \ln P_T = 0$.
- Law of one price holds for tradables: $P_T = EP_T^*$.

Stage 1: Wage setting

The nominal wage in sector i, W_{im}, maximises

$$\left[N_{im}\left(\frac{W_{im}}{P_m}-b\right)\right]^{\lambda_i}\left[(\eta-1)^{-1}\,\frac{W_{im}}{P_m}\left(\frac{W_{im}}{P_{im}}\right)^{-\eta}\right]^{(1-\lambda_i)}$$

subject to

$$\begin{aligned}
N_{im} &= \left(\frac{W_{im}}{P_{im}}\right)^{-\eta} \\
P_m &= P(W_{im}, W_{jm}) \\
P_{im} &= P_i(W_{im}, W_{jm}) \\
W_{jm} &= f\left(W_{im}\right).
\end{aligned}$$

Bargained wage

Real wage

$$w_{im} = \frac{W_{im}}{P_m} = [1 + \lambda_i M_{im}]\, b,$$

The real consumption wage in a sector is a mark-up on the value of unemployment.

$$\begin{aligned} M_{im} &= \epsilon_{im} / (\eta \varphi_{im} - \epsilon_{im}) \\ \varphi_{im} &= (1 - d \ln P_i / d \ln W_i)_m \\ \epsilon_{im} &= (1 - d \ln P / d \ln W_i)_m \end{aligned}$$

$d \ln P_i / d \ln W_i$ and $d \ln P / d \ln W_i$ differ depending on monetary regime and what sector is wage leader.

The monetary regime and wage leadership

$$d \ln P = \gamma d \ln P_N + (1- \gamma) d \ln P_T .$$

$$d \ln P_N - d \ln P_T = \theta \left(d \ln W_N - d \ln W_T \right) .$$

Inflation targeting: $d \ln P = 0$.

Monetary union: $d \ln P_T = 0$.

Stackelberg leader i also takes into account that $f' > 0$ in $W_{jm} = f\left(W_{im}\right)$.

In Nash equilibrium and for follower j $f' = 0$.

Regime-specific mark-ups under different bargaining set-ups

Leader	(1) *Nash*	(2) *N*	(3) *T*
M_{NI}	$\frac{1-\theta}{\gamma\theta}$	$\frac{1-\theta}{\gamma\theta}$	$\frac{1-\theta}{\gamma\theta}$
M_{TI}	$\frac{1-\theta}{(1-\gamma)\theta}$	$\frac{1-\theta}{(1-\gamma)\theta}$	$\frac{1-\theta}{(1-\gamma)\theta}$
M_{NM}	$\frac{1-\gamma\theta}{\gamma\theta}$	$\frac{1-\theta}{\gamma\theta}$	$\frac{1-\gamma\theta}{\gamma\theta}$
M_{TM}	$\frac{(1+\gamma\theta)(1-\theta)}{\theta(1-\gamma+\gamma\theta)}$	$\frac{(1+\gamma\theta)(1-\theta)}{\theta(1-\gamma+\gamma\theta)}$	$\frac{1-\theta}{(1-\gamma)\theta}$

- Under inflation targeting, the Nash equilibrium coincides with the two Stackelberg equilibria, since $M_{il}^{Nash} = M_{il}^{N} = M_{il}^{T}$ for $i = N, T$.
- So, it does not matter what sector is wage leader under pattern bargaining and pattern bargaining always gives the same outcome as uncoordinated bargaining.
- Leader takes into account that

$$\frac{d \ln W_j}{d \ln W_i} = \frac{d \ln P}{d \ln W_i},$$

but since $d \ln P = 0$ under inflation targeting, the leader solves the same optimisation problem as the follower (and as in the Nash game).

- In a monetary union, the real consumption wage in a sector is the same when the sector is wage follower in a Stackelberg game as in a Nash game, since $M_{iM}^{j} = M_{iM}^{Nash}$ for $i, j = N, T$, $i \neq j$.
- The follower in a Stackelberg game solves the same optimisation problem as it would in a Nash game.
- In a monetary union, the real consumption wage in the non-tradables sector is lower in the Stackelberg game when the sector is wage leader than in the Nash game, as $M_{NM}^{Nash,T} > M_{NM}^{N}$.
- The Stackelberg game with the non-tradables sector as wage leader results in higher employment in both sectors than in the Nash game.
- The real consumption wage in the tradables sector is higher in the Stackelberg game when the sector is leader than in the Nash game, as $M_{TM}^{T} > M_{TM}^{Nash,N}$.
- The Stackelberg game with the tradables sector as leader results in lower employment in both sectors than in the Nash game.

Intuition for higher wage in the tradables sector when it is leader

- A wage increase in the tradables sector reduces output there.
- As a consequence demand for non-tradables, the price of non-tradables and the CPI fall.
- The CPI fall strengthens the incentive to raise wages in the tradables sector.

- The CPI fall causes the wage in the non-tradables sector to fall.
- This reduces the CPI even more and strengthens the incentive to raise the wage in the tradables sector.

Intuition for lower wage in the non-tradables sector when it is leader

- A wage increase in the non-tradables sector raises the price of non-tradables and the CPI.

- The CPI rise causes the wage in the tradables sector to rise.
- As a consequence demand for non-tradables falls, which tends to offset the rise in the price of non-tradables.
- The smaller rise in the price of non-tradables means a larger fall in employment in the non-tradables sector.
- This reduces the incentive to raise the wage in the non-tradables sector.

Table 7: Equilibrium outcomes without wage norms, $\lambda_N = \lambda_T = .5$

Regime	Inflation Targeting						Monetary Union					
Leader	*Nash*	*Nash*	*N*	*N*	*T*	*T*	*Nash*	*Nash*	*N*	*N*	*T*	*T*
γ	.25	.75	.25	.75	.25	.75	.25	.75	.25	.75	.25	.75
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
w_N	1.50	1.17	1.50	1.17	1.50	1.17	3.00	1.33	1.50	1.17	3.00	1.33
w_T	1.17	1.50	1.17	1.50	1.17	1.50	1.16	1.24	1.16	1.24	1.17	1.50
N_N	.12	.47	.12	.47	.12	.47	.03	.34	.13	.58	.031	.28
N_T	.47	.12	.47	.12	.47	.12	.24	.12	.49	.18	.237	.08
N	.60	.60	.60	.60	.60	.60	.28	.46	.61	.76	.268	.36
V_N	.06	.08	.06	.08	.06	.08	.06	.11	.06	.10	.061	.09
V_T	.08	.06	.08	.06	.08	.06	.04	.03	.08	.04	.040	.04
Π_N	.05	.14	.05	.14	.05	.14	.02	.11	.05	.17	.023	.09
Π_T	.14	.05	.14	.05	.14	.05	.07	.04	.14	.06	.069	.03
Ω_N	.05	.10	.05	.10	.05	.10	.04	.11	.05	.13	.038	.09
Ω_T	.10	.05	.10	.05	.10	.05	.05	.03	.10	.05	.052	.04

Comparison norm and loss aversion

The perceived utility of an employed worker in sector i is given by:

$$\widetilde{w}_i = w_i^{1+\alpha_k} / w_n^{\alpha_k} = W_i^{1+\alpha_k} / W_n^{\alpha_k} P$$

where

$$\alpha_k = \begin{cases} \alpha_1 \text{ when } w_i \leq w_n, \\ 0 \text{ when } w_i > w_n \end{cases}$$

The marginal utility of a wage increase is higher immediately below the wage norm than immediately above

$$\frac{\partial \widetilde{w}_i}{\partial w_i} = (1+\alpha_k) \left(\frac{w_i}{w_n} \right)^{\alpha_k} .$$

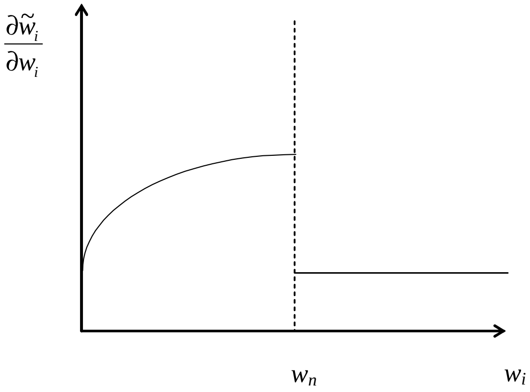

Figure 1: Union-perceived marginal utility of the real wage for an employed worker (The diagram is drawn under the assumption that $0 < \alpha_1 < 1$).

The leader's wage is assumed to be the wage norm.
The trade union utility function thus looks the same as before in the leader sector i:

$$\widetilde{w}_i = w_i^{1+\alpha_k} / w_n^{\alpha_k} = w_i^{1+\alpha_k} / w_i^{\alpha_k} = w_i$$

For the follower j there could be:

- A corner solution with $w_j = w_i$
- An interior solution with $w_j \neq w_i$

Corner solution requires

$$\lim_{w_{jm} \to w_{im}^-} \lambda_j \left[-\eta \varphi_{jm} + \frac{\widetilde{w}_{jm}(\alpha_1 + \epsilon_{jm})}{(\widetilde{w}_{jm} - b)} \right] + (1 - \lambda_j) \left[\epsilon_{jm} - \eta \varphi_{jm} \right] > 0$$
$$\lim_{w_{jm} \to w_{im}^+} \lambda_j \left[-\eta \varphi_{jm} + \frac{\widetilde{w}_{jm}(\alpha_2 + \epsilon_{jm})}{(\widetilde{w}_{jm} - b)} \right] + (1 - \lambda_j) \left[\epsilon_{jm} - \eta \varphi_{jm} \right] < 0.$$

Interior solution for the follower

Utility of an employed worker is still a mark-up on the value of unemployment

$$\widetilde{w}_{jm} = \left[1 + \lambda_j \widetilde{M}_{jm}\right] b,$$

where

$$\widetilde{M}_{jm} = (\alpha_k + \epsilon_{jm}) \,/\, \left(\eta \varphi_{jm} - \epsilon_{jm} - \lambda_j \alpha_k\right).$$

Follower's wage:

$$w_{jm} = \left[1 + \lambda_j \widetilde{M}_{jm}\right]^{\frac{1}{1+\alpha_k}} b^{\frac{1}{1+\alpha_k}} w_{im}^{\frac{\alpha_k}{1+\alpha_k}}.$$

Wage response of follower:

$$\frac{d \ln W_{jm}}{d \ln W_{im}} = \frac{\alpha_k}{1+\alpha_k} + \frac{1}{1+\alpha_k} \frac{d \ln P}{d \ln W_{im}}.$$

The follower's wage may be higher or lower than the norm depending on parameters.

Leader	N	T
M_{NI}	$\frac{(1-\theta)(1+\alpha_k)}{\theta(\alpha_k+\gamma)}$	
$\widetilde{M}_{TI}$	$\frac{(1+\alpha_k)(1-\theta)}{(1-\gamma\theta)-(1+\lambda_T\alpha_k)(1-\theta)}$	
M_{TI}		$\frac{(1-\theta)(1+\alpha_k)}{\theta(\alpha_k+1-\gamma)}$
$\widetilde{M}_{NI}$		$\frac{(1+\alpha_k)(1-\theta)}{(1-(1-\gamma)\theta)-(1+\lambda_N\alpha_k)(1-\theta)}$
M_{NM}	$\frac{(1-\theta)(1+\alpha_k)}{\theta(\alpha_k+\gamma)}$	
$\widetilde{M}_{TM}$	$\frac{(1+\alpha_k+\gamma\theta)(1-\theta)}{\theta(1-\gamma+\gamma\theta)-\lambda_T\alpha_k(1-\theta)}$	
M_{TM}		$\frac{(1-\theta)(1+\alpha_k)}{\theta(\alpha_k+1-\gamma)}$
$\widetilde{M}_{NM}$		$\frac{1+\alpha_k-\gamma\theta}{\gamma\theta-\lambda_N\alpha_k}$

Corner solution for the follower

- Vartiainen (2007): bargaining system where the follower's wage mimics the leader's wage is conducive to high employment and welfare.
- When the leader knows that the follower will set the same wage, the incentives for wage restraint are strong.
- Here there is a set of possible corner solutions.

Lower bound for corner solution $(w_i = w_j \equiv w^l)$ defined by $(\partial \ln \Omega_j / \partial \ln w_j)_- = 0$ while $(\partial \ln \Omega_j / \partial \ln w_j)_+ < 0$.

Upper bound for corner solution $(w_i = w_j \equiv w^u)$ defined by $(\partial \ln \Omega_j / \partial \ln w_j)_+ = 0$ while $(\partial \ln \Omega_j / \partial \ln w_j)_- > 0$.

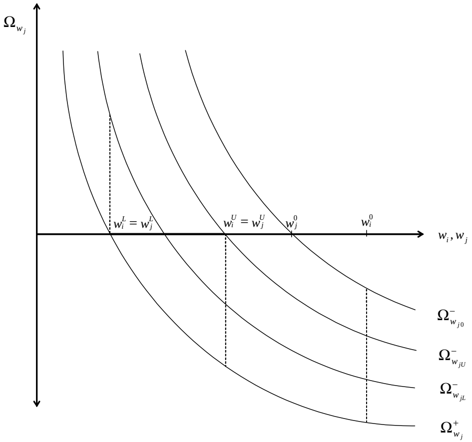

Figure 2: The set of possible corner solutions

Macroeconomic outcomes of choice of wage leader

- Due to the discontinuous objective function of the follower standard optimisation techniques are insufficient.
- Leader may set wage strategically to achieve the equilibrium that gives it the highest utility.
- Numerical solutions needed to determine type of equilibrium.
- What is the impact of relative sector size?
- Do wage setters in the two sectors agree on the choice of leader?
- How does the degree of loss aversion affect the type of equilibrium?

Table 8: Equilibrium outcomes with wage norms and a high degree of loss aversion ($\lambda_N = \lambda_T = .5$ and $\alpha_1 = .3$)

Regime	Inflation Targeting				Monetary Union			
Leader	N	N	T	T	N	N	T	T
γ	.25	.75	.25	.75	.25	.75	.25	.75
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
w_N	1.167	1.167	1.500	1.167	1.158	1.167	3.000	1.333
w_T	1.167	1.500	1.167	1.167	1.158	1.235	1.167	1.333
N_N	.203	.474	.123	.609	.211	.575	.031	.312
N_T	.609	.123	.474	.203	.632	.181	.237	.104
N	.812	.596	.596	.812	.843	.756	.268	.416
Ω_N	.045	.104	.053	.134	.045	.127	.038	.104
Ω_T	.134	.053	.104	.045	.135	.049	.052	.035
Type of equilibrium	Corner	$w_j > w_i$	$w_j > w_i$	Corner	Corner	$w_j > w_i$	$w_j > w_i$	Corner

Results I: Strong loss aversion

- $\alpha_1 = .3$
- With strong loss aversion two types of equilibria occur: corner solutions for the follower and interior solutions where $w_j > w_i$.
- Regardless of monetary regime, corner solutions are likely to arise when leadership is assigned to the smaller sector.
- Aggregate employment (but not necessarily welfare) much higher for corner solutions than interior solutions.
- Leadership for the smaller sector is thus likely to promote employment.
- Under inflation targeting, both sectors would prefer to be wage follower.
- In a monetary union, both sectors are better off if the N-sector is wage leader

Table 9: Equilibrium outcomes with wage norms and a low degree of loss aversion ($\lambda_N = \lambda_T = .5$ and $\alpha_1 = .03$)

Regime	Inflation Targeting				Monetary Union			
Leader	N	N	T	T	N	N	T	T
γ	.25	.75	.25	.75	.25	.75	.25	.75
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
w_N	1.460	1.167	1.500	1.180	1.460	1.167	3.000	1.333
w_T	1.180	1.500	1.167	1.460	1.170	1.235	1.167	1.333
N_N	.125	.474	.123	.465	.129	.575	.031	.312
N_T	.465	.123	.474	.125	.481	.181	.237	.104
N	.590	.596	.596	.590	.609	.756	.268	.416
Ω_N	.051	.104	.053	.105	.053	.127	.038	.104
Ω_T	.105	.053	.104	.051	.105	.049	.052	.035
Type of equilibrium	$w_j < w_i$	$w_j > w_i$	$w_j > w_i$	$w_j < w_i$	$w_j < w_i$	$w_j > w_i$	$w_j > w_i$	Corner

Results II: Weak loss aversion

- $\alpha_1 = .03$
- With weak loss aversion corner solutions are less likely.
- If the T-sector is small $(\gamma = .75)$ and wage leader, a corner solution arises.
- When there are interior solutions, the wage of the follower may be higher or lower than the norm depending on sector size.
- Under inflation targeting, leadership for the larger sector promotes employment.

Conclusions

- Analysis of wage leadership is more complex than one might think.
- Difficult to build case that leadership for tradables sector promotes employment.
- Under inflation targeting and standard union utility functions it does not matter who is wage leader.
- Under monetary union, leadership for tradables sector gives lower employment than leadership for non-tradables sector.
- Wage comparisons and loss aversion may promote employment.
- If loss aversion is sufficiently high employment-promoting corner solutions can be achieved by assigning leadership to the smaller sector.

What is wrong with the real world?

- Or does the model miss something?
- More centralisation within tradables sector than within non-tradables sector? Yes.
- Public sector instead of private, profit-maximising non-tradables firms? Possibly.
- More rational considerations in tradables than in non-tradables sector? Probably.
- Easier to make correct assessments about productivity growth in tradables sector? Yes.