Pattern Bargaining and Wage Leadership in a Small Open Economy[*]

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Abstract

Pattern bargaining where the tradables (manufacturing) sector acts as wage leader is a common form of wage bargaining in Europe. Our results question the conventional wisdom that such a bargaining set-up produces wage restraint. We find that all forms of pattern bargaining give the same macroeconomic outcomes as uncoordinated bargaining under inflation targeting and a flexible exchange rate. Under monetary union (a fixed exchange rate) wage leadership for the non-tradables sector is conducive to wage restraint and high employment, whereas wage leadership for the tradables sector is not. Loss aversion and comparison thinking in wage setting, where unions evaluate the utility of the wages of their members relative to a wage norm, may lead the follower to set the same wage as the leader. Such equilibria can arise when the leader sector is the smaller sector and promote high employment.

Keywords: Pattern Bargaining, Wage Setting, Inflation Targeting, Monetary Regimes

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1 Introduction

The wage-setting arrangements of many Western European countries are characterised by bargaining between employers and unions at the industry level. Pattern bargaining is usually a key feature of these systems. This means that a key sector, usually the engineering sector, concludes the first agreement in a wage bargaining round and that this agreement sets a norm that guides subsequent wage contracts in other sectors. Pattern bargaining thus works as a coordination device. Typical examples are Austria, Denmark, Germany, Norway and Sweden (EEAG 2004).

This form of pattern bargaining has often been explained by a perceived need to organise collective bargaining in such a way that it can ensure a degree of wage moderation consistent with high employment. It is usually believed that this can be achieved by choosing a tradables sector, heavily exposed to international competition, as wage leader. The gradual decline in the relative importance of the manufacturing (tradables) sector and the associated rise of the services (non-tradables) sector has, however, put the earlier system under strain in many countries. Clearly, it is easier for a sector to secure the position of wage leader the larger the sector.

The wage bargaining system in Sweden provides a good example of both earlier thinking and the current problems for pattern bargaining. Since the conclusion in 1997 of a framework agreement determining how wage bargaining should be conducted (the so-called Industry Agreement), it has been generally accepted that the manufacturing sector should act as a wage leader, setting the norm for wage increases in all industry-level wage contracts.[1] This principle has also been written into the instruction of the National Mediation Office. The thinking behind this goes back to the early 1970s and the normative "Scandinavian model of wage formation", according to which wage increases should follow the room given by price and productivity increases in the tradables sector.[2] The idea was that in the fixed exchange-rate system of the time, this norm would discipline wage setting, as firms in the tradables sector would have to adjust their prices to those of foreign competitors if they were to maintain their market shares. Hence, wage setters would realise that higher wage

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[1] See, for example, Lönebildning för full sysselsättning (1999), God sed vid lönebildning (2006) or Medlingsinstitutet (2007).

[2] The Scandinavian model of wage formation was originally formulated as a basis for wage bargaining in Norway; see, for example, Aukrust (1972). The Swedish version was termed the EFO model, after the initials of the chief economists in the leading labour market organisations, who adapted the model to Sweden; see Edgren, Faxén and Odhner (1973). An early analysis of the model was provided by Calmfors (1975).

increases than according to the norm would reduce the profit share in the tradables sector and cause unemployment. The belief was that the incentives for wage moderation would be much weaker under uncoordinated bargaining or if the non-tradables sector instead would set the norm for wage increases, as the possibilities to shift wage increases on to prices are much greater there.

Recently, the wage leadership role of the manufacturing sector has begun to be questioned in Sweden. There is an ongoing discussion within the labour market organisations on whether or not there is a need to revise bargaining procedures. This discussion was triggered by conflicts, especially on the employer side, regarding bargaining outcomes in the 2007 wage negotiations on new three-year wage contracts. There was widespread discontent on the part of service sector employers' associations with the wage leadership role of the manufacturing sector: it was widely argued by service sector employers that they had to adjust to an inappropriate wage norm determined by the manufacturing sector. Similar discussions have taken place in other European countries, too, for example Germany.

As far as we know, there is no previous academic research on the consequences of different choices of wage leader. Our aim is to fill this gap. A key issue is how the effects of different choices of wage leader are influenced by the monetary regime: a flexible exchange rate with inflation targeting or membership in a monetary union (an irrevocably fixed exchange rate). Another aim is to explain why negotiated wage increases in subsequent wage bargaining tend to follow the key sector wage agreement very closely. We also examine the assertion sometimes made that the key sector agreement provides a "floor" for subsequent agreements. A final issue is how the effects of choosing a sector as wage leader are affected by its size. Our analysis is a follow-up to Calmfors (2008), who discussed the development of pattern bargaining in Sweden in an informal way.

We present a two-sector model of a small open economy. Pattern bargaining is modelled as a Stackelberg game where either the tradables or the non-tradables sector can act as wage leader. Uncoordinated bargaining is modelled as a Nash equilibrium. We consider first a case with standard trade union utility functions. This analysis gives a few unexpected results. It turns out that the monetary regime is crucial for the effects of wage leadership. Under inflation targeting, the two Stackelberg equilibria coincide with the Nash equilibrium. Pattern bargaining thus provides identical outcomes to uncoordinated bargaining and it does not matter which sector is wage leader.

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In monetary union, the real wage in the follower sector is the same under pattern bargaining as under uncoordinated bargaining. If the tradables sector is leader in a Stackelberg game, it sets a higher wage than in the Nash equilibrium. In contrast, the non-tradables sector sets a lower wage when it is wage leader in a Stackelberg game than in the Nash game. As a consequence, with pattern bargaining aggregate employment is higher with the non-tradables sector than with the tradables sector as wage leader. This result goes against the conventional wisdom, according to which wage leadership for the tradables sector is regarded as conducive to wage restraint and high employment.

We also analyse a case where trade union utility in the follower sector depends on a reference wage ("the wage norm"), which is taken to be the wage set by the wage leader. The idea is to capture the tendency to use the bargained wage in the key sector as the comparison norm in subsequent bargaining in other sectors. This analysis provides an explanation of the strong tendency for pattern bargaining to result in more or less identical wage outcomes in different sectors. Using the Kahneman-Tversky (1979) concept of loss aversion, we show the possibility of corner solutions where it is optimal for the follower to set the same wage as the leader. Such corner-solution equilibria can arise under both monetary regimes when the smaller sector is wage leader. The leader may then have an incentive to act strategically to induce the follower to choose such an equilibrium. We show that "comparison thinking" in combination with loss aversion in wage setting may give more wage restraint and higher employment compared to a situation where such comparisons do not matter for trade union utility, because the possibility of favourable corner-solution equilibria is opened up.

The paper is organised as follows. Section 2 briefly reviews the related literature. The model assumptions regarding output, employment, prices and monetary policy are presented in Section 3. Section 4 analyses wage setting assuming standard trade union utility functions and compares different equilibria. Section 5 considers the case where the leader determines a wage norm that influences union utility in the follower sector. Section 6 provides numerical results. Section 7 concludes.

2 Related literature

There exists a literature on the impact of the monetary regime on wages and employment when wage setters are large. This literature challenges the conventional wisdom of the neutrality of money, i.e. that money does not affect real wages, output and employment. Cukierman and Lippi (1999), Soskice and Iversen (2000), Coricelli et al. (2006) and Larsson (2007) are contributions to this research. The main idea is that when trade unions are large enough to internalise the impact of their wage decisions on aggregate variables, the potential response of the central bank will affect the labour market outcome in terms of real wages and employment.

One mechanism is that trade unions may be inflation averse (in addition to caring about unemployment and real wages). Large unions then have an incentive to set low wages, promoting low unemployment, to avoid that a time-inconsistent liberal central bank (putting a high weight on low unemployment) will inflate as in Cukierman and Lippi (1999) and Coricelli et al. (2006). Another, perhaps more plausible, mechanism is that conservative central banks (emphasising price stability) may exert a positive effect on employment by providing a deterrent to high wages: large wage setters will perceive a higher cost of wage increases in terms of employment, the more inclined is the central bank to pursue contractionary monetary policy in response to wage hikes (Soskice and Iversen, 2000, Corricelli et al., 2006).[3]

Although most of the literature considers closed economies, exceptions include Vartiainen (2002, 2008), Holden (2003) and Larsson (2007). Vartiainen (2002) and Holden (2003) compare inflation targeting under a flexible exchange rate with a credibly fixed exchange rate regime in a two-sector model of a small open economy. The conclusion is that in the tradables sector, the real wage is higher under inflation targeting than under a fixed exchange rate, while the reverse applies in the non-tradables sector. Under rather general assumptions, aggregate employment levels as well as welfare are higher under inflation targeting than under a fixed exchange rate. Larsson (2007) shows that when perfect labour mobility is introduced in a similar setting, worker migration offsets the effects of the monetary regime and the neutrality of money is restored. However, in reality, labour mobility is limited and the prediction that the monetary regime matters is likely to be empirically relevant.

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[3] See also Calmfors (2004) for a review of this literature.

All the models discussed above assume that wages in different parts of the economy are set simultaneously and thus independently of each other (Nash equilibrium). Our contribution is to analyse also Stackelberg games where one sector acts as wage leader and the other as wage follower. The Stackelberg equilibria are compared with the Nash equilibrium, which is thus used as a benchmark. The closest counterpart to our paper is Vartiainen (2008) who analyses how Stackelberg leadership in general may be beneficial for employment but not the consequences of different choices of wage leader.

3   The model

Consider a small open economy consisting of a tradables (T) and a non-tradables (N) sector, where subscript $i = N, T$ indicates sector. Each sector consists of a continuum of identical perfectly competitive firms. The firms in each sector are indexed on the interval [0,1]. The economy is inhabited by a large number of households with identical utility functions and which consume the two goods. Households consist of two groups: one group provides labour to firms, the other group is made up of "capitalists" owning the firms. The nominal wage in each sector is set through bargaining between one large union and one employers' federation. In the labour market the individual takes wages as given.

The monetary target is given and credible to all players. The timing of events is as follows: In stage one, wages are set. In stage two, the central bank determines monetary policy given the wages set in stage one. In stage three, production, employment, consumption and prices are determined. This is done given the wages and monetary policy decided in the previous stages. The model is solved by backward induction and the equilibrium is subgame perfect.

3.1   Production, consumption and employment

In the last stage of the game, profit-maximising firms decide how much to produce and utility-maximising households how much to consume. Both firms and households take prices and wages as given.

3.1.1 Firms

Firms in each sector produce a homogeneous good with labour as the only input. A representative firm in sector i maximises real profits Π_i by choosing employment N_i so as to:

$$\max_{N_i} \Pi_i = (P_i Y_i - W_i N_i)/P, \tag{1}$$

where P_i is the product price in the sector, W_i is the nominal wage in the sector, Y_i is the output of the firm and P is the aggregate price index, subject to the production function:

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

where $\theta_i \in (0,1)$. The first-order condition for profit maximisation gives employment in a representative firm in sector i:

$$N_i = \left(\frac{W_i}{P_i}\right)^{-\eta_i}, \tag{2}$$

where $\eta_i = (1-\theta_i)^{-1} > 1$ is the labour demand elasticity with respect to the real product wage W_i/P_i. The corresponding supply function is given by:

$$Y_i = \frac{1}{\theta_i} \left(\frac{W_i}{P_i}\right)^{-\sigma_i}, \tag{3}$$

where $\sigma_i = \theta_i/(1-\theta_i)$ is the output elasticity with respect to the real product wage. Substituting the profit-maximising levels of output and employment into the profit function, it can be written;

$$\Pi_i = \frac{1}{\eta_i - 1} \frac{W_i}{P} \left(\frac{W_i}{P_i}\right)^{-\eta_i}. \tag{4}$$

3.1.2 Households

Households do not save but instead spend all their current incomes. We assume that households have Cobb-Douglas preferences over the two types of goods. A household solves the following optimisation problem:

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

where C_i is consumption of good i, subject to

$$I/P = (P_N C_N + P_T C_T)/P,$$

where I is the nominal income of the household. Real income is given by

$$I/P = \begin{cases} w_i \text{ for a worker employed in sector } i \\ \pi_i \text{ for a capitalist in sector } i \\ 0 \text{ if unemployed,} \end{cases}$$

where $w_i = W_i/P$ is the real consumption wage and π_i is the real income from profits of a capitalist in sector i. Solving the problem yields the household demand functions $C_N = \gamma I/P_N$ and $C_T = (1-\gamma)I/P_T$. Denoting aggregate income $\tilde{I}$, aggregate demand for non-tradables $\tilde{C}_N$ and aggregate demand for tradables $\tilde{C}_T$, we obtain

$$\begin{aligned} \tilde{C}_N &= \gamma \frac{\tilde{I}}{P_N} \\ \tilde{C}_T &= (1-\gamma) \frac{\tilde{I}}{P_T}. \end{aligned} \tag{5}$$

The consumer price level (CPI) is given by

$$P = P_N^{\gamma} P_T^{1-\gamma}. \tag{6}$$

The budget share, γ, of non-traded goods is a measure of the economy's openness, so that when $\gamma = 0$ the economy is completely open with production of only tradables and when $\gamma = 1$ the economy is completely closed with production of only non-tradables.

Tradables produced in different countries are perfect substitutes. So, there exists a common world market for tradables. This market clears and determines a foreign-currency price of tradables, which by way of the small-country assumption is taken as exogenously given by domestic producers. Aggregate output of non-tradables is $\int_0^1 Y_N di = Y_N$. Aggregate output of tradables is $\int_0^1 Y_T di = Y_T$. Clearing of the domestic market for non-tradables implies $Y_N = \tilde{C}_N$. It then follows that $Y_T = \tilde{C}_T$. To see this, use the fact that the zero-savings assumption implies that nominal aggregate expenditure must equal nominal aggregate income (the nominal value of output), i.e. $P_N Y_N + P_T Y_T = P_N \tilde{C}_N + P_T \tilde{C}_T$.

We assume that the production technology is the same in the two sectors, i.e. $\theta_N = \theta_T \equiv \theta$. Using the equality between domestic supply and demand in both sectors, the demand functions (5) and the supply functions (3), we obtain the following condition for "relative market clearing":

$$\frac{P_N}{P_T} = \left(\frac{\gamma}{1-\gamma} \right)^{1-\theta} \left(\frac{W_N}{W_T} \right)^{\theta}. \tag{7}$$

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The equation states that the relative price between non-tradables and tradables P_N/P_T is uniquely determined by the relative wage between the sectors W_N/W_T. Since the elasticity between the relative price and the relative wage is $\theta < 1$, an increase in the relative wage causes a less than proportional increase in the relative price. (7) will play a crucial role in the subsequent analysis.

3.1.3 Employment

It will be convenient for the subsequent analysis to rewrite the labour demand equations in terms of real consumption wages. By using the definition of the aggregate price level (6) and the equation for the equilibrium relative price (7) we obtain:

$$N_N = w_N^{-\eta} \left(\frac{w_N}{w_T}\right)^{(1-\gamma)\sigma} \left(\frac{\gamma}{1-\gamma}\right)^{(1-\gamma)} \tag{8}$$

$$N_T = w_T^{-\eta} \left(\frac{w_T}{w_N}\right)^{\gamma\sigma} \left(\frac{\gamma}{1-\gamma}\right)^{-\gamma}. \tag{9}$$

Equations (8) and (9) imply that employment in a sector depends negatively on the real consumption wages in both sectors.[4] Aggregate employment is obtained by summing employment in the two sectors:

$$N = \left(\frac{w_N}{w_T}\right)^{(1-\gamma)\sigma} \left(\frac{\gamma}{1-\gamma}\right)^{(1-\gamma)} w_N^{-\eta} + \left(\frac{w_T}{w_N}\right)^{\gamma\sigma} \left(\frac{\gamma}{1-\gamma}\right)^{-\gamma} w_T^{-\eta} \tag{10}$$

3.2 Monetary policy

Let E denote the nominal exchange rate in domestic currency per unit of foreign currency and P_T^* the exogenously given foreign-currency price of tradables. Since the law of one price applies for tradables, we have $P_T = EP_T^* = E$ if we normalise the foreign-currency price to unity.

Taking logs and differentiating, (6) implies

$$d\ln P = \gamma d\ln P_N + (1-\gamma)d\ln P_T. \tag{11}$$

Under inflation targeting, the central bank pursues monetary policy in such a way that $d\ln P = 0$ always. This means that policy must induce such exchange rate changes that price changes for tradables exactly offset the effects on the CPI of price changes for non-tradables. More precisely,

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[4] Note that $(1-\gamma)\sigma - \eta = [(1-\gamma)\theta - 1]/[1-\theta] < 0$ and $\gamma\sigma - \eta = [\gamma\theta - 1]/[1-\theta] < 0$.

Table 1: Producer and consumer price effects under the two regimes

Regime	(1) I	(2) M
$\dfrac{d\ln P_N}{d\ln W_N}$	$(1-\gamma)\theta\left[1 - \dfrac{d\ln W_T}{d\ln W_N}\right]$	$\theta\left[1 - \dfrac{d\ln W_T}{d\ln W_N}\right]$
$\dfrac{d\ln P_T}{d\ln W_N}$	$-\gamma\theta\left[1 - \dfrac{d\ln W_T}{d\ln W_N}\right]$	0
$\dfrac{d\ln P}{d\ln W_N}$	0	$\gamma\theta\left[1 - \dfrac{d\ln W_T}{d\ln W_N}\right]$
$\dfrac{d\ln P_T}{d\ln W_T}$	$\gamma\theta\left[1 - \dfrac{d\ln W_N}{d\ln W_T}\right]$	0
$\dfrac{d\ln P_N}{d\ln W_T}$	$-(1-\gamma)\theta\left[1 - \dfrac{d\ln W_N}{d\ln W_T}\right]$	$-\theta\left[1 - \dfrac{d\ln W_N}{d\ln W_T}\right]$
$\dfrac{d\ln P}{d\ln W_T}$	0	$-\gamma\theta\left[1 - \dfrac{d\ln W_N}{d\ln W_T}\right]$

(11) implies that $d\ln P_T = -\gamma/(1-\gamma)d\ln P_N$. In monetary union (with a fixed exchange rate) it simply holds that $d\ln P_T = 0$.

Taking logs of the relative goods market equilibrium condition (7) and differentiating gives:

$$d\ln P_N - d\ln P_T = \theta\left(d\ln W_N - d\ln W_T\right). \tag{12}$$

Together with (11), (12) determines the perceived elasticities of prices with respect to wages on the part of wage setters under the two monetary regimes and different wage bargaining arrangements. In Table 1, column (1) shows the price elasticities under inflation targeting (I) and column (2) the corresponding elasticities under monetary union (M). The elasticities are total elasticities, taking into account the possibility that a wage change in one sector may affect the wage in the other sector.

4 Wage setting

In the first stage of the game, wages are set through bargaining between one large union and one employers' federation in each sector. The union organises all workers in the sector and the employers' federation organises all firms in the sector. The employers' federation seeks to maximise

the profit of a representative firm in the sector. The union tries to maximise the rents from unionisation. Since the union is utilitarian and there is no labour mobility between the sectors, the rents from unionisation equal the excess of the utility of union members over the situation that would prevail in the absence of a union. Jobs are randomly assigned among the workers in each sector. L_i is the number of union members per firm in sector i. Workers are risk neutral so that the utility of an employed worker in sector i is equal to the real consumption wage w_i. The utility of an unemployed worker is b, which is taken as exogenous. b can be thought of as the value of home production. Union utility in sector i is thus given by:

$$V_i = N_i w_i + (L_i - N_i)b - L_i b = N_i(w_i - b). \tag{13}$$

The nominal wage W_i in sector i is set so as to maximise a weighted (geometric) average of the utilities of the two parties:

$$\Omega_i = [N_i (w_i - b)]^{\lambda_i} \Pi_i^{1-\lambda_i},$$

where λ_i is the "relative bargaining power" of the union in sector i. Equivalently, the maximisation problem can be written:

$$\max_{\ln W_i} \ln \Omega_i = \lambda_i \ln \left[N_i \left(\frac{W_i}{P} - b \right) \right] + (1 - \lambda_i) \ln \left[(\eta - 1)^{-1} \frac{W_i}{P} \left(\frac{W_i}{P_i} \right)^{-\eta} \right].$$

The maximisation is done under a set of constraints that differ depending on the monetary regime and the bargaining set-up. In all cases, wage setters realise that the sector they bargain in is so large that the wage has a potential effect on both the own product price and the aggregate price level. The constraints can be written on the following general form:

$$
\begin{aligned}
N_i &= \left(\frac{W_i}{P_i} \right)^{-\eta} \\
P &= P(W_i, W_j) \\
P_i &= P_i(W_i, W_j) \\
W_j &= f(W_i),
\end{aligned}
$$

where index j denotes the other sector. Let $\varphi_i = 1 - d\ln P_i/d\ln W_i$ and $\epsilon_i = 1 - d\ln P/d\ln W_i$.

The first-order condition for maximisation is

$$\Omega_{W_i} = \lambda_i \left[\frac{w_i \epsilon_i}{(w_i - b)} - \eta \varphi_i \right] + (1 - \lambda_i) [\epsilon_i - \eta \varphi_i] = 0, \tag{14}$$

10

where $\Omega_{W_i} = \partial \ln \Omega_i / \partial \ln W_i$ throughout the paper. The first-order condition states that the marginal gain for the union from a wage increase must balance the marginal loss for the employers' federation. The marginal gain for the union is the (positive) difference between the utility gain from a higher real consumption wage and the utility loss from lower employment. Solving for the real consumption wage we obtain

$$w_i = \frac{W_i}{P} = [1 + \lambda_i M_i] \, b, \tag{15}$$

where $M_i = \epsilon_i / (\eta \varphi_i - \epsilon_i)$. The real consumption wage in a sector is thus a positive mark-up on the value of unemployment. The parameters φ_i and ϵ_i depend on the monetary regime and the wage-setting arrangement and will therefore determine how the equilibria differ. Below we analyse both a Nash equilibrium (uncoordinated bargaining) and the two possible Stackelberg equilibria (pattern bargaining) with one of the sectors as wage leader and the other as wage follower.

4.1 The wage follower

It is instructive to first analyse wage behaviour of the follower in a Stackelberg game. The follower takes the nominal wage set by the leader as given. It thus acts in the same way as in a Nash game, when each sector takes the nominal wage of the other sector as given. The assumption of a given money wage in the other sector means that $f' = 0$. Hence, we have

$$\varphi_i = 1 - d \ln P_i / d \ln W_i = 1 - \partial \ln P_i / \partial \ln W_i \tag{16}$$

and

$$\epsilon_i = 1 - d \ln P / d \ln W_i = 1 - \partial \ln P / \partial \ln W_i \tag{17}$$

in (15) when it applies to the follower sector in a Stackelberg game and to each sector in a Nash game.

4.2 The wage leader

Bargaining in the leader sector in a Stackelberg game also has to take into account the reaction function of the follower, i.e. the leader internalises the impact of its wage decision on the wage of

the follower. Letting index i denote the leader and index j the follower, applying (15) to the leader gives

$$
\begin{aligned}
\varphi_i &= 1 - \frac{d\ln P_i}{d\ln W_i} = 1 - \frac{\partial\ln P_i}{\partial\ln W_i} - \frac{\partial\ln P_i}{\partial\ln W_j}\frac{d\ln W_j}{d\ln W_i} \\
\epsilon_i &= 1 - \frac{d\ln P}{d\ln W_i} = 1 - \frac{\partial\ln P}{\partial\ln W_i} - \frac{\partial\ln P}{\partial\ln W_j}\frac{d\ln W_j}{d\ln W_i}.
\end{aligned}
$$

When evaluating the price effects of an own wage increase, the leader thus takes into account that prices are not only influenced by the direct effect of the own wage increase but also by an indirect effect from the induced change in the wage of the follower. It follows immediately from (15) applied to the follower sector that

$$
\frac{d\ln W_j}{d\ln W_i} = \frac{d\ln P}{d\ln W_i}, \tag{18}
$$

i.e. the elasticity of the nominal wage in the follower sector with respect to the nominal wage in the leader sector equals the elasticity of the CPI with respect to the nominal wage in the leader sector. This is the consequence of the fact that for a given value of unemployment b, (15) determines a unique real consumption wage W_i/P for the follower in each regime.

4.3 Perceived price elasticities under different monetary regimes and bargaining arrangements

To compare different equilibria we need to develop the expressions in Table 1 for the perceived total price elasticities under different monetary regimes and bargaining arrangements. We do so by inserting the proper values of $d\ln W_N/d\ln W_T$ and $d\ln W_T/d\ln W_N$. In a Nash equilibrium we set both derivatives to zero. If sector i is wage leader, it internalises the impact it has on the follower sector j according to (18) and we thus impose $d\ln W_j/d\ln W_i = d\ln P/d\ln W_i$. The follower sector j, on the other hand, takes W_i as given and we therefore impose the restriction $d\ln W_i/d\ln W_j = 0$ for it.

In Table 2, columns (1)-(3) show the perceived price elasticities under inflation targeting for different wage-setting assumptions. Column 1 applies to the Nash equilibrium, column 2 to the

Table 2: Producer and consumer price effects across regimes and assumptions about wage leadership

	(1)	(2)	(3)	(4)	(5)	(6)
Regime	I	I	I	M	M	M
Leader	$Nash$	N	T	$Nash$	N	T
Restrictions	$\frac{d\ln W_i}{d\ln W_j}=0, \forall i$	$\frac{d\ln W_N}{d\ln W_T}=0$	$\frac{d\ln W_T}{d\ln W_N}=0$	$\frac{d\ln W_i}{d\ln W_j}=0, \forall i$	$\frac{d\ln W_N}{d\ln W_T}=0$	$\frac{d\ln W_T}{d\ln W_N}=0$
$\frac{d\ln P_N}{d\ln W_N}$	$(1-\gamma)\theta$	$(1-\gamma)\theta$	$(1-\gamma)\theta$	θ	$\frac{\theta}{1+\gamma\theta}$	θ
$\frac{d\ln P_T}{d\ln W_N}$	$-\gamma\theta$	$-\gamma\theta$	$-\gamma\theta$	0	0	0
$\frac{d\ln P}{d\ln W_N}$	0	0	0	$\gamma\theta$	$\frac{\gamma\theta}{1+\gamma\theta}$	$\gamma\theta$
$\frac{d\ln P_T}{d\ln W_T}$	$\gamma\theta$	$\gamma\theta$	$\gamma\theta$	0	0	0
$\frac{d\ln P_N}{d\ln W_T}$	$-(1-\gamma)\theta$	$-(1-\gamma)\theta$	$-(1-\gamma)\theta$	$-\theta$	$-\theta$	$-\frac{\theta}{(1-\gamma\theta)}$
$\frac{d\ln P}{d\ln W_T}$	0	0	0	$-\gamma\theta$	$-\gamma\theta$	$-\frac{\gamma\theta}{(1-\gamma\theta)}$

Stackelberg equilibrium with the non-tradables sector as wage leader and column 3 to the Stackelberg equilibrium with the tradables sector as wage leader. Columns (4)-(6) show the corresponding elasticities in monetary union.

It is useful to first give the intuition in the Nash equilibrium. Consider first inflation targeting. Then by definition there are no consumer price effects, which implies that both $d\ln P/d\ln W_N$ and $d\ln P/d\ln W_T$ are zero. The mechanisms at work are as follows. If there is a wage increase in the tradables sector, there is a reduction in output in that sector, leading to lower aggregate income and lower demand for non-tradables. The fall in demand puts downward pressure on the price of non-tradables. To offset the effect on the CPI, the central bank must engineer an exchange rate depreciation, raising the price of tradables. A one-percent wage increase in the tradables sector will cause the price of non-tradables to fall by $(1-\gamma)\theta$ percent and the price of tradables to rise by $\gamma\theta$ percent.

A wage increase in the non-tradables sector generates upward pressure on the CPI. Hence, under inflation targeting the central bank must engineer an exchange rate appreciation to counter this effect. A one-percent wage increase in the non-tradables sector will raise the price of non-tradables by $(1-\gamma)\theta$ percent, whereas the price of tradables will fall by $\gamma\theta$ percent.

In monetary union, the nominal exchange rate does not change in response to a wage change.

If the wage increases in the tradables sector, the price of tradables is not affected, but output falls. This in turn leads to a fall in aggregate income, which reduces the demand for non-tradables. A one-percent wage increase in the tradables sector is associated with a price fall in the non-tradables sector of θ percent and a fall in the CPI of $\gamma\theta$ percent. A wage increase in the non-tradables sector causes a negative supply shift in the sector. The elasticities of the price of non-tradables and the CPI with respect to the wage in the non-tradables sector are θ and $\gamma\theta$ respectively.

How does pattern bargaining change the perceived elasticities? It is obvious that the consumer price effects under inflation targeting are still zero. But the table also shows that the perceived producer price elasticities under inflation targeting are the same as in the Nash game. This is self-evident for a wage change by the follower, who takes the money wage of the leader as given. The reason why the perceived price elasticity is the same for the leader as well is that the effect of the leader's wage on the follower's wage according to (18) goes via the CPI. Since the wage leader internalises the fact that the central bank will prevent an own wage increase from raising the CPI, it realises that the nominal wage of the follower will remain unchanged just as in the Nash game.

Under a fixed exchange rate, the bargaining arrangement *does* matter for the size of the price elasticities. Consider first the case where the non-tradables sector is leader. An increase in the N-sector wage raises the price of non-tradables. With a given nominal wage in the tradables sector, a one-percent rise in W_N causes P_N to rise by θ percent. As a consequence the CPI rises by $\gamma\theta$ percent. But the wage setters in the non-tradables sector realise that this consumer price increase will cause the wage in the tradables sector to increase by as much. As the tradables sector increases its wage, output in the sector falls (as P_T is fixed) and thus also aggregate income. The associated fall in demand counteracts the rises in both the price of non-tradables and the CPI. Hence, both the own producer price and the consumer price effects of a wage rise in the non-tradables sector are perceived to be smaller when the sector is wage leader than when wages are set simultaneously.

If the tradables sector is wage leader the mechanisms at work are as follows. A rise in W_T causes a fall in the output of tradables and thus in aggregate income. This reduces the demand for non-tradables and causes their price to drop. The associated fall in the CPI leads to a *decrease* in the nominal wage in the non-tradables sector, holding the real consumption wage there, W_N/P,

Table 3: Wage mark-up factors across regimes and bargaining arrangements

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}	$\frac{(1+\gamma\theta)(1-\theta)}{\theta(1-\gamma+\gamma\theta)}$	$\frac{(1+\gamma\theta)(1-\theta)}{\theta(1-\gamma+\gamma\theta)}$	$\frac{1-\theta}{(1-\gamma)\theta}$

unchanged. The nominal wage reduction in the N-sector amplifies the decreases in the price of non-tradables and the CPI. Wage setters in the tradables sector will thus perceive larger falls in the price of non-tradables and the CPI when they are wage leaders than when wages are set simultaneously.

4.4 Comparison of equilibria

We use (15) to compare the wage outcomes under different bargaining set-ups and monetary regimes. In this part of the paper we focus exclusively on within-sector comparisons of monetary regimes and bargaining set-ups which implies that differences in the mark-up $\lambda_i M_i$ only depend on differences in M_i.[5] So a ranking of M_i (which will subsequently be referred to as the "mark-up factor") across regimes and bargaining arrangements is also a ranking of the corresponding real wages. By using the perceived total price elasticities under different bargaining set-ups and monetary regimes in Table 2, we obtain the mark-up factors in Table 3. Below, let superindex $k = N, T, Nash$ indicate the Stackelberg equilibrium with sector N as leader, the Stackelberg equilibrium with sector T as leader and the Nash equilibrium, respectively. Multiple superindices indicate that the mark-up factor assumes the same value for the indicated institutional settings. As before subindex $i = N, T$ indicates for which sector the mark-up factor applies. Subindex $m = I, M$ denotes the monetary regime. The following propositions can be made.

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[5] The rankings of real wages and employment across sectors in a given regime have been addressed by Vartiainen (2002) and Holden (2003).

Proposition 1 *Under inflation targeting, the Nash equilibrium coincides with the two Stackelberg equilibria, since $M_{iI}^{Nash} = M_{iI}^N = M_{iI}^T$ for $i = N, T$. So, it does not matter what sector is wage leader under pattern bargaining and this form of bargaining gives the same outcome as uncoordinated bargaining.*

This is an important conclusion as it implies - in contradiction to the presumption in the general debate - that the bargaining set-up is irrelevant under inflation targeting.[6] The result is easy to understand. The difference between a Nash and a Stackelberg game is that the leader in the latter game takes the effect of its wage decision on the follower's wage into account. But this effect goes via a change in the CPI: the follower's nominal wage rises equiproportionally to the CPI increase so that the real consumption wage is held constant. But under inflation targeting this channel is cut off, as the central bank prevents the CPI from changing. Hence, the central bank response implies that the leader can take the follower's nominal wage as constant also in the Stackelberg game. This means that each sector faces exactly the same optimisation problem when the game is Nash, when the sector is wage leader in a Stackelberg game and when the sector is follower in a Stackelberg game. The implication is that the real consumption wage in each sector is the same in all three cases. This implies that employment and profits are the same across alternative bargaining set-ups.

Proposition 2 *In 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 intuition is obvious, since the follower in the Stackelberg game solves the same optimisation problem as the sector would in the Nash game. Note, however, that the equality of real consumption wages between the two games does not imply equality between nominal wages, as these will differ to the extent that the CPI levels differ.[7]

Proposition 3 *In 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 $M_{NM}^{Nash} > M_{NM}^N$.*

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[6] This result hinges on the assumption of Cobb-Douglas preferences since this implies reaction functions according to which the wage in one sector is independent of the wage in the other sector. Vartiainen (2008) analyses the case of CES-preferences where the wage set in one sector is a function of the wage set in the other sector, but he looks only at inflation targeting and does not address the possibility of comparison norms.

[7] See footnote 9.

The Stackelberg game with the non-tradables sector as wage leader results in higher employment in both sectors, and thus also higher aggregate employment, than in the Nash game.

Proof. It is straightforward to show that $M_{NM}^{Nash} > M_{NM}^{N}$ is equivalent to $(1 - \gamma\theta)/\gamma\theta > (1 - \theta)/\gamma\theta$, which must hold as $\gamma < 1$. ∎

When the non-tradables sector is wage leader, wage bargainers in that sector know that if they raise the wage, the resulting increase in the price of non-tradables pushes up the CPI. This triggers a wage increase in the tradables sector. As a consequence, output of tradables and aggregate income fall. This lowers the demand for non-tradables and counteracts the rise in the price of non-tradables. This additional negative producer price effect has a moderating influence on wage setting in the non-tradables sector which is not present in the Nash equilibrium. The negative producer price effect also triggers a fall in consumer prices that benefits both employers and employees, but this effect is smaller in magnitude than the disciplining producer price effect.[8]

The employment consequences follow directly from equations (8)-(9). As the real consumption wage is lower in the (leader) non-tradables sector than in the Nash equilibrium (Proposition 3) and the same in the (follower) tradables sector (Proposition 2), employment in both sectors must be higher in the Stackelberg equilibrium with the non-tradables sector as wage leader than in the Nash equilibrium.

Proposition 4 *In monetary union, 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 $M_{TM}^{T} > M_{TM}^{Nash}$. The Stackelberg game with the tradables sector as leader results in lower employment in both sectors than in the Nash game.*

Proof. It can be shown that $M_{TM}^{T} > M_{TM}^{Nash}$ if, and only if, $(1 - \theta)/(1 - \gamma)\theta > (1 + \gamma\theta)(1 - \theta)/\theta(1 - \gamma + \gamma\theta)$. This is equivalent to $\gamma\theta > \gamma\theta(1 - \gamma)$, which must hold since $\gamma < 1$. ∎

In monetary union, there are no producer price effects that affect the wage decision in the tradables sector, as the price of tradables is fixed. But there is a negative consumer price effect

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[8] As W_N/P is lower in this case than in the Nash equilibrium and W_T/P the same, it follows from the relative market clearing equation that P_N/P_T is lower. With a given P_T, P_N and thus also P must be lower. It follows that the nominal wage in the (follower) tradables sector W_T is lower in the Stackelberg equilibrium with the non-tradables sector as wage leader than in the Nash equilibrium. A similar reasoning shows that the nominal wage in the (follower) non-tradables sector W_N is higher in the Stackelberg equilibrium with the tradables sector as wage leader than in the Nash equilibrium.

from a wage rise in the tradables sector that comes from the fall in output of tradables, and hence in aggregate income, which causes a reduction in the demand for non-tradables and consequently a fall in the CPI. This negative consumer price effect strengthens the incentives for a high wage in the tradables sector in both the Nash and the Stackelberg equilibrium, since it raises the purchasing power of the wage. But the incentive effect is stronger in the latter case. The reason is that the reduction in the CPI causes the bargainers in the non-tradables sector to reduce the wage there. This reduces consumer prices even more than in the Nash game. Hence, since the negative consumer price effect is amplified by the fall in non-tradables wages, the incentive for high wages in the tradables sector is even stronger when the sector is wage leader under pattern bargaining than in the Nash equilibrium.

Because the real consumption wage is higher in the (leader) tradables sector than in the Nash equilibrium and the same in the (follower) non-tradables sector, it follows directly from equations (8) and (9) that employment in both sectors is lower in the Stackelberg equilibrium with the tradables sector as wage leader than in the Nash equilibrium.

The above results go against the conventional wisdom that under fixed exchange rate or monetary union pattern bargaining with the tradables sector as wage leader promotes wage restraint and high employment as compared to uncoordinated bargaining.[9] The outcome in our model is the reverse one: it is pattern bargaining with the non-tradables sector as wage leader that is conducive to wage restraint and high employment in a fixed exchange rate regime.

Proposition 5 *When there is sequential wage setting, the leader sector sets the same real consumption wage across monetary regimes, i.e. $w_{iI}^i = w_{iM}^i$ for $i = N, T$. The follower's wage is, however, regime-specific. When the non-tradables sector is wage leader, the (follower) tradables sector sets a lower real wage in monetary union than under inflation targeting as $M_{TM}^N < M_{TI}^N$. When the tradables sector is leader, the (follower) non-tradables sector sets a lower real wage under inflation targeting than under monetary union as $M_{NI}^T < M_{NM}^T$. It follows that with the non-tradables sector as leader, employment in both sectors, and thus also aggregate employment, is higher under monetary union than under inflation targeting. With the tradables sector as leader, employment in both sectors, and thus also aggregate employment, is instead higher under inflation targeting than under*

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[9] See, e.g., Calmfors (2008).

monetary union.

The conclusions on wages follow directly from Table 3. The difference in wage outcomes for a sector between the two monetary regimes are the same when it is a follower in the Stackelberg game as in the Nash game, which has earlier been analysed by Vartiainen (2002), Holden (2003) and Larsson (2007).[10] The reason why the Stackelberg leader sets the same real consumption wage under both monetary regimes is that it is in effect solving the same *real* optimisation problem in both cases. According to equation (15) and the discussion in Section 4.3, the follower's choice if real consumption wage is independent of the real consumption wage chosen by the leader. Hence, when optimising, the leader takes the follower's real consumption wage as given. The perceived effect of a one percent change in the leader's real consumption wage on the relative price between non-tradables and tradables will therefore - according to equation (12) - be the same independent of the regime. This implies that the leader meets the same incentives in both regimes and sets the same real consumption wage.

The conclusions regarding employment follow from the conclusions on wages and the employment equations (8)-(10). Because only the follower's wage decision is regime specific, the regime that promotes most wage restraint for the follower (inflation targeting for the non-tradables sector, monetary union for the tradables sector) is the one giving the highest aggregate employment. Under pattern bargaining the choice of wage leader thus matters for which monetary regime gives the highest employment. This complements the results of Holden (2003) and Larsson (2007), who found that with uncoordinated (Nash) bargaining inflation targeting results in higher aggregate employment than monetary union under realistic parameter assumptions.

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[10] The intuition for a lower real consumption wage in the tradables sector under monetary union than under inflation targeting in the Nash game is as follows. An increase in the real consumption wage in the tradables sector reduces employment and output there and hence also aggregate demand. This reduces the price of non-tradables. To compensate for that, the central bank engineers a rise in the price of tradables under inflation targeting, which counteracts the fall in employment in the tradables sector. This effect reduces the cost of real consumption wage rises in the tradables sector. Under monetary union there is no such offsetting effect from a price rise for tradables. There is a similar intuition for why the real consumption wage in the non-tradables sector is lower under inflation targeting than under monetary union in the Nash game. If there is a rise in the real consumption wage in the non-tradables sector, this causes a rise in the price of non-tradables. Under inflation targeting the central bank engineers a fall in the price of tradables, which tends to lower output in the tradables sector. This in turn counteracts the rise in the price of non-tradables and hence increases the employment losses in the non-tradables sector. Under monetary union there is no such fall in the price of tradables that raises the cost of wage increases in the non-tradables sector.

5 Wage setting with wage norms

A well-known feature of collective bargaining is the important role played by wage comparisons. As noted in the introduction, under pattern bargaining the wage increases negotiated in the key sector often become a reference norm for subsequent agreements. There is a strong tendency for wage increases in other sectors to follow this norm closely. This section extends our analysis to account for this phenomenon. This is done by incorporating the Kahneman-Tversky (1979) concept of loss aversion in the way proposed by Bhaskar (1990), according to which a larger weight is attached to losses relative to a reference norm than to gains.

5.1 Trade union utility

We now assume that the utility of an employed worker in sector i, as perceived by the union, depends on both the real wage received and on a wage comparison norm, denoted w_n.[11] Following Holden and Wulfsberg (2007), the assumption is that the perceived utility of an employed worker in sector i is $\widetilde{w}_i = w_i^{1+\alpha_k}/w_n^{\alpha_k}$, where α_k measures the importance of wage comparisons. In accordance with the Kahneman-Tversky hypothesis of loss aversion, α_k takes on different values depending on whether or not the wage exceeds the norm. More specifically, we assume that wage comparisons matter for union-perceived utility only when the wage is below the comparison norm, i.e.

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

The implication is that the union-perceived marginal utility of the real wage for an employed worker is a non-differentiable function at $w_i = w_n$ and takes on a larger value for a wage immediately below than for a wage immediately above the norm, as shown in Figure 1, since

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

We continue to assume that the union-perceived utility of an unemployed worker is the value of home production b. For the union, wage comparisons thus play no role with regard to the unemployed.

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[11] Our assumption is thus that comparison thinking influences the union utility function, which matters for wage setting, but not the utility function of consumers, which determines the demand functions for goods.
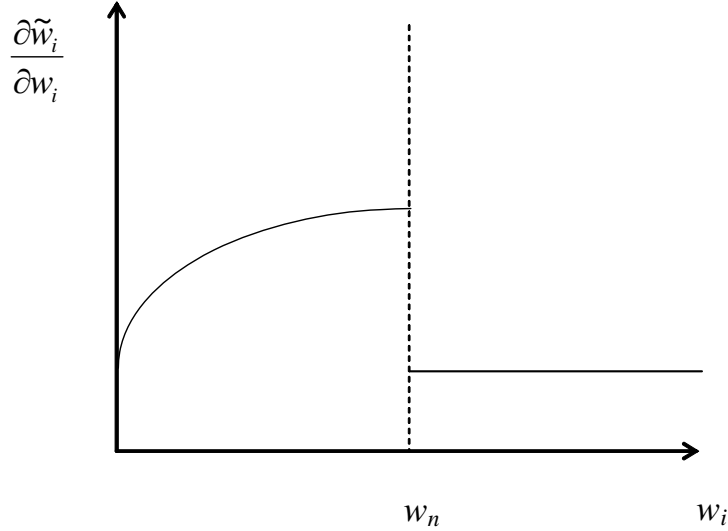
Figure 1: Union-perceived marginal utility of the real wage for an employed worker (N.B. The diagram is drawn under the assumption that $0 < \alpha_1 < 1$).

Hence, the utility function for the union in sector i is now;

$$V_i = N_i \left(\widetilde{w}_i - b \right) = N_i \left[\frac{w_i^{1+\alpha_k}}{w_n^{\alpha_k}} - b \right]. \tag{19}$$

(19) is now substituted for the earlier (13) in the weighted utility function to be maximised when the wage is set.

5.2 The wage follower

We first examine the optimisation problem of the follower. We assume that the real consumption wage in the leader sector serves as the reference norm. As before we denote the leader by subindex i and the follower by subindex j. Hence, the assumption is that $w_n = w_i$. It follows that the wage in the follower sector is now set so as to maximise:

$$\Omega_j = \left[N_j \left(\frac{w_j^{1+\alpha_k}}{w_i^{\alpha_k}} - b \right) \right]^{\lambda_j} [\Pi_j]^{1-\lambda_j}.$$

The nominal wage in the follower sector is thus given by the solution to

$$\max_{\ln W_j} \ln \Omega_j = \lambda_j \ln \left[N_j \left(\frac{W_j^{1+\alpha_k}}{W_i^{\alpha_k} P} - b \right) \right] + (1 - \lambda_j) \ln \left[(\eta - 1)^{-1} \frac{W_j}{P} \left(\frac{W_j}{P_j} \right)^{-\eta} \right]$$

subject to

$$N_j = \left(\frac{W_j}{P_j} \right)^{-\eta}$$
$$P = P(W_j, W_i)$$
$$P_j = P_j(W_j, W_i),$$

and taking W_i as given. Let $\varphi_j = (1 - d\ln P_j / d\ln W_j)$ and $\epsilon_j = (1 - d\ln P / d\ln W_j)$ as before. Note that:

$$\frac{\partial}{\partial \ln W_j} \ln \left(\frac{W_j^{1+\alpha_k}}{W_i^{\alpha_k} P} - b \right) = \frac{\frac{W_j^{1+\alpha_k}}{W_i^{\alpha_k} P} \left(1 + \alpha_k - \left(\frac{\partial \ln P}{\partial \ln W_j} \right) \right)}{\left(\frac{W_j^{1+\alpha_k}}{W_i^{\alpha_k} P} - b \right)} = \frac{\widetilde{w}_j (\alpha_k + \epsilon_j)}{(\widetilde{w}_j - b)},$$

where

$$\widetilde{w}_j \equiv \frac{W_j^{1+\alpha_k}}{W_i^{\alpha_k} P} = \frac{w_j^{1+\alpha_k}}{w_i^{\alpha_k}} = w_j \left(\frac{w_j}{w_i} \right)^{\alpha_k}.$$

The discontinuity of the union utility function means there could be both an interior and a corner solution. The interior solution is given by:

$$\frac{\partial \ln \Omega_j}{\partial W_j} = \Omega_{W_j} = \lambda_j \left[-\eta \varphi_j + \frac{\widetilde{w}_j (\alpha_k + \epsilon_j)}{(\widetilde{w}_j - b)} \right] + (1 - \lambda_j) \left[\epsilon_j - \eta \varphi_j \right] = 0 \tag{20}$$

Solving (20) for $\widetilde{w}_j$, we obtain:

$$\widetilde{w}_j = \left[1 + \lambda_j \widetilde{M}_j \right] b, \tag{21}$$

where $\widetilde{M}_j = (\alpha_k + \epsilon_j) / \left(\eta \varphi_j - \epsilon_j - \lambda_j \alpha_k \right)$. Equation (21) states that the union-perceived utility of an employed worker is again a mark-up over the value of unemployment. Equivalently, equation (21) can be written as an equation for the real consumption wage in sector j, which is homogenous of degree one in the value of unemployment and the wage in the leader sector:

$$w_j = \left[1 + \lambda_j \widetilde{M}_j \right]^{\frac{1}{1+\alpha_k}} b^{\frac{1}{1+\alpha_k}} w_i^{\frac{\alpha_k}{1+\alpha_k}}, \tag{22}$$

With an interior solution, the real wage in the follower sector is thus a mark-up on a weighted geometric average of the value of unemployment and the wage norm set by the leader sector.

A corner solution with $w_j = w_i$ is obtained when

$$\lim_{w_j \to w_i^-} \Omega_{W_j}^- \equiv \lim_{w_j \to w_i^-} \frac{\partial \ln \Omega_j}{\partial \ln W_j} = \lambda_j \left[-\eta \varphi_j + \frac{\widetilde{w}_j(\alpha_1 + \epsilon_j)}{(\widetilde{w}_j - b)} \right] + (1 - \lambda_j) \left[\epsilon_j - \eta \varphi_j \right] > 0$$

$$\lim_{w_j \to w_i^+} \Omega_{W_j}^+ \equiv \lim_{w_j \to w_i^+} \frac{\partial \ln \Omega_j}{\partial \ln W_j} = \lambda_j \left[-\eta \varphi_j + \frac{\epsilon_j \widetilde{w}_j}{(\widetilde{w}_j - b)} \right] + (1 - \lambda_j) \left[\epsilon_j - \eta \varphi_j \right] < 0,$$

where $\Omega_{W_j}^- \equiv \Omega_{W_j}$ for $w_j \leq w_i$ and $\Omega_{W_j}^+ = \Omega_{W_j}$ for $w_j > w_i$. This means that when the weighted gain to the bargaining parties of a wage increase is positive immediately below the wage w_i set by the leader, but negative immediately above this wage, it is optimal for the follower to choose the same wage as the leader. This is a consequence of our loss aversion assumption.

5.3 The wage leader

Since the wage comparison norm is the wage of the leader, the utility of an employed worker in the leader sector is the same as in Section 4.1 i.e. $\widetilde{w}_i = w_i^{1+\alpha_k} / w_i^{\alpha_k} = w_i$. It follows that the trade union utility function will be the same, as will the weighted utility function to be maximised in the wage-setting process. The employment and price equations are also identical.

However, the maximisation problem of the leader is now more complex than in Section 4.1 because of the possibility of various types of equilibria for the follower. It is not enough for the leader to maximise subject to the response function of the follower given the type of equilibrium for the latter. The leader can also set its wage strategically to achieve the type of equilibrium (corner solution or interior solutions for the follower) that gives it the highest utility.

We proceed in the following way. In a first step, we analyse potential equilibria with interior solutions for the follower. In a second step, we analyse potential equilibria with corner solutions for the follower. In a third step, we derive the actual equilibria that are realised.

Table 4: Wage mark-ups under different assumptions about sector serving as wage norm

Leader	N	T
M_{NI}	$\frac{(1-\theta)(1+\alpha_1)}{\theta(\alpha_1+\gamma)}$	
$\widetilde{M}_{TI}$	$\frac{(1+\alpha_1)(1-\theta)}{(1-\gamma\theta)-(1+\lambda_T\alpha_1)(1-\theta)}$	
M_{TI}		$\frac{(1-\theta)(1+\alpha_1)}{\theta(\alpha_1+1-\gamma)}$
$\widetilde{M}_{NI}$		$\frac{(1+\alpha_1)(1-\theta)}{(1-(1-\gamma)\theta)-(1+\lambda_N\alpha_1)(1-\theta)}$
M_{NM}	$\frac{(1-\theta)(1+\alpha_1)}{\theta(\alpha_1+\gamma)}$	
$\widetilde{M}_{TM}$	$\frac{(1+\alpha_1+\gamma\theta)(1-\theta)}{\theta(1-\gamma+\gamma\theta)-\lambda_T\alpha_1(1-\theta)}$	
M_{TM}		$\frac{(1-\theta)(1+\alpha_1)}{\theta(\alpha_1+1-\gamma)}$
$\widetilde{M}_{NM}$		$\frac{1+\alpha_1-\gamma\theta}{\gamma\theta-\lambda_N\alpha_1}$

5.4 Potential equilibria with interior solutions for the follower

With an interior solution for the follower, the wage response function of the latter can be derived from (22) as:
$$\frac{d\ln W_j}{d\ln W_i} = \frac{\alpha_k}{1+\alpha_k} + \frac{1}{1+\alpha_k}\frac{d\ln P}{d\ln W_i},$$
where $\alpha_k = \alpha_1 > 0$ applies for $w_j < w_i$ and $\alpha_k = \alpha_2 = 0$ for $w_j > w_i$.

5.4.1 Potential interior solutions with a lower wage for the follower than for the leader

We first examine potential equilibria with interior solutions for the follower where $w_j < w_i$. The real wage of the leader is still given by an equation of the same form as (15). The real wage of the follower is given by equation (22). Dividing the two equations by each other gives

$$\frac{w_j}{w_i} = \left(\frac{1+\lambda_j\widetilde{M}_j}{1+\lambda_i M_i}\right)^{\frac{1}{1+\alpha_1}}.$$

Assuming, for simplicity, that $\lambda_i = \lambda_j = \lambda$, it is obvious that an equilibrium with $w_j < w_i$ requires that $\widetilde{M}_j < M_i$. The expressions for these mark-up factors under our various leadership

Table 5: Critical values for the importance of wage comparisons, α_1, below which there is a potential equilibrium with a lower wage for the follower than the leader

Leader	N	T
Inflation targeting	$\dfrac{1-2\gamma}{1+\lambda(1-\theta)/\theta}$	$\dfrac{1-2(1-\gamma)}{1+\lambda(1-\theta)/\theta}$
Monetary union	$-\dfrac{\left[2\gamma+\frac{\lambda}{\theta}(1-\theta)\right]}{2\left[1+\frac{\lambda}{\theta}(1-\theta)\right]}$ $\pm\left(\dfrac{\left[2\gamma+\frac{\lambda}{\theta}(1-\theta)\right]^2}{4\left[1+\frac{\lambda}{\theta}(1-\theta)\right]^2}+\dfrac{\left[1-2\gamma+\gamma(1-\gamma)\theta\right]}{\left[1+\frac{\lambda}{\theta}(1-\theta)\right]}\right)^{1/2}$	$-\dfrac{\left[2(1-\gamma)+\frac{\lambda}{\theta}(1-\theta)\right]}{2\left[1+\frac{\lambda}{\theta}(1-\theta)\right]}$ $\pm\left(\dfrac{\left[2(1-\gamma)+\frac{\lambda}{\theta}(1-\theta)\right]^2}{4\left[1+\frac{\lambda}{\theta}(1-\theta)\right]^2}+\dfrac{\left[2\gamma-1-\gamma^2\theta\right]}{\left[1+\frac{\lambda}{\theta}(1-\theta)\right]}\right)^{1/2}$

and monetary regime assumptions are given in Table 4. It can be shown that the condition for a potential equilibrium with a lower wage for the follower than for the leader is that the α_1-term, measuring the importance of wage comparisons, is below a critical value $\overline{\alpha}$, the magnitude of which depends on the monetary regime and what sector is leader. These critical values are given in Table 5. It can be seen that under inflation targeting an equilibrium with a lower wage for the follower than the leader can never come about if the leader sector is the larger one. If, for example, under inflation targeting the N-sector is leader and $\gamma > \frac{1}{2}$, so that this sector is the larger one, the critical value is negative (first row, first column in the table). But since α is always positive by assumption, it can never be below this critical value.[12]

5.4.2 Potential interior solutions with a higher wage for the follower than for the leader

In the case of an interior solution with a higher wage for the leader than for the follower, equation (15) gives the wage outcomes for both the leader and the follower. The mark-up factors are the same as in Table 3, as $\alpha_2 = 0$ when $w_j > w_i$ implies that we are back to the case without comparison norms.

From Table 3, it is straightforward to derive under what conditions interior solutions with a

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[12] Similarily, if the tradables sector is wage leader and this sector is the larger, i.e. $1 - \gamma > \frac{1}{2}$, then the critical value is again negative (first row, second column in Table 5).

Table 6: Conditions for a higher wage for the follower than the leader in the case of an interior solution for the follower

Leader	N	T
Inflation targeting	$\gamma > \frac{1}{2}$	$1 - \gamma > \frac{1}{2}$
Monetary union	$\gamma > \frac{1}{2}$	$1 - \gamma > \frac{1}{2} + \gamma^2\theta/2$

higher wage for the follower than the leader could occur. Table 6 shows that in three out of four possible cases an equilibrium with a higher wage for the follower than for the leader can only occur when the leader is the larger sector: the two inflation-targeting cases and the monetary-union case with the non-tradables sector as leader. In the monetary-union case with the tradables sector as leader, it is not enough that this sector is the larger one for the follower (non-tradables) sector to set the higher wage: the size of the leader (tradables) sector must be above a critical limit: $\frac{1}{2} + \gamma^2\theta/2$. The intuition for the effect of size on the relative wage is that a larger leader sector has a stronger incentive for wage moderation, as its wage rises induce larger effects on the rest of the economy, which causes negative feedback effects on the own sector's utility.

5.5 Possible equilibria with corner solutions for the follower

Next, we examine the possibility of an equilibrium with a corner solution for the follower where it sets the same wage as the leader. Vartiainen (2007) has shown that a bargaining system where the follower's wage mimics the leader's wage is conducive to high employment and high welfare under the assumption of monopoly unions. The explanation is that the leader's wage choice is disciplined by the "irresponsibility" of the follower: because the leader knows that its wage will also be the follower's wage, it has a strong incentive for wage restraint. A natural question is whether such a beneficial equilibrium can arise as a corner solution in our model.

To examine this, we solve the leader's optimisation problem under the assumption that the follower's wage equals the leader's wage, i.e. $W_j = W_i$. If we again assume that $\lambda_i = \lambda_j = \lambda$, we can compare the mark-up factors M_i after having inserted the proper total price elasticities

$d \ln P_i / d \ln W_i$ and $d \ln P / d \ln W_i$ in the expressions for ϵ_i and φ_i. It turns out that under this assumption, the wage outcome for the leader is the same independent of monetary regime and which sector is wage leader, as $M_{NI}^N = M_{NM}^N = M_{TI}^T = M_{TM}^T = (1-\theta)/\theta$.[13]

The described behaviour of the leader is an equilibrium behaviour only if the follower does choose the corner solution perceived by the leader. This requires that $\Omega_{W_j}^- > 0$ and $\Omega_{W_j}^+ < 0$.[14] We show in the Appendix that at the wage chosen by the leader under the corner solution assumption, $w_i = (1 + \lambda(1-\theta)/\theta)b$, the second inequality never holds. Instead, it is always the case that $\Omega_{W_j}^+ > 0$. This implies that the follower always chooses a higher wage than the leader in this case. Hence, in our model there does not exist an equilibrium of the Vartiainen type where the leader sets its wage by optimising against a response function for the follower according to which the latter mimics the leader's wage.

However, this does not rule out the existence of corner solutions. Indeed, such solutions may exist. To find them, the following procedure is adopted. Consider, for example, a potential equilibrium with an interior solution for the follower resulting in $w_j < w_i$, as analysed in Section 5.4.1. The leader could set its wage strategically so as to avoid ending up in such an equilibrium and instead force the follower to choose a corner solution. This will be done if an equilibrium with a corner solution for the follower gives the leader higher welfare than the equilibrium with the interior solution.

To analyse the possibility of a corner solution, Figure 2 is helpful. Assume there is a potential equilibrium with an interior solution for the follower where the leader sets the wage w_i^0 and the follower sets the lower wage w_j^0. The curve denoted $\Omega_{W_{j0}}^-$ shows how Ω_{W_j} depends on w_j when $\alpha_k = \alpha_1 > 0$ and applies for $w_j < w_i^0$ and $w_i = w_i^0$. The curve denoted $\Omega_{W_j}^+$ shows how Ω_{W_j} depends

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[13] The intuition for this result is simple. The leader would choose different wages in the different cases only if the perceived total price elasticities $d \ln P_i / d \ln W_i$ and $d \ln P / d \ln W_i$ differ. If the relative wage between the two sectors W_N/W_T is always unity, such differences can never arise. Instead, all total price elasticities are then zero. This follows from the definition of the CPI and the condition for relative market clearing in goods markets, i.e. from (6) and (7). A constant relative wage between the two sectors holds the relative goods price P_N/P_T constant. With a fixed exchange rate (monetary union), P_T is fixed. Hence also P_N, and therefore also the consumer price index P, are fixed. With inflation targeting P is held fixed by the central bank. This can be consistent with a fixed relative price P_N/P_T only if P_N and P_T also remain fixed. Hence, a wage leader, believing that the wage follower will set the same wage, will always perceive that there will be no price consequences of a wage change. This means that the wage leader solves exactly the same optimisation problem regardless of whether it is the tradables or the non-tradables sector that is wage leader and regardless of the monetary regime.
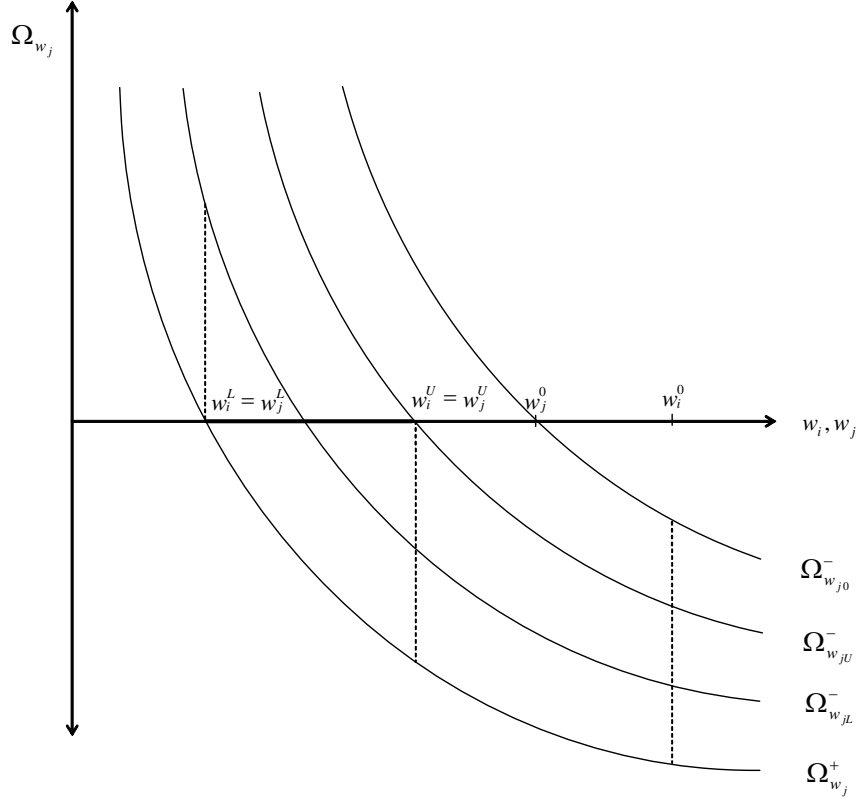
[14] See Section 5.2.

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Figure 2: The set of possible corner solutions

on w_j when $\alpha_k = \alpha_2 = 0$ and applies for $w_j > w_i$. The assumption $\alpha_1 > \alpha_2 = 0$ ensures that the $\Omega_{W_{j0}}^-$-curve lies above the $\Omega_{W_j}^+$-curve. $w_i = w_i^0$ and $w_j = w_j^0$ is a possible equilibrium, since $w_j = w_j^0$ gives $\Omega_{W_j}^- = 0$.

Assume now that the leader lowers is wage from w_0^i. This shifts the $\Omega_{W_j}^-$-curve downwards as $\Omega_{W_j}^-$ depends positively on w_i.[15] w_i could be lowered to w_i^U at which point $\Omega_{W_j}^- = 0$ (depicted by the $\Omega_{W_{jU}}^-$-curve) at the same time as $\Omega_{W_j}^+ < 0$ (depicted by the $\Omega_{W_j}^+$-curve). This represents an

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[15] As $\Omega_{W_j}^- = \lambda\left[-\eta\varphi_j + \{(\alpha_1 + \varepsilon_j)/(1 - b/\widetilde{w}_j)\} + (1-\lambda)(\varepsilon_j - \eta\varphi_j)\right]$ and $\widetilde{w}_j = w_j^{1+\alpha_1}/w_i^{\alpha_1}$, it follows that $\partial\Omega_{W_j}^-/\partial\widetilde{w}_j < 0$ and $\partial\widetilde{w}_j / \partial w_i < 0$. Hence $\partial\Omega_{W_j}^-/\partial w_i > 0$.

upper bound for a corner solution with $w_i = w_j$. A lower bound is found for the wage $w_i^L = w_j^L$, which gives $\Omega_{W_j}^+ = 0$ and $\Omega_{W_{jL}}^- > 0$. So, $w_i^L = w_j^L < w_i = w_j < w_i^U = w_j^U$ all represent possible equilibria with a corner solution for the follower.

To find out whether the realised equilibrium is one with an interior or a corner solution for the follower, one has to calculate the (weighted) utility for the wage setter in the leader sector in the various possible equilibria. The leader sets its wage strategically to reach the equilibrium which provides it with the highest welfare. It is not possible to derive analytical solutions, so to explore what equilibria will result we resort to numerical simulation.

6 Numerical Solutions

The objective of our numerical analysis is to evaluate the effects of the choice of wage leader for employment and welfare in the two monetary regimes under different assumptions on the importance of loss aversion. We are particularly interested in the impact of relative sector size, whether wage setters in the two sectors will agree on the appropriate choice of leader and how the degree of loss aversion affects the type of equilibrium. To study the impact of wage norms we compare equilibrium outcomes and welfare in the case with wage norms as described in Section 5 to the benchmark setting without wage norms as described in Section 4. Throughout the numerical analysis we set $\theta = .8$ to capture decreasing returns to scale. We normalise b to one and make sure that the results yield reasonable mark-ups on the value of unemployment.

6.1 Equilibrium without wage norms

The first set of results concern welfare effects of wage setting systems and monetary regimes in the absence of wage norms. Since the objective functions are continuous and differentiable under this assumption, each regime-specific equilibrium is unique. The uniqueness of equilibria made it possible to provide an analytical ranking of real wages and employment as stated in Propositions 1-5. However, to assess the importance of wage norms, quantitative measures of key variables and welfare also in the case without norms are needed. Table 7 displays equilibrium real wages,

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	1.500	1.167	1.500	1.167	1.500	1.167	3.000	1.333	1.500	1.167	3.000	1.333
w_T	1.167	1.500	1.667	1.500	1.167	1.500	1.158	1.235	1.158	1.235	1.167	1.500
N_N	.123	.474	.123	.474	.123	.474	.031	.337	.126	.575	.031	.278
N_T	.474	.123	.474	.123	.474	.123	.244	.121	.488	.181	.237	.082
N	.596	.596	.596	.596	.596	.596	.276	.458	.614	.756	.268	.360
V_N	.061	.079	.061	.079	.061	.079	.063	.112	.063	.096	.061	.093
V_T	.079	.061	.079	.061	.079	.061	.039	.029	.077	.043	.040	.041
Π_N	.046	.138	.046	.138	.046	.138	.024	.112	.047	.168	.023	.093
Π_T	.138	.046	.138	.046	.138	.046	.071	.038	.141	.056	.069	.031
Ω_N	.053	.104	.053	.104	.053	.104	.039	.112	.054	.127	.038	.093
Ω_T	.104	.053	.104	.053	.104	.053	.052	.033	.104	.049	.052	.036

employment, union utility, profits and the value of the objective functions of wage setters for $\lambda = .5$. Columns (1) to (6) display the results under inflation targeting and columns (7) to (12) the results under monetary union. For each regime, the first two columns show the Nash equilibrium for $\gamma = .25$ and $\gamma = .75$, respectively, and the last four columns the corresponding outcomes when one of the sectors is wage leader.

Table 7 verifies, of course, Propositions 1-5 in Section 4. Under inflation targeting all the equilibria with given sector sizes coincide. Under monetary union, we know from Propositions 3 and 4 that, compared to the Nash game, aggregate employment is higher in the Stackelberg game with the non-tradables sector as leader and lower in the Stackelberg game with the tradables sector as leader. The table shows that the employment differences may be substantial. Welfare, measured by the weighted utility of the employers' federation and the union, Ω_i, is higher for *both* sectors with the non-tradables sector as leader than in the Nash equilibrium and with the tradables sector

as leader. So, both sectors would prefer the non-tradables sector to be leader. Looking at the welfare of unions and employers' federations, i.e. at V_i and Π_i respectively, the results by and large point in the same direction as for the weighted utility in the sector, Ω_i. Under inflation targeting, both unions and employers' federations are, of course, indifferent between uncoordinated bargaining (Nash equilibrium), being wage leader and being wage follower. In monetary union, unions and employers' federations generally prefer sequential bargaining with the N-sector as wage leader. The only exception is the union in the non-tradables sector, which is indifferent between uncoordinated bargaining and being wage leader when it is the smaller sector.

6.2 Equilibrium with wage norms

Next, consider the case when the wage norm is set by the leader and the follower sector is loss averse. First, we consider the case when the follower is highly loss averse and second, the case when the follower cares very little about deviations from the norm.

6.2.1 High degree of loss aversion

Table 8 displays the equilibrium outcomes for $\alpha_1 = .3$. For this particular parameterisation, two of the three different types of equilibria may arise. We either obtain corner solution equilibria or interior solution equilibria with a higher wage for the follower than for the leader. We first note that regardless of regime, corner solutions arise when the N-sector is wage leader and $\gamma = .25$ or when the T-sector is wage leader and $\gamma = .75$. This suggests that corner solutions are more likely when the smaller sector is wage leader. The corner-solution equilibria give higher aggregate employment than the interior-solution equilibria. In these numerical examples with a high degree of loss aversion, wage leadership for the smaller sector thus promotes employment.

Do wage setters in the two sectors agree on who should be wage leader? Under inflation targeting the answer is no. While (the larger) follower sector benefits from the corner-solution equilibrium, the smaller leader would prefer to be follower (and thereby achieve an interior solution where the follower sets a higher wage than the leader). Suppose that $\gamma = .25$ so that the non-tradables sector

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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

is smaller. When the N-sector is leader, as in column (1), it achieves a utility level of .045 and the follower T-sector a utility level of .134. If instead the smaller T-sector is leader as in column (3), this would give the N-sector a slightly higher utility of .053, but reduce the utility of the T-sector to .104. In a monetary union, however, wage setters always agree on who should be wage leader under this parameterisation. Regardless of which sector is larger, it is always optimal to have the non-tradables sector as wage leader.

To analyse whether comparison thinking could be employment-promoting we next compare Tables 7 and 8. We already discussed that, for this parameterisation, the case with wage norms gives rise to either corner solution equilibria or interior solution equilibria where the follower sets a higher wage than the follower. But in the interior solution equilibria in Table 8 with a higher wage for the follower than the leader $\alpha_2 = 0$ by assumption. This implies that the wages set in these

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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

interior equilibria coincide with the Stackelberg equilibria without wage norms, i.e. the solutions displayed in Table 7. The only difference between the two cases is then that wage norms may give rise to corner solution equilibria if the smaller sector is wage leader. Since these corner solutions always yield better outcomes in terms of employment than the corresponding Stackelberg equilibria without comparison thinking, it is possible that comparison-thinking could be employment-promoting. This is an important conclusion, since it goes against the conventional wisdom that comparison thinking leads to union militancy and employment losses.

6.2.2 Low degree of loss aversion

Do our results change when the follower cares very little about wage comparisons? Intuitively, we expect this case to closely mimic that without wage norms. Table 9 displays the equilibrium

outcomes for a low degree of loss aversion, $\alpha_1 = .03$. The results suggest that both types of interior solution equilibria now are possible. Starting with inflation targeting, columns (1) and (4) suggest that letting the smaller sector be wage leader gives interior solution equilibria where the follower sets a lower wage than the leader. Similarly, columns (2) and (3) suggest that leadership for the larger sector generates an equilibrium where the follower sets a higher wage than the leader. Aggregate employment is higher when the larger sector is wage leader. The explanation is that a larger sector has a stronger incentive for wage moderation as a high wage induces more adverse consequences the larger the sector via the impact on central bank behaviour: this wage moderation then spills over to the wage of the follower. Turning to the case of a monetary union, we obtain interior solution equilibria except when $\gamma = .75$ and the tradables sector is wage leader: such a setting generates a corner solution also for this low degree of loss aversion. When there are interior solutions, leadership for the non-tradables sector promotes employment, in particular when that sector is large. This is the same result as in Table 7.

Under inflation targeting, the larger sector is indifferent between being leader and being follower. The smaller sector, however, is slightly better off being wage follower in this regime. In monetary union, the pattern is the same as when loss aversion is high: the welfare of wage setters in the two sectors is maximised when the non-tradables sector is wage leader. This applies regardless of which sector is larger.

6.3 Differences in bargaining power

Our analysis has questioned the conventional wisdom that wage leadership for the tradables sector promotes wage restraint and high employment. This makes it natural to ask whether our assumptions have missed some important parts of reality. One potential candidate is the assumption of equal relative bargaining strength in the two sectors ($\lambda_N = \lambda_T$) in the analysis of wage setting with norms.[16] A possible argument is that employers have a stronger bargaining position in the tradables than in the non-tradables sector, because they have the option of completely closing down domestic facilities and moving production abroad. To examine the implications of such a possibility, we assu-

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[16] This assumption was not made in the general analysis of wage setting without norms in Section 4.

Table 10: Equilibrium outcomes with wage norms, larger bargaining power for employers in the tradables than in the non-tradables sector and a high degree of loss aversion ($\lambda_N = .9, \lambda_T = .1$ 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	1.532	1.279	1.100	1.033	1.532	1.279	1.400	1.067
w_T	1.140	1.166	1.100	1.033	1.137	1.104	1.400	1.067
N_N	.126	.422	.272	1.117	.127	.446	.082	.953
N_T	.508	.154	.817	.372	.514	.172	.245	.318
N	.634	.576	1.089	1.489	.641	.618	.327	1.271
Ω_N	.065	.119	.203	.078	.066	.126	.032	.073
Ω_T	.120	.042	.030	.046	.120	.041	.087	.074
Type of equilibrium	$w_j < w_i$	$w_j < w_i$	Corner	Corner	$w_j < w_i$	$w_j < w_i$	Corner	Corner

me that $\lambda_T = .1$ and $\lambda_N = .9$ in Table 10.

We find four cases with corner solutions and four cases with interior solutions for the follower. In three out of four cases (the exception is monetary union and $\gamma = .25$), leadership for the tradables sector gives the highest employment. The intuition is that the low relative bargaining strength for the union side in the tradables sector implies an incentive for wage restraint which is transmitted also to the non-tradables sector via norm setting. Looking at the (weighted) utility for the two sectors, it turns out that, in all the three cases where leadership for the tradables sector gives the highest employment, there will be disagreement between the sectors on who should be the wage leader.

The upshot is thus that with comparison thinking stronger bargaining power for employers in the tradables than in the non-tradables sector may give the result that wage leadership for the tradables sector is conducive to high aggregate employment.

7   Discussion

In many European economies wage bargaining takes place at the industry level. It is common that one sector, usually a tradables (manufacturing) sector like engineering, acts as wage leader and concludes the first agreement in a wage round, so-called *pattern bargaining*. Recently, the wage leadership role of the tradables sector has been challenged by non-tradables (service) sectors in many countries.

Conventional wisdom holds that wage leadership for the tradables sector is conducive to wage restraint and high employment. The argument is that international competition provides incentives for wage moderation in that sector which is believed to be transmitted to the rest of the economy. We have examined whether this is indeed the case in a standard model of a small open economy with a tradables and a non-tradables sector and how outcomes depend on the monetary regime. Our surprising conclusion is that it is hard to corroborate the conventional wisdom. In general, the analysis of the effects of various types of pattern bargaining turns out quite complex.

First, assuming standard trade union utility functions, we found that under inflation targeting pattern bargaining gives the same macroeconomic outcomes as uncoordinated bargaining. It does not matter which sector is wage leader in this monetary regime. In contrast, the type of bargaining does matter under monetary union (a fixed exchange rate). But contrary to conventional wisdom, in that case pattern bargaining with the tradables sector as wage leader gives less wage restraint and lower aggregate employment than uncoordinated bargaining. Pattern bargaining with the non-tradables sector as wage leader gives more wage restraint and higher aggregate employment than uncoordinated bargaining. Both sectors attain the highest welfare with the non-tradables sector as wage leader, so there is no conflict of interest regarding the choice of wage leader.

Second, letting trade union utility depend on wage comparisons and introducing loss aversion, we showed the possibility of equilibria where the follower chooses the same wage as the leader. This could help explain the tendency towards uniform wage developments under pattern bargaining.

Such equilibria may arise when the *smaller* sector (independently of whether it is the tradables or the non-tradables sector) is wage leader. They are associated with wage restraint and high aggregate employment. So, contrary to what is usually believed, it turns out in our model that comparison thinking and loss aversion may be beneficial for employment.

Would other assumptions than those in our basic model change our conclusions? One possibility is that the bargaining strength of employers may be larger in the tradables than the non-tradables sector, because production there can be shifted abroad. We show that the likelihood that wage leadership for the tradables sector is conducive to wage restraint and high aggregate employment increases under this assumption. However, it is not obvious that the relative bargaining power of employers is larger in the tradables than in the non-tradables sector: a counterargument is that the rate of unionisation is lower in the non-tradables than in the tradables sector.

Another caveat is that coordination in wage bargaining is probably higher in the tradables sector, which tends to be dominated by large corporations, than in the non-tradables sector, which usually has a more fragmented structure. More internalisation of adverse effects of high wages in the tradables sector could therefore be expected to exercise more pressure for wage restraint there, which via wage leadership could spread to the less coordinated non-tradables sector.

Another possible objection to our analysis has to do with the public sector. We have modelled the non-tradables sector as consisting of private, profit-maximising firms. To the extent that non-tradables are produced in the public sector, other mechanisms may be at work. Finally, wage bargainers in the tradables sector often like to portray themselves as more rational and aware of wage-employment-profit trade-offs than bargainers in the non-tradables sector. If this is true, wage setting in the two sectors ought to be modelled in different ways.

To conclude, a number of considerations could be added to our model. This might change the conclusions. Still, we find it a puzzle that a straightforward analysis of pattern bargaining does not support the conventional wisdom that wage leadership for the tradables (manufacturing) sector is conducive to aggregate wage restraint and high employment.

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Appendix

Proof that $\lim\limits_{w_j \to w_i} \Omega^+_{W_j} > 0$ **when** $w_i = (1 + \lambda(1-\theta)/\theta)\, b$

Since $\alpha_k = 0$ when $w_j > w_i$ we obtain:

$$\lim_{w_j \to w_i} \Omega^+_{W_j} = \lambda_j \left[-\eta\varphi_j + \frac{\widetilde{w}_j \epsilon_{jm}}{(\widetilde{w}_j - b)} \right] + (1 - \lambda_j) \left[\epsilon_j - \eta\varphi_j \right]$$

In a corner solution

$$\widetilde{w}_j = \frac{w_j^{1+\alpha_k}}{w_i^{\alpha_k}} = w_j = w_i = \left[1 + \lambda\frac{1-\theta}{\theta} \right] b.$$

Under inflation targeting and N-sector leadership:

$$\epsilon_{TI} = 1$$

$$\varphi_{TI} = 1 - \gamma\theta$$

This implies:

$$\lim_{w_j \to w_i} \Omega^+_{W_j} = \lambda \left[-\eta(1 - \gamma\theta) + \frac{w_i}{(w_i - b)} \right] + (1 - \lambda)\left[1 - \eta(1 - \gamma\theta)\right] = \frac{\gamma\theta}{1-\theta} > 0.$$

Due to symmetry, the proof for the T-sector is analogous.

In a monetary union, under N-sector leadership:

$$\epsilon_{TM} = 1 + \gamma\theta$$

$$\varphi_{TM} = 1$$

This implies:

$$\lim_{w_j \to w_i} \Omega^+_{W_j} = \lambda \left[-\eta + \frac{w_i(1 + \gamma\theta)}{(w_i - b)} \right] + (1 - \lambda)\left[1 + \gamma\theta - \eta\right] = \frac{\gamma\theta}{1-\theta} > 0.$$

When the T-sector is wage leader in a monetary union:

$$\epsilon_{NM} = 1 - \gamma\theta$$

$$\varphi_{NM} = 1 - \theta$$

This implies:

$$\lim_{w_j \to w_i} \Omega^+_{W_j} = \lambda \left[-\eta(1 - \theta) + \frac{w_i(1 - \gamma\theta)}{(w_i - b)} \right] + (1 - \lambda)\left[1 - \gamma\theta - \eta(1 - \theta)\right] = \frac{(1 - \gamma)\theta}{(1 - \theta)} > 0$$

and the proposition follows.