Collective Bargaining, Awareness of General Equilibrium Effects, and Unemployment*

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Abstract

We explore the significance of general equilibrium feedback effects for wage-bargaining. We examine a two-sector economy and show that if agents only consider labor demand effects low real wages and low unemployment are the result. With an intermediate view, i.e. when partial equilibrium effects within a sector are taken into account, high real wages and unemployment result. If all general equilibrium effects are perceived simultaneously, we once again obtain a situation with low wages and unemployment. The assumption that unions and employers' federations are unable to incorporate all feedback effects from other sectors may explain why unemployment is high in some European countries.

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1 Introduction

Although the average European unemployment rate remains high, there are marked differences across countries. For instance, the unemployment rate in Germany was markedly above that of the Netherlands during the first decade of the 21th century,[1] although wages in both countries are primarily set by collective bargaining. In this paper we argue that the degree to which unions and employers' associations recognize general equilibrium effects when they determine wages may explain such differences.

With all the interactions they encompass, economies are highly complex systems. While obvious, direct relationships are easily recognized, more indirect, complex effects may be hard to perceive and accordingly overlooked. With the help of a simple model we examine what happens when agents negotiating wages are not aware of all the interactions operating in an economy, but only perceive obvious direct relationships. For this purpose, we consider wage-bargaining between labor unions and employers' associations embedded in a two-sector economy and analyze the outcomes of three different perspectives taken by agents involved in wage bargaining. The model is closed by a system of unemployment insurance financed by income taxes, i.e. the government's budget constraint. We first elucidate a bargaining process that we call General Equilibrium Bargaining (GEB). GEB implies that all general equilibrium effects are taken into account when wages are negotiated. Next we analyze a bargaining process called Myopic Bargaining (MB). Under MB bargaining parties are assumed to be highly myopic, taking only the direct employment effects of wage determination into account without recognizing changes in product prices, etc. Finally we investigate Partial Equilibrium Bargaining (PEB). For PEB we assume that the bargaining parties recognize, and hence take into account, the *direct* effects on their sector that result from wage setting without considering feedback from the remaining sector and changes in taxes and unemployment benefits.

We show that wages and unemployment are always higher under PEB than under GEB or MB. This means that an intermediate recognition level of general equilibrium effects is less desirable than either considering all general equilibrium effects or limiting considerations to the employment effect of the wage negotiated. We briefly outline the reasons why wages and unemployment are higher with PEB than under GEB. Under PEB two negative effects of wage increase in a sector (say sector 1) are neglected. First,

[1] The "Dutch unemployment miracle" is described in Visser and Hemerijck (1997) and Nickell and van Ours (2000).

the price level and the wage of a worker in the other sector (say sector 2) rises, causing a decline in output and employment in sector 2. As a consequence, the relative price between sector 1 and sector 2 and employment in sector 1 decline which, in turn, makes unions and employers in sector 1 worse off. As a second effect, taxes to finance the unemployed or nominal unemployment benefits increase, causing a depreciation of the value of the bargaining parties' objective function. Both effects, alone or jointly, cause bargaining parties to settle for higher wages under PEB than under GEB. The first effect is present if there is a real wage rigidity or wage negotiations in sector 2. Hence our results will turn out to be robust for different types of wage settings in sector 2.

The result has policy implications. Centralized (industry-level) wage bargaining can be associated with PEB and thus incurs the risk of high unemployment when bargaining parties do not account for all general equilibrium effects. Hence one might consider ways of improving centralized wage bargaining and thus inducing a switch from PEB to GEB. While holding lectures on general equilibrium effects is perhaps a rather diverting suggestion, efforts to evidently incorporate general equilibrium effects and their impact on wages and employment in the objective functions of unions and employer associations would be helpful as long as centralized wage bargaining prevails. As we set out in the next section, the "employment miracle" in the Netherlands over the last two decades may be an example of such efforts.

The paper is organized as follows: In the next section we motivate our analysis and relate it to the literature. In section 3 we introduce the model. In section 4 we compare the outcomes of these three different types of bargaining. Section 5 extends our model to take into account simultaneous wage-bargaining in both sectors. This reinforces our conclusions and enables us to derive the magnitude of unemployment differences for the different perspectives. Section 6 presents our conclusions.

2 Motivation and Literature

There is a vast amount of literature about the impact of labor market institutions on unemployment, which we will not attempt to summarize here. In general, unemployment has been associated in the literature with labor market factors affecting supply and demand for labor, including unemployment benefit systems, institutional settings for wage determination, and minimum wages.

The main point we make in our paper is that insufficient recognition of general equilib-

rium effects can considerably reinforce the negative impact of particular labor market institutions on unemployment. We show that collective wage agreements yield high unemployment under PEB, while they only create moderate unemployment under GEB and MB. We argue that our analysis represents a new twist in thinking about the possible outcomes of collective wage agreements.

The Netherlands may be an example of collective bargaining where general equilibrium effects have been taken into account. In the "Wassenaar Accord" in 1982, the government, unions, and employers' organizations agreed on broad-based wage moderation to stimulate job creation in the economy. Such an economy-wide approach can be interpreted as GEB.

In this paper we compare three different awareness structures, one each for GEB, PEB and MB. Within each awareness structure, all agents have the same awareness, there is no uncertainty about the lack of awareness of the other agents, and one agent does not need to reason about lack of awareness of the other agent. It is nevertheless useful to relate our analysis to the unawareness models in the literature on how to model reasoning about unawareness consistently. Formalizing the concept of unawareness has turned out to be a difficult task. As shown in the seminal paper by Dekel, Lipman, and Rustichini (1998), the prevailing model representing uncertainty by a state space allows only for a trivial notion of unawareness: If an agent is unaware of anything then he is unaware of everything and thus knows nothing. A subsequent strand in the literature has developed important theories using multiple state spaces to model non-awareness (Li 2009; Heifetz, Meier, and Schipper 2006; Galanis 2009, and using a mathematical logic perspective in Halpern and Rego 2006 and Board and Chung 2009).

We relate our work on partial equilibrium bargaining to this literature in the following way. In the unawareness models by Heifetz, Meier, and Schipper (2006) and Li (2009), each agent has a subjective state space that is less detailed than the full state space and allows for multi-person unawareness. Ozbay (2008) applies these concepts of unawareness to incomplete contracts. Galanis (2009) showed how general unawareness structures by Heifetz, Meier, and Schipper (2006) can be used to model unawareness of theorems. The analogy of our model to the latter is as follows: Under partial equilibrium bargaining, the unions and the employers' associations assume that sector 2 is irrelevant for wage bargaining and thus absent from economic changes in sector 1. This means that when agents bargain over wages, they are oblivious of interdependencies with sector 2 when they evaluate a wage level. Agents may be aware of the existence

of other economic sectors, but they do not recognize interdependencies with them.[2]

When the wage in sector 1 is changed, all changes in quantity, prices, and wages are attributed to changes in sector 1. Among other things, this means that the relationship between employment and wages in sector 1 is viewed as a function of wages and parameters. The parameters are objectively dependent on the outcomes in sector 2, but subjectively they are simply perceived by the agents as real numbers under partial equilibrium, as for them sector 2 appears irrelevant. Similarly, the objective functions are functions of quantity, price, and wages in sector 1 and parameters. We assume that under partial equilibrium bargaining agents are unaware of the impact of sector 2 but do not make mistakes regarding the current size of the parameters.[3]

A plausible way of explaining the behavior of agents might run as follows: Suppose agents estimate econometrically the employment/wage relationship in sector 1 using data from many quarters taking into account the fact that the economy may be affected by shocks impacting on this relationship. If agents estimate a labor demand specification in which only real wages in sector 1, other sector 1 variables and parameters representing all other influences appear, then agents will not discover feedback effects from sector 2 when the wage in sector 1 is changed.

Finally, our work is related to the macroeconomic literature on limited ability of agents to process information. Many economists have suggested that departures from rationality may be important in macroeconomics (Akerlof 2002, Sargent 1993). The notion that agents are unable to process all available information at once plays an important role in recent papers on the microfoundation of the Phillips curve (Woodford 2003, Ball 2000 and Mankiw and Reis 2002). These approaches view imperfect information acquisition as a device for capturing the limited ability of agents to process information. We adopt a similar notion and assume that unions and employers may not be able to process information about general equilibrium feedback effects. In a companion paper (Beilharz and Gersbach 2004) we suggest that voters' lack of recognition of complex economic links may give rise to economic policies that eventually lead to a crisis.

Our paper is related to the seminal work of Calmfors and Driffill (1988) who derive a hump-shaped relationship between the degree of wage-bargaining centralization and real wages or unemployment. In focusing on general equilibrium feedback effects, we

[2]Sector 2 may be relevant for them in other economic activities. For instance, when they act as consumers, they may buy goods produced in sector 2.

[3]Allowing for parameter mistakes – e.g. by fixing the parameters at some historical levels – would reinforce our results and represent a fruitful area for future research.

keep centralization constant, but vary the level of sophistication toward equilibrium feedback effects. Therefore our work is complementary to Calmfors and Driffill. For a given degree of centralization, we show that different levels of equilibrium effect considerations by the bargaining agents are associated with the pattern of unemployment rates described.

3 Model

In this section, we develop a model in order to analyze different wage-bargaining processes associated with different degrees of sophistication in the knowledge of agents about feedback effects.

There are two sectors producing good 1 and good 2. The only input in production is labor.[4] The production functions are given by

$$q_1 = L_1^{\beta} \tag{1}$$

$$q_2 = L_2^{\beta} \tag{2}$$

with $0 < \beta < 1$. Subscripts 1 and 2 denote the first and second sector, respectively. We assume that workers are immobile across industries, i.e. they can only work in one sector. The total labor input is $L_1 + L_2$. Labor supply is assumed to be inelastic and is given by $\overline{L_1}$ in sector 1 and $\overline{L_2}$ in sector 2.

Profits accrue to some firm-owners (henceforth "capitalists"), who do not work. The strict separation of working class and capital owners is made for unambiguous objectives pursued by unions and employers' federations. We assume that all types of workers and capitalists have the same symmetric Cobb Douglas utility function[5]:

$$u = c_1^{\frac{1}{2}} \cdot c_2^{\frac{1}{2}} \tag{3}$$

c_1 and c_2 denote the consumption levels for good 1 and good 2. We assume that workers own no shares so that labor unions are only concerned about wages. The concrete

[4] In the long run, there is no loss of generality associated with neglecting capital, provided that capacity constraints are not binding and that the long-run capital stock is determined by equating the marginal product of capital with real world interest.

[5] The symmetry assumption is made solely for ease of presentation.

distribution of shares among capitalists is irrelevant, as all individuals have the same preferences and demand functions are unit-elastic to income. Thus, any distribution of shares yields the same aggregate demand. One could imagine that shares of firms are traded in such a way that each shareholder holds the market portfolio.

In the labor market of sector 2, we proceed in two steps. First, we assume an exogenously given real wage, denoted by $\overline{rw}_2$. Second, in section 5, the wage is also determined by collective wage-bargaining. $\overline{rw}_2$ is assumed to exceed the market clearing real wage so that it becomes binding, and unemployment occurs in the second sector. The nominal wage w_2 is then $p \cdot \overline{rw}_2$. A variety of regulations can cause a real wage floor. Later we will explain $\overline{rw}_2$ by centralized wage setting in sector 2.

Wages for labor in the first sector are determined by the wage-bargaining process that will be the focus of our examination. Unemployment is financed by a flat tax on total income, denoted by τ. We assume that the unemployed obtain a fixed real benefit, denoted by $\overline{ri}$, that is lower than the real wage in sector 2.

At this stage a remark about our working assumption is necessary. Our description of labor markets mirrors a situation with non-competitive wages in several industries. We first focus on wage determination in one industry given real wages in other industries; then we endogenize wage-setting in other industries as well.

3.1 Markets and the Government's Budget Constraint

In the first step, we derive supply and demand for goods and labor. Throughout the paper we normalize the price of the second good to 1, i.e.

$$p_2 = 1 \tag{4}$$

By utility maximization for an individual worker or capitalist, we obtain the following demand equations for consumption:

$$c_1 = \frac{1}{2} \cdot \frac{b}{p_1} \tag{5}$$

$$c_2 = \frac{1}{2} \cdot b \tag{6}$$

b denotes the budget of the individual. It consists of wages for workers in sector 1 and 2, and of profits if the individual is a capitalist. In the case of unemployment, b denotes unemployment benefits.

Profit functions of the firms are sales minus costs. Therefore:

$$\pi_1 = p_1 q_1 - w_1 L_1 \tag{7}$$

$$\pi_2 = q_2 - w_2 L_2 \tag{8}$$

Firms are price-takers in both sectors. We obtain the standard first-order conditions for profit maximization in sector 1 and 2 as:

$$w_1 = p_1 \beta L_1^{\beta-1} \tag{9}$$

$$w_2 = \beta L_2^{\beta-1} \tag{10}$$

Since the income elasticity of the demand functions for goods across all types of individuals is 1, we can aggregate the demand by aggregating the budgets of all agents using (5) or (6). Let C_1 and B denote the aggregated demand for good 1 and the aggregated budget, respectively. Market clearing for good 1 is then given by

$$C_1 = \frac{1}{2} \cdot \frac{B}{p_1} = q_1 \tag{11}$$

Using the identity that aggregate budgets equal GDP, which is $p_1 q_1 + q_2$, we obtain

$$\frac{1}{2} \cdot \frac{p_1 q_1 + q_2}{p_1} = q_1 \tag{12}$$

This equation can be simplified to our final market clearing equation

$$p_1 = \frac{q_2}{q_1} = \frac{L_2^\beta}{L_1^\beta} \tag{13}$$

The appropriate consumer price index is

$$p = p_1^{\frac{1}{2}} \cdot p_2^{\frac{1}{2}} = p_1^{\frac{1}{2}} \tag{14}$$

This price index guarantees that changes in prices do not affect a household's utility as long as the real income remains constant.

We will assume that the exogenous real wage $\overline{rw}_2$ will be binding in sector 2, so that the labor market for workers will not clear. Nominal gross wages for workers in sector 2 are given by:

$$w_2 = \overline{rw}_2 \cdot p \tag{15}$$

Gross unemployment benefits ub are similarly defined as

$$ub = \overline{ri} \cdot p \tag{16}$$

with an exogenously given real value of benefits $\overline{ri} \leq \overline{rw}_2$.[6] Unemployment, denoted by Δ, is given by

$$\Delta = \overline{L}_1 - L_1 + \overline{L}_2 - L_2 \tag{17}$$

To finance the unemployment benefits, the government is assumed to use a flat tax, denoted by τ, on the total income of all individuals.[7] The tax is determined by the government's budget constraint:

$$(p_1 q_1 + q_2) \cdot \tau = ub(1 - \tau) \cdot \Delta \tag{18}$$

[6]The use of a flat payment for unemployment benefits rather than a replacement rate allows for closed form solutions.

[7]For simplicity of exposition, we assume that unemployed individuals are also taxed.

3.2 Market Equilibria

The above system of equations can be solved analytically as a function of the wage w_1 in the first sector for all relevant variables. Wage negotiations in sector 1 are the main focus in the first part of our paper and are discussed later. The solution for the equilibrium as a function of w_1 is derived in the appendix, and is summarized in table (1).

Table 1: Solution of the Equation System

$p_1(w_1)$	$(\frac{w_1}{\overline{rw}_2})^{\frac{2\beta}{2+\beta}}$
$p_2(w_1)$	1
$p(w_1)$	$(\frac{w_1}{\overline{rw}_2})^{\frac{\beta}{2+\beta}}$
$L_1(w_1)$	$\left(\frac{\beta}{w_1}(\frac{w_1}{\overline{rw}_2})^{\frac{2\beta}{2+\beta}}\right)^{\frac{1}{1-\beta}}$
$L_2(w_1)$	$\left(\frac{\beta}{\overline{rw}_2}(\frac{\overline{rw}_2}{w_1})^{\frac{\beta}{2+\beta}}\right)^{\frac{1}{1-\beta}}$
$\Delta(w_1)$	$\overline{L_1} - L_1 + \overline{L_2} - L_2$
$ub(w_1)$	$\overline{ri} \cdot p$
$\tau(w_1)$	$\frac{ub \cdot \Delta}{p_1 L_1^{\beta} + L_2^{\beta} + ub \cdot \Delta}$
$q_1(w_1)$	$\left(\frac{\beta}{w_1}(\frac{w_1}{\overline{rw}_2})^{\frac{2\beta}{2+\beta}}\right)^{\frac{\beta}{1-\beta}}$
$q_2(w_1)$	$\left(\frac{\beta}{\overline{rw}_2}(\frac{\overline{rw}_2}{w_1})^{\frac{\beta}{2+\beta}}\right)^{\frac{\beta}{1-\beta}}$

The previous solutions for p_1, p, L_1, L_2 as a function of w_1 from the table must be inserted in Δ, ub and τ. In the following, we will denote the equilibrium that still depends on w_1 by $E(w_1)$, which is given by:

$$E\Big(p_1(w_1), p(w_1), L_1(w_1), L_2(w_1), \Delta(w_1), ub(w_1), \tau(w_1), q_1(w_1), q_2(w_1), w_1\Big) \tag{19}$$

In the next section, we discuss how w_1 is determined within a wage-bargaining process in sector 1.

3.3 Welfare

The following welfare considerations are important to keep in mind when we proceed with our analysis. If agents recognize all feedback effects, aggregate welfare in terms of the utilitarian welfare function is strictly monotonically decreasing in w_1 as soon as the wage is above the market clearing level in sector 1. This holds for both cases when there is real wage rigidity in sector 2 or when labor markets clear in sector 2. The latter case will be considered later in the paper. In contrast, utilities of workers who remain employed in sector 1 are increasing in w_1, while workers in sector 2 and unemployed individuals, caused by an increasing value of w_1, are worse off.

3.4 The Wage-Bargaining Process in Sector 1

We assume that wages in sector 1 are determined by collective bargaining between a union and an employers' association.[8] The union has the following objective function:

$$\Gamma_u = \frac{w_1(1-\tau) - ub(1-\tau)}{p} \cdot L_1 \tag{20}$$

Γ_u results from utility maximization of the labor union for its members (see Manzini 1998). It is the difference between the union members' utility in case of agreement and the utility in case of disagreement in the negotiation.

Profits accrue to the group of capital owners L_k represented by an employers' federation whose objective is to maximize real net profits:

$$\Gamma_e = \frac{\pi_1(1-\tau)}{p} \tag{21}$$

[8] Manzini (1998) provides a survey of collective bargaining processes. Haller and Holden (1990 and 1997) have made important contributions to our understanding of wage bargaining. In particular, Haller and Holden (1990) have shown that non-cooperative wage negotiations do not necessarily lead to efficient outcomes as in the Rubinstein bargaining model. The reason is that the union can call a strike which disrupts production and thus reduces the payoffs of both players and such strikes with a length in real time can occur in equilibrium. Haller and Holden (1997) show that bargaining between groups consisting of heterogeneous members and ratification requirements may induce inefficiencies in bargaining as the required majorities to approve an outcome in a group may be so high that it precludes mutually beneficial agreements. Our work is complementary to these works. We highlight how lack of awareness of general equilibrium effects creates inefficient bargaining outcomes even if players behave cooperatively.

We assume that wages are determined by the Nash-bargaining solution with equal bargaining power. The outcome is the wage maximizing the Nash-bargaining product, i.e. the general objective function

$$\Gamma = \Gamma_u \cdot \Gamma_e = \frac{w_1 - ub}{p} \cdot L_1 \cdot \frac{\pi_1}{p} \cdot (1-\tau)^2 \tag{22}$$

We consider a labor market where firms and employees are not wage-takers but negotiate wages. Then, all other variables of the system (employment, prices, output, etc.) depend on the negotiated wage. The question arises as to which dependencies are taken into account by the wage-bargaining parties. When determining wages, do they only consider employment effects or also changes in prices, unemployment benefits etc.? And do such different levels of sophistication in the perception of general equilibrium effects change the outcome, i.e. the negotiated wage, and hence all prices and allocations? In this paper, we investigate three different levels of sophistication.

3.4.1 General Equilibrium Bargaining

We begin with the general objective function, written explicitly as:

$$\Gamma = \frac{w_1 - ub}{p(p1, p2)} \cdot L_1 \cdot \frac{p_1 L_1^{\beta} - w_1 L_1}{p(p1, p2)} \tag{23}$$

We first consider the possibility of *all* general equilibrium effects being taken into account by the bargaining parties. Hence, changes in output, prices in all sectors, and changes in unemployment benefits etc. are calculated for various wages w_1 and enter the common objective. We call this bargaining process, in which agents account for all general equilibrium effects that occur when a wage is negotiated, General Equilibrium Bargaining (GEB). We distinguish two subcases. In the first GEB scenario, bargaining parties also take into account how changes in wages may affect taxes τ. In the second GEB scenario, τ is taken as fixed. We work with the latter version of GEB. The first GEB scenario would reinforce our results, as we will argue later.

This GEB scenario implies that we must insert the solutions for the variables ub, p, L_1 and p_1 from table (1) into the objective function (23), then take the derivative with respect to w_1, and solve the first-order condition for w_1. By taking the derivative of Γ in this way, all dependencies on w_1 are accounted for. The Nash-bargaining solution is determined as the wage that maximizes Γ.

3.4.2 Myopic Bargaining

We next examine the case where agents do not or cannot perceive all feedback effects operating at the general equilibrium level. At one extreme, one might imagine a situation where unions and industry associations only take into account the employment effect $L_1(w_1)$, i.e. only consider the employment rate change associated with a change in wages, while assuming all other variables remain constant. Firms derive the employment effect of a given wage by solving the first-order condition of profit maximization for labor demand L_1, which is dependent on the negotiated wage w_1. When we only insert the labor demand $L_1(w_1)$ from profit maximization into the objective function (23), and treat all other variables (like p_1, ub etc.) as constants, we assume that agents only consider the direct employment effect of a wage agreement while ignoring all other interactions in the economy. The wage-bargaining process based on this myopic assessment of the economy is called Myopic Bargaining (MB).

3.4.3 Partial Equilibrium Bargaining

The most plausible scenario is likely the case where agents only consider the most direct changes occurring in response to a variation in w_1, i.e. effects that occur *directly* in their sector. In doing so, the bargaining parties consider not only the employment effect L_1 of the negotiated wage w_1, but also the price effect $p_1(w_1)$ (and hence p). The unemployment benefits $ub(w_1)$ and all other variables in the economy - notably output and price in sector 2 - are assumed (by the bargaining agents) to remain constant. We call the bargaining process based on this assessment of feedback from wage setting Partial Equilibrium Bargaining (PEB).

Table (2) summarizes the different views of the bargaining processes.

3.5 Overall Equilibria

The overall equilibrium must be calculated for each type of bargaining process denoted by E^{MB}, E^{PEB}, and E^{GEB}, respectively. In order to derive the overall equilibria, we first have to calculate the wages w_1 that result in the different bargaining processes. Accordingly, we have to insert the variables corresponding to the different views under which bargaining takes place in the Nash-bargaining function of unions and employers' associations (see equation (23)).

Table 2: Bargaining Processes

Bargaining Type	Variables Changes considered	Variables Changes not considered
MB	$L_1(w_1)$	p_1, p, ub, variables of sector 2
PEB	$L_1(w_1)$, $p_1(w_1)$, $p(w_1)$	ub, variables of sector 2
GEB	all variables	

3.5.1 GEB Equilibrium

In order to derive the wage resulting under GEB, we insert all the variables $p_1(w_1), p(w_1)$, $L_1(w_1)$, $ub(w_1)$ from table (1) into Γ. The resulting objective function, denoted by Γ^{GEB}, is given as

$$\Gamma^{GEB} = \left(\frac{w_1}{\overline{rw}_2}\right)^{\frac{2\beta(1+\beta)}{(2+\beta)(1-\beta)}} \left[\overline{ri}\left(\frac{w_1}{\overline{rw}_2}\right)^{\frac{\beta}{2+\beta}} - w_1\right]\left[w_1\left(\frac{\beta}{w_1}\right)^{\frac{2}{1-\beta}} - \left(\frac{\beta}{w_1}\right)^{\frac{1+\beta}{1-\beta}}\right] \tag{24}$$

The first-order condition with respect to w_1 is given by

$$\frac{d\Gamma^{GEB}}{dw_1} = \frac{2\left(\frac{w_1}{\overline{rw}_2}\right)^{\frac{2\beta(1+\beta)}{(2+\beta)(1-\beta)}} \left[w_1\beta - \overline{ri}\left(\frac{w_1}{\overline{rw}_2}\right)^{\frac{\beta}{2+\beta}}\right]\left[w_1\left(\frac{\beta}{w_1}\right)^{\frac{2}{1-\beta}} - \left(\frac{\beta}{w_1}\right)^{\frac{1+\beta}{1-\beta}}\right]}{(2+\beta)(1-\beta)w_1} = 0 \tag{25}$$

Solving for w_1 yields the wage in the GEB equilibrium, w_1^{GEB}.[9] After some elementary algebra and rearrangement of terms, we obtain[10] ,

$$w_1^{GEB} = \frac{\overline{ri}^{\frac{2+\beta}{2}}}{\beta(\beta\overline{rw}_2)^{\frac{\beta}{2}}} \tag{26}$$

[9] Although there are several solutions to equation (25), only one is economically meaningful.

[10] Note that firms are assumed to be price takers in the labor market. Hence, although employers' associations have general equilibrium awareness, the representative firm in each sector is a price and wage taker. To substantiate this distinction we could assume a large number of identical firms and that the employer association maximizes aggregate profits. Then, the current economy would be multiplied by the number of firms and the results would remain unchanged. For simplicity, we work with only one representative firm.

Note that w_1^{GEB} depends positively on $\overline{ri}$ and negatively on $\overline{rw}_2$. The higher the unemployment benefits, the higher the wage requirements, as the threat point of the union is higher. On the other hand, high real wages in the other sector lead to cautious nominal wage setting in the agents' own sector. How agents' *real* wages are affected by real wages in the other sector will be discussed later. Inserting w_1^{GEB} into the variables of table (1), we obtain the overall equilibrium under GEB, $E^{GEB} = E(w_1^{GEB})$.

3.5.2 MB Equilibrium

In the MB case, we assume that agents only recognize the dependence of L_1 on w_1, which is derived from profit maximization (9) as:

$$L_1 = \left(\frac{p_1\beta}{w_1}\right)^{\frac{1}{1-\beta}} \tag{27}$$

In the objective function (23) we now only insert $L_1(w_1)$ from (27). All other variables are assumed to remain constant as w_1 varies. The objective function under MB amounts to

$$\Gamma^{MB} = \frac{w_1 - ub}{p^2}\left(\frac{p_1\beta}{w_1}\right)^{\frac{1}{1-\beta}}\left[p_1\left(\frac{p_1\beta}{w_1}\right)^{\frac{\beta}{1-\beta}} - w_1\left(\frac{p_1\beta}{w_1}\right)^{\frac{1}{1-\beta}}\right] \tag{28}$$

In the MB case, we *first* take the derivative of Γ^{MB} with respect to w_1 and *then* insert all the relevant variables for $p_1(w_1), p(w_1), ub(w_1)$ etc. from table (1) into the first-order condition. The resulting first-order condition for the MB wage then becomes

$$\frac{d\Gamma^{MB}}{dw_1} = \frac{\left[w_1\left(\frac{\beta}{w_1}\right)^{\frac{2}{1-\beta}} - \left(\frac{\beta}{w_1}\right)^{\frac{1+\beta}{1-\beta}}\right]\left[\overline{ri}\left(\frac{w_1}{\overline{rw}_2}\right)^{\frac{\beta}{2+\beta}}(1+\beta) - 2w_1\beta\right]}{(\beta-1)w_1\left(\frac{w_1}{\overline{rw}_2}\right)^{\frac{2\beta(1+\beta)}{(2+\beta)(\beta-1)}}} = 0 \tag{29}$$

This can be solved for the economically meaningful wage under MB, denoted by w_1^{MB}:

$$w_1^{MB} = \frac{(\overline{ri}(1+\beta)/2)^{\frac{2+\beta}{2}}}{\beta(\beta\overline{rw}_2)^{\frac{\beta}{2}}} \tag{30}$$

Inserting this into $E(w_1)$ yields the corresponding equilibrium $E^{MB} = E(w_1^{MB})$.

3.5.3 PEB Equilibrium

In our intermediate PEB approach, agents consider the change in employment L_1 and the price p_1 (and hence p) when the wage is negotiated. Agents calculate the variable changes from profit maximization, goods market clearing and the price index definition (equations 9, 13, and 14). Solving these three equations simultaneously for L_1, p_1, and p, we obtain

$$L_1 = \frac{\beta}{w_1} L_2^{\beta} \tag{31}$$

$$p_1 = \Big(\frac{L_2^{1-\beta} w_1}{\beta}\Big)^{\beta} \tag{32}$$

$$p = \Big(\frac{L_2^{1-\beta} w_1}{\beta}\Big)^{\frac{\beta}{2}} \tag{33}$$

Note that in the above equations L_2 is perceived to be constant by the agents under PEB when the wage changes. Next, we insert again the above expressions for L_1, p_1, and p into the objective function (23), simplify the said expressions, and obtain

$$\Gamma^{PEB} = (w_1 - ub)(1-\beta)\Big(\frac{\beta}{w_1}\Big)^{1+\beta} L_2^{\beta(1+\beta)} \tag{34}$$

Again we set the partial derivative of Γ^{PEB} with respect to w_1 to zero. Treating L_2 and ub as constants captures the partial equilibrium perspective of agents who are unaware of all general equilibrium interactions. These generally cause a change of L_2 and ub (and hence Γ) as w_1 changes. In order to obtain the overall equilibrium, we insert the requisite variables (L_2 and ub) from table (1) into $\frac{d\Gamma^{PEB}}{dw_1} = 0$, yielding

$$\begin{aligned} \frac{d\Gamma^{PEB}}{dw_1} &= \frac{(\beta-1)\beta}{w_1^2}\Big(\frac{\beta}{w_1}\Big)^{\beta}\Big(\frac{\beta}{\overline{rw}_2}\Big)^{\frac{\beta(1+\beta)}{1-\beta}}\Big(\frac{w_1}{\overline{rw}_2}\Big)^{\frac{\beta^2(1+\beta)}{(2+\beta)(\beta-1)}}\Big[w_1\beta - \overline{ri}\Big(\frac{w_1}{\overline{rw}_2}\Big)^{\frac{\beta}{2+\beta}}(1+\beta)\Big] \\ &= 0 \end{aligned} \tag{35}$$

Solving the first-order condition for w_1^{PEB} yields

$$w_1^{PEB} = \frac{(\overline{ri}(1+\beta))^{\frac{2+\beta}{2}}}{\beta(\beta\overline{rw}_2)^{\frac{\beta}{2}}} \tag{36}$$

Again, we insert this solution into the variables of table (1) to obtain the equilibrium $E^{PEB} = E(w_1^{PEB})$. In the following section we compare the results obtained using the GEB, MB, and PEB conditions.

4 Results

We now compare the equilibria associated with the different levels of sophistication in wage negotiations. To this end, we first establish

Proposition 1

(i) For $\beta, \overline{rw}_2$ and $\overline{ri} > 0$, we have $w_1^{PEB} > w_1^{GEB}$.

(ii) For $\beta, \overline{rw}_2$ and $\overline{ri} > 0$, we have $w_1^{PEB} > w_1^{MB}$.

Proof:

For the first step, we compare equations (36) and (26). $w_1^{PEB} > w_1^{GEB}$ is true if, and only if

$$\frac{(\overline{ri}(1+\beta))^{\frac{2+\beta}{2}}}{\beta(\beta\overline{rw}_2)^{\frac{\beta}{2}}} > \frac{\overline{ri}^{\frac{2+\beta}{2}}}{\beta(\beta\overline{rw}_2)^{\frac{\beta}{2}}} \tag{37}$$

which is true since the expression can be reduced to $\beta > 0$.

For the second step we compare the equilibrium wages w_1^{PEB} and w_1^{MB} in equations (36) and (30). $w_1^{PEB} > w_1^{MB}$ is true if, and only if

$$\frac{(\overline{ri}(1+\beta))^{\frac{2+\beta}{2}}}{\beta(\beta\overline{rw}_2)^{\frac{\beta}{2}}} > \frac{(\overline{ri}(1+\beta)/2)^{\frac{2+\beta}{2}}}{\beta(\beta\overline{rw}_2)^{\frac{\beta}{2}}} \tag{38}$$

which reduces to $2 > 1$, completing the proof.

□

We now analyze the consequences for unemployment. In every equilibrium, labor demands in sector 1 and sector 2 are given by (see table (1))

$$L_1(w_1) = \left(\frac{\beta}{w_1}\left(\frac{w_1}{\overline{rw}_2}\right)^{\frac{2\beta}{2+\beta}}\right)^{\frac{1}{1-\beta}} \tag{39}$$

$$L_2(w_1) = \left(\frac{\beta}{\overline{rw}_2}\left(\frac{\overline{rw}_2}{w_1}\right)^{\frac{\beta}{2+\beta}}\right)^{\frac{1}{1-\beta}} \tag{40}$$

For $0 < \beta < 1$, we thus have $\frac{dL_1}{dw_1} < 0$ and $\frac{dL_2}{dw_1} < 0$. This implies that aggregate employment decreases when the wage w_1 rises. If $L = L_1 + L_2$ denotes aggregate employment in the economy, we obtain

Corollary 1

(i) $L(w_1^{GEB}) > L(w_1^{PEB})$

(ii) $L(w_1^{MB}) > L(w_1^{PEB})$

Corollary 1 stipulates a hump-shaped relationship between the far-sightedness of wage negotiating agents and unemployment. In the case of a very myopic view (MB), both negotiated wages and unemployment are quite low. With an intermediate view (PEB), wages and unemployment are high. Under the most far-sighted view, where all general equilibrium consequences of a negotiated wage are considered, wages and unemployment are again low.

We note that our model exhibits intuitive comparative statics with respect to unemployment benefits in all three types of bargaining processes.

Corollary 2

$$\frac{\partial L(w_1^{GEB})}{\partial \overline{ri}} < 0\,, \quad \frac{\partial L(w_1^{PEB})}{\partial \overline{ri}} < 0 \quad \textit{and} \quad \frac{\partial L(w_1^{MB})}{\partial \overline{ri}} < 0$$

A higher level of real unemployment benefits increases the disagreement point of the union and allows it to reach higher wages in the negotiation with the employer federation. This, in turn, causes relatively higher unemployment.

4.1 Interpretation of the Results

We start by explaining why w_1^{PEB} is higher than w_1^{GEB}. Within the PEB view, agents recognize that increasing wages implies less employment. The agents are aware that a

lower employment rate implies less output and thus a rise in price p_1 and accordingly in p. All other factors are assumed to stay constant; under this view the wage is chosen to maximize the Nash-bargaining objective function.

In the introduction we have summarized the main intuition for our result. The first effect is the unawareness of a price level effect causing employment and output changes in sector 2 and, as a consequence, in sector 1 under PEB. The second effect are changes of unemployment benefits not recognized under PEB. We now describe these effects in more detail. What unions and employers in the first sector do not perceive within PEB are particular consequences of a higher price level p. In sector 2, where nominal wages w_2 are kept so that real wages w_2/p remain constant, the rise in price index as a consequence of higher wages must lead to a rise in the nominal wage. In turn, higher nominal wages in sector 2 lead to a corresponding decline in labor demand, which causes a decrease in employment and output. This, in turn, causes a rise in p_2 relative to p_1, i.e. a fall of p_1. A decline in p_1 leads of course to lower profits in sector 1 (which interferes with the employers' objective) and lower employment (counter to the union's objective). A low employment level in the first sector leads to the following change of events. First, less output is made followed by an increase in price p_1. This causes a higher price index and, in turn, higher wages in sector 2. The labor level then decreases again, continuing this vicious cycle until no further changes occur.

All these interactions with the other sector exacerbate the consequences of high wages in sector 1, but are not accounted for by agents under a PEB view. Furthermore, a higher price index implied by a higher wage does not only lead to a rise in w_2, but also to a rise in ub. Although this also depreciates the value of the union's objective function, it is not perceived by the agents with a PEB perspective. In summary, we may say that agents are prepared to agree on high wages because they are not aware of all the interactions, and thus underestimate the detrimental effects of high wages.

In the next step, we explore the question why the negotiated wage under MB is lower than under PEB. If ignoring general equilibrium effects leads to bad outcomes, why does the MB outcome, where even fewer effects are considered, not lead to even higher unemployment than PEB? The agents with a MB perspective are very myopic, and hence only consider employment reactions. On the other hand, agents with a PEB perspective consider both employment and price reactions. Thus, when unions and employers consider high wages, they think of a reduction of labor. This has negative consequences for both the union's and the employers' objectives, as a reduction of

labor means a reduction of both the wage bill *and* the profits from lower output. The latter occurs because although overall income declines, income shares for capital and labor remain constant. The rise in the price (due to less employment and therefore less output) is not considered by agents under MB. A high price p_1 increases both profits and employment, thus boosting both the union's and the employers' objective. This positive impact is not perceived, and attention is restricted to the negative employment effect of high wages. Hence, unions and employers are very cautious, and negotiate lower wages under MB than under PEB.

Finally, we observe that the wage under MB is lower than under GEB. With MB unions would like to increase the wage w_1 as it increases the wage bill of the employed. However, both unions and employer associations perceive all the consequences of such an increase to be negative. In particular, the level of employment and profit seem to decline strongly, as price p_1 is perceived as remaining constant. Under GEB there are negative feedback effects from the second sector, but the price adjustment is taken into account. The latter is stronger than the former, so the negotiated wage in sector 1 is smaller with MB than it is with GEB.

The results in Proposition 1 and Corollary 1 are similar to a well-known observation in labor economics, namely that in an economy with highly decentralized wage negotiations, wages and unemployment are quite low, whereas in an economy with more centralized wage-bargaining, wages and unemployment are high. In economies with totally centralized wage settings, wages and unemployment are again quite low (Calmfors and Driffill 1988). These authors vary the number and the size of sectors and with them the degree of bargaining centralization, while we vary the degree of far-sightedness. Our model may reinforce the results of Calmfors and Driffill in the following sense: Agents negotiating wages on a very decentralized (firm-) level will not care about general equilibrium effects because of their insignificant size, thus leading to an MB type of bargaining. Increasing centralization and thereby the scope for which negotiated wages are applicable will induce agents to increasingly consider general equilibrium effects, leading first to a PEB and finally to a GEB perspective. This would reveal the hump-shaped pattern observed by Calmfors and Driffill and would provide another explanation.

In PEB, as opposed to GEB, the underestimation of these negative employment and benefits effects, coupled with the overestimation of the positive price effect that stems from high wages, lead to a shift in the maximum of the objective functions to the right.

This shift causes a higher wage agreement, which in turn involves higher unemployment. Table (3) summarizes the estimations of variables using a PEB method in comparison to that of a GEB method, as well as consequences for employment, etc.

Table 3: Estimations and Impacts under PEB/ GEB

Variable	Estimation under PEB relative to GEB	Impact on employment and output under PEB relative to GEB
p_1, p	overestimated	negative
L_1	overestimated	negative
ub	underestimated	negative

At this point, an important remark needs to be made on our analysis so far. If the tax effects were taken into account by the agents under a general equilibrium view, they would be even more cautious. High wages lead to high unemployment and, therefore, high taxes in order to finance unemployment benefits. These taxes further reduce the net wage and profit income, i.e. the objective function.

5 Extensions and Robustness

In this section, we discuss some possible extensions for our model. We first investigate the case where wage negotiations take place in both sectors. Next, we analyze the case of competitive wages in the second sector. Furthermore, we discuss some other variations on the wage-bargaining perspectives. Finally, we outline critical issues in future research to endogenize the level of awareness.

5.1 Wage Negotiations in Both Sectors

Thus far, we have assumed fixed real wages in sector 2, i.e. in the rest of the economy. We now analyze what occurs when agents in sector 2 bargain over wages as well. In section 3 we calculated nominal wage-bargaining outcomes in sector 1 under different

levels of sophistication. These wages were a reaction to a given real wage in sector 2. In order to justify the given real wage in the second industry, one might imagine an agreement between employers' associations and unions whereby the purchasing power of negotiated wages is maintained by adjusting nominal wages to changes in the price level. We now endogenize the second wage negotiation.

Given the wage reaction functions, we can calculate Nash Equilibria for the wage-setting games between the two sectors. We first analyze the Nash Equilibrium for GEB, then for MB and PEB.

Maximization of the Nash bargaining objective function of unions and employers yields the optimal wages w_1, dependent on β, $\overline{ri}$, and $\overline{rw}_2$. For fixed parameters β and $\overline{ri}$, the resulting wages can be interpreted as a reaction to a given $\overline{rw}_2$ in the other sector. Under GEB, the reaction function was

$$w_1^{GEB} = \frac{\overline{ri}^{\frac{2+\beta}{2}}}{\beta(\beta\overline{rw}_2)^{\frac{\beta}{2}}} \tag{41}$$

Dividing w_1^{GEB} through the price level (see table (1)) in the GEB equilibrium yields the corresponding real-wage reaction function:

$$\frac{w_1}{p}^{GEB} = \frac{\frac{\overline{ri}^{\frac{2+\beta}{2}}}{\beta(\beta\overline{rw}_2)^{\frac{\beta}{2}}}}{\left(\frac{w_1^{GEB}}{\overline{rw}_2}\right)^{\frac{\beta}{2+\beta}}} \tag{42}$$

Inserting w_1^{GEB} and simplifying yields

$$\frac{w_1}{p}^{GEB} = \frac{1}{\beta} \cdot \overline{ri} \tag{43}$$

Note that this expression can also be obtained by assuming a symmetrical equilibrium with $p = 1$. To do this, set $\overline{rw}_2 = w_1^{GEB}$ in (41) and solve for w_1^{GEB}. We observe that the chosen real wage in sector 1 does not depend on the real wage $\overline{rw}_2$ in sector 2. This surprising fact is a result of the following reasoning: a higher real wage in sector 2 leads to less employment and output, and thus to a rise in the price p_2. The increasing price index then induces the parties to agree on higher wages because their

goal is to maximize real income. The rises in w_1 and p cancel each other out. Since we are dealing with a symmetric economy, a reaction function in sector 2 to real wages in sector 1 would be identical. In the symmetric equilibrium, both prices p_1 and p_2 are equal to 1, as is the price index p.

Applying the same procedure to the MB and PEB cases also yields flat real-wage reaction functions. Obviously, the flat reaction functions are also the Nash equilibria of the wage-setting game between the two symmetrical sectors. We now summarize the resulting Nash equilibrium wages:

$$w_{NE}^{GEB} = \frac{1}{\beta} \cdot \overline{ri} \tag{44}$$

$$w_{NE}^{MB} = \frac{(1+\beta)/2}{\beta} \cdot \overline{ri} \tag{45}$$

$$w_{NE}^{PEB} = \frac{(1+\beta)}{\beta} \cdot \overline{ri} \tag{46}$$

where the lower index stands for **N**ash **E**quilibrium. Accordingly, we obtain

Proposition 2

(i) For $0 < \beta < 1$ and $\overline{ri} > 0$ we have $w_{NE}^{PEB} > w_{NE}^{GEB}$.

(ii) For $0 < \beta < 1$ and $\overline{ri} > 0$ we have $w_{NE}^{PEB} > w_{NE}^{MB}$.

Proof:

The two statements follow directly from the assumptions $0 < \beta < 1$ and $\overline{ri} > 0$, and by comparing equations (44) (45) (46).

□

As was expected, we obtain the result that w_{NE}^{PEB} is greater than w_{NE}^{GEB} and w_{NE}^{MB} for the Nash equilibria. This means that the PEB view, where feedback effects from other sectors or from the state are ignored by agents, leads to higher wages in equilibrium than both the GEB view, where all general equilibrium effects are considered, and

the MB view, where only the employment effect of wage-setting is taken into account. Correspondingly, unemployment is higher than in the GEB or MB cases in the PEB Nash equilibrium. We further observe that all equilibrium wages depend positively on the real income for the unemployed $\overline{ri}$. Since the utility loss of a job loss is alleviated when real incomes for the unemployed increase, unions, in this case, require higher wages. We can conclude that our results will also hold when wage negotiations take place in all sectors.[11]

In the next step, we assess the magnitude of the (un)employment differences among the different levels of sophistication in the information considered in wage negotiations. We denote total employment in the Nash equilibrium by L_{NE}^{GEB}, L_{NE}^{PEB}, and L_{NE}^{MB}. Using the expression for $L_1(w_1)$ or $L_2(w_1)$ in table (1), and bearing in mind that $p = 1$ and thus $\overline{rw}_2 = w_1$ in the symmetric equilibrium, we obtain

Corollary 3

The relationship of employment levels across different types of bargaining is given by:

(i) $\dfrac{L_{NE}^{PEB}}{L_{NE}^{GEB}} = (1+\beta)^{\frac{1}{\beta-1}}$

(ii) $\dfrac{L_{NE}^{PEB}}{L_{NE}^{MB}} = 2^{\frac{1}{\beta-1}}$

As Corollary 3 indicates, employment differences depend solely on production elasticity β. The magnitude of the differences may be very large. Suppose, e.g., that $\beta = \frac{1}{2}$, then

$$\frac{L_{NE}^{PEB}}{L_{NE}^{GEB}} = \frac{4}{9} \text{ and } \frac{L_{NE}^{PEB}}{L_{NE}^{MB}} = \frac{1}{4}.$$

5.2 Competitive Wages in Sector 2

We ask ourselves how the results are affected when we consider a situation of flexible wages in the second industry? In the following, we will argue that the "rankings" between PEB, GEB, and MB do not change. To this end, we first compare GEB and PEB followed by PEB and MB.

[11] One could also imagine a game where unions and employers do not choose wages simultaneously but one after another. Due to the flat reaction functions, however, such Stackelberg equilibria would not differ from the symmetrical Nash equilibria.

Within PEB, the agents see the partial equilibrium effects of wage-setting (in their sector), but they ignore feedback effects from other sectors or from the state. Feedback effects from sector 2 originate from the fact that wage determination in sector 1 affects the output in sector 2. Increasing wages in sector 1 imply lower employment, and therefore lower output and a higher price for good 1, as goods are complements in our model. A rise in p_1 leads to a rise in the price level, causing a nominal wage adjustment in sector 2 if real wages are to be kept constant.

This in turn causes negative feedback effects not taken into account under PEB. Higher nominal wages lead to a lower employment rate in sector 2 (see equation 10) and hence to less output and a rise in price p_2 (relative to p_1). A rise in p_2 actually means a fall in p_1 ($p_2 \equiv 1$). For a negotiated wage, this implies less employment in sector 1, less output, etc.

When wages are competitive in the second industry, this effect does not occur. Wages always adjust in order to obtain full employment and hence full output in sector 2, so that p_2 does not increase relative to p_1. Therefore, there is no feedback effect causing a decline in employment and output in sector 1. It is therefore correct to ignore feedback effects from other sectors.

Which feedback effects emanate from the state? Higher wages in sector 1 imply lower employment and output, and hence a rise in p_1 and price index p. In order to keep real unemployment benefits constant, the state must increase nominal unemployment benefits ub. This causes a decline of the objective function Γ (see equation (23)) that is unforeseen by the agents. Thus, even with flexible wages in other sectors, agents agree upon higher wages under PEB than under GEB because they do not consider the negative feedback effects from the state.[12]

Using MB, feedback effects from the state are also ignored. While agents with a PEB view see the positive price effect that follows from high wages (through less employment, i.e. less output in sector 1), people engaging in MB fail to consider this fact. Ignoring the positive effect of high wages, "myopic bargainers" are more cautious, and therefore end up with lower wage agreements.

Summarizing, we can say that flexible wages in sector 2 alleviate the detrimental consequences from a PEB view, but the fact remains that wages and unemployment are higher under PEB than under GEB or MB.

[12] A higher prevailing tax rate reinforces this effect.

5.3 The Importance of Feedback Effects

In our paper we have dealt with three different views taken by agents on the economic feedback effects from wage-setting. Two of the views are polar cases. One of the polar cases is the general equilibrium view where agents consider *all* feedback effects in the economy. The opposite case is the myopic view, where only the direct employment effect in the corresponding sector is taken into account.

While the two polar cases are canonical, one could imagine different possibilities for the intermediate partial equilibrium view. In our model there are three major sources of feedback effects caused by wage-setting. The first source is the sector in which the wage negotiations take place. We expect this source to be a minimum consideration for a partial equilibrium view, as is the case in our model. The other sources are the state (unemployment benefits and taxes) and the feedback from other sectors. Considering feedback effects from both sources – and thus from the whole economy – leads to the general equilibrium view.

To assess the relative importance of feedback effects from the other sector and from the state, we consider another variant of PEB. Suppose that bargaining parties account for feedback effects caused by the state when it adjusts the nominal unemployment benefits ub so that real incomes for the unemployed remain constant and equal to $\overline{ri}$. If agents with a PEB perspective were to consider these adjustments in nominal unemployment benefits (henceforth PEB^*), i.e. if they took account of the fact that $ub = \overline{ri} \cdot p$ with $p = p_1^{\frac{1}{2}}$, the results would change slightly. The same calculations as before show that in this case the reaction of sector 1 wages to real wages in sector 2 becomes

$$w_1^{PEB^*} = \frac{(\overline{ri}(2+\beta)/2)^{\frac{2+\beta}{2}}}{\beta(\beta\overline{rw}_2)^{\frac{\beta}{2}}} \tag{47}$$

Accordingly, the Nash equilibrium wage for the case where there is bargaining in both sectors becomes

$$w_{NE}^{PEB^*} = \frac{(2+\beta)/2}{\beta} \cdot \overline{ri} \tag{48}$$

We observe that the wages are lower than the wages resulting when state feedback effects are not considered. This is because, under PEB^* more negative feedback effects

from high wages are taken into account by agents, which leads to more cautious wage determination. We also see, however, that the wages are still higher than the wages under GEB or MB (see equations (26), (44), and (30), (45)). Thus, we can conclude that while this extension of PEB alleviates the burden for unemployment, it is still inferior to the other views, and thus neglecting feedback effects from the other sector is most crucial.

5.4 Immediate Extensions

The basic framework can be extended in several other meaningful ways. First, instead of unemployment benefits the unions' reservation utility might correspond to competitive wage. The analysis for this case would largely remain the same, but the arguments related to the unemployment level would disappear. Second, we might allow that unemployment benefits are a function of previous wages, which in the context of the present, static model can be translated into a function of ongoing wages. While an analytic solution is no longer possible, such a modification tends to increase the relative disadvantage of PEB versus GEB. Unions do not recognize in this scenario that the increase of the member's utility will be smaller when wages are raised.[13]

5.5 Endogeneous Perception

Main Issues

In this paper we have assumed one given level of awareness for employers and unions. Interesting further research topics would be to consider what happens when[14]

- awareness differs between employers and unions
- agents feign less awareness than they actually have.

The first modification can be justified by access to information, information processing, and other factors outlined in chapter 2 that might differ between employers and unions. Since the common objective function is a product of the unions' objective and

[13]Examples are available upon request.
[14]Many of the issues in this section have been raised at meetings by Steinar Holden.

the employers' objective, different views could be incorporated[15] and would yield intermediate outcomes. For instance, if the union has a PEB perspective, and employers bargain from a GEB viewpoint, then the resulting wage would be between w_1^{PEB} and w_1^{GEB}. The second point relates to strategic behavior. It is conceivable that agents with a good knowledge of economic interactions might have an incentive to demonstrate unawareness. This is addressed next.

Incentives to demonstrate unawareness

The cooperative Nash bargaining procedure outlined so far assumes the maximization of a common objective function. However, the maximum of this function differs from the maxima of the individual objective functions, i.e. those of the unions (see equation 20) and the employer associations (see equation 21). Our model makes it easy to verify that employers always (for all perception abilities) tend to bring wages down as far as possible until the level of unemployment benefits is reached. On the other hand, the optimal wage for the unions' objective is always (for every view) higher than the wage maximization of the common objective function.

Now let us assume that both parties have a GEB view. It is worthwhile for the unions to pretend to have a PEB view instead, as this way they can push the wage toward the maximum of their own objective function. On the other hand, from a GEB viewpoint, employers have no incentive to feign PEB awareness only, since this would push wages higher, thus undermining their objective.[16]

To round off these arguments, we can conclude that unions always have an incentive to feign a PEB view, while employers always have an incentive to feign a GEB or even MB view. This might have two consequences. First, unions have incentives to be strategically unaware of general equilibrium effects by not adopting appropriate reasoning regarding the consequences of a wage increase. Second, unions may collect data and adopt reasoning to neutralize the data and reasoning of employer associations. The standard argument of unions that wage increases have positive effects by stimulating aggregate demand could be seen in this light.[17]

[15] For instance, if employers have a GEB view and unions behave according to PEB, each factor would be treated accordingly.

[16] In our model employers always have an incentive to demonstrate a MB view, since this yields the lowest wage. However, starting from GEB, feigning MB perception only might not be credible.

[17] We note that there are circumstances under which the claims of the union are true.

6 Discussion and Conclusion

We have developed a general equilibrium model to study how the agents' ability to identify general equilibrium effects affects wage negotiations and unemployment. We have shown that a partial equilibrium view of the economy leads to high wages and unemployment. In contrast, if employers' associations and unions take either all or only a very few general equilibrium effects into account, low wages and low unemployment result.

One might consider the case of intermediate awareness of general equilibrium effects to be the most plausible for those countries where wages are negotiated at the industry level. It is likely that taking all general equilibrium effects into consideration is too demanding in wage negotiations. Hence, our model may explain why unemployment rates are high in European countries with industry-level bargaining. Moreover, our results suggest that firm-level wage-bargaining, which may follow a myopic bargaining process, would be preferable to industry-level bargaining.

7 Appendix

We solve the system of equations for any equilibrium that still depends on w_1, i.e. $E(w_1)$. The first order conditions for profit maximization in sector 1 and 2 are

$$w_1 = p_1 \beta L_1^{\beta-1} \tag{49}$$

$$w_2 = \beta L_2^{\beta-1} \tag{50}$$

Dividing (49) by (50), we obtain

$$\frac{w_1}{w_2} = p_1 \left(\frac{L_1}{L_2}\right)^{\beta-1} \tag{51}$$

The goods market clearing condition is given by

$$p_1 = \frac{q_2}{q_1} = \left(\frac{L_2}{L_1}\right)^{\beta} \tag{52}$$

implying

$$\left(\frac{L_1}{L_2}\right)^{\beta-1} = p_1^{\frac{1-\beta}{\beta}} \tag{53}$$

Inserting this into 51 and solving for p_1 yields

$$p_1 = \left(\frac{w_1}{w_2}\right)^{\beta} \tag{54}$$

The price index is defined by

$$p = p_1^{\frac{1}{2}} \tag{55}$$

Inserting $w_2 = \overline{rw}_2 \cdot p$ into (54) and solving for p_1 we obtain

$$p_1 = \left(\frac{w_1}{\overline{rw}_2}\right)^{\frac{2\beta}{2+\beta}} \tag{56}$$

The price index is therefore

$$p = p_1^{\frac{1}{2}} = \left(\frac{w_1}{\overline{rw}_2}\right)^{\frac{\beta}{2+\beta}} \tag{57}$$

Inserting p_1 in (49) and solving for L_1 yields

$$L_1 = \left(\frac{\beta}{w_1}\left(\frac{w_1}{\overline{rw}_2}\right)^{\frac{2\beta}{2+\beta}}\right)^{\frac{1}{1-\beta}} \tag{58}$$

The second first order condition implies

$$L_2 = \left(\frac{\beta}{w_2}\right)^{\frac{1}{1-\beta}} \tag{59}$$

Inserting $w_2 = \overline{rw}_2 \cdot p$ yields the solution for L_2:

$$L_2 = \left(\frac{\beta}{\overline{rw}_2}\left(\frac{\overline{rw}_2}{w_1}\right)^{\frac{\beta}{2+\beta}}\right)^{\frac{1}{1-\beta}} \tag{60}$$

The above solutions for p_1, p, L_1, L_2, i.e. equations (56), (57), (58), (60) must now be inserted into the definitions of Δ, ub, and τ to obtain the complete solution for the system of equations as indicated in table (1).

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