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ABSTRACT

Awareness of General Equilibrium Effects and Unemployment*

We examine wage bargaining in a two-sector economy when the employers and labour unions in each sector are not always aware of all the general equilibrium feedback effects. We show analytically that if agents only consider labour 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 simultaneously considered, we once again obtain a situation of 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 in Europe is high.

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Keywords: awareness of general equilibirum effects, sectoral wage bargaining and unemployment

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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 is over 10% in Germany and below 5% in the Netherlands[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.

We consider wage-bargaining between labor unions and employers' associations embedded in a two-sector economy, and we analyze the outcomes of three different perspectives taken by agents bargaining over wages. First, we assume that labor unions and employers' associations take *all* general equilibrium effects into account when maximizing their objectives. Second, we investigate the case in which only the employment effects of wage setting are considered while all other variables are assumed to stay constant. Third, we analyze the intermediate case where agents take account of partial equilibrium effects in their sector, whereas feedback effects from other sectors are ignored.

Our main finding is that unemployment is highest when an intermediate view is employed. The significant differences in the other two views hold if there is a collective wage agreement in one sector of the economy, or in both sectors simultaneously.

The paper is a response to the extensive literature on the European unemployment problem, which is reviewed briefly in the next section. Since unemployment is substantially structural in nature and could, in principle, be reduced, it is difficult to explain why the level is currently so much higher than in the US. Our paper suggests that the degree to which agents recognize general equilibrium effects in countries with collective bargaining arrangements or minimum wage laws can provide an alternative explanation as to why unemployment is high or low. In particular, if unions and employers' associations are not able to incorporate all feedback effects from other sectors or from the government's budget constraint when negotiating wages, they end up with high wages and unemployment, and fail to recognize an alternative outcome with low unemployment.

We examine a general equilibrium model with two industry sectors and labor as input

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

in production. 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 called 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 therefore take into account, the *direct* effects on their sector that result from wage setting without taking into account feedback from the other sector and changes of 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 considering all general equilibrium effects, or limiting considerations to the employment effect of the negotiated wage. We briefly summarize why wages and unemployment are higher with PEB than under GEB. Under PEB, the following consequences of wage increase in a sector (say sector 1) are neglected. As a first effect, the price level and the real value of the marginal product of a worker in the other sector (say sector 2) may rise, 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 union's objective function. Both effects, alone or jointly, cause bargaining parties to settle for more moderate wages under GEV than under PEV. The first effect is present if there is a real wage rigidity or wage negotiations in sector 2. Since one effect is sufficient to cause higher wages with PEV than with GEV, our results will turn out to be robust for different types of wage settings in sector 2.

The result has the following implications on policy. First, our paper suggests that a low degree of centralization, i.e. firm level wage bargaining, can be justified on new grounds, since this corresponds to myopic bargaining and thus leads to low unemployment. Centralized 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. Second, one might consider ways in which to improve centralized

wage bargaining, and thus induce a switch from PEB to GEB. While holding lectures on general equilibrium effects is a more amusing suggestion, efforts to 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 will discuss in the concluding section, the employment miracle in the Netherlands over the last two decades might be an example of such efforts.

We then compare our results to a well-known phenomenon in labor economics, namely, the observation of a hump-shaped relationship between the degree of wage-bargaining centralization and real wages or unemployment (Calmfors and Driffill (1988)). The analysis of Calmfors and Driffill assumes a constant nominal income in the economy and therefore abstracts from income effects. Our contribution focuses exactly on general equilibrium feedback effects resting on aggregate income changes. 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 lead to different unemployment rates.

The question arises where these different levels of sophistication towards equilibrium effects may stem from. While there are many explanations in the literature on bounded rationality and learning, one plausible source for such phenomena are costs of information concerning general equilibrium effects. For employees and employers at the firm level, the costs of information concerning (all) general equilibrium effects arising from wage negotiations would outweigh the gains, as general equilibrium effects are negligible. For large unions and employers however, information acquisition could be beneficial for both bargaining parties, as neglecting general equilibrium effects has a large impact. Moreover, information costs can be shared by each member of the union and the employers' association. We will return to theses issues in the last section.

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

2 Relation to the Literature

There is a vast amount of literature discussing the impact of labor market institutions on unemployment, which we will not try to summarize here.[2] 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.[3]

The main point we make in our paper is that insufficient recognition of general equilibrium 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 way of thinking about the possible outcomes of collective wage agreements.

Our paper is related to political implementation and reform design issues. First, Saint-Paul (1994, 1995, 1997, 2000) has shown that the redistributive goals that motivate labor market institutions in Europe can be achieved at a much lower cost using more traditional tax and transfer instruments. However, the current level of regulation can be explained by a political equilibrium, since there is a bias towards maintaining the status quo. Second, as suggested by Coe and Snower (1997) for the labor market and by Gersbach and Sheldon (1996) for the combination of product and labor market reforms, many policies appear to be complementary. The employment effect of each policy is greater when it is implemented in conjunction with other policies than when it is implemented in isolation. Broad packages of labor market reforms can internalize complementarities across reform steps. Third, Piketty (1998) has suggested that unemployment remains high because a necessary decline in low-skilled people's wages would be associated with a low social status or human value, which may not be widely accepted in the public. The results in our paper suggest that high unemployment may also be the result of insufficient recognition of general equilibrium effects.

Our analysis is closely related to the learning and bounded rationality perspective in economics. Although our focus on the level of recognition of general equilibrium is

[2]Surveys and detailed accounts of labor market factors as root causes of the unemployment problem in Europe can be found e.g. in Layard, Jackman and Nickell (1991), Bean (1994), Krugman (1994), Alogoskoufis, Bean, Bertola, Cohen, Dolado and Saint-Paul (1996), Lindbeck (1996), Siebert (1997), Nickell (1997).

[3]For a recent paper on how these factors lead to a cut of fixed labor costs by firms, see Boone (2000).

novel, our work follows the recent literature on deviations from rational expectation, exemplified by different variants of the learning literature as surveyed in Evans and Honkapohja (1999), Fudenberg and Levine (1996) and Sargent (1993).

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:

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

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

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 distribution of shares among capitalists is irrelevant, as all individuals have the same

[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. However, there may be feedback effects from wage setting to capital deepening, which may also explain the persistence of unemployment (see e.g. Blanchard and Wolfers (2000).

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

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

$$p_1 = \frac{q_2}{q_1} \tag{13}$$

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 low-skilled workers will not clear. Nominal gross wages for low-skilled 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:

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

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).

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 by $E(w_1)$, which is given by:

[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.

Table 1: Solution of the Equation System

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

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

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:

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

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 consideration 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:

[8] Manzini (1998) provides a recent survey of collective bargaining processes.

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

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.

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 account for 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 method of assessing the feedback from wage setting Partial Equilibrium Bargaining (PEB).

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

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 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 eq. (23)).

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

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

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

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

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] ,

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

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:

[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.

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

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 2, 9, 13, and 14). Solving these three equations simultaneously for L_1, p_1, and p, we obtain

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

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

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

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 the information on which wage negotiations are based. 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 of unemployment. In every equilibrium, labor demands in sector 1 and sector 2 are given by (see table (1))

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

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

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.

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 PEV. The second effect are changes of unemployment benefits not recognized under PEV. In this section, we 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.

The results in proposition 1 and corollary 1 share some similarities with 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)). Assuming the demand is exogenously given, Calmfors and Driffill do not need to account for feedback effects from the demand side. They vary the number and size of sectors and with them the degree of bargaining centralization. In contrast, we vary the degree of far-sightedness, also obtaining a hump-shaped curve for wages and unemployment, respectively.

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. First, 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. Finally, we discuss some other variations on the wage-bargaining perspectives.

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 information 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. When these nominal wage agreement and one-to-one adjustments to price level changes occur in both sectors, employers and employees are in fact choosing a particular real wage when they choose a particular nominal wage.

Given the two real-wage reaction functions, we can thus 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 2

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 2 indicates, employment differences depend solely on production elasticity β. The magnitude of the differences may be very large. For instance, suppose $\beta = \frac{1}{2}$, then $\dfrac{L_{NE}^{PEB}}{L_{NE}^{GEB}} = \dfrac{4}{9}$ and $\dfrac{L_{NE}^{PEB}}{L_{NE}^{MB}} = \dfrac{1}{4}$.

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.

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

[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.

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 eq. (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.

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.

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 Further 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.[12]

6 Discussion and Conclusion

We have developed a general equilibrium model to study how the agents' ability to identify the 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. The Netherlands might 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 to a broad based wage moderation to stimulate job creation in the economy. Such an economy-wide approach can be interpreted as GEB.

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. Plausibly, the extent to which general equilibrium effects are incorporated in the bargaining process depends on the measure of agents represented both by the labor union and by the employers' association.

Such a statement may be justified by adopting and adapting the concept of misconceptions introduced by Romer (2003).[13] These misconceptions occur when the errors

[12] Examples are available upon request.

[13] See also Gersbach and Schniewind (2000) for a simulation of learning dynamics that can lead to MB or PEB equilibria as steady states of those processes.

of individuals are correlated with one another. When the number of decision-makers in unions and employer associations are monotonically increasing in the value added or sales generated by the sector under consideration, awareness of general equilibrium effects is a function of the size of the sector.[14]

As the occurrence of PEB depends on the size of the sector, our model may explain why unemployment rates are high in European countries with industry-level bargaining. It is likely, that taking all general equilibrium effects into consideration is too demanding in wage negotiations. Hence our results suggest that firm-level wage-bargaining, where general equilibrium effects are usually ignored, would be preferable to industry-level bargaining.

Numerous issues deserve further attention. As suggested above, one of the causes for lack of awareness might be due to the fragmentation of the bargaining level. Then it may be useful to study the convergence properties of an economy with many sectors with PEB or MB solutions in each sector.

[14] As shown by Romer (2003), this function may not be strictly increasing everywhere.

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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

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

The goods market clearing condition is given by

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

implying

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

Inserting this into 51 and solving for p_1 yields

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

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

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

The price index is therefore

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

Inserting p_1 in (49) and solving for L_1 yields

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

The second first order condition implies

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

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

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

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).