Wirtschaftswissenschaftliche Fakultät
der Eberhard Karls Universität Tübingen

Unions, Efficiency Wages and Unemployment

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Tübinger Diskussionsbeitrag Nr. 210
August 2001

Wirtschaftswissenschaftliches Seminar
Mohlstraße 36, 72074 Tübingen

Gewerkschaften, Effizienzlöhne und Arbeitslosigkeit

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Zusammenfassung

In einem allgemeinem Gleichgewichtsmodell wird ein unvollkommener dualer Arbeitsmarkt, bei dem in einem Sektor sowohl Effizienzlöhne gezahlt werden als auch Gewerkschaften vertreten sind, die das Lohnniveau für Ihre Mitglieder aushandeln, mit monopolistischer Konkurrenz auf dem Gütermarkt kombiniert. Es zeigt sich, dass nicht nur die Verhandlungsmacht der Gewerkschaften, sondern auch Marktmacht der Unternehmen auf dem Gütermarkt die Arbeitslosigkeit erhöhen. Dies liegt darin begründet, dass zum einen ein höherer Wettbewerbsdruck die Lohnforderungen der Gewerkschaften reduziert und zum anderen die Unternehmen nur einen geringeren Preisaufschlag auf ihre Kosten verlangen können. Beide Effekte führen dazu, dass die Preise für diese Güter sinken, wodurch die Güter- und die Arbeitsnachfrage steigen.

<u>JEL-Klassifikation</u>: J41, J42, J51

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Abstract

This paper develops a dynamic general equilibrium dual labour market model which incorporates both efficiency wages and union bargaining with monopolistically competitive firms. In one sector, a traditional sector produces a homogeneous good and firms face perfect competition on the product market. In the other sector, monopolistically competitive firms produce a horizontally differentiated good. In this sector, unions represent the interests of the workers and through bilateral bargaining with the employers, try to capture some of the rents which accrue here. Further, firms can increase their profits by paying the workers with the highest productivity an efficiency wage. Therefore, there is not only a wage differential between the two sectors, but also within the unionized sector. It is shown that not only the degree of union bargaining power but also the market power firms possess on the product market leads to an increase in unemployment.

<u>JEL-Classification</u>: J41, J42, J51

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[b] I thank Manfred Stadler, Stephan Hornig and Helge Sanner for extremely helpful comments. All remaining errors are of course mine.

1 Introduction

How do efficiency wages and trade unions affect unemployment? Most labour market models analyse this question within a single labour market economy. However, there is substantial empirical evidence that wages differ significantly and persistently across sectors of an economy and that this wage structure cannot be solely explained by differences in human capital or general work characteristics, i.e. observationally identical workers receive different wages depending on which sector they are employed in (see, e.g. OECD 1994). This leads to the conclusion that the wage differences are more likely to stem from market imperfections and that emphasis needs to be placed on the differences between various sectors of the economy.

The model presented here, explains these wage differentials by the joint interaction of efficiency wages and unions with firms facing imperfect competition on the product market. This is done by assuming the existence of a dual labour market, an approach first developed by Harris, Todaro (1970) and further developed in seminal articles by Calvo (1978), McDonald, Solow (1985) and Bulow, Summers (1986). In this class of models, the labour market is dichotomized into a primary sector where, for example, wages are higher, there is more job security, lower turnover rates etc. and a secondary sector, where the exact opposite holds. This implies that wages are attached more to jobs rather than to workers, with all "good" jobs in one sector. Although in reality, of course, the labour market can be segregated into a whole continuum of sectors, the simplifying assumption of only two sectors has proven to be a good approximation with a large body of empirical evidence in support of the theory (see, e.g. Haisken-DeNew, Schmidt (1999) and Dickens, Lang (1993) as well as the survey in Saint-Paul 1996).

The secondary sector produces a homogeneous traditional good and is comprised of menial jobs for which the wage is determined by market clearing. The primary sector is characterized by imperfect competition so that rents will accrue here. This gives unions an incentive to operate in this sector as they will bargain for a share of this economic surplus for their members. As a result, wages in this sector will be above their market clearing level, i.e. an equilibrium non-competitive wage differential exists between the two sectors. These higher wages will induce agents currently not employed in the high-wage sector to be prepared to spend a longer time (unemployment spell) applying for these jobs. Therefore, increased competition on the product market which leads to lower rents and thus also lower wages, should also lead to lower unemployment. This is exactly the idea stated in the OECD Jobs Study (OECD 1994, p.23) and presented more formally below.

Hart (1982) was among the first to analyse the interaction of unions and price-setting firms. However, he assumes monopolistic competition in the Chamberlin sense which means the number of firms is exogenous and several strong assumptions about the demand functions need to be made in order to obtain a unique equilibrium. More recently, the combination of unions and imperfect product markets has been taken up by Dutt, Sen (1997) and Arnsperger, de la Croix (1990). However, in contrast to here, both of these models only assume a single sector labour market. Pichler (1993) has developed a model in which both efficiency wage considerations and unions are combined. However, in her model, the union wage is higher than the efficiency wage which is at odds with the empirical evidence. There are also several recent papers which analyse various affects of unions within a dual labour market setup. Roberts *et al.* (2000) analyse a two-stage bargaining process in which unions first determine a national minimum wage and then subsequently the wage in the primary sector. A dynamic innovation-based growth model is developed by Stadler (1999). The original Calvo (1978) model is extended by Dixon *et al.* (1999), who incorporate a standard menu cost setup. Finally, Burda (1988), analyses how unions affect unemployment duration spells. However, apart from the model by Stadler (1999), all of these papers have in common that the product market is treated as being perfectly competitive. However, this is, of course, not only an unrealistic assumption, but also overlooks the fact that the labour and product market are uniquely interdependent.[1] The approach used here, is to extend the original Calvo (1978) model firstly by assuming that unions and efficiency wage considerations coexist and secondly, by introducing monopolistic competition in the primary sector.

We find that higher market power on the producer side increases wages and also reduces the negative unemployment effect of higher wages. The reason for this is that less intense product market competition allows firms to more easily pass on

[1] Stadler (1999) assumes a perfectly competitive consumer goods sector and an imperfectly competitive intermediate goods sector. Whereas in that model, market power arises due to innovative activities, here it stems from the consumer demand side.

higher labour costs to consumers. Therefore, the (absolute) elasticity of labour demand with respect to wages decreases. As union utility is assumed to depend both on the attained wage level for its members as well as the number of members themselves, a lower wage elasticity will induce unions to raise their wage demands so that the bargained wage level and consequently unemployment, increase. These theoretical findings are confirmed in empirical research by, amongst others, Nickell (1999), and Nickell *et al.* (1994).

The next section derives the optimal consumption and production decisions of the agents in the economy. Sections 3 and 4 outline the wage bargaining process and general equilibrium. A conclusion is presented in Section 5.

2 Household and Producer Decisions

The economy is divided into two sectors. In the primary sector, a composite manufacturing good M, is produced, whilst a traditional good T is produced in the secondary sector. As stated in the Introduction, there is empirical evidence that observationally identical (i.e. homogeneous) workers receive different wages depending on which sector they are employed in. Here, firms in the primary, manufacturing sector either pay their workers an efficiency wage or a wage derived from negotiations with unions operating in this sector. This means that the wage in this sector will be above its market-clearing level, whereas the labour market in the secondary or traditional sector is assumed to be perfectly competitive.[2] The assumption that unions only operate in the high-wage sector is common, (see, e.g. Layard *et al.* 1991) as there are no economic rents to be shared in the traditional sector. As shown below, the bargained wage is always above the wage level paid in the traditional good sector.

The economy consists of N homogeneous and risk-neutral workers who are allo-

[2] Even in Europe, market clearing in the secondary labour market is not contradicted by empirical evidence (see Dolado *et al.* 1996). There is of course a wage floor influenced either by the level of social security in a country or national minimum wage levels. However, seeing as unions here are concerned about relative wages, the absolute height of the wage in the traditional sector is not important. See, e.g. Jones (1987) for a model with a binding minimum wage level in the secondary sector.

cated across the sectors as follows

$$N = N_M + N_T \tag{1}$$

$$N_T = L_T, \qquad N_M = L_M + U_M \tag{2}$$

where N_T is the size of the workforce in the traditional sector. As the labour market in the traditional sector always clears, the employed labour force L_T, and the total size of this sector N_T, always coincide. The number of individuals in the manufacturing sector is given by N_M and consists of L_M employed and U_M unemployed. These unemployed choose to wait for a high-paying job, i.e. they decide not to take up a job in the low-wage sector. This is in accordance with the empirical evidence, that although unemployment is a bad signal, being in a low-wage job may well be an even worse signal.[3] However, in the equilibrium derived below, with risk-neutral workers, the wage in the traditional sector must equal the expected average wage in the manufacturing sector.

2.1 Households

Each household is treated as an infinitely-lived dynasty. All dynasties are assumed to have the same discount rate and identical preferences. The intertemporal elasticity of substitution is set to unity, so that intertemporal utility U is given by

$$U(C) = \int_0^\infty \exp(-\rho t) \ln C_t dt \tag{3}$$

where ρ is the subjective rate of time preference and C_t is total consumption of a composite good at time t with

$$C_t = M_t^\mu T_t^{1-\mu} \tag{4}$$

where μ is the expenditure share spent on manufacturing goods. M represents a bundle of n varieties of the manufacturing good for which households' preferences

[3] See Laing (1993) and McCormick (1990), for theoretical models of signalling and job search as well as Bulow, Summers (1986), who provide both theoretical arguments and empirical facts within a dual labour market model on the assumption that only the currently unemployed will receive jobs in the high-wage sector and as to whether this kind of unemployment is voluntary or involuntary.

are given by a CES utility function (see Dixit, Stiglitz 1977)

$$M = \left[\sum_{1}^{n} m_i^{\kappa} \right]^{\frac{1}{\kappa}}, \qquad 0 < \kappa < 1 \tag{5}$$

with m_i as the consumed quantity of the manufacturing good of brand i. Here, κ is a measure of the homogeneity of the goods. As κ approaches one, the goods become almost perfect substitutes for one another. Defining $\sigma \equiv 1/(1-\kappa)$, then σ represents the elasticity of substitution between any two variants. As can be seen from equation (5), consumers have a "love of variety" and an increase in the number of brands produced between which consumers can choose increases their utility.

Consumers face a three stage optimisation problem. First, they must decide how to divide total income between savings and consumption. Formally, households maximise utility as given by (3) subject to the intertemporal budget constraint

$$\dot{A} = r_t A_t + I_{wt} - P_t C_t \tag{6}$$

where A denotes household assets, r is the interest rate, I_w is average wage income and P the macroeconomic price index.

Solving this intertemporal optimisation problem results in the Keynes-Ramsey rule

$$\frac{\dot{C}}{C} = r - \rho \tag{7}$$

which implies

$$r = \rho \tag{8}$$

and thus a constant interest rate in the equilibrium.

In a second stage, in each period (so that the time index t can be omitted without loss of information) consumers optimally allocate their total income between manufacturing and traditional goods, that is they choose M and T so as to

$$\begin{aligned} &\max C = M^{\mu} T^{1-\mu} \\ &\text{s.t.:} \qquad p_M M + p_T T = I \end{aligned} \tag{9}$$

where p_T the price of the traditional good and I denotes total household income. p_M is the price index of the composite manufacturing good which is defined as

$$p_M \equiv \left[\sum_{1}^{n} p_{m_i}^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \tag{10}$$

with p_{m_i} as the price demanded by firm i in the manufacturing sector. Thus, a higher number of firms operating in this sector reduces the price index.

This optimisation problem results in

$$T = \frac{1-\mu}{p_T} I \text{ and } M = \frac{\mu}{p_M} I \tag{11}$$

as the income shares spent on traditional and manufacturing goods respectively.

In a third step, consumers decide how to divide their total spending on manufacturing goods amongst the n variants. This leads to a demand for variant i by household j of

$$m_{ij} = \frac{p_{m_i}^{-\sigma}}{p_M^{-(\sigma-1)}} \mu I \tag{12}$$

Assuming that the number of firms n is large means that the effect on the price index p_M of a change in the price of a single firm p_{m_i} can be neglected. In this case, the (absolute) price elasticity of demand for each variety is constant and equal to σ.

2.2 Firms

Each firm in the traditional sector produces according to an identical technology, with aggregated output given by

$$T = L_T \tag{13}$$

This means that labour in this sector has a constant unitary marginal productivity. Seeing as firms in this sector face perfect competition, it must hold that

$$p_T = w_T \tag{14}$$

with w_T as the traditional sector wage rate. Labour productivity and thus the price level in this sector is normalized to one.

As stated above, firms in the manufacturing sector bargain over wages with unions but also face efficiency-wage considerations. Each worker j employed by the firm has a firm-specific productivity denoted by θ_j^{-1}, where θ is a random variable uniformly distributed in the unit interval for all workers, whose precise realisation only becomes known after wage bargaining has taken place and the worker is actually hired by the firm. Depending on the value of this productivity, the firm will either pay the worker the union wage which acts as a lower bound, or the higher efficiency wage. Thus, expected output by a representative manufacturing sector firm i takes places according to

$$\mathrm{E}[m_i] = \Gamma(\mathrm{E}[\theta_j^{-1}])(\mathrm{E}[e]L_{m_i})^{\alpha}, \quad \Gamma > 0, \quad 0 < \alpha < 1 \tag{15}$$

where Γ is a technology parameter and $\mathrm{E}[e]$ denotes expected effort (as *ex ante* it is not clear which wage level the worker receives) with effort e given by

$$e = \begin{cases} (w_e - w_m + 1)^{\lambda} & \text{for } w_e > w_m \\ 1 & \text{for } w_e \leq w_m \end{cases} \tag{16}$$

L_{m_i} denotes the amount of labour employed by firm i in the manufacturing sector, and w_e and w_m are the efficiency and union wage, respectively. Further, firms also incur fixed costs f. In the following, the value of labour's output elasticity α and the fixed costs f are chosen so as to guarantee that firms have decreasing average costs to ensure that the number of firms is finite. Therefore, given the demand function for variants of the manufacturing good (12), firms maximise their (expected) present discounted value V_{m_i}

(17)

$$\max_{L_{m_i}} \int_0^{\infty} \mathrm{E}[\pi_i] \exp(-rt)dt = \max_{L_{m_i}} \int_0^{\infty} [p_{m_i}(m_i)\mathrm{E}[m_i] - \mathrm{E}[\bar{w}_{m_i}]L_{m_i} - f] \exp(-rt)dt$$

where $\mathrm{E}[\bar{w}_{m_i}]$ is the expected average wage to be determined below.

This optimisation problem is identical in every period so that the time index t can be omitted without loss of content. Profit maximization leads to

$$p_{m_i} = \frac{1}{\kappa} \frac{\mathrm{E}[\bar{w}_{m_i}]}{\partial \mathrm{E}[m_i]/\partial L_{m_i}} \tag{18}$$

From (18) it can be seen that κ is both a measure of the heterogeneity of goods and also indicates the degree of product market competitiveness. Thus, $1/\kappa$ denotes the mark-up factor by which prices exceed marginal costs. Thus, a higher value of κ implies a higher degree of market competition, with $\sigma = \infty(\kappa = 1)$ as the special case of perfect competition.

Totally differentiating (18) with respect to labour and expected wages and assuming symmetrical firms, making it possible to drop the index i, gives

$$\kappa \frac{\partial p_m}{\partial \mathrm{E}[m]} \frac{\partial \mathrm{E}[m]}{\partial L_m} dL_m + \frac{\mathrm{E}[\bar{w}_m] \partial^2 \mathrm{E}[m] / \partial L_m^2}{(\partial \mathrm{E}[m] / \partial L_m)^2} dL_m - \frac{1}{\partial \mathrm{E}[m] / \partial L_m} d\mathrm{E}[\bar{w}_m] = 0$$

which using the production function as given by (15) and rearranging yields

$$\frac{dL_m}{d\mathrm{E}[\bar{w}_m]} \frac{\mathrm{E}[\bar{w}_m]}{L_m} \equiv \epsilon_{L_m, \mathrm{E}[\bar{w}_m]} = \frac{-1}{1 - \alpha\kappa} \tag{19}$$

Equation (19) shows that a reduction in product market competitiveness, i.e. a lower value of κ, reduces (in absolute terms) the elasticity of labour demand. This is because lower pressure from competitors means that firms can demand higher mark-up prices. Therefore, if wages increase, firms do not have to bear the total burden of these increased costs by dismissing workers, but can instead pass on some of the higher costs to the consumer. The more market power a firm has, the higher is the share of the burden that is passed on to consumers and the lower is the share that the firm itself has to bear, i.e. the lower is the number of workers that are dismissed.

3 Wage Setting

As stated in the Introduction, there is strong empirical evidence showing that identical workers receive different wages. In the model here, not only do the wages between workers in the traditional and manufacturing sector differ, but there will also be some workers in the manufacturing sector who have such a high value of firm-specific productivity θ_j^{-1}, that the firm will choose to pay them an efficiency wage which is higher than the wage derived from union bargaining (see Beck *et al.* 2001 for a similar setup). Thus, the wage which results from the bargaining process between firms and unions acts as a minimum binding wage in this sector, with the efficiency wage as a mark-up over this wage level.

The wage-setting process can be modelled as a two-stage game. In the first stage, *right-to-manage* wage negotiations take place between firms and unions. In this stage, the union wage is determined and firms hire labour as given by their labour demand function and the bargained wage. In stage two, of those hired, a fraction will receive an efficiency wage and the others will receive the bargained union wage. This game is solved by backward induction so that stage 2 is solved first.

In order to decide whether a worker should receive the efficiency or the union wage, the firm must compare when profits are higher. Seeing as this decision only needs to be made for hired workers (with the hiring level determined by the labour demand function and the union wage), firms need to compare per-worker profits. Seeing as the price level p_m and the technological level Γ affect per-worker profits identically irrespective of the wage a worker actually receives, the per-worker (relative) profit function π^r when the firm pays an efficiency wage is

$$\pi^r = \theta_j^{-1} e^{\alpha} - w_e$$

$$\frac{\partial \pi^r}{\partial w_e} = \frac{\alpha\lambda}{\theta_j}(w_e - w_m + 1)^{\lambda(\alpha-1)} - 1 \stackrel{!}{=} 0$$

$$w_e = \left(\frac{\alpha\lambda}{\theta_j}\right)^{\frac{1}{\lambda(1-\alpha)}} + w_m - 1 \tag{20}$$

Therefore, the efficiency wage is higher than the union wage iff

$$\left(\frac{\alpha\lambda}{\theta_j}\right)^{\frac{1}{\lambda(1-\alpha)}} - 1 > 0$$

$$\theta_j < \alpha\lambda \equiv \theta^* \tag{21}$$

It can easily be checked that for values of θ_j below this critical level, per-worker profits are higher than if the firm were to pay the union wage but workers only exert the minimum unit effort amount.

In order to precisely determine average wages, it is necessary to first derive the expected efficiency wage that will be paid, i.e. we need to know $\mathrm{E}[\theta_j|\theta_j < \theta^*]$. With the uniform distribution this value is easily calculated as $\theta^*/2$. Inserting this value into the efficiency wage equation above yields

$$\mathrm{E}[\bar{w}_e] = 2^{\frac{1}{\lambda(1-\alpha)}} + w_m - 1 \tag{22}$$

where $\mathrm{E}[\bar{w}_e]$ is the expected average efficiency wage. Therefore, the expected average wage $\mathrm{E}[\bar{w}_m]$ a firm in the manufacturing sector pays is given by

$$\mathrm{E}[\bar{w}_m] = \theta^* \bar{w}_e + (1 - \theta^*) w_m \tag{23}$$

which, by inserting equations (21) and (22), yields

$$\mathrm{E}[\bar{w}_m] = \alpha\lambda\left(2^{\frac{1}{\lambda(1-\alpha)}} - 1\right) + w_m \tag{24}$$

Having determined the average efficiency wage it is also possible to determine the average expected effort. First, noting that expected effort of someone receiving the average efficiency wage is

$$\mathrm{E}[e|\bar{w}_e] = 2^{\frac{1}{1-\alpha}} \tag{25}$$

means that average expected effort is

$$\begin{aligned} \mathrm{E}[e] &= \theta^* 2^{\frac{1}{1-\alpha}} + (1-\theta^*) \\ &= \alpha\lambda(2^{\frac{1}{1-\alpha}} - 1) + 1 \end{aligned} \tag{26}$$

Using this, we are now able to turn to stage 1 where wage bargaining between firms and unions takes place.

Unions derive utility from wages and employment levels. Specifically, the unions' aim is to demand higher wages w_m than those paid in the traditional sector, i.e.

$$\max_{w_m} V = \int_0^\infty [L_{m_t}(w_{m_t} - w_{T_t})] \exp(-\rho t) dt \tag{27}$$

where V represents intertemporal union utility and ρ is the union discount rate.[4] As above, the wage rate will be constant in a steady state so that the time index t can be omitted. Thus, during the wage bargaining process, a necessary condition for unions to maximise their utility is

$$\frac{dV}{dw_m} = \frac{\partial V}{\partial w_m} + \frac{\partial V}{\partial L_m}\frac{dL_m}{dw_m} \overset{!}{=} 0 \tag{28}$$

There are two opposing effects in (28). On the one hand, increases in the wage level directly increase union utility. On the other hand, there is an indirect effect as the size of the workforce will decline with higher wages, thereby reducing union utility. In the optimum these two effects need to be equalized.

The most common way of modelling such negotiations is the (generalised) co-operative Nash bargaining solution. Here, the Nash-maximand which is simply

[4] It is assumed that unions have the same subjective discount rate ρ as do individuals.

the product of the respective difference in payoffs if an agreement is reached to the payoff each party receives if no agreement is reached, is maximised with respect to the wage level. If no agreement is reached, firms have a (negative) fallback position $\mathrm{E}[\pi_0] = -f$ due to their fixed costs. For this reason, the Nash-maximand effectively only contains variable profits $\mathrm{E}[\pi_V]$ net of the fixed costs, i.e. $\mathrm{E}[\pi] + f \equiv \mathrm{E}[\pi_V]$. For the unions on the other hand, this fallback position is the wage rate paid in the traditional sector, which all workers could receive at any time.[5] Therefore, the Nash-maximand Ω is given by

$$\Omega = V^{\beta}(\mathrm{E}[\pi_V])^{1-\beta} \tag{29}$$

where β is the bargaining power that unions have. Maximising equation (29) with respect to the wage rate yields

$$\frac{\partial \Omega}{\partial w_m} = \beta V^{\beta-1}\mathrm{E}[\pi_V]^{1-\beta}\frac{\partial V}{\partial w_m} + (1-\beta)V^{\beta}\mathrm{E}[\pi_V]^{-\beta}\frac{\partial \mathrm{E}[\pi_V]}{\partial w_m} \overset{!}{=} 0 \tag{30}$$

Using the envelope theorem by which $\frac{\partial \mathrm{E}[\pi_V]}{\partial w_m} = -L_m$, means that (30) simplifies to[6]

$$\mathrm{E}[\pi_V]\frac{\partial V}{\partial w_m} = \frac{1-\beta}{\beta} V L_m \tag{31}$$

With union utility given by (27) and the variable profits to labour costs ratio by

$$\frac{\mathrm{E}[\pi_V]}{\mathrm{E}[\bar{w}_m]L_m} = \frac{1-\alpha\kappa}{\alpha\kappa} \tag{32}$$

together with the elasticity of labour demand as given by (19), means that equation (31) leads to a union wage of

$$w_m = \frac{\alpha\kappa + \beta(1-\alpha\kappa)}{\alpha\kappa} \tag{33}$$

As can be seen form equation (33), this wage is independent of worker firm-specific productivity θ_j. The reason for this is that this variable is stochastically determined and cannot be influenced by the union. Further, the wage differential

[5] Unions treat this wage as exogenous. In other words, they ignore the effect wage negotiations in the manufacturing sector have on the labour supply in the traditional sector.

[6] See Appendix A.1 for the proof that this result holds even when some workers receive an efficiency wage.

as given by equation (33), increases with union bargaining power β. For the extreme case that unions have no bargaining power, ($\beta = 0$), the union wage and the wage paid in the traditional sector equalize irrespective of the intensity of product market competition. At the other extreme, if all the bargaining power is with the unions, ($\beta = 1$), then the wage differential between the traditional sector and union wage reaches its maximum. Equation (33) shows that the bargained wage is a decreasing function of product market competitiveness κ. This is because more intense competition increases the labour demand elasticity with respect to wages. Therefore, a given increase in the wage level will lead to a larger decrease in labour demand. In other words, the negative effect on union utility of higher wages gains in importance. For this reason, unions will lower their respective wage demands. Thus, although product market competition is assumed to not directly influence union bargaining power, it does have an indirect effect through the elasticity of labour demand and thereby on the resulting wage rate. Therefore, not only stronger union bargaining power, but also the product market power of firms leads to higher relative wages.

4 General Equilibrium

Only by determining the general equilibrium values of all endogenous variables is it possible to take all direct and indirect effects of changes in exogenous variables into account. This is especially important in the model presented here, as a change in any of the exogenous variables will lead to a change in the expected wage to be earned in the primary sector and thereby has an immediate effect on the household job-taking decision and thus also has indirect implications for the secondary sector. As has been shown above, due to efficiency wage considerations and the presence of unions in the primary sector, a non-competitive wage differential exists between the two sectors. Since labour is homogeneous, all workers would prefer a job in the high-wage manufacturing sector. However, this wage differential leads to lower labour demand than the market-clearing level, so that not all workers can be absorbed by this sector. Therefore, workers at the beginning of their careers or those that become unemployed, must decide whether to try and obtain a high-wage job but face the risk of a period of unemployment, or to enter the traditional sector where they can instantaneously find a job. In a steady state equilibrium and with risk-neutral workers, expected utility of the two options must be identical.

For the reasons discussed above, only workers from the unemployed pool are considered for primary jobs. As there must be a positive probability of finding a job in this sector, there must also be labour turnover in any period of time. This occurs due to structural change in the economy or because workers earning the union wage quit in the hope of finding a new job where they will receive the higher efficiency wage. This means that each job in the manufacturing sector faces the probability $s(q, \theta^*)$ of being terminated, where q is the rate of structural change so that $\partial s/\partial q > 0$. The lower the value of θ^*, the lower is the probability that workers will quit their present jobs as the probability that their firm-specific productivity will be above the threshold value at the next firm declines, i.e. $\partial s/\partial \theta^* > 0$. Further, there exists a job-finding rate a, determined endogenously below. This means that all possible transitions between the states of unemployment and the primary sector are Poisson processes. As steady state (expected) wages in both sectors are constant and with symmetrical firms in the manufacturing sector, i.e. $\mathrm{E}[\bar{w}_{m_i}] = \mathrm{E}[\bar{w}_M]$, the Bellman equations for the three possible states a worker can be in, i.e. employed in the traditional sector, employed in the manufacturing sector or unemployed, are

$$\rho V_T = w_T \tag{34}$$

$$\rho V_M = \mathrm{E}[\bar{w}_M] + s(V_U - V_M) \tag{35}$$

$$\rho V_U = a(V_M - V_U) \tag{36}$$

with V_T, V_M and V_U as the respective present values associated with the three states. Using the fact that in equilibrium the present value of becoming unemployed must be equal to that of taking up a job in the traditional sector, $V_U = V_T$, means that equations (34) – (36) yield a job-finding rate a of

$$a = \frac{\alpha\kappa(\rho + s)}{\beta(1 - \alpha\kappa) + \alpha^2\kappa\lambda\left(2^{\frac{1}{\lambda(1-\alpha)}} - 1\right)} \tag{37}$$

Equation (37) together with the steady state flow condition whereby the number of people exiting the primary sector during any period of time must equal the number of unemployed U_M finding a job in this time period, $aU_M = sL_M$, determines unemployment as

$$U_M = \frac{\beta s(1-\alpha\kappa) + \alpha^2\kappa\lambda s\big(2^{\frac{1}{\lambda(1-\alpha)}} - 1\big)}{\alpha\kappa(\rho+s)} L_M \tag{38}$$

Equation (38) fully closes the model. Table 1 shows all comparative static effects that result in the general equilibrium.

Table 1: Comparative Statics

	α	β	κ	μ	ρ	λ	q	f	Γ	N
$\mathrm{E}[\bar{w}_m]$	+	+	-			-				
L_m	-	-	+			+		+		
p_m	+	+	-			-		+	-	
n	-	+	-	+	+	-	-	-		+
u_M	+	+	-		-	-	+			
p_M	+	+	?	-	-	-	+	+	-	-
M	-	-	+	+	+	+	-	-	+	+
L_M	-	-	+	+	+	+	-			+
N_M	+	-	+	+	-	+	+			+
N_T	-	+	-	-	+	-	-			+
Y	-	+	-	+	+	-	-			+

Combining equation (18) with the zero-profit condition yields

$$p_m = \frac{\mathrm{E}[\bar{w}_m]L_m + f}{\mathrm{E}[m]} = \frac{\mathrm{E}[\bar{w}_m]L_m + f}{\Gamma\mathrm{E}[\theta]\left(\mathrm{E}[e]L_m\right)^\alpha}$$

Noting that *ex ante* $\mathrm{E}[\theta] = 1/2$, this can be solved for per-firm employment L_m to give

$$L_m = \frac{f(\alpha\kappa)^2}{(1-\alpha\kappa)\left(\alpha\kappa + \beta(1-\alpha\kappa) + \alpha^2\kappa\lambda\big(2^{\frac{1}{\lambda(1-\alpha)}} - 1\big)\right)} \tag{39}$$

Thus, both higher union bargaining strength and higher product market power by firms (i.e. a lower value of κ), have a negative influence on individual firm labour demand. Further, a higher value of effort elasticity λ means that productivity of workers being paid an efficiency wages rises, so that *c.p.* the equilibrium level of per-firm labour demand also increases.

The focus here is on the number of firms n and on the equilibrium unemployment rate $u_M \equiv U_M/N_M$. The reason for this is that with the Dixit, Stiglitz (1977) setting of monopolistic competition assumed here, firms act strategically independent of each other. This has as a consequence that the size of the market neither has an influence on the mark-up factor firms can charge over their marginal costs, nor does it influence the scale at which these firms produce. Instead, all market effects work through a change in the number of equilibrium varieties n which are produced in the economy. This number can be derived as[7]

$$(40) \quad n = \frac{\mu(\rho+s)(1-\alpha\kappa)\left(\beta(1-\alpha\kappa)+\alpha\kappa\left(\alpha\lambda\left(2^{\frac{1}{\lambda(1-\alpha)}}-1\right)+1\right)\right)N}{f\left[\mu\rho(\alpha\kappa)^2+((1-\mu)(\rho+s)+\mu\alpha\kappa s)\left(\beta(1-\alpha\kappa)+\alpha\kappa\left(\alpha\lambda\left(2^{\frac{1}{\lambda(1-\alpha)}}-1\right)+1\right)\right)\right]}$$

From equation (40) it can be shown that the number of firms is negatively related to labours' output elasticity α. This can be explained by the fact that productivity rises with α. As can be seen from equation (12), a lower number of firms, which reduces the price index p_M, shifts the demand curve for the remaining firms upwards. As prices and wages remain unaffected by the number of firms, the higher output associated with increasing values of α automatically increase firms' revenues so that the new equilibrium is characterized by fewer firms producing at higher output levels. Higher union bargaining power β will lead firms to shed labour, reducing their wage bill. These firms will then earn short-run positive profits, which will be eroded in the long-term as new firms enter the manufacturing sector. A rise in product market competition intensity κ lowers the manufacturing sector wage which directly reduces firms' labour costs. However, this effect is outweighed by the positive effect of κ on labour demand, so that net costs increase, forcing some firms to exit this sector as they now make a loss. Further, a higher value of κ has the added effect of reducing the price a firm can demand, so that *c.p.*, revenue drops. As there is no strategic interaction

[7] See the Appendix A.2 for the derivation.

between firms, lower revenue forces some firms out of the market (or to merge with other firms). In other words, more intense product market competition leads to fewer but larger firms. Similarly, higher fixed costs f, are also counteracted by fewer firms operating at higher output levels.

Increases in either the consumption share of manufacturing goods μ, the subjective rate of time preference ρ, or the size of the population N, all lead to higher demand for manufacturing goods. This ensures that firms increase their revenue and make positive profits in the short-term which induces more firms to enter this sector, thereby increasing employment in the high-wage sector. Thus, households have two channels, μ the income share spent on manufacturing goods and their rate of time preference ρ, by which they can influence their own employment chances and the decision whether to face a spell of unemployment and search for a high-wage job or immediately take up a job in the traditional sector.

A higher value of the effort elasticity λ will reduce the number of firms operating. The reason for this effect is that an increase in λ makes firms more profitable and increases their output. With no corresponding increase in demand, prices will decrease which leads to a loss in revenue and forces some firms out of the market with the remaining firms producing at a higher output level.

The higher the rate of structural change q, the lower is the equilibrium number of firms. The reason for this is that frictional unemployment increases so that total wage income earned by the households in the economy declines. This in turn means that demand for manufacturing products decreases, forcing some firms to exit the market as they would make losses.

The other endogenous variable of crucial interest is the unemployment rate u_M which is given by

$$u_M = 1 - \frac{\alpha\kappa(\rho+s)}{\alpha\kappa(\rho+s) + \beta s(1-\alpha\kappa) + \alpha^2\lambda\kappa s\left(2^{\frac{1}{\lambda(1-\alpha)}} - 1\right)} \tag{41}$$

To understand the comparative static effects, it is necessary to analyse both the change in employment and the number of workers looking for jobs in this sector. Changes in either labours' output elasticity α, competition intensity κ, or union bargaining power β, all gives rise to an "output" and a "number of firms" effect on total employment. An increase in α will not only increase worker productivity so that labour demand per-firm declines, the corresponding higher output will also lead to a reduction in the number of firms. Simultaneously, the higher expected average wages will entice some workers previously employed in the traditional sector to start searching for a job in the high-wage manufacturing sector. Finally, a higher value of α also increases the critical threshold value of job-specific productivity θ^*. This will induce some workers currently receiving the union wage to quit their job as they now have a higher probability of finding a job in which they receive the higher efficiency wage. Therefore, the unemployment rate is unambiguously an increasing function of labour's output elasticity.

Higher values of union bargaining power β lowers per-firm output but leads to a higher number of firms. However, due to the higher wages that result as β increases, some workers previously employed in the traditional sector will now quit that sector and become unemployed and look for a job in the high-wage sector. Therefore, with lower labour demand and more job searchers, the unemployment rate must increase with union bargaining power. Note however, that even if unions have no bargaining power, i.e. $\beta = 0$, unemployment will still exist due to some workers receiving efficiency wages in this sector preventing it from clearing. These efficiency wages decisively depend on the value of λ. Although an increase in this parameter will lower the number of firms, it also leads to a reduction in expected wages so that labour demand increases. This reduction in expected wages has the further effect of leading some workers to stop searching for a job in this sector, so that the job-finding rate increases. Even though this effect is slightly counteracted by the increase in the critical job-specific productivity θ^* which will lead some workers earning the union wage to quit their jobs, the overall effect of a higher effort elasticity is a fall in the unemployment rate.

The output effect occurs with higher values of κ as it lowers the union and thereby expected average wages and thus increase per-firm labour demand and output. However, simultaneously, the higher degree of competition reduces the number of firms which has a negative effect on total output. At the same time, due to the decline in expected manufacturing sector wages, some workers will stop searching for a job in this sector, thereby decreasing the number of unemployed and increasing the rate at which the remaining unemployed find a new job. It can be shown that the per-firm output effect and the effects associated with the decrease in the manufacturing sector wage always dominate the number of firms effect so that the unemployment rate unambiguously falls. Therefore, just as higher union bargaining power is bad for employment, so is higher market power by firms.

The final two effects which can be seen from (41) are the influence that the subjective discount rate ρ, and the rate of structural change q via s, have. Turning to the former, it can be seen that a higher discount rate lowers the unemployment rate. This can be explained twofold. Firstly, the consumption level increases with ρ, leading firms to produce more and consequently hire increased levels of labour. This means that the job-finding rate a increases. Secondly, some of the formerly unemployed will now opt for a job in the traditional sector as with higher values of ρ, the present value of high-wage jobs decreases. Therefore, an immediate low-wage income as opposed to a spell of no income whilst applying for a high-wage job becomes more attractive. Both effects lower the unemployment rate. The opposite holds for increases in q. Although it too leads to a higher job-finding rate a, at the same time more people become unemployed at any given time. This not only directly increases unemployment but also indirectly via lower national income Y which in turn reduces goods and labour demand. Lastly, it can be seen from equations (38) and (41), that if $s = 0$, implying that there are no job-separations, then no unemployed individual can ever hope to find a job in the high-wage sector. For this reason, all workers who do not find a manufacturing sector job, will immediately take up a job in the traditional sector.

5 Conclusion

This paper has developed a dual labour market model which combines efficiency wage considerations and union wage bargaining with monopolistically competitive firms. It was shown that unemployment not only positively depends on higher union bargaining power but also on the amount of market power that firms possess on the product market and the degree in which firms pay their workers an efficiency wage. There are two effects by which the level of product market competition influences unemployment. Firstly, there is the direct effect by which more intense competition leads to lower mark-up prices. This price reduction is concomitant with higher product market (and therefore labour) demand.

But there is also an indirect effect associated with the competition intensity. More intense competition means that firms are less well able to pass on increased costs to consumers. Therefore, the only other way firms can reduce their costs is by dismissing a part of their workforce. Therefore, higher product market competition intensity also leads to a higher (absolute) elasticity of labour demand. However, seeing as the level of employment is important for union utility, unions will lower their wage demands correspondingly. These lower bargained wages also reduce the efficiency wage paid which in turn means that fewer workers quit their jobs and consequently, that the unemployment rate is lower. However, it should be noted that even if economic rents are decreased when competition becomes more intense, there are numerous other channels through which firms can achieve economic rents, e.g. through innovations (see STADLER 1999). Therefore, higher product-market competition must be one part of a whole policy-mix needed to substantially reduce EU unemployment.

Nevertheless, positive effects on unemployment of increased competition are still to be expected and are often stated as one of the benefits of European Monetary Union. As price levels become more comparable within the EU, it does indeed seem likely that this will increase the elasticity of substitution between two variants leading not only to lower wages but consequently also lower unemployment. The model here predicts that this increased competition leads to fewer but larger firms, i.e. that firms merge in order to obtain economies of scale and reduce their costs. However, this emphasizes that it is increasingly important that government policies are aimed at strengthening product market competition and that it is recognized that unions as such only have a dwindling influence on national unemployment levels.

Appendix

A.1 Derivation of the Union Wage

As stated in the main text, the production function is given by

$$\mathrm{E}[m] = \Gamma \mathrm{E}[\theta^{-1}]\left(e(w_m)L_m(w_m)\right)^{\alpha}$$

so that optimal labor demand is

$$\begin{aligned}\frac{\pi_m}{\partial L_m} &= \frac{\partial p_m}{\partial \mathrm{E}[m]}\frac{\partial \mathrm{E}[m]}{\partial L_m}\mathrm{E}[m] + p_m\frac{\partial \mathrm{E}[m]}{\partial L_m} - \bar{w}_m \stackrel{!}{=} 0\\ &\frac{\partial \mathrm{E}[m]}{\partial L_m}p_m\kappa - \bar{w}_m = 0\end{aligned}$$

Here we require

$$\begin{aligned}\frac{\partial \pi_m}{\partial \bar{w}_m} &= \frac{\partial p_m}{\partial \mathrm{E}[m]}\frac{\partial \mathrm{E}[m]}{\partial \bar{w}_m}\mathrm{E}[m] + p_m\frac{\partial \mathrm{E}[m]}{\partial \bar{w}_m} - L_m - \bar{w}_m\frac{\partial L_m}{\partial \bar{w}_m} \stackrel{!}{=} 0\\ &= \frac{\partial \mathrm{E}[m]}{\partial \bar{w}_m}p_m\kappa - L_m - \bar{w}_m\frac{\partial L_m}{\partial \bar{w}_m}\end{aligned}$$

which can be rewritten as

$$\begin{aligned}\frac{\partial \pi_m}{\partial \bar{w}_m} &= \left(\frac{\partial \mathrm{E}[m]}{\partial L_m}\frac{\partial L_m}{\partial \bar{w}_m} + \frac{\partial \mathrm{E}[m]}{\partial e}\frac{\partial e}{\partial \bar{w}_m}\right)p_m\kappa - L_m - \bar{w}_m\frac{\partial L_m}{\partial \bar{w}_m}\\ &= \frac{\partial L_m}{\partial \bar{w}_m}\left(\frac{\partial \mathrm{E}[m]}{\partial L_m}p_m\kappa - \bar{w}_m\right) + \frac{\partial \mathrm{E}[m]}{\partial e}\frac{\partial e}{\partial \bar{w}_m}p_m\kappa - L_m\end{aligned}$$

As the term in brackets is equal to zero and further, as can be seem from equation (26), expected effort is independent of the union wage, this equation simplifies to $-L$.

A.2 Derivation of the Equilibrium Number of Firms

From the definition of the size of the working population, it is possible to derive the size of the traditional sector as

$$N_T = N - nL_m\left(1 + \frac{s(2w_m - (2-\lambda))}{(\rho + s)(2-\lambda)}\right) \tag{A.1}$$

Further, using the optimal income shares households spend on either type of good yields

$$N_T = \frac{1-\mu}{\mu} n p_m m$$
$$= \frac{1-\mu}{\mu} n(\mathrm{E}[\bar{w}_m] L_m + f) \tag{A.2}$$

Equating equations (A.1) and (A.2) and making the appropriate substitutions makes it possible to solve for the number of firms as

$$n = \frac{2\mu(\rho+s)(1-\alpha\kappa)(\alpha\kappa+\beta(1-\alpha\kappa))N}{f\left[2\beta(1-\alpha\kappa)((1-\mu)(\rho+s)+\mu s\alpha\kappa)+\alpha\kappa(2(\rho+s)(1-\mu(1-\alpha\kappa))-\mu\rho\lambda\alpha\kappa)\right]}$$

Multiplying per-firm labor demand as given by equation (39) with the equilibrium number of firms gives total employment in the manufacturing sector. This value for L_M can in turn be inserted into the unemployment equation (38) to yield the number of unemployed.

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