Economics Department

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ECO No. 2000/18

EUI WORKING PAPERS

EUROPEAN UNIVERSITY INSTITUTE

EUROPEAN UNIVERSITY INSTITUTE, FLORENCE

ECONOMICS DEPARTMENT

EUI Working Paper **ECO** No. 2000/18

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BADIA FIESOLANA, SAN DOMENICO (FI)

Printed in Italy in September 2000
European University Institute
Badia Fiesolana
I – 50016 San Domenico (FI)
Italy

Growth Externalities, Unions, and Long-term Wage Accords

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July 2000

Abstract

This paper presents an innovation driven endogenous growth model, where firms and unions bargain over wages. We find that the degree of centralization of the bargaining structure plays a crucial rule for economic performance. Central bargaining, which incorporates the leapfrogging externality incorporated in firm-level bargaining, will yield lower rates of unemployment for a given rate of economic growth. The increase in labor resources will in turn also yield faster growth rates in a corporatist economy. Indeed, when unions focus on issues other than short term wage increases, they may even outperform the non-unionized economy, as they can internalize the knowledge externality through long-term wage moderation accords.

Keywords: Unions, Endogenous Growth, Unemployment.
JEL-Classification: J51, O41.

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* The author would like to thank Giuseppe Bertola for discussion and valuable hints.
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1 Introduction

The success of the Dutch Polder model has to a resurgent interest into the nature of wage accords. It is uncontested that the Dutch model has lead to high employment, fast economic growth, and eventually to a low rate of unemployment. The striking feature of the Dutch Polder model is the fact that it has been agreed upon by weak unions, but at a centralized level of bargaining, over a longer time horizon, and essentially included little else but an agreement to moderate wages. Indeed, Muysken (1999) as far as to argue that the Dutch Polder model is about little else but wage moderation vis-à-vis its main trading partner, Germany.

The Dutch Polder model is but a last element in a row of wage agreements throughout Europe. The first evidence comes from Sweden, where a strong single union for a long period of time pursued long-term goals, in particular full employment (arbete at alle), the welfare state and prosperity(Meidner, Rehn et al, 1953, Rehn, 1952). In the Swedish Rehn-Meidner model, a key element has been the solidaric wage policy, which in many circumstances implied wage moderation, in particular for the highly skilled employees (Agell and Lommerud, 1993).

Another interesting case has been Austria, which has historically been the most corporatistic regime in Europe, apart maybe from Sweden. During the 1960s and 1970s, when the Austrian economy has characterized by high rates of economic growth, the president of the Austrian trade unions claimed that the result of the wage bargaining should yield a productivity and inflation compensation. Needless to say, wages did indeed follow this Benya-rule throughout the period, with deviations largely due to forecasting errors (Nowotny, 1999). Given an initial moderation of wages, the pursuit of the Benya-rule perpetuated the initial moderate agreement throughout the period.

Finally, even Germany initiated an initiative to breach a long-term wage agreement, in the Bündnis für Arbeit. The declared goal of this long-term agreement between social partners has been to promote employment and growth through wage moderation. Apart from complementing government policies, this agreement has failed, as unions required employers to give job garantees to compensate for the wage moderation (Heise, 2000).

The common features of the successful wage accords have been a basically unilateral but long-term agreement to moderate wages, where firms did not

have to commit to any other accompanying policy or concessions. Whilst the bargaining level of the accord has been at the central level, the relative bargaining power of the unions did not seem to matter, having both the strong Swedish Landsorganisationen and the weak Dutch unions signing long-term wage accords. By contrast, the intervention of unions into firm policy seemed to have exhibited a negative impact on the German agreement, as firms did not be willing to make any form of concessions.

The question then arises why unions would be willing to sign such an agreement, and by the same token why firms, which evidently benefit from wage moderation seem so reluctant to make concessions. The paper will agree that the central element, which can explain such a behavior lies in the internalization of macroeconomic, in particular endogenous growth, externalities, which is beneficial to the union and its members. By contrast incumbent firms are indifferent to a wage accord, as the entire surplus of the internalization goes to novel firms, leaving incumbents unaffected.

2 Related Literature

There exists a vast literature on the impact of the impact of unions on wage bargaining and the economic performance. The debate has essentially focused on two issues, the bargaining power of trade unions, and the level of the bargaining, from firm-level to the national, and even supranational level (Strozzi, 2000).

The idea that the degree of centralization of the bargaining structure exhibits a nonlinear relation dates back to Calmfors and Driffill (1988). They have shown that as bargaining level increases from the firm level to the industry level, wage rates increase, as the lower degree of product substitution allows unions to demand higher wage increases. By contrast, as the level of bargaining increases further to the national level, unions begin to internalize the leapfrogging externality of wage increases which get translated into subsequent price increases, hence wage deals become moderate again, leading to a better economic performance.

The hump-shape hypothesis of Calmfors and Driffill (1988) has been challenged both on theoretical and empirical grounds. The OECD (1994, p. 18ff) notes that the beneficial effect of corporatist, or centralized-bargaining, economies lies in the creation of private sector employment due to low wage

deals, which is in contrast with the evidence. It appears that small variations in the observation period and in the country sample may eliminate the findings of Calmfors and Driffill. On the other hand, high degrees of centralization are often correlated with high union bargaining power, and we may contribute bad economic performance to the later factor. Rowthorn (1992) puts forward two critiques to Calmfors and Driffill. First, he notes that different degrees of unionization across sectors, which implicitly assumes different degrees of union bargaining power across sector, will lead to wage dispersion for given average values of corporatism, hence weakening the clear cut correlation as suggested by Calmfors and Driffill. Second, he suggests that the hump-shape may break down completely as unions cease to pursue only short-term material gains. Barth and Zweimueller (1995) have demonstrated that one can preserve the hump-shape even in the presence of wage dispersion.

This paper addresses the second aspect in the Rowthorn-critique. It argues that in the presence of a macroeconomic externality, unions may prefer to pursue long-term policies which focus not only on short term monetary gains in the form of higher wages, as suggested by Calmfors and Driffill, but on long-term economic perspectives, in particular economic growth. The paper shows that this policy can be unilaterally implemented by unions by committing to long-term wage moderation.

In the presence of macroeconomic externalities, unions have always been considered as an important element to explain economic performance. Bertola (1994) has shown that in the presence of irreversible investment and firing costs, unions can exploit their increased bargaining power to extract a larger share of national income, thus reducing investment and economic growth. Irmen and Wigger (2000) extend the Uhlig and Yanagawa (1996) overlapping generations framework, where workers – the young generation – save and thus a reallocation of income to labour is growth enhancing, to include unions. Whilst Uhlig and Yanagawa make the case for capital taxation, Irmen and Wigger show that unions, which raise wages, have similar impact on the reallocation of income, foster savings, and thus economic growth. Whilst Irmen and Wigger claim that workers, who engage most in accumulation, are the driving force of growth as opposed to capitalists, and hence increasing wages fosters economic gorwth, this paper claims that Schumpeterian innovators are the engine of growth. Raising wages will therefore increase innovation costs and therefore reduce

economic growth. If unions, however, engage in wage moderation, innovation and economic growth will increase, inducing faster wage growth and thus potentially higher welfare. In that respect, a long-term wage agreement can be interpreted as a dynamic coalition between workers and firms establishing an efficient equilibrium allocation (Cooley and Smith, 1989 and Prescott and Boyd, 1986).

3 Households and Unions

Households face four types of choices in this model economy. First, they have to choose between whether they wish to consume their labor and non-labor income today or in the future. In other words, they face an intertemporal tradeoff between consumption and savings. Second, they have to choose which quantities from a variety of goods they wish to consume today. Given homothetic preferences, we can separate the two problems. Hence, they also face an intratemporal tradeoff between different varieties of consumption goods. Third, they have to choose between whether to offer labor services or not. We shall abstract from this choice by assuming that households supply one unit of labor inelastically. This assumption is made for the sake of simplicity, as it allows us to determine all unemployment as involuntary. Fourth, households have to choose whether to join a trade union or not. Assuming that trade union membership is free but conditioned on employment in an organized sector, this choice is trivial. All households with a job in an organized sector will join the union and will be represented by the union in wage negotiations.

Households determine their intertemporal consumption pattern by maximizing an intertemporal utility function, where we assume point-in-time utility (felicity) to be linear,

$$U_s = \int_s^{\infty} c_t e^{-\rho(t-s)} dt \qquad (1)$$

where ρ is the individual rate of time preference, and c_t is aggregate consumption over time t. Households maximize utility subject to an intertemporal budget constraint,

$$\dot{a}_t = r_t a_t + w_t (1 - u_t) - c_t , \qquad (2)$$

which states that a household saves that part of interest income $r_t a_t$, and labor income w_t for those who expect not to be unemployed u_t, that is not spent on consumption c_t. Unemployed workers receive no benefits, which, however, has no consequences on the macroeconomic outcome, as well be shown lateron. Hamiltonian optimization of the utility function subject to the budget constraint with respect to consumption, asset accumulation, and a shadow price of income yields an intertemporal Euler condition,

$$r_t = \rho, \tag{3}$$

which fixes the rate of interest at the individual rate of time preference. This condition implies that savings are completely elastic. If the interest rate only slightly exceeds the intertemporal rate of time preference, households will completely refrain from consumption, leading to an excess supply of loanable funds that drives the interest back to the rate of time preference. By contrast, if the interest falls short of the rate of time preference, households immediately demand infinite amounts of credit for consumption, driving the interest rate back up. The intuition for this result is simple. In the absence of a diminishing marginal product of consumption, given that felicity is linear, households are indifferent about the time of consumption. As they can transfer funds across time at the interest rate, but discount future consumption at the rate of time preference, any difference between the two will lead to either a shift of consumption into the present or the infinite future.

In every point in time, households demand differentiated products according to the following constant elasticities of substitution subfelicity function,

$$c_t = [\int_0^{n_t} x_{i,t}^{\frac{\varepsilon-1}{\varepsilon}} di]^{\frac{\varepsilon}{\varepsilon-1}}, \tag{4}$$

where $x_{i,t}$ is a specific product variety. As households spend $p_t c_t$ on consumption products, the budget constraint for optimization reads,

$$\int_0^{n_t} p_{i,t} x_{i,t} di \leq p_t c_t, \tag{5}$$

where $p_{i,t}$ is the price of a specific service i. The final stage in the household problem yields after optimization a demand function for a specific product,

$$x_{i,t} = \left(\frac{p_{i,t}}{p_t} \right)^{-\varepsilon} c_t , \tag{6}$$

and we find that ε is the demand elasticity for any particular product. Moreover, we obtain a definition for the price index of consumption products,

$$p_t = [\int_0^{n_t} p_{i,t}^{1-\varepsilon} di]^{\frac{1}{1-\varepsilon}} . \tag{7}$$

4 The Product Market

We assume that each differentiated product is provided by a single profit-maximizing firm, which uses labor as the sole input. For simplicity, we assume that technology is linear in its labor force $e_{i,t}$,

$$x_{i,t} = e_{i,t} , \tag{8}$$

where labor productivity has been normalized to unity. Firms hire workers on an organized labor market for a negotiated wage of $w_{i,t}$. Firms maximize profits, defined as revenues over costs,

$$\pi_{i,t} = p_{i,t} x_{i,t} - w_{i,t} e_{i,t} , \tag{9}$$

subject to demand (6), which yields a well-known optimality condition,

$$p_{i,t} = \frac{\varepsilon}{\varepsilon - 1} w_{i,t} , \tag{10}$$

namely that the price is equal to the mark-up over costs. Service sector firms therefore lucrate rents equal to,

$$\pi_{i,t} = \frac{1}{\varepsilon - 1} w_{i,t} e_{i,t} , \tag{11}$$

Firms will, either jointly or separately, have to negotiate over wages with the respective trade union, as will be discussed below.

5 Industry Unions and Employment

Unions organize workers in order to extract rents from employers. We assume that unions are benevolent, and hence try to maximize welfare for their members. Given the linearity of utility in consumption, this is equivalent to maximizing income of the union members. For the moment, we shall assume that unions can only negotiate over current wages, hence the union operating in sector i has an objective function $\varpi_{i,t}$ equal to,

$$\varpi_{i,t} = s_{i,t} w_{i,t} e_{i,t} + (1 - s_{i,t}) o_t e_{i,t}, \tag{12}$$

given that workers remain in the sector with probability $s_{i,t}$, leading to earnings of $w_{i,t}e_{i,t}$, and will have to leave the sector with probability $(1 - s_{i,t})$, in which case they will earn the outside option income of $o_{i,t}e_{i,t}$. Evidently, as the union demands a higher wage, the probability to remain in the sector declines. However, the wage elasticity of survival can be shown to be constant. In order to show this point, we separate the wage elasticity of survival into an employment elasticity of survival and a wage elasticity of employment. Substituting technology (8) and the mark-up equation (10) into product demand (6), we find that the wage elasticity of employment is equal to $-\varepsilon$. Given that there are no voluntary quits and that everybody is a union member, everybody will survive on the job if and only if employment does not decline, whereas only a certain proportion of the workforce remains on the job if employment within a firm declines, hence

$$s_{i,t} = P(e_{i,t} > e_{i,t-1}) + e_{i,t} / e_{i,t-1} P(e_{i,t} \leq e_{i,t-1}). \tag{13}$$

Noting that employment within a particular firm is bound to decline in a growing economy (Zagler, 2000), equation (13) reduces to $s_{i,t} = e_{i,t}/e_{i,t-1}$, implying that the employment elasticity of survival is equal to unity. Hence, the wage elasticity of survival equals,

$$\eta = \frac{\partial s_{i,t}}{\partial w_{i,t}} \frac{w_{i,t}}{s_{i,t}} = -\varepsilon. \tag{14}$$

The outside option, which workers, who will have to leave the firm, are facing, depends on their chance to find another union job, a job in the innovation sector, or whether they will be forced into unemployment, in which case they will not receive any payments,

$$o_t = (1-\varphi u_t)w_t + \delta\varphi u_t w_t^{RD}. \qquad (15)$$

Evidently, as unemployment increases, the probability to get another union job (1 - φu_t), which yields the average wage w_t declines (Layard, Nickell, and Jackman, 1991, p. 101), implying that workers either have to look for a job in the innovation sector, which they obtain and accept with probability δ, or become unemployed. Note that the outside option is dramatically reduced in the case of centralized bargaining, where the first term in equation (15) vanishes.

Firms and unions engage in bargaining over the wage, and it can be shown that the outcome to this bargaining process will equal the maximum of the following expression, the so-called Nash maximand (Rubinstein, 1982),

$$\Omega_t = [\varpi_{i,t} - o_t]^{\beta}[\pi_{i,t}] = [s_{i,t}e_{i,t}(w_{i,t} - o_t)]^{\beta}[p_{i,t}x_{i,t} - w_{i,t}e_{i,t}], \qquad (16)$$

where the first expression equals the union's objective function minus the union's threat point in case of no agreement, in which case all union members would have to refrain to the outside option. The second term equals the firm's objective function, noting that the firm's threat point equals zero, as no agreement implies no production and hence no revenues, but also no costs. β describes the relative bargaining power of unions, and equals zero in case of no union power, leading to the market solution, and infinity in the case of a monopoly union which can set wages univocally.

Taking logs and derivatives, applying the envelope theorem, and making use of the definition of profits (11) and the wage elasticity of survival (14), we obtain the following first-order condition for an optimal bargain,

$$\frac{w_{i,t} - o_t}{o_t} = \frac{\beta}{\varepsilon - 1 - \beta(\eta + 1)} = \frac{\beta}{(1+\beta)(\varepsilon - 1)}, \qquad (17)$$

stating that the share of the rent the union can extract depends positively o its bargaining power, negatively on the elasticity of substitution on the product market, and positively on the elasticity of survival. The first result is self-explaining. Noting that higher wages get translated into higher prices due to the mark-up equation (10), a higher price elasticity of demand ε exhibits a drastic reduction in demand and hence employment, and thus weakens the bargaining position of unions. Finally, a high wage elasticity of

survival allows unions to negotiate tougher, and thus increase the wage mark-up.

The outside option can be straightforwardly referred to as the reservation wage. In the absence of any disutility of labor, households should offer their entire labor services on the labor market if the wage only slightly exceeds the reservation wage, but refrain from offering labor services if the wage falls short of the reservation wage. In the presence of unions, $\beta > 0$, equation (17) therefore drives a wage between the labor supply schedule and the labor demand schedule. We may therefore already conclude that as the wage exceeds its marginal product, union activity leads to unemployment.

6 Equilibrium

Once we know the value of the outside option, equation (17) solves the model straightforwardly. The outside option (14) contains five endogenous variables, the average wage in the unionized part of the economy w_t, the wage in the nonunionized innovation sector w_t^{RD}, the probability to obtain and accept a job in the unionized sector, φu_t, and the innovation sector, δ, respectively, and the unemployment rate u_t.

Given symmetry over technology and preferences in the consumption goods sector, no firm or union can agree upon a different wage, without triggering adjustment processes in the negotiations of other, or even their own, firms. This implies that in equilibrium we must have $w_{i,t} = w_t$ for all i. This in turn implies that all product market firms set identical prices, according to the mark-up equation (10). Substituting this into the price index, (7), and then into demand (6), yields aggregate consumption as a function of product market employment, $e_t = e_{i,t} n_t$, and the number of available products,

$$c_t = e_t n_t^{\frac{1}{\varepsilon-1}}. \tag{4'}$$

Along the balanced growth path, employment in the consumption product sector will be constant, implying that the growth rate of consumption depends on the growth rate of variety only,

$$\hat{c}_t = \tfrac{1}{\varepsilon-1}\hat{n}_t, \tag{4''}$$

which is also equal to the growth rate of real wages, as can be seen by differentiating the price index (7). Finally, we find that in an equilibrium with positive growth, individual firms will permanently deploy workers, at the same rate as new products, and hence new firms arrive at the market, since $e_{i,t} = e_{i,t} = e_t/n_t$, we have

$$\hat{e}_{i,t} = -\hat{n}_t\,, \tag{8'}$$

This now allows us to determine the probability to obtain a job in the unionized sector, which following Layard, Nickell, and Jackman (1991, p. 145), equals

$$\varphi = 1 - r_t / \hat{e}_{i,t} = 1 + \rho/(\varepsilon - 1)\hat{c}_t\,, \tag{18}$$

where we have made use of the Euler equation (3) and the growth rate of aggregate consumption (4). In order to determine both the wage in the innovation sector and the probability to obtain and accept a job in the unionized sector, we now turn to the determinants of the innovation sector.

7 Economic Growth and the Innovation Sector

People engage in activities to introduce new varieties to the goods market. This costly activity takes time and effort. Unger and Zagler (2000), have recently made the effort to estimate arrival functions for new product innovations. They find evidence that the number of employed researchers has a direct positive impact on the arrival rate of new innovations, that the number of existing product innovations has a positive indirect effect, as the number of differentiated products increases the number of potential research networks, which exhibit a direct effect on the arrival rate of innovations. This leads to the following specification for the arrival rate of new innovations,

$$\dot{n}_t = \phi n_t s_t\,. \tag{19}$$

Competitive firms in the innovation sector maximize profits. The highest price a potential service provider can pay to an innovator will equal the value $v_{i,t}$ of any given firm i. The only costs for an innovator are wages w_t^{RD},

paid to scientists, s_t. Hence, given technology as stated in (16'), the marginal cost for the provision of a new variety will equal its price,

$$v_{i,t} = \frac{w_t^{RD}}{\phi n_t}. \tag{20}$$

As the innovation has to be prefinanced, an innovator has to raise the costs of an innovation on capital market. No arbitrage on the capital market implies that the change in the sales value of an innovation and the maximal amount of dividends which one can lucrate from an innovation must equal the return from a safe investment, $r_t v_{i,t}$,

$$\dot{v}_{i,t} + \pi_{i,t} = r_t v_{i,t}, \tag{21}$$

where the maximum amount of dividends evidently equals the running profits $\pi_{i,t}$ of a product market firm applying the innovation. Dividing both sides of equation (21) by the capital market value $v_{i,t}$, eliminating the growth rate with the time derivative of (20), profits from equation (11), and the capital market value from equation (20), and the interest rate from the intertemporal Euler equation (3), we obtain

$$\hat{w}_t^{RD} - \hat{n}_t + \frac{\phi e_t}{\varepsilon - 1} \frac{w_t}{w_t^{RD}} = \rho. \tag{21'}$$

By differentiating equation (21'), we find that along the balanced growth path, where employment in the consumption goods sector is constant, the relative consumption goods to innovation sector wage, w_t^{RD}/w_t, is constant along the balanced growth path.

We can determine the relative wage by looking at the innovation sector labor market. For the sake of simplicity, assume that not everybody is capable of working in the innovation sector, but only a fraction δ of the workforce, and that the ability gets revealed to both the employee and the employer at the job interview. Moreover, as the type of innovation changes over time, we shall assume that your previous ability or disability to work in the innovation sector exhibits no impact on whether you are able to work in the sector now, hence jobs in the innovation sector only last for one period. Keeping this in mind, we find that the total potential labor supply in the innovation sector is constant and equal to $\delta(1 - e_t)$.

In order to determine the wage in the innovation sector, note that the innovation sector wage must be equal or below the consumption goods sector wage, else everyone would stream into the innovation sector labor market, leading to a breakdown in the consumption goods sector. Assuming that workers can only have one job interview every instant, or one attempt to match to a vacancy, once the wage in the innovation sector falls below a certain threshold, the innovation sector reservation wage, workers will refrain from looking for a job in the innovation sector, but only apply for jobs in the unionized consumption goods sector.

Whilst in the absence of unions the influx of workers into the consumption goods sector drives innovation sector wage to their consumption goods sector counterparts, a closed labor market in the consumption goods sector implies that competition in the innovation sector labor market drives innovation sector wages down to the innovation sector reservation wage. As in this case workers choose not to accept jobs in the innovation sector, this reservation wage reduces to the first term in equation (15), namely $(1 - \varphi u_t)w_t$.

We can therefore eliminate the relative wage in the no arbitrage condition (21). Moreover, as the entire labor force, which we shall normalize to unity, can be either working in the product market sector, e_t, the innovation sector, s_t, or be unemployed, we can eliminate product market employment from equation (21') as well, resulting in a relationship between economic growth and unemployment,

$$\hat{c}_t = \frac{\phi}{\varepsilon - 1}(1 - u_t) - (1 - \varphi u_t)[\rho - (\varepsilon - 2)\hat{c}_t]. \qquad (22)$$

This equation summarize in which way the economy allocates resources to the different sectors, and therefore describes a resource constraint. Note in particular that as unemployment increases, there are less labor resources available for every sector, implying a decline in economic growth. Note that in the market solution, the $(1 - \varphi u_t)$ term vanishes, leading to lower growth rates, as innovation labor becomes more expensive.

8 Unemployment and Union Size

We are now able to determine all elements of the outside option (15), and can therefore derive the unemployment rate as a function of growth and the

industrial relation regime. Assuming that unemployment is small, so that the square of the unemployment rate is negligible, the unemployment rate in the case of firm level bargaining equals,

$$u_t^f = \frac{\beta}{\varphi(1-\delta)(\beta\varepsilon+\varepsilon-1)}, \tag{23}$$

where the f denotes firm-level bargaining. The unemployment rate depends on the growth rate through two channels. First, an increase in the growth rate increases labor demand in the innovation sector, raising innovation. This pushes the outside option up, leading to higher wage deals in the unionized sector, rendering more people unemployed. As the unions push up wages when wages in other sectors increase, we may refer to this effect as the intersectoral leapfrogging effect. Second, an increase in the growth rate implies that more new firms open in the unionized sector, increasing the probability for a fired worker to obtain a new unionized job. This, again, increases the outside option, fostering high wage deals and unemployment. As this effect is due to a decline in the value of the job of an employed worker, we may refer to it as a capitalization effect (Aghion and Howitt, 1993). Finally, note that by setting the relative union power to zero, we obtain the market outcome, denoted by *m*,

$$u_t^m = 0, \tag{24}$$

where unemployment equals zero.

In contrast to the firm-level bargaining (19), centralized bargaining will produce a different outcome. the reason is essentially due to the leapfrogging externality present in firm-level bargaining, but widely absent in centralized bargaining. In the prior, a firm which reaches a high wage deal will raise the average wage of the unionized sector, and therefore augment the outside option, leading to higher wage deals everywhere, resulting in high unemployment. In centralized bargaining, the outside option widely vanishes, which leads to an unemployment rate equal to,

$$u_t^c = \frac{(1+\beta)(\varepsilon-1)}{\varphi\delta(\beta\varepsilon+\varepsilon-1)}, \tag{25}$$

where the c stands for centralization. Evidently, due to a lower value of the outside option, a centralized union will strike a lower wage deal, leading to lower unemployment for every rate of economic growth.

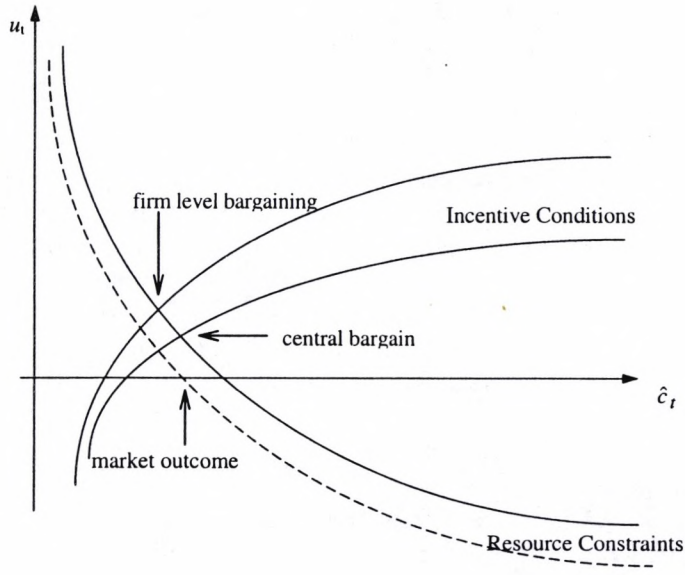
We can represent the equilibria of the different industrial relations regimes on a unifying graph. With the exception of the market outcome, the resource constraint (22) is identical for all regimes. It is a downward sloping plane in a growth-unemployment graph. The second condition differs across regimes due to the specifities of the bargaining situation. Given that it is the different level of the outside option, which determines the location of the locus, we may refer to it as an incentive constraint. With the exception of the market outcome, the slope of the incentive constraint is upward sloping, since

$$\frac{\partial u_t}{\partial \hat{n}_t} = \frac{\rho u_t}{\varphi \hat{n}_t^2}. \tag{26}$$

Figure 1 below summarizes the results. We observe a result rather similar to the findings of Calmfors and Drifill (1988). The market solution leads to the lowest rate of unemployment and to the highest rate of growth. The firm-level bargaining leads to both the highest levels of unemployment and the lowest rates of economic growth. The centralized bargaining situation is somewhere in between these two regimes, resulting in the typical hump-shape curve as presented in Calmfors and Drifill (1988). However, the analysis presents an important extension. The actual level of unemployment depends upon the growth rate experienced within the economy, which has been ignored as a control variable in their analysis.

In any case, the analysis leads to a strong conclusion, that unions are an obstacle to economic growth and foster unemployment. However, the question arises whether unions really peruse the policies as described in the simple one period bargaining solution presented in chapter III. In the following, we will ask whether unions can improve the situation of their members by offering a deal which would find acceptance among firms.

Graph 1: The unemployment to economic growth space



9 Externalities, Social Optimum, and Long-Term Union Policy

The economy previously described contains three types of externalities. First, there is monopolistic competition in the product markets, leading to product prices above their socially optimal level. Second, there is a knowledge externality in the growth process. As existing knowledge enters innovation technology (19) without cost, innovators tend to produce to few innovations in equilibrium, leading to a suboptimal rate of economic growth. Finally, the industrial organization regime presents the third type of externality. It is therefore by no means clear whether the results presented in the previous sections indeed maximize welfare of union members. In order to answer this question, we would have to compare the social planer solution with the market outcomes, and judge whether union policy could indeed be ameliorated.

First, note that that the monopolistic competition externality is due to the fact that firms face a downward sloping demand schedule (6), leading them to reduce quantities in order to increase prices and profits. It is well-known that either a revenue subsidy equal to $1/(\varepsilon - 1)$ or a wage subsidy equal to $1/\varepsilon$ would lead to welfare optimal prices, and hence eliminate the externality. However, as subsidies have to be raised by non-distortionary taxation, must governments will refrain from undertaking such a policy. As the same result can be generated by wage moderation of $(\varepsilon - 1)/\varepsilon$ below the market wage, unions could in principle internalize the monopolistic competition externality as well, and thus induce the welfare optimum. Workers will benefit from such a union policy only indirectly, however, through lower product prices and higher profits. Given that a single firm, and hence a single firm-union only exhibits a negligible influence on the aggregate price level, this policy can only be induced by centralized bargaining. Given that unions will have a hard time to communicate their indirect influence on welfare to union members, and that they will reject the distributional consequences of higher profits, wage moderation, though desirable, appears unlikely.

Second, we have to ask how to internalize the knowledge externality. In order to develop this point, consider an institution, or a firm operating under perfect competition, which purchases the exclusive right of all knowledge at a price κ_t, and sells at a market price q_t to innovators, leaving aside the problem of property rights for the moment. Then profits of the knowledge institutions would equal,

$$\Pi_0 = \int_0^\infty \kappa_t n_t e^{-rt} dt - \int_0^\infty q_t \dot{n}_t e^{-rt} dt = \int_0^\infty (\kappa_t - q_t / r) n_t e^{-rt} dt - q_0 n_0 . \quad (27)$$

Maximizing profits implies an optimal pricing rule for the initial period equal to

$$\kappa_0 = q_0 (1 + 1/\rho), \quad (28)$$

where we have substituted the interest rate from the Euler-condition (3), and for any subsequent period,

$$\kappa_t = q_t / \rho . \quad (28')$$

Evidently, the knowledge holder immediately makes windfall profits from all existing knowledge which he did not have to purchase at the beginning of operation, with no consequences for his pricing policy thereafter.
The appropriation of knowledge property rights now alters the decision of innovation sector firms in three ways. First, they have to pay a cost κ_t for all the knowledge they apply when innovating new products, but receive, second, a price q_t from the knowledge holder for every new innovation, hence innovation sector firms maximize profits,

$$\pi_t = v_{i,t}\dot{n}_t - w_t^{RD} s_t - \kappa_t n_t + q_t \dot{n}_t, \tag{29}$$

subject to technology (15). Third, firms now actively choose the amount of knowledge they demand for their innovations, leading to two first order conditions,

$$\frac{\partial \pi_t}{\partial s_t} = v_{i,t}\phi n_t - w_t^{RD} + q_t \phi n_t, \tag{30}$$

and

$$\frac{\partial \pi_t}{\partial n_t} = v_{i,t}\phi s_t - \kappa_t + q_t \phi s_t. \tag{30'}$$

Together with equation (29'), we can then determine optimal purchasing and sales prices of knowledge, where the sales price will equal

$$\kappa_t = \frac{v_{i,t}\hat{n}_t}{1-\rho\hat{n}_t}, \tag{28"}$$

and the purchasing price follows from (28'). Subsequently, we can then also determine the optimal price of an innovation, which equals

$$v_{i,t} = \frac{(1-\rho\hat{n}_t) w_t^{RD}}{\phi n_t}, \tag{29'}$$

Compared with equation (20), we find that optimal price of an innovation is lower by a fraction $1-\rho\hat{n}_t$ than the market price. Apart from technical difficulties, the optimal price can therefore be achieved by subsidizing the sales price of an innovation (20) by an amount τ, implying $v'_{i,t} = v_{i,t} + \tau$,

hence $\tau = \rho w_t^{RD} \hat{n}_t / \phi n_t$, which is increasing over time as wages grow faster than innovations. Governments therefore face three difficulties in promoting the welfare optimal solution, first their is a technical difficulty in determining innovation revenues, then there is the problem of raising non-distortionary taxes to finance the subsidy, and finally governments will have to spend ever increasing amounts of money to sustain the welfare optimal equilibrium. Given that the growth rate of innovation differs from the growth rate of consumption, not even the share of subsidies to output is constant. Only if GDP would include non-tangible investment into new innovations at the hypothetical market price q_t, would the share of government spending to GDP be stationary.

Noting that innovation sector wages are proportional to wages in the organized sector, the alternative possibility to induce the social optimum would be for unions to negotiate a wage moderation of $1-\rho\hat{n}_t$. Once again, this wage deal can only be agreed upon by centralized unions, given the fact that small unions have no impact on aggregate wages, but every incentive to deviate from a wage moderation agreement.

Given that wage moderation leads to faster economic growth, real wages will grow faster as well (4"), leading in the long-run to higher wages, and therefore to a direct increase in the welfare of unionized workers. Given that wage moderation also internalizes the monopolistic competition externality, wage moderation is in any case welfare improving. As opposed to the indirect effects, wage moderation to internalize the knowledge externality exhibits direct, however intertemporal effects on wages.

However, while workers may benefit from wage moderation, incumbent firms do not. Three offsetting effects are the cause of the indifference of firms to strike a wage accord or not. First, note that running profits, which for a particular product market firm will equal $c_t/(\varepsilon n_t)$ in equilibrium, decline, as the wage moderation will also induce lower current consumption. Whilst workers will see their wages, and hence utility increase at the growth rate of consumption, profits will only grow at $\hat{c}_t - \hat{n}_t$, with the remaining profits going to emerging firms. Incumbent firms, as opposed to unions, are therefore much less willing to strike a long-term wage accord, hence unions will have a hard time to negotiate other forms of compensation from a wage moderation accord, but must more or less unilaterally set the lower wage.

An agreement to moderate wages most be long-lasting, and product market and innovation sector firms must be aware of this fact. If they consider the

wage moderation to be temporary in nature, product market firms will seize the opportunity to make windfall profits out of a lower purchasing prices, and discount future rents immediately. Innovation sector firms will hold back innovations and sell when the prices have gone up again, actually reducing economic growth.

For this reason, growth pacts between unions and firms will have to contain a long-lasting feature. This can be either in the form of wage formulas, where an initial wage moderation is carried over by strict productivity rules, as was the case in Austria, where the deal is agreed upon for several years to come, as was the fact for the Dutch Polder model, or when unions commit to low R & D wage rates due to a solidaric wage policy, as has been the case in Sweden.

10 Conclusions

This paper has shown that long-term wage accords may indeed improve the performance of an economy in the presence of macroeconomic externalities. The intuition for this result is straightforward. If innovation takes two factors, existing knowledge and effort, but only the later gets remunerated, then equilibrium prices are distorted, with innovation sector labor being paid too much, and the existing stock of knowledge being paid too little. Union policy which accounts for this effect can therefore improve the situation and install a welfare improving industrial relations system. Moreover, we have seen that government policy is much less apt to install similar policies, both because of the technical difficulties of the required tax and subsidy scheme, and due to the necessity of permanently increasing subsidy rates.

The wage accord has to meet certain features. First, it is intertemporal in nature, with forgone income yielding higher wages only in the future, and unions may need to convince their members of the advantages or necessities of such a long-term agreement. We have seen arguments based on solidarity both within a generation and amongst generations as one possible union communication strategy, as has been the case in Sweden, and arguments along the line of competitiveness in the Netherlands, where wage moderation today has been interpreted as an investment into high growth and high future income, which indeed it is.

The wage accord must be settled on the central bargaining level, as leapfrogging would prevent industry level or firm-level unions to stick to a wage accord, and it must run over longer time horizons, in order for innovators to invest into new products and technologies.

Wage accords will be more beneficial to unions and its members then to incumbent firms, which won't see their profits increase all that much. This implies on the one hand that the burden of the wage accord must be fully carried by unions, but on the other hand that the unions bargaining power is irrelevant for the outcome of the agreement. Given that unions unilaterally must forgo wages, it is of little relevance whether the accord is officially signed, or whether unions unilaterally commit themselves to according wage policy strategy.

Indeed we have seen both officially signed wage accord, as the Dutch Wassenaar agreement, and unilateral union commitment to pursue long-term wage policies. Whilst the Austrian Benya-formulae exhibits the feature to extrapolate a given rate of wage moderation into the indefinite future, hence internalizing the growth externality according to equation (29'), the Swedish solidaric wage policy may be interpreted as a means to reduce the relative wage in equation (21'), leading to similar results for economic growth.

In short, we have seen that wage accords may lead to both faster economic growth, lower unemployment, and higher welfare, at the cost of lower initial wages, which may explain both the success and failure of these industrial relations agreements.

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