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WAGE DIFFERENTIALS IN ITALY: MARKET FORCES, INSTITUTIONS, AND INFLATION

by

*Christopher L. Erickson

**Andrea C. Ichino

*Christopher L. Erickson
Assistant Professor
Anderson Graduate School of Management
University of California, Los Angeles
Los Angeles, California 90024

Telephone: 310/825-1697

and

**Andrea C. Ichino
Ricercatore, Bocconi University & IGIER

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INSTITUTE OF INDUSTRIAL RELATIONS

UNIVERSITY OF CALIFORNIA

LOS ANGELES

Collective Bargaining and the Process of Creative Destruction: Local versus Industry-wide Wage Setting

Karl Ove Moene
Department of Economics
University of Oslo
0317 Oslo 3, NORWAY

and

Michael Wallerstein
Department of Political Science
University of California, Los Angeles
Los Angeles, CA 90024, USA

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Abstract

We compare plant-level and industry-wide wage bargaining in a vintage capital model where technical change occurs through the entry of new plants and the closing of old ones. With plant-level bargaining, the wage rate varies according to the productivity of the plant. With industry-level bargaining, the wage in all plants depends on the average productivity in the industry. Relative to local bargaining, industry-level bargaining produces higher wages in older plants but lower wages in modern plants. As a consequence, plant-level bargaining protects existing plants, but may create higher entry barriers than centralized bargaining. Industry-wide bargaining lowers the average age of plants in the industry, thus increasing average productivity. Whether industry bargaining or local bargaining results in higher output and employment depends on the unions' share of firms' revenues. When the difference between the union wage and the competitive wage is small, both aggregate employment and average productivity are higher with industry-wide bargaining.

I. Introduction

In recent years, employers in a number of European countries have sought, often successfully, to decentralize collective bargaining. The highly centralized bargaining at the national level that governed private sector wage growth in Sweden from 1956 to 1982 has been completely abandoned. The national association of Swedish employers–who played a pivotal role in building the system of centralized bargaining in the early postwar period–now advocates decentralizing wage bargaining to the level of the enterprise or plant (Myrdal 1991, Swenson 1992). Norwegian employers tried to force the unions to accept more decentralized bargaining, but failed when a general lockout in 1986 ended with a union victory (Dølvik and Stokland 1992). In Britain, the Thatcher government took the lead in promoting the decentralization of bargaining from the industry to the local level. According to a survey conducted by Gregg and Yates (1991: 370–71), 17 per cent of British companies indicated that industry-level bargaining had declined in importance between 1985 and 1990, while only three per cent stated that the importance of industry-level bargaining had increased. In contrast, plant-level bargaining was said to become more important in 14 per cent of the companies and less important in only two per cent during the same time period. Even in the United States, where industry-level bargaining was always confined to a few industries, the Caterpillar company took a five month strike in the winter of 1992 in order to break the system of de facto industry-level bargaining in which the United Auto Workers demanded equivalent contracts from all employers in the same industry.

Whether or not the replacement of national or industry-level wage setting by local bargaining is good for the economy is a matter of wide disagreement. A series of empirical studies have concluded that highly centralized bargaining at the national level is conducive to maintaining low levels of unemployment in countries where unions are strong.[1] The general theoretical argument is that there are important externalities in wage-setting whereby the wage gains for one group of workers lowers the welfare of other groups of workers. The externalities may be due to the effect of wage increases on consumer prices (Calmfors and Driffill 1988, Jackman 1990), on the cost of complementary inputs in production (Wallerstein 1990), or on the likelihood that unemployed workers can find new jobs (Layard, Nickell and Jackman 1991). A bargaining system that enables such externalities to be internalized by the wage setters, the argument goes, will result in lower wages and higher employment.

Some studies have quarreled with the claim that the relationship between the centralization of bargaining and unemployment is monotonic. Calmfors and Driffill (1988), for example, argue that union wage demands are highest at intermediate levels of centralization. Alvarez, Garrett and Lange (1991) suggest that centralized bargaining only constrains wage increases when accompanied by social democratic participation in government. But the most fundamental disagreement comes from those who focus on the wage differentials as opposed to aggregate wage growth.

Many of the arguments in favor of local bargaining concern the tendency of centralized bargaining to suppress occupational, regional and plant-specific wage differences.[2] While unions have lamented the decline in solidarity, firms have welcomed the increased control over their wage distribution. Employers argue that local bargaining enhances their ability to provide better work incentives and to increase productivity by modernizing equipment and reorganizing production methods (Windmuller 1987: 115). In Moene, Wallerstein and Hoel (1992) we have studied the incentive effect of local bargaining on workers' effort. The topic of this paper is the relationship between the level of wage-bargaining, wage dispersion among plants, and the productivity growth that occurs through the entry and exit of firms or plants.

Schumpeter (1942) attributed the dynamic of capitalist economies to what he called the "process of creative destruction" in which existing productive units are incessantly being dissolved as new units are inaugurated. Industries expand by building new plants and contract by scrapping obsolete ones. Entering firms introduce new techniques that drive the least efficient of the existing firms out of the market. When new techniques are embodied in new plant and equipment, technical progress entails continual turnover of plants and firms.

All of the existing theoretical comparisons of different bargaining systems, to the best of our knowledge, are derived from models in which both technology and the number of firms or plants are fixed. In this paper we investigate the relative performance of local and centralized wage bargaining in an industry where the rate of technical improvement in new equipment is exogenously given, but where the rate of adoption of new methods is endogenously determined by the number of plants that enter and exit in each period. In particular, we follow the work of Johansen (1959) and Salter (1960), and study wage bargaining within a vintage capital model where the productivity of each plant is determined by the date it was built.[3]

We compare the effects of centralized wage bargaining that sets a uniform wage throughout the industry, and decentralized bargaining that allows wages to vary according to the productivity of each plant. In this setting, local and industry-level bargaining have quite different effects on the entry and exit of firms or plants.[4] Local bargaining creates entry barriers for new plants with the most productive equipment, but allows less productive plants to remain in operation for a longer time. Industry-wide bargaining forces less productive plants out of the market but may lower entry barriers for new, more productive entrants. Thus industry-level bargaining induces a more modern industry structure with higher average productivity without necessarily reducing employment or output in comparison to local bargaining.

The idea that a compression of wage differentials through centralized bargaining would increase productivity by stimulating structural change was first suggested by the Swedish union economist Gösta Rehn in the 1950s. Although Rehn's argument was influential among Swedish policy makers in the early postwar period, it has been largely neglected in the current debates over the desirability of decentralized bargaining. One exception is Agell and Lommerud (1991) who make a similar argument in the context of an endogenous growth model, but with less attention to alternative bargaining systems.[5]

The basic industry model is presented in Section II. In Section III we present the case of a competitive labor market to be used as a benchmark. Plant and industry-level bargaining are described and contrasted with a competitive labor market in Sections IV and V. Section VI contains our central results comparing plant-level with industry-level bargaining in terms of average plant age (which determines average productivity), the number of plants built each period, aggregate profits, the price of output, employment in the industry and the average wage level. Section VII concludes the paper. Most proofs have been placed in an appendix.

II. The Basic Model

We use a vintage capital model where output per workers depends on the age of the plant to analyze the impact of different bargaining systems on the adoption of new techniques. To focus sharply on questions of exit and entry, we leave aside the choice of factor proportions in production. We assume that once a plant is built, additional investment is neither useful nor necessary. The capacity of the plant and the labor required to operate it are assumed to be fixed. Thus the only choices firms make are when to build new plants and when to shut old plants down.

Let the profits or cash flow per worker at time s generated by a plant built at time t be written:

$$\pi(s,t) = p(s)b(t) - w(s,t) \tag{1}$$

where $p(s)$ is the price, $b(t)$ is the productivity of a plant of vintage t, and $w(s,t)$ is the wage rate (which may differ by the age of the plant as well as time). Since plant-level employment is fixed, we can simplify our notation by choosing units such that employment per plant equals one. The market value of a newly built plant is given by the present value of future profits (or quasi-rents) earned over the plant's lifetime:

$$V(t) = \int_t^\infty e^{-\rho(s-t)} h(s,t)\pi(s,t)ds \tag{2}$$

where ρ represents the discount rate and $h(s,t)$ is the rate of capacity utilization in period s for a plant of vintage t.

We assume there is a nondecreasing supply curve for new plants. If the supply curve is rising, the cost of a new plant depends on how many are being built at the same time. In addition, the cost of new plants may change over time. Let $n(t)$ denote the number of new plants build at time t. Then the investment cost of building new plants can be written as $C(n(t),t)$ with $\partial C/\partial n \geq 0$. With free entry, new plants will be brought into production until the present value of profits when the plant is new equals the cost of the initial investment for the marginal unit, or

$$V(t) - C(n(t),t) = 0. \tag{3}$$

Once plants are built, investment costs are sunk. Firms will keep existing plants in operation as long as $\pi(s,t) \geq 0$ or revenues cover the variable costs. Thus, the optimal rate of capacity utilization is

$$h(s,t) = \begin{cases} 1 & \text{if } p(s)b(t) - w(s,t) \geq 0; \\ 0 & \text{if } p(s)b(t) - w(s,t) < 0. \end{cases} \tag{4}$$

Aggregate industry output is given by

$$Q(s) = \int_{-\infty}^{s} h(s,\tau)n(\tau)b(\tau)d\tau. \tag{5}$$

The price is a function of the quantity produced as well as time, or

$$p(s) = p(Q(s),s) \quad \text{with} \quad \frac{\partial p}{\partial Q} \leq 0. \tag{6}$$

If the industry produces a traded good and if domestic production is small relative to world production, then $(\partial p/\partial Q) = 0$. Otherwise $(\partial p/\partial Q) < 0$. Individual firms, however, are assumed to act as price-takers. In order for an equilibrium to exist, we need to assume that either the supply curve of new plants is increasing ($\partial C/\partial n > 0$) or the demand curve for the industry output is decreasing ($\partial p/\partial Q < 0$) or both.

Workers are assumed to have a common reservation wage or outside option of $r(s)$. Therefore

$$w(s,t) \geq r(s) \quad \forall s,t. \tag{7}$$

Finally, the productivity of new plants is assumed to grow exponentially at a constant rate of $\gamma > 0$, or

$$b(s) = b_0 e^{\gamma s}. \tag{8}$$

where b_0 is a positive constant.

To keep the model analytically tractable, we restrict our analysis to steady state equilibria defined by

$$p(s) = p \quad \forall s,$$

$$n(s) = n \quad \forall s,$$

and

$$h(s,t) = \begin{cases} 1 & \text{for } s \leq t+\theta; \\ 0 & \text{for } s > t+\theta. \end{cases}$$

That is, along the steady state path the industry is characterized by a constant price p, a constant number of plants n of each vintage and a constant economic lifespan θ for each plant that is built. The existence of a steady state, as we have defined it, requires that the cost of new plants, the reservation wage, and the demand for the industry's output $D(p,s)$ all grow at the same rate as productivity:

$$r(s) = r_0 e^{\gamma s}, \tag{9}$$

$$C\big(n(s),s\big)=C\big(n(s)\big)e^{\gamma s}, \tag{10}$$

$$D(p,s)=D(p)e^{\gamma s}\Leftrightarrow p\big(Q(s),s\big)=p\big(e^{-\gamma s}Q(s)\big). \tag{11}$$

These last three assumptions are plausible if productivity growth in the industry is the same as productivity growth in the economy as a whole. Then equation (9) asserts that the reservation wage grows at the same rate as economy-wide productivity while equation (10) states that the cost of constructing new plants rises at the same rate as wages increase. The price of capital equipment per unit of output produced, however, is constant along the steady state path, as is the price of the industry's output. According to equation (11), demand grows at the same rate as wage incomes.

In a steady-state equilibrium, equation (5) can be solved and aggregate output written as

$$Q(s)=\frac{nb_0}{\gamma}(1-e^{-\gamma\theta})e^{\gamma s}. \tag{12}$$

The expression for the price becomes

$$p=p\left(\frac{nb_0(1-e^{-\gamma\theta})}{\gamma}\right) \tag{13}$$

which is decreasing in n and θ when $p'(\cdot)<0$. Total employment in the industry, denoted L, is given by $L=n\theta$. Average industry productivity is given by

$$\frac{Q(s)}{n\theta}=\frac{b_0(1-e^{-\gamma\theta})}{\gamma\theta}e^{\gamma s}\equiv\overline{b}(s). \tag{14}$$

Note that $\overline{b}(s)$ is a decreasing function of θ, the age of the oldest plant in operation, as long as $\gamma\theta>0$.[6] The level of productivity goes down as the average age of plants in operation increases. Plants' operating life θ is given implicitly by the condition that revenues just cover the variable costs of the marginal plant in operation or, from equations (4) and (8):

$$pb(s-\theta) = pb_0 e^{\gamma(s-\theta)} = w(s, s-\theta). \tag{15}$$

III. Competitive labor market

With a competitive labor market, the wage in all plants in operation is equal to the reservation wage:

$$w(s,t) = r(s) = r_0 e^{\gamma s}. \tag{16}$$

In a perfectly competitive labor market, the wage does not differ according to the productivity of the plant. The exit condition can be written as

$$pb_0 e^{-\gamma\theta} = r_0 \tag{17}$$

which implies an economic lifespan of

$$\theta = \frac{1}{\gamma}\ln(pb_0/r_0) \tag{18}$$

for plants of each vintage. Note that $\theta > 0$ if and only if initial profits are positive or $pb_0 - r_0 > 0$.

The effects of a change in the reservation wage are summarized in Proposition 1:

Proposition 1. *With a competitive labor market, an increase in the wage has the following effects: (a) Plants' operating life is reduced. (b) Employment falls. (c) If $p'(\cdot) = 0$, the number of plants of each vintage declines. (d) If $p'(\cdot) < 0$, the price increases and the number of plants of each vintage can either rise or fall.*

The proof is in the appendix.

These are standard results. An increase in the wage increases the average productivity in the industry by pushing the least efficient plants out of the market. Employment in the industry falls. The price increases, if it is not fixed in world markets. The only ambiguity concerns the number of new plants that are built each year. If the price is exogenous, the number of new plants falls. If the price is endogenous and demand is sufficiently inelastic, the departure of older plants allows the profits earned by the most modern plants to increase which induces increased building of new plants.

IV. Local bargaining

Throughout the paper, we assume that the objective of the workers' bargaining unit is to maximize the wage received by its members. Since we have assumed that employment in each plant is fixed, there is no trade-off between wages and employment at the local level, other than the threat that the plant will be closed if it is unprofitable. Thus local bargainers on the union side will seek as high wages as possible within the constraint of maintaining non-negative profits.

In the event of industrial conflict, we assume that workers' income drops to zero. Workers may receive strike support, but we assume all such support comes out of their own collective savings. In other words, we assume that the union local receives no support from outside. National unions or union confederations seldom provide support for local strikes without some control over local bargaining. In addition, workers are assumed to be unable to obtain alternative employment at the reservation wage without severing their relationship with their current employer. In sum, the unions' payoffs in bargaining at time

s in a plant of vintage t are given by

$$u(s,t) = \begin{cases} w(s,t) & \text{if there is an agreement} \\ 0 & \text{if there is a strike or lockout} \end{cases} \tag{19}$$

Firms are also assumed to receive no income during industrial disputes. The pay-offs to the owners of a production unit of vintage t in period s are, therefore,

$$\pi(s,t) = \begin{cases} pb(t) - w(s,t) & \text{if there is an agreement} \\ 0 & \text{if there is a strike or lockout} \end{cases} \tag{20}$$

The reservation wage acts as a constraint on the wage agreement; workers would not work for less than $r(s)$. Otherwise $r(s)$ does not affect the negotiated outcome (Sutton 1986). Applying standard bargaining theory and taking account of the constraint $w(s,t) \geq r(s)$, one gets

$$w(s,t) = \max\big(\alpha pb(t), r(s)\big) \tag{21}$$

where $\alpha \in [0,1]$ represents the relative share of the quasi-rents received by the workers when $\alpha pb(t) \geq r(s)$. Note that $\alpha pb(t)$ is constant over time. It depends on the price, which is constant along the steady state path, and productivity, which is determined by the date the plant was built. For local bargaining to have any effect on wages, $\alpha pb(t) > r(t)$ or the union wage must exceed the reservation wage when the plant is new. Over time, however, the reservation wage increases and eventually overtakes the constant term $\alpha pb(t)$.

Let σ denote the age of the plant when the difference between the union wage and the reservation wage falls to zero, or

$$\alpha pb_0 e^{\gamma(s-\sigma)} = r_0 e^{\gamma s}. \tag{22}$$

From (22) we have

$$\sigma = \frac{1}{\gamma}\ln(\alpha pb_0/r_0) \tag{23}$$

provided $\alpha p b_0 > r_0$. Otherwise $\sigma = 0$. Note that the union wage differential disappears before the plant would have been closed in a competitive labor market, or $\sigma < \theta = (1/\gamma)\ln(pb_0/r_0)$ (from equation (18)), for $\alpha < 1$. Therefore the wage profile in a plant of vintage t with local bargaining is given by

$$w(s,t) = \begin{cases} \alpha p b(t) & \text{for } s \in [t, t+\sigma]; \\ r(s) & \text{for } s \in [t+\sigma, t+\theta]. \end{cases} \tag{24}$$

Since the wage with local bargaining equals the reservation wage after the period $s = t+\sigma$, the exit condition is identical to the case with a competitive labor market.

The comparison of local bargaining with a competitive labor market is summarized in Proposition 2:

Proposition 2. *Relative to the equilibrium of a competitive labor market, local wage bargaining (with α high enough such that $w(s,t) > r(s)$ in the most modern plants) has the following effects: (a) The number of plants of each vintage is lower. (b) If $p'(\cdot) = 0$, plants' operating life is unchanged and aggregate employment is less. (c) If $p'(\cdot) < 0$, the price and the plants' operating life is increased while aggregate employment may be either higher or lower.*

The proof is in the appendix.

Part (a) is a standard result. The increased wage that results from local bargaining lowers the present value of future profits which, in turn, lowers investment in the industry. Parts (b) and (c) are more surprising. Since wages are tied to the productivity of the plant with local bargaining, the difference between the union wage and the reservation wage falls to zero as plants become older and relatively less productive. If the price is exogenous, this implies that existing plants are kept in operation for the same period as in a competitive labor market. If the price goes up as output declines, however, existing plants are kept in operation longer. In this case, local bargaining reduces the industry's average productivity by increasing the average plant age. With productivity lower, employment can increase, although output has fallen. With local bargaining and endogenous prices, unions reduce average productivity as they raise the average wage.

V. Industry-wide bargaining

We characterize industry bargaining as setting a common wage for the industry. One of the purposes of industry bargaining, from both the union's and employers' point of view, is to take wages out of the competition. Thus we assume that central wage setters insist on equal treatment for workers in all plants, regardless of differences in productivity or profitability.

In order to focus on the impact of setting a uniform wage at the industry level, we extend our earlier assumptions with as few changes as possible. We assume the union maximizes the common wage rate while the employers' association maximizes the aggregate profits earned by existing firms in the industry.[7] As before, both the union and employers are assumed to receive zero income during a strike or lockout. Thus, the payoffs in industry bargaining are assumed to be

$$u(s) = \begin{cases} w(s) & \text{if there is an agreement} \\ 0 & \text{if there is a strike or lockout} \end{cases} \tag{25}$$

for the union and

$$\overline{\pi}(s) = \begin{cases} \int_{s-\theta}^{s} \big(pb(t) - w(s)\big)\,dt & \text{if there is an agreement} \\ 0 & \text{if there is a strike or lockout} \end{cases} \tag{26}$$

for the firm.

Again applying standard bargaining theory, the wage agreement with industry bargaining is given by

$$w(s) = \max\big(\alpha p\bar{b}(s), r(s)\big) \tag{27}$$

where $\bar{b}(s)$ is the average productivity in the industry (given in equation (14)). Note, again, that the negotiated wage must be at least as high as the reservation wage or employers will be unable to recruit labor. As long as α is sufficiently high such that the constraint $w(s) \geq r(s)$ is not binding, the wage depends on the average industry productivity as well as the price of output. In the case with local bargaining, the wage in each plant is constant over time, (until the plant becomes so old that workers receive the reservation wage), while wages in different plants vary according to the plant's age. In the case with industry-level bargaining, wages are constant across plants but rising over time at the same rate as productivity growth.

Combining the centrally bargaining wage with the exit condition (15) yields an implicit expression for the lifespan of plants with industry-level bargaining:

$$\theta = (\alpha/\gamma)(e^{\gamma\theta} - 1). \tag{28}$$

To see that there exists a unique positive θ that satisfies equation (28) for $\gamma > 0$ and $\alpha \in (0,1)$, let the RHS of (28) be denoted $f(\theta)$. The function $f(\theta)$ is a continuous, differentiable function with $f(0) = 0$, $f'(\theta) > 0$, $f''(\theta) > 0$, $f'(0) = \alpha < 1$ and $f'(\infty) = \infty$. It follows that there is a unique $\theta > 0$ such that $f(\theta) = \theta$. Note that plants' operating life is independent of both price and productivity with industry-level bargaining. The economic lifespan is a declining function of α:

$$\frac{d\theta}{d\alpha} = \frac{e^{\gamma\theta} - 1}{\gamma(1 - \alpha e^{\gamma\theta})} < 0, \tag{29}$$

since $\alpha e^{\gamma\theta} = f'(\theta) > 1$ when $f(\theta) = \theta$. As $\alpha \to 1$, $\theta \to 0$.

The comparison of industry-level bargaining with the case of a competitive labor market is summarized in Proposition 3:

Proposition 3. *Relative to the equilibrium of a competitive labor market, industry-level bargaining (with α high enough such that $w(s) > r(s)$) has the following effects: (a) Plants operating life is reduced. (b) Aggregate employment is lower. (c) If $p'(\cdot) = 0$, there are fewer plants of each vintage. (d) If $p'(\cdot) < 0$, the price is higher and the number of plants of each vintage may be either higher or lower.*

The proof is virtually the same as for Proposition 1 and is therefore omitted.

The comparative static results for industry-wide bargaining are identical to the comparative static consequences of an increase in the reservation wage in a non-union labor market as summarized in Proposition 1. In both cases, we are studying the effects of a uniform wage increase for all firms in the industry.

VI. Local versus Industry Bargaining

In the two previous sections, we compared both local and industry-level bargaining with a non-union labor market. In this section we compare local and industry-level bargaining to each other. Since we lack a good theory of how the unions' share α might vary with the scope of wage-setting, we assume that α is the same in both local and industry-wide bargaining.

The time path of wages over the lifespan of a single plant under alternate systems of wage determination is illustrated in Figure 1 for the case when the output price is fixed in world markets. Superscripts represent different systems of wage determination: A competitive labor market is indicated by C, local bargaining by L, and industry-wide bargaining by I. The revenue earned by a plant built at $t = 0$ is constant at pb_0. The competitive wage is given by the rising exponential curve that begins at r_0. With local bargaining, the wage is constant at αpb_0, since the productivity of the plant is constant, until the plant is sufficiently old such that the constraint $w(s,t) \geq r(s)$ becomes binding (at $s = \sigma$). From $s = \sigma$ until the plant is shut down at $s = \theta^C = \theta^L$, the wage with local bargaining equals the competitive wage. With industry-level bargaining, the wage starts at $\alpha p\overline{b}(0)$ (which is less than αpb_0 since $\overline{b}(0) < b_0$) and rises with the average productivity in the industry, notwithstanding the stagnant productivity in each individual plant. At $s = \theta^I$, the plant earns zero profits under industry bargaining and is closed.

Figure 1 About Here.

Figure 2 illustrates the distribution of wages in different plants at a single point in time $s = 0$, again in the case where the price is exogenous. The declining exponential curve that begins at pb_0 represents the revenues earned by plants of each vintage, ordered from newest to oldest. With local bargaining, wages among plants that are less than σ periods old differ in proportion to differences in productivity. In plants older than $t = \sigma$, wages with local bargaining equal the reservation wage. With industry bargaining, workers in all plants receive the same wage of $\alpha p\bar{b}(0)$.

Figure 2 About Here.

It is clear from either Figure 1 or 2 that industry-level bargaining results in a shorter lifespan θ when $p'(\cdot) = 0$ as long as α is high enough such that the union wage with industry-level bargaining exceeds the competitive wage. In order to state the general result, we need some additional notation. Let α^L_{min} and α^I_{min} denote the largest values of α such that the union wage equals the reservation wage in the cases of local and industry bargaining respectively. In addition, let p^C denote the price with a competitive labor market. Then

$$\begin{aligned} \alpha^L_{min} &= r/(p^C b_0) \quad \text{and} \\ \alpha^I_{min} &= r/\big(p^C \bar{b}(0)\big). \end{aligned} \tag{30}$$

Since $b_0 > \bar{b}(0)$, $\alpha^L_{min} < \alpha^I_{min}$. If $\alpha \leq \alpha^L_{min}$, the level of bargaining makes no difference as the union is too weak to affect wages in any bargaining system. Therefore, we will restrict our attention to $\alpha \in (\alpha^L_{min}, 1]$.

The comparison of the lifespan of plants in different bargaining systems is stated in the next proposition.

Proposition 4. *The operating life of plants is shorter or equal with industry-level bargaining than with plant-level bargaining. If $\alpha > \alpha^I_{min}$ or if $p'(\cdot) < 0$, then the operating life of plants is strictly shorter with centralized bargaining.*

Proof: From Propositions 2 and 3 we have

$$\theta^I \leq \theta^C \leq \theta^L \tag{31}$$

with $\theta^I < \theta^C$ if $\alpha > \alpha^I_{min}$ and $\theta^C < \theta^L$ if $p'(\cdot) < 0$. QED.

If α is high enough such that $w^I(s) > r(s)$, industry bargaining lowers θ in comparison to the competitive case. If the price is endogenous, local bargaining increases θ in comparison to the competitive case. Either is a sufficient condition for $\theta^I < \theta^L$. Since the lifespan of plants is shorter with industry-level bargaining, the average age of plants in operation is lower and average productivity is higher. Thus industry-level bargaining is associated with a higher level of productivity.

The effect of the level of bargaining on n, the number of plants of each vintage, may go in either direction, as stated in the next proposition.

Proposition 5. *(a) If α is sufficiently close to (or lower than) α^I_{min}, the number of firms of each vintage is higher with industry than with local bargaining. (b) If $C'(n) > 0$ and α is sufficiently close to one (which requires that $C(0)$ be sufficiently close to zero), the number of firms of each vintage is higher with local than with industry bargaining.*

The proof is in the appendix.

When $\alpha \in (\alpha^L_{min}, \alpha^I_{min}]$, only local bargaining affects wages. For this range of α, industry-level bargaining is equivalent to a competitive labor market, which implies that $n^I = n^C$. Since proposition 2 states that $n^L < n^C$, we have $n^L < n^I$ for $\alpha \in (\alpha^L_{min}, \alpha^I_{min}]$. By continuity, $n^L < n^I$ for α slightly larger than α^I_{min} as well.

As α increases, however, the relationship between n^L and n^I may flip. Figure 3 illustrates the market value of a new plant, $V(t)$, under local and industry bargaining as functions of α when $p'(\cdot) = 0$, $C'(n) > 0$ and $C(0) = 0$. Under these assumptions, new plants have a higher market value with industry-level bargaining when α is less than α^* (and more than α^L_{min}). When α is higher than α^*, however, the market value of new plants is higher with local bargaining. Since entry increases as the market value of new plants rises (when $C'(n) > 0$), $n^L < n^I$ for $\alpha \in (\alpha^L_{min}, \alpha^*)$ and $n^L > n^I$ for $\alpha \in (\alpha^*, 1)$. It is shown in the appendix that this comparison of n^L and n^I does not depend on the assumption of a fixed price.

Figure 3 About Here.

On the one hand, firms that build new and more productive plants will have to pay wages that exceed the wages in older plants with local bargaining, thus discouraging entry. On the other hand, the union wage differential shrinks as the plant ages with local bargaining, allowing the plant to remain profitable for a longer period of time. Which of these two effects is stronger depends on the union's share of the quasi-rents α. If α is close to α^I_{min}, or if the difference between the union wage and the competitive wage is small with industry-wide bargaining, local wage bargaining creates a higher entry barrier than centralized bargaining. If α is sufficiently high, however, industry-wide bargaining can impose the greater barrier to entry. Note that if $C(0) > 0$, then α cannot exceed some maximum value that is less than one without causing the industry to disappear. If $C(0)$ is sufficiently high, local bargaining creates the higher entry barrier for all feasible values of α.

Next we turn to the comparison of industry and local bargaining in terms of the price of output and industry employment.

Proposition 6. *(a) If $p'(\cdot) < 0$ and α is sufficiently close to (or lower than) α^I_{min}, the price is higher with local bargaining. (b) If $p'(\cdot) < 0$ and α is sufficiently close to one, the price is higher with industry-level bargaining.*

The proof is in the appendix.

Proposition 7. *(a) If α is sufficiently close to (or lower than) α^I_{min} and $p'(\cdot)$ is sufficiently close to zero, employment is higher with industry-level bargaining. (b) If α is sufficiently close to (or lower than) α^I_{min} and $p'(\cdot)$ is sufficiently negative, employment is higher with local bargaining. (c) If α is sufficiently close to one, employment is always higher with local bargaining.*

Proof: Parts (a) and (b) follow directly from the equivalence of industry-level bargaining and a competitive labor market when $\alpha \in (\alpha^L_{min}, \alpha^I_{min}]$ together with Proposition 2. When α is close to one, we have $\theta^I < \theta^L$ from Proposition 4. If $C'(n) > 0$, we have $n^I < n^L$ from Proposition 5 and $L^I = \theta^I n^I < \theta^L n^L = L^L$. If $C'(n) = 0$ and $p'(\cdot) < 0$, we have $p^I > p^L$ from Proposition 6. In this case also, employment must be less with industry bargaining since industry-wide bargaining raises average productivity and lowers the quantity produced. QED.

Compared to the case with a competitive labor market, both local and industry-level bargaining reduce output and employment (provided α is high enough so that the union affects the wage). Which bargaining system lowers output and employment more depends on the slope of the demand curve and the value of α. If the union share of the quasi-rents is high enough, then employment and the quantity produced are both higher with local bargaining. If the union share of the quasi-rents is close to α^I_{min}, however, the quantity produced is higher with industry-level bargaining.

Whether employment is higher with industry-level bargaining when α is close to α^I_{min} depends on the industry's demand curve. When $p'(\cdot)$ is equal to zero or small in absolute value, industry-wide bargaining raises employment relative to local bargaining when α is relatively low. If $p'(\cdot)$ is highly negative, however, local bargaining can raise employment even though less is being produced, since production is less efficient.

Finally, we determine the impact of the bargaining level on the average industry wage. In the case of industry-level bargaining, the average wage is the common wage. Writing the industry wage at $s = 0$ we have

$$w^I(0) = \alpha p b_0 \left[\frac{1 - e^{-\gamma\theta}}{\gamma\theta}\right]. \tag{32}$$

With local bargaining, we have to calculate the average wage, denoted $\overline{w}^L(s)$, at $s = 0$:

$$\begin{aligned} \overline{w}^L(0) &= \frac{1}{\theta}\left[\int_{-\sigma}^{0} \alpha p b(\tau) d\tau + (\theta - \sigma) r\right] \\ &= \left(\frac{\sigma}{\theta}\right) \alpha p b_0 \left[\frac{1 - e^{-\gamma\sigma}}{\gamma\sigma}\right] + \left(\frac{\theta - \sigma}{\theta}\right) r. \end{aligned} \tag{33}$$

Comparing equations (32) and (33), we have:

Proposition 8. *(a) If α is sufficiently close to (or lower than) α^I_{min}, the average wage is higher with local bargaining. (b) If α is sufficiently close to one, the average wage is higher with centralized bargaining.*

Proof: Part (a) follows from $\overline{w}^L(s) > r(s) = w^I(s)$ if $\alpha \in (\alpha^L_{min}, \alpha^I_{min}]$ (from Proposition 2). To prove part (b), we take the limits of the real product wage as α approaches one. Since $\sigma \to \theta^L$ and $\theta^I \to 0$ as $\alpha \to 1$, we have

$$\lim_{\alpha \to 1} \frac{\overline{w}^L(0)}{p^L} = b_0 \left[\frac{1 - e^{-\gamma\theta^L}}{\gamma\theta^L}\right] \tag{34}$$

and

$$\lim_{\alpha \to 1} \frac{w^I(0)}{p^I} = b_0. \tag{35}$$

Since $(1 - e^{-\gamma\theta})/\gamma\theta < 1$ for $\theta > 0$, $(w^I/p^I) > (\overline{w}^L/p^L)$ for α sufficiently close to one. We have $p^I \geq p^L$ for α close to one from Proposition 6. Therefore, $w^I > \overline{w}^L$. QED.

The impact of bargaining level on the average wage mirrors the impact on the market value of new plants illustrated in Figure 3. When the union's share of the quasi-rents is high, local bargaining increases the value of new plants (thus increasing the number of entrants) and lowers average wages in comparison to industry-wide bargaining. When the union's share is sufficiently low such that the union-competitive wage differential is small with centralized bargaining, industry bargaining results in lower average wages, higher aggregate profits and increased entry. If union leaders cared only about the average wage received by union members, the union leadership would prefer decentralized bargaining when α is relatively low and centralized bargaining when α is relatively high.

VII. Conclusion

Local bargaining is sensitive to local conditions. That, in fact, is among the chief virtues claimed by its supporters. Sensitivity to local conditions means that fewer less efficient plants are driven out of business compared to centralized wage negotiations. The other side of the coin is that wages are sensitive upwards in the most efficient plants. This implies that building new plants may be less profitable with local bargaining than with industry-level bargaining. Industry-level bargaining forces less efficient plants to shut down at a faster rate but local wage bargaining may create a higher entry barrier for more efficient plants.

Industry-level bargaining shortens the average age of plants in operation, thereby increasing average productivity. Whether or not industry-level bargaining increases the number of plants that are built each period and the total output produced depends on α, the union's share of the firms' quasi-rents. When α is close to one, industry bargaining is inferior to local bargaining in terms of the number of new plants built each period, total output produced and employment in the industry. When the union is less strong in the sense that the union wage with industry bargaining is not too much higher than the competitive wage, however, industry-wide bargaining results in greater entry, higher aggregate output and a lower average union wage than local bargaining. When the difference between the centrally bargained wage and the competitive wage is small and when $p'(\cdot)$ is not too large in absolute value, employment in the industry is also higher with industry-level bargaining. In other words, plant-level bargaining reduces both average productivity and aggregate employment in comparison to industry-level bargaining under the conditions that typically prevail in the traded goods sector in Western Europe.[8]

Nevertheless, the trend today is toward greater plant-level bargaining in Europe. Union support and opposition to increased local bargaining in Scandinavia is easy to explain in terms of self-interest. Those unions whose members might gain in terms of higher average wages from increased local bargaining rights, generally the unions located in the traded goods sector of the economy, have been least resistant to the relaxation of central control over wage-setting that employers have proposed. What is puzzling, at least in terms of the model of this paper, is the growing support among employers for purely local bargaining. It is possible that technical advance in advanced industrial economies has become less dependent on new plant and equipment and more dependent on the training and effort of the work force, as suggested by Streeck (1987). If this is true, the effect of the bargaining level on workers' incentives, a topic not analyzed here, may be more important for employers than the impact on workers' wages. Yet, as long as entry entails large sunk costs, our analysis indicates that moving to a system of very decentralized bargaining may lower the birthrate of new plants while it extends the life of plants already in existence.

Appendix

Proof of Proposition 1

Rewrite the entry condition (3) and the price equation (6) using $pb_0 = r_0 e^{\gamma\theta}$ from equation (17) as

$$r_0 \int_0^\theta e^{-\rho\tau}(e^{\gamma\theta} - e^{\gamma\tau})d\tau - C(n) = 0, \tag{A.1}$$

$$p\left(\frac{nb_0}{\gamma}(1 - e^{-\gamma\theta})\right) - (r_0/b_0)e^{\gamma\theta} = 0. \tag{A.2}$$

Differentiating with respect to r_0 and using Cramer's rule yields

$$\frac{d\theta}{dr_0} = \frac{1}{\Delta}\left\{\frac{C'(n)e^{\gamma\theta}}{b_0} - \frac{b_0 p'(\cdot)(1 - e^{-\gamma\theta})}{\gamma}\int_0^\theta e^{-\rho\tau}(e^{\gamma\theta} - e^{\gamma\tau})d\tau\right\} \tag{A.3}$$

and

$$\frac{dn}{dr_0} = \frac{1}{\Delta}\left\{\frac{r_0\gamma e^{2\gamma\theta}}{b_0}\int_0^\theta e^{-\rho\tau}d\tau + \left[nb_0 p'(\cdot)e^{-\gamma\theta} - \frac{r_0\gamma e^{\gamma\theta}}{b_0}\right]\int_0^\theta e^{-\rho\tau}(e^{\gamma\theta} - e^{\gamma\tau})d\tau\right\} \tag{A.4}$$

where

$$\Delta = r_0 b_0 p'(\cdot)(e^{\gamma\theta} - 1)\int_0^\theta e^{-\rho\tau}d\tau + C'(n)\left[nb_0 p'(\cdot)e^{-\gamma\theta} - \frac{r_0\gamma}{b_0}e^{\gamma\theta}\right] < 0.$$

Proof of part (a): Since $\Delta < 0$, we have $(d\theta/dr_0) < 0$ from (A.3).

Proof of part (c): Equation (A.4) indicates that the sign of (dn/dr_0) is ambiguous. When $p'(\cdot) = 0$, however, (A.4) reduces to

$$\frac{dn}{dr_0} = \frac{(r_0/b_0)\gamma e^{\gamma\theta}}{\Delta}\int_0^\theta e^{(\gamma-\rho)\tau}d\tau < 0.$$

Proof of part (d): As $p'(\cdot) \to -\infty$, we have from (A.4)

$$\frac{dn}{dr_0} \to \frac{p'(\cdot)nb_0e^{-\gamma\theta}}{\Delta}\int_0^\theta e^{-\rho\tau}(e^{\gamma\theta} - e^{\gamma\tau})d\tau > 0$$

which shows that the (dn/dr_0) can be positive if $p'(\cdot)$ is sufficiently negative. If $(dn/dr_0) < 0$, there are fewer plants built each year and, since $(d\theta/dr_0) < 0$, each has a shorter economic lifespan. In this case, total output declines and, if $p'(\cdot) < 0$, the price increases. If $(dn/dr_0) > 0$, then (dV/dr_0) must be positive which implies that $(dp/dr_0) > 0$. Thus, $(dp/dr_0) > 0$ in both cases.

Proof of part (b): Since θ falls, average productivity rises. With a higher average productivity and lower aggregate output, there must be less employment. QED.

Proof of Proposition 2

With local bargaining, the entry condition (equation 3) can be written as

$$(1-\alpha)r_0 e^{\gamma\theta}\int_0^{\sigma} e^{-\rho\tau}d\tau + r\int_{\sigma}^{\theta} e^{-\rho\tau}(e^{\gamma\theta}-e^{\gamma\tau})d\tau - C(n) = 0. \qquad (A.5)$$

The price equation remains the same as in the competitive case. Differentiating (A.5) and (A.2) with respect to α yields

$$\frac{d\theta}{d\alpha} = \frac{(r_0 b_0/\gamma)(e^{\gamma\theta}-1)p'(\cdot)}{\Delta}\int_0^{\sigma} e^{-\rho\tau}d\tau \qquad (A.6)$$

and

$$\frac{dn}{d\alpha} = \frac{r_0 e^{\gamma\theta}}{\Delta}\left[(r_0\gamma/b_0)e^{\gamma\theta} - p'(\cdot)nb_0 e^{-\gamma\theta}\right]\int_0^{\sigma} e^{-\rho\tau}d\tau \qquad (A.7)$$

where

$$\Delta = r_0 b_0 p'(\cdot)(e^{\gamma\theta}-1)\left[(1-\alpha)\int_0^{\sigma} e^{-\rho\tau}d\tau + \int_{\sigma}^{\theta} e^{-\rho\tau}d\tau\right] + C'(n)\left[nb_0 p'(\cdot)e^{-\gamma\theta} - (r_0\gamma/b_0)e^{\gamma\theta}\right] < 0.$$

Proof of part (a): From $\Delta < 0$ and (A.7) we have $(dn/d\alpha) < 0$.

Proof of part (b): If $p'(\cdot) = 0$, then $(d\theta/d\alpha) = 0$ and $(dL/d\alpha) = d(n\theta)/d\alpha = \theta(dn/d\alpha) < 0$.

Proof of part (c): Note that $(d\theta/d\alpha) > 0$ when $p'(\cdot) < 0$. In turn, $(d\theta/d\alpha) > 0$ implies $(dp/d\alpha) > 0$ since $\theta = (1/\gamma)\ln(pb_0/r_0)$. Finally, we have

$$\begin{aligned}\frac{dL}{d\alpha} &= \theta\frac{dn}{d\alpha} + n\frac{d\theta}{d\alpha} \\ &= \frac{r_0}{\Delta}\left[\frac{nb_0p'(\cdot)(e^{\gamma\theta} - (1+\gamma\theta))}{\gamma} + \frac{r_0\gamma\theta e^{2\gamma\theta}}{b_0}\right]\int_0^\sigma e^{-\rho\tau}d\tau.\end{aligned}$$

Since $e^{\gamma\theta} > (1+\gamma\theta)$, $(dL/d\alpha) > 0$ if $p'(\cdot)$ is sufficiently negative. Thus employment can be either higher or lower when $p'(\cdot) < 0$. QED.

Proof of Proposition 5

Proof of part (a): If $\alpha \in (\alpha^L_{min}, \alpha^I_{min}]$, $n^I = n^C > n^L$ from propositions 2 and 3.

Proof of part (b): Since new units enter until $V = C(n)$, we can derive the effects on n of different bargaining regimes via the effects on V as $\alpha \to 1$. With industry bargaining $\theta^I = (\alpha/\gamma)(e^{\gamma\theta^I} - 1)$ (from equation (28)). Inserting $(\alpha/\gamma)(e^{\gamma\theta^I} - 1)$ for θ^I in the expression for the average productivity (equation (14)), we can write $\bar{b}(s) = (b_0/\alpha)e^{\gamma(s-\theta^I)}$ and the present value of future cash flows at $s = 0$ as $V^I = p^I b_0 A^I$ where

$$A^I = \int_0^{\theta^I} e^{-\rho\tau}d\tau - e^{-\gamma\theta^I}\int_0^{\theta^I} e^{(\gamma-\rho)\tau}d\tau. \qquad (A.8)$$

With local wage bargaining $\theta^L = (1/\gamma)ln(p^L b_0/r_0)$ (from equation (18)) and $\sigma = (1/\gamma)ln(\alpha p^L b_0/r_0)$ (from equation (23)). Using $r(s) = \alpha p^L b_0 e^{\gamma(s-\sigma)}$, we write the present value of future cash flows at $s = 0$ as $V^L = p^L b_0 A^L$ where

$$A^L = (1-\alpha)\int_0^\sigma e^{-\rho\tau}d\tau + \int_\sigma^{\theta^L}(1 - \alpha e^{\gamma(\tau-\sigma)})e^{-\rho\tau}d\tau. \qquad (A.9)$$

Taking the derivative $dV^j/d\alpha$ with $j = I, L$, we have

$$\begin{aligned}
\frac{dV^j}{d\alpha} =& b_0 \left[\frac{dp^j}{d\alpha} A^j + p^j \frac{dA^j}{d\alpha} \right] \quad \text{where} \\
\frac{dA^I}{d\alpha} =& \gamma e^{-\gamma\theta^I} \frac{d\theta^I}{d\alpha} \int_0^{\theta^I} e^{(\gamma-\rho)\tau} d\tau \quad \text{and} \\
\frac{dA^L}{d\alpha} =& - \int_0^{\sigma} e^{-\rho\tau} d\tau - e^{-\gamma\sigma} \int_{\sigma}^{\theta^L} e^{(\gamma-\rho)\tau} d\tau.
\end{aligned}$$

As $\alpha \to 1$, both V^I and V^L approach zero, but not at the same speed. Formally,

$$\lim_{\alpha\to 1} V^I = 0 \quad \text{and} \quad \lim_{\alpha\to 1} \frac{dV^I}{d\alpha} = 0$$

since $A^I \to 0$ and $\theta^I \to 0$ as $\alpha \to 1$. In contrast

$$\lim_{\alpha\to 1} V^L = 0 \quad \text{and} \quad \lim_{\alpha\to 1} \frac{dV^L}{d\alpha} = -p^L b_0 \int_0^{\theta^L} e^{-\rho\tau} d\tau < 0$$

since $A^L \to 0$ and $\sigma \to \theta^L$ as $\alpha \to 1$. Hence, when α is less than one but sufficiently close to one, $V^I < V^L$ which implies that $C(n^I) < C(n^L)$ and $n^I < n^L$. QED.

Proof of Proposition 6:

Proof of (a): If $\alpha \in (\alpha^L_{min}, \alpha^I_{min}]$ and $p'(\cdot) < 0$, then we have $p^L > p^C = p^I$ from Proposition 2 and 3.

Proof of (b): There are two cases to consider, when $C'(n) > 0$ (and C(0) is close to zero) and when $C'(n) = 0$. When $C'(n) > 0$, we have $n^I < n^L$ as $\alpha \to 1$ from Proposition 5 and $\theta^I < \theta^L$ from Proposition 4. Therefore, $Q^I < Q^L$ (from equation (12)) which implies that $p^I > p^L$. When $C'(n) = 0$, free entry implies $V^I = p^I b_0 A^I = p^L b_0 A^L = V^L$ where A^I and A^L are given in (A.8) and (A.9). Therefore, $(p^L/p^I) = (A^I/A^L)$. Using l'Hopital's rule we then have $\lim_{\alpha\to 1}(p^L/p^I) = \lim_{\alpha\to 1}(A^I/A^L) = 0$. QED.

Endnotes

[1] See, among others, Bruno and Sachs (1985), Bean, Layard and Nickell (1986), McCallum (1983, 1986) and Layard, Nickell and Jackman (1991). The theoretical literature on the impact of the degree of bargaining centralization on employment and other economic outcomes, is reviewed in Moene, Wallerstein and Hoel (1992).

[2] See, for example, Heitger (1987) and the British Department of Employment (1988).

[3] For an overview with empirical applications, see Førsund and Hjalmarsson (1987).

[4] We do not distinguish between firms and plants. Firms are assumed to be price-takers in the output market throughout the analysis.

[5] See, also, Roemer (1991) for a study of solidaristic bargaining with an entirely different focus.

[6] The function $f(x) = (1 - e^{-x})/x$ is strictly decreasing in x.

[7] The assumption that the union is not concerned about employment is not as clearly appropriate as in the case of plant-level bargaining. While labor requirements are fixed at the local level in our model, employment varies at the industry level. Moreover, large industrial unions, like the German metalworkers, are often described as attaching great weight to employment in determining their wage demands (Schettkat and Soskice 1992). Our reason for maintaining the assumption of wage maximization is to clarify the impact of setting a uniform industry wage, holding union preferences constant.

[8] There are not many studies of the union wage differential in Western Europe, partly because in many industries almost all workers are covered by union contracts. Nevertheless, the studies that exist suggest that union wage differentials are smaller in Britain than in the United States, and close to zero in West Germany (Hirsch and Addison 1976, Svejnar 1981).

Given the low unemployment that existed in Norway and Sweden until very recently, the difference between the wages set in the central agreement cannot have been much higher than the level that would have existed without unions.

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Figure 1
Time Path of Wages with Local and Industry Bargaining
(fixed price case)

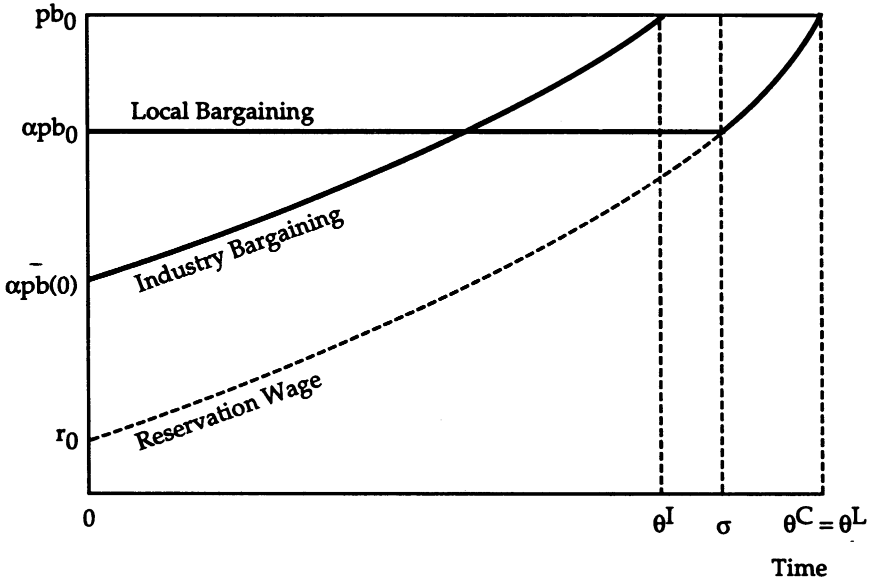

Figure 2
The Distribution of Wages Across Plants
with Local and Industry Bargaining
(fixed price case)

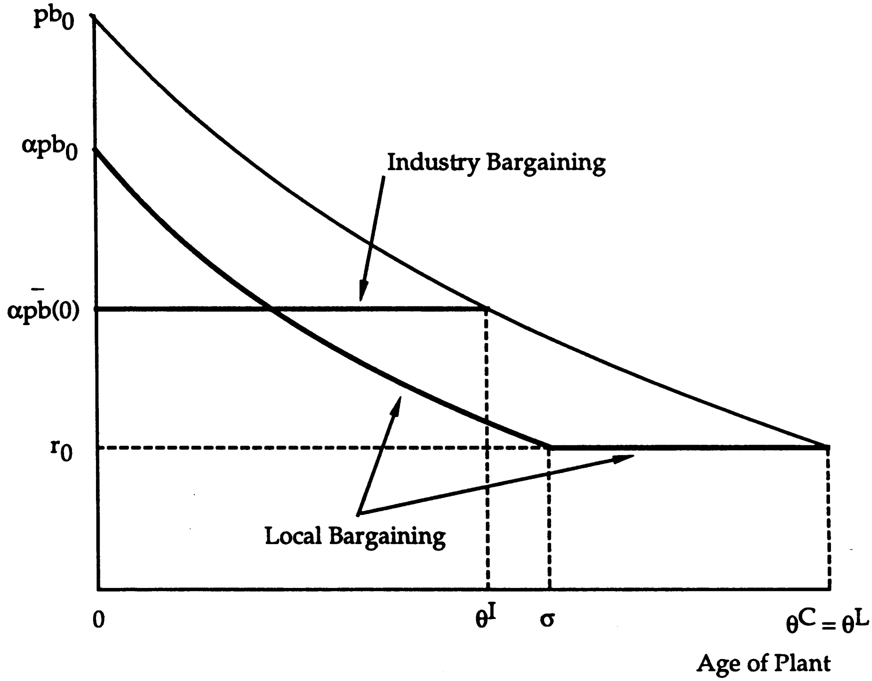

Figure 3
Market Value of a New Plant with Local and Industry Bargaining
(fixed price case)