A simple model of extensions of collective contracts

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Abstract

A model of contract extensions is developed, in which wages bargained by a union and an employers' federation may be automatically extended to smaller firms in the same industry. In the model, a fringe of labour intensive firms are always in the market but respond to extensions of higher wages by larger, capital intensive firms, by cutting back on output rather than exiting at a critical wage. This has the advantage that it avoids the counterfactual prediction of some standard models that all firms belong to the employers'association – since they have excluded other firms by selecting a sufficiently high wage. The implications of extensions are derived, and we find that even though the fringe firms remain active, wages are likely to be substantially higher when extensions occur, and moreover joint surplus of firms and workers in the industry is much higher in the extensions case. This comes, however, at the expense of consumer surplus.

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1 Model

A number of reasons have been suggested for why there might be extensions of collective contracts. Amongst the most prominent (see Villanueva (2015)) are: to ensure common working conditions within an industry; to limit wage inequality; to reduce gender wage gaps; to stop the "undercutting" of working conditions. In addition, by restricting cheaper labour, extensions may encourage investment in labour productivity increasing measures in less efficient firms.

Much of the existing modelling of the motivation for, and impact of, extensions has modelled protectionism for insiders by raising rivals' costs, starting with Williamson (1968) (see also Salop and Scheffman (1987) for similar ideas in a different context).

In these models there is a critical wage which is high enough to keep entrants out of the industry, but not so high that incumbent or capital intensive firms cannot make profits; thus in Haucap et al. (2001), if incumbent firms set wages, they may be set at such a level to just keep entrants out, but no higher. If wages were any lower there would be a discrete jump in supply from entrants, which would lead to a discontinuous drop in profits.

Here we develop a model that has a similar flavour, but avoids any discontinuity. We will develop a model of a fringe of labour intensive firms that are always in the market but respond to extensions of higher wages by cutting back on output rather than exiting at a critical wage. This has several advantages. It avoids the counterfactual prediction that all firms belong to the employers' association – since they have excluded other firms. It also allows for standard bargaining tools to be applied. In Haucup et al., depending on parameters, we may be in a region where firms wish to deter entry, but unions would prefer a lower wage as it allows for entry and hence more employment both due to more firms (with inefficient entrants actually employing more workers per unit of output) and to higher demand. (Workers will also have a discontinuous payoff at the point where entrants are deterred.) Standard Nash bargaining cannot be applied due to the discontinuity in firm profits once the wage falls below the entry deterring wage, which leads to a non-convex bargaining set.[1] In our set-up, we can avoid this source of non-convexity. This feature has empirical appeal given that bargaining is a crucial part of the institutional environment in which extensions occur, unlike for example Haucup et al. where either the firm or the union unilaterally sets the wage. Bargaining in this context leads to interesting trade-offs. Firms are less resistant to wage increases than they otherwise might be, while union negotiators, who represent all workers in the industry, will have less incentive to hold wages down to avoid keeping entrants out.

[1] A standard solution would be to allow for randomization over wages, but this is hard to interpret as the outcome of a bargain in this context.

We model the industry as being composed of a fixed number of "large" firms that operate under constant returns and engage in Cournot-Nash behaviour, plus a competitive fringe of firms that operate under decreasing returns. The latter take the price as given. The motivating idea, not formally modelled, is that there are a small number of large firms which are not credit constrained and behave strategically; the fringe is composed of small firms with credit constraints (hence fixed capital) which not only have decreasing returns to labour, but also are small and so behave competitively. We will also need to assume that they are relatively inefficient for the residual demand curve to allow the large firms to be profitable, and this accords well with the usual idea in the literature that the large firms are more efficient and so have the incentive, by increasing the wage, to increase the relative costs of the smaller scale firms.[2]

In more detail, we assume that the industry is composed of n_L identical "large" firms which operate under constant returns to scale, with labour requirement αq_L where q_L is firm output, $\alpha > 0$, and n_F identical fringe firms with labour requirement $\beta q_F^2/2$ where q_F is firm output, $\beta > 0$. Industry inverse demand is $p = a - bQ$, $a, b > 0$, where p is price, and Q is total industry output.

We assume that wages cannot go below $w_0 > 0$. This can be interpreted as the minimum wage or as the disutility of work/outside option – we will take the latter interpretation for the surplus calculations below.[3] Workers are risk neutral and supply one unit of labour. Throughout we assume that there is an elastic supply of labour at w_0.

The model is a two-stage game. In the first stage, wages are determined. Wages for large firms, w, are bargained between an employers' association (EA) representing large firms and a union representing *all* workers in the industry (as in Haucup et al.). We will consider two scenarios:

No extensions: wages in the fringe firms w_F are fixed at w_0.

Extensions: the wage $w \geq w_0$ negotiated by the large firms is extended to all other firms in the industry, so that $w_F \geq w$, and we assume that fringe firms will choose equality $w_F = w$ as this maximises their profits.[4]

In the second stage, the large firms are Cournot-Nash competitors, with the fringe firms' output competitively supplied. This is a "Right-to-Manage" model: all firms take the wage as given when they take output/employment decisions. This stage is a standard competitive fringe equilibrium (see Okuguchi (1985) for a general treatment). Thus a large

[2] The decreasing returns assumption we make implies that for the fringe firms, at higher scale, their marginal costs increase relative to those of the larger firms when the wage rises.

[3] For simplicity we shall not consider bargaining in the fringe firms. See Petrakis and Vlassis (2004) for a model in which the less efficient firm also has firm-union bargaining. It would also be straightforward to extend the model to introduce an upward sloping labour supply curve and assume that the wage in the fringe firms clears the market.

[4] Individual price-taking firms prefer a lower wage to a higher wage.

firm, when deciding its output, takes output of other large firms as fixed, but allows for a competitive response from the fringe.

The outcome of stage one will be a residual demand curve for the oligopolistic firms which depends on w_F, and their own cost functions which depend on w.

We solve the *second stage* first. Fringe firms maximise profits

$$\pi_F = pq_F - w_F \beta q_F^2/2, \tag{1}$$

so that $q_F = p/(\beta w_F)$. Residual demand for large firms, denoted by Q_L, is then

$$Q_L = \frac{a-p}{b} - \frac{n_F p}{\beta w_F},$$

so that the residual inverse demand function can be written as

$$p = \hat{a} - \hat{b} Q_L, \tag{2}$$

where $\hat{a} \equiv a/(b\xi)$ and $\hat{b} \equiv \xi^{-1}$, $\xi \equiv \left(b^{-1} + n_F/(\beta w_F)\right)$. We will put w_F as an argument of $\hat{a}$ and $\hat{b}$ when we want to emphasise their dependence on w_F.

A large firm's profit is

$$\pi_L = pq_L - w\alpha q_L,$$

and so the second-stage leads to a Cournot-Nash equilibrium output of

$$q_L^* = \frac{\hat{a}(w_F) - \alpha w}{\hat{b}(w_F)(n_L + 1)}, \tag{3}$$

with large firm profits π_L, after simplification, of bq_L^{*2}. Substituting this solution for q_L back into (2) (where $Q_L = n_L q_L$) gives the equilibrium price

$$p^* = \hat{a}(w_F) - \hat{b}(w_F)\, n_L \frac{\hat{a}(w_F) - \alpha w}{\hat{b}(w_F)(n_L + 1)}. \tag{4}$$

1.1 First stage: determination of w

Turning to the *first stage* next, consider first how the wage w impacts a large firm's profits under the two scenarios.

No extensions: $d\pi_L/dw = 2bq_L(dq_L/dw) < 0$ as $dq_L^*/dw < 0$ for $q_L > 0$ from (3) when w_F is constant. As expected, large firms prefer lower wages. Here the wage that the large firms pay has no effect on the residual demand curve that they face.

Extensions: As the wage varies, $\hat{a}$ and $\hat{b}$ also vary due to the costs of the fringe firms changing. At a higher wage the residual demand curve shifts outwards. In this case, it is relatively straightforward to establish the following (see Appendix for proof):

Proposition 1 *In the model with extensions, provided the fringe firms are sufficiently inefficient relative to the large firms, then the latter will benefit from increasing wages up to some point. Specifically, if*

$$\beta > \frac{n_F \alpha b}{a}, \tag{5}$$

and $\bar{w}$ is defined as the highest wage that the industry can sustain (i.e., the minimum wage at which $q_L = 0$), then $\bar{w} > 0$ and there is a $\hat{w} \in (0, \bar{w})$ such that π_L is increasing in w over $[0, \hat{w}]$ and decreasing over $[\hat{w}, \bar{w}]$.

This captures the intuition that over a range, a higher w has a sufficiently negative effect on the supply of the fringe firms that the demand facing the large firms increases by an amount that more than offsets the cost increase they face. So for w_0 low enough, large firms would like to set a wage strictly above w_0. We assume that condition (5) holds in what follows and restrict discussion to this case where w_0 is lower than $\hat{w}$.

1.1.1 Bargaining

We take w_0 to be the breakdown wage in bargaining (recall that w_0 is the reservation wage of workers), and using a standard utilitarian formulation for the union utility function

$$u(w) = (w_F - w_0) l_F + (w - w_0) l_L,$$

where $l = l_F + l_L$ is total industry employment, and l_F and l_L are (aggregate) employment at fringe firms and large firms, respectively:

$$l_F = \frac{n_F p^2}{2\beta (w_F)^2}, \tag{6}$$

$$l_L = \frac{n_L \alpha (\hat{a}(w_F) - \alpha w)}{\hat{b}(w_F)(n_L + 1)}. \tag{7}$$

Likewise we assume that firms' breakdown payoff is 0.

Who benefits from wage extensions? Start with the case where firms have all the bargaining power and can set the wage. We have seen that in the no-extensions case the EA would set the wage as low as possible, i.e., at w_0, and since we assume that wages are at their minimum level in the fringe, we will have both wages equal. This then effectively is a special case of the extensions regime, but under condition (5), Proposition 1 implies that whenever $\hat{w} > w_0$, a higher uniform wage of $\hat{w}$ is preferred by the EA. So the EA prefers the extensions regime.

The fringe firms may also be better off. Provided $q_L^* > 0$, the profits of a fringe firm are, substituting $q_F = p/(\beta w_F)$ into (1) and using (4), at $w_F = w$:

$$\pi_F = \frac{w\left(a\beta + n_L\alpha\left(n_F b + w\beta\right)\right)^2}{2\left(n_L+1\right)^2\beta\left(n_F b + w\beta\right)^2}. \tag{8}$$

At $w = 0$, $d\pi_F/dw > 0$.[5] A higher industry wage is effectively a means of coordinating at a lower output level, and despite the higher wage costs, this is beneficial for the fringe firms as well as the large firms, at least starting from a sufficiently low w_0.

Looking at union utility, starting from $w = w_0$, the union prefers a higher wage as workers will get some surplus from employment in both extension and no extension cases. However at higher wages employment will fall. In the no-extensions case, the union gets no payoff from workers hired (at w_0) in the fringe, and as wages paid by large firms rise, the fringe rapidly increases employment at the expense of large firms, leading to a relatively small benefit from the large firms; in the case of extensions, an increase in the wage, while benefitting workers in both types of firm, additionally means that employment at w doesn't drop off at such a rate.

In Figure 1, for the parameter values shown,[6] this effect is substantial – in the no extensions case, employment in the large firms falls to zero at $w = 0.2$, at which point all employment is at the lower wage w_0 paid by the fringe firms, whereas with extensions this occurs at $w = 0.8$. The figure also plots aggregate surplus of the market participants (union payoff plus all firms' profits) and again this is substantially higher with extensions.[7] For these parameters, the optimal wage for the large firms is $w = 0.17$, and for the union it is 0.47 (and 0.125 in the absence of extensions). We would expect bargaining to lead to a wage somewhere between these two numbers, and indeed Nash bargaining leads to a wage of 0.28 (it is 0.08 in the absence of extensions, not much more than w_0). Thus extensions, by leading to a higher industry wage, benefits the employers association and the union, may also benefit the fringe firms because of the reduction in competition, and leads to a higher joint surplus. Of course any such increase in surplus is at the expense of an even greater reduction in consumer surplus. Particularly striking in this example is the fact that introducing extensions leads to a very substantial increase in the ideal wage for both the employers' association and the union.

Crucial in this is the fact that unions and the employers' association can take surplus away from consumers in the form of higher prices. For a good that is traded internationally,

[5] $d\pi_F/dw \mid_{w=0} = \left(a\beta + n_L n_F \alpha_F b\right)^2 / \ 2\left(n_L+1\right)^2\beta\left(n_F b\right)^3 > 0$. The intuition is simply that at $w = 0$ the competive fringe firms keep the price at 0. Thus any increase in the price has to be beneficial. Of course for $w_0 > 0$, fringe profits may be decreasing for wages above w_0.

[6] For these parameters, with extensions, aggregate employment across each type of firm is the same when $w = 0$ and $w = 0.8$, though is somewhat higher in the large firms for intermediate wages.

[7] The total surplus with no extensions at $w = 0.2$ is just the profits of the fringe firms at the reservation wage, given the large firms no longer participate.

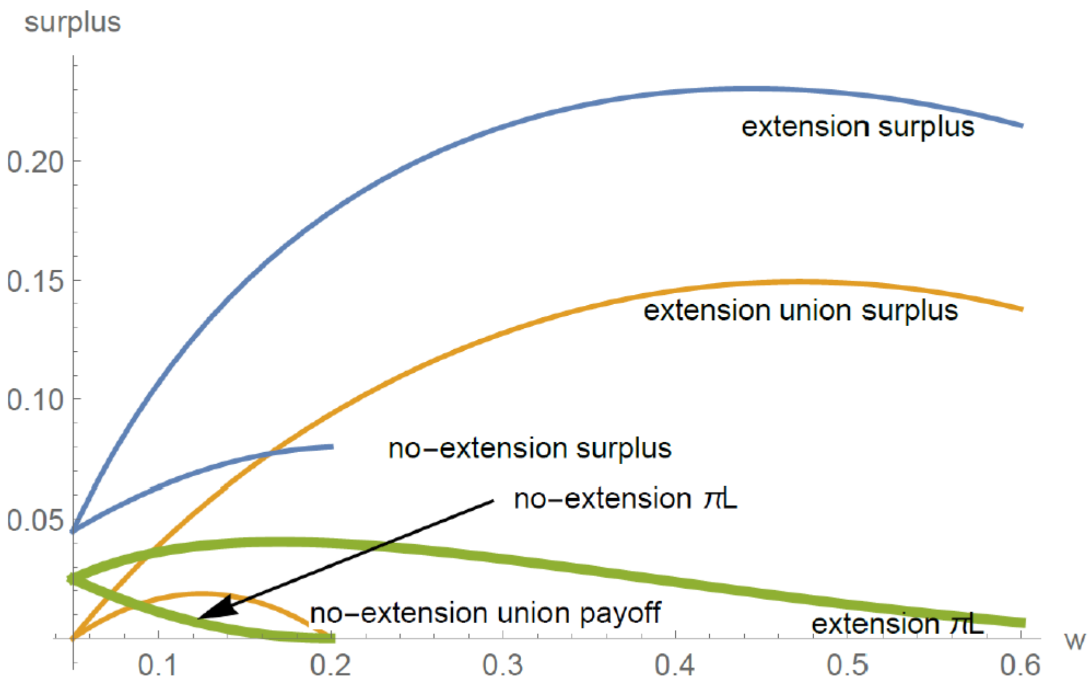

Figure 1: Aggregate surplus and union payoff as w varies for cases with/without extensions; parameter values: $a = 1$, $b = 1$, $\alpha = 1$, $\beta = 100$, $n_L = 2$, $n_F = 20$, $w_0 = 0.05$.

this is much less likely to be the case, and we might expect the benefits from extensions to be correspondingly lower.

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A Proof of Proposition 1

Proof. Using $\pi_L = bq_L^2$ and substituting in for q_L from (3) and for $\hat{a}$ and $\hat{b}$, so that

$$q_L = \frac{(a\beta - n_F \alpha b - w\alpha\beta)}{(n_L + 1)b\beta}, \tag{9}$$

we get

$$\frac{d\pi_L}{dw} = \frac{(n_F\alpha b - a\beta + w\alpha\beta)\left(n_F^2\alpha b^2 - n_F b\beta\left(a - 3\alpha w\right) + 2\alpha\beta^2 w^2\right)}{\left(n_L + 1\right)^2 b\beta\left(n_F b + \beta w\right)^2}.$$

The denominator is positive. The first term in the numerator is negative at $w = 0$ by (5), increasing in w but negative so long as $q_L > 0$ by (9). The second term is also negative at $w = 0$ by (5), increasing in w, but at $w = \bar{w}$ (i.e., such that $q_L = 0$), by (9) (i.e., setting the numerator in (9) to zero and substituting into the second term) it is positive. Consequently $\frac{d\pi_L}{dw} = 0$ at a unique point, $\hat{w} \in [0, \bar{w}]$, and π_L is single-peaked. Solving we get

$$\hat{w} = ((n_F b(n_F \alpha b + 8a\beta))^{0.5}/\alpha^{0.5} - 3n_F b)/4\beta].$$

■