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Trade Union Power and Economic Efficiency

Ever since the pioneering work of Dunlop(1944) , the impact of trade unions on economic performance has been the subject of scrutiny by economists. Not surprisingly the debate has generated no little controversy. In recent times the orthodox view of unions as one of rent seeking monopolies which create distortions and hence efficiency losses has been challenged by an alternative view of unions as potentially productivity enhancing.

Relative to a benchmark case of a fully competitive allocation (with no externalities), this view of the rent seeking activity of unions leading to resource allocation inefficiency is not in question. The extent of the inefficiency is directly related to the wage premium extracted by the union and much of the literature has focussed on empirical analysis of the wage premium. Once controls for other factors are taken into account the wage premium is often found to be of the order of 5-10% in the UK, (Stewart, 1983,) about 10–20% in the USA(Hirsch and Addison, 1985), and Lewis(1986) and about 20% in Canada (Robinson and Tomes, 1984). A useful survey of both the methodology and the evidence is in Booth(1995). Attempts have also been made to quantity the efficiency loss associated with these wage premia. Early U.S. studies used a partial equilibrium framework (Rees, 1963, Johnson and Mieskowski, 1970).The obvious disadvantage of this approach is that other existing distortions are necessarily excluded from consideration and hence the removal of union wage premia is always efficiency increasing. Despite this limitation, these studies found surprisingly small potential efficiency gains (0.15% and 0.33% of GNP respectively)from the removal of quite large wage premia (15%). More recently, CGE approaches which can, and do, take into account other distortions have been used. Not surprisingly the already small welfare gain from eliminating union wage premia falls even further. For example the pioneering work by De Fina, (1983), finds efficiency gains from eliminating existing union wage premium of 15% to be less than 0.1% of GNP – which is about half that of previous partial equilibrium studies. Similarly Fisher and Waschik (1999) using Canadian data estimate a potential efficiency gain from removing union wage premium of 15% to be at most 0.05% of GNP. One might be tempted to conclude somewhat contentiously (as indeed Fisher and Waschik do) that the story of rent seeking unions as distortive agents is " Much Ado About Nothing"[i].

All of the studies discussed above are based on a conventional static full information resource allocation model. More recently, the impact of unions in dynamic and/or limited information settings has been studied. Using British data, Menezes et.al. (1998) analyse the impact of union s on R & D performance. They conclude that " The effects of union power are only negative when (a) union density is very high (b) the union bargains only over wages". Using Canadian data, Odgers et.al. (1997) show that union activity has negative impacts because investment tends to be lower. By contrast, using British data, Heyes and Stuart (1998) and Green et.al.(1999) find that unions promote training outcomes and thus have a positive role to play in boosting skill formation. But perhaps the most influential studies have taken a view of unionism based on an application of Hirschman's (1970) exit-voice approach to labour market analysis. The fundamentals of this approach are presented in Freeman (1976) and Freeman and Medoff (1979, 1984). In essence this view of unionism sees unions as providing a collective voice which allows a channel for workers to express discontent other than by simply quitting.[ii] It is argued that this reduces hiring and firing costs and hence increases firm specific investments, particularly with respect to human capital. Whilst there is considerable evidence from a number of countries that unions do reduce quits (Freeman (1980), Blau and Kahn (1983), Freeman and Medoff (1984), Miller and Mulvey (1993), Lucifora (1998)), the evidence on productivity enhancement is mixed, with some studies showing large positive effects (Brown and Medoff, (1978)) and others showing insignificant (Ehrenberg et al(1983)), or even negative effects (Clark (1984), Warren (1985), Denny(1997)). Doubts about unions enhancing productivity stem at least in part from the observation that unions impact negatively on profitability - a finding often present in the same studies that show unionism enhancing productivity. As Hirsch and Addison (1985) put it " .. large and widespread productivity effects as reported by Brown and Medoff (1978) are implausible in the light of the consistently negative union effect on profits found in these studies." Similar results on the negative impact of unions on profitability has been reported using British data by Menezes(1997).

The above mentioned studies reporting the impacts of unionism on profitability, productivity, training, turnover and innovation are explicitly empirical in character. They can be seen as providing a useful set of "stylised facts" which somewhat tentatively can be characterised as follows:

i. unions impact negatively on profitability
ii. unions impact negatively on investment
iii. unions are probably instrumental in reducing turnover
iv. unions are probably instrumental in improving training outcomes
v. unions are probably instrumental in raising productivity

Two questions which arise naturally are (i) how are these empirical results to be explained (ii) what implications do they carry for economic efficiency? The real difficulty with appraising these empirical results is the absence of a fully articulated model which captures the productivity enhancing and investment effects. As Brown and Medoff (1978) themselves state, " The idea that unions make firms … more productive would be much more persuasive if the mechanisms by which productivity is improved could be isolated." In an earlier study Booth and Chatterji (1998) formalise a model of on the job training which shows that unionism can raise productivity by lowering quits. In essence the argument is that on the job training has some firm specific component as well as some general portable component. The latter is the source of trained workers quitting the training firm which results in society losing the benefit of the firm specific component of training. By raising wages, unions deter such wasteful quits. In effect, union power offsets the implicit monopsony power of the firm. Although this model captures much of the flavour of the exit-voice approach, it does not focus explicitly on union rent seeking activity. Hence it is unable to analyse whether the productivity gain from unionism offsets the potential loss from lower firm profitability which might adversely affect the firm's investment.

In this paper the earlier framework of Booth and Chatterji (1998) is extended to allow not only for productivity increase but also potential profitability decrease. This merges the orthodox monopoly view of rent seeking profitability reducing unionism with the "new" productivity enhancing view in a single unified framework which seeks to account for the "stylised facts" discussed earlier. The objective is not only to clarify the various routes through which unionism might operate in the new view but also to directly compare whatever benefits might accrue from productivity enhancement with the (slight) losses that previous static resource allocation models have reported. The model explicitly concentrates on the issue of efficiency. [iii]As in Booth and Chatterji (1998) the model is one of on the job training in which a trained workers productivity is always greater in the training firm than in any other firm which employs trained workers. The fundamental issues are: (i) how many workers receive training;(ii) what is the post training wage; and, (iii) what is the consequent impact on efficiency. In section 1 below we set out the assumptions of the model. In Section 2 we compute the first best solution. Section 3 shows that long term contracting possibilities can achieve first best. This is contrasted with a situation in which we analyse the training firm's choices in the absence of the ability to enforce long term contracts and in the absence of unionism. It is demonstrated that efficiency falls. In Section 4 we argue that unions will set up quite naturally in order to extract some of the profits made by the training firm. We analyse the impact of union power on the number of trainees, productivity, profitability and efficiency. The "paradox" of productivity enhancement coupled with declining investment and profitability is resolved. It is shown that taking all the effects into account, raising union power from zero to a modest level is efficiency improving but that continuous rises in union power ultimately reduce efficiency.[iv] Section 5 uses numerical simulations to show the impact of changing key parameter values whilst Section 6 concludes.

Section 1: Framework and Assumptions[v]

We use a two period model to analyse training and quitting decisions. In the first period workers can undergo training in a training firm, or they can enter the unskilled labour market. No production takes place in the first period.[vi] The training process imparts both general and some firm specific skills. In the second period, some workers who have completed their training with the training firm may quit to find another job requiring their general skills. The remainder stay with the training firm . Output is thus produced in (i) the training firm which uses the general and specific skills of its own trainees; (ii) other (non-training) firms using the general skills of the workers they "poached" from the training firm; and (iii) firms using unskilled workers. We assume constant returns to scale so that the marginal productivity of each of these three types of workers is equal to their average productivity and is given by α, x, and b respectively. We assume that x, the productivity of workers if they quit, (which corresponds to the general skills acquired in the training process) is unknown till after the training process is completed. Ex ante, in period 1, only the distribution of x across workers is known. We assume that this distribution is uniform with support on $[a^-, a^+]$.[vii] If a trained worker stays with the training firm (thereby using both general and firm specific skills acquired in the training process) his productivity is assumed to be higher (if only by a small amount) than the best he could do in any non training firm where he uses his general skills only. Thus $\alpha > a^+$. Similarly since training increases productivity, we assume $a^- > b$. As in Booth and Chatterji (1998) , these two assumptions are crucial. They may be summarised as:

$$\alpha > a^+ > a^- > b \qquad (1)$$

If n is the number of trainees taken on by the training firm in period 1, we assume that the total cost of training is strictly convex in n and given by C(n). This assumption that the marginal cost of training increases with the number of trainees is what ensures that the number of trainees engaged is determinate. Again to simplify calculations in Sections 4 and 5 and without any significant loss of generality, we assume :

$$C(n) = (\tfrac{1}{2})c\, n^2 \qquad (2)$$

where c is a constant, representing the marginal cost per trainee.

The productivity parameters, viz. α , a^+ , a^- , b and the marginal cost of training parameter c constitute the five parameters of the model.

Denoting the second period quit rate by q, the average productivity of those skilled workers who quit the training firm is denoted by μ where:

$$a^- \leq \mu \leq a^+ \qquad (3)$$

whilst the average productivity of all trainees is given by :

$$\beta = (1-q)\,\alpha + q\,\mu \qquad (4)$$

Section 2: The Social Planner and First Best

The Social Planner seeks to maximise the social surplus S from the investment in training. His choice variables are just n and q. The social surplus is given by:

$$S = \beta n - (\tfrac{1}{2}) c n^2 - bn \qquad (5)$$

From (4) it is obvious that β takes its maximum value of α when q = 0 and since S is increasing in β, the planner sets q =0. The optimum value of n then requires just that the marginal benefit from training (α) equals the marginal cost given by (cn + b). Hence the first best solution is given by:

$$\hat{q} = 0,\ \hat{n} = (\alpha - b)/c,\ \hat{S} = (\alpha - b)^2 / 2c \qquad (6)$$

If trained workers who can quit can earn only their marginal product in non training firms, [viii] the planner can decentralise the first best solution by simply setting the second period wage in the training firm at a level which ensures that quits are zero. Denoting the second period wage paid in the training firm by w, only those workers for whom x exceeds w will quit. The upper bound of potential quitters wages is a^+. Hence the planner chooses:

$$\hat{w} = a^+ \qquad (6a)$$

Finally, in a decentralised setting, the planner has to ensure that workers are willing to undergo training. Denoting the first period training wage by t, the ex ante expected return to a worker from training is given by :

$$E(R) = t + (1-q)w + q\mu \qquad (7)$$

In order to undertake training E(R) must be at least as large as b, the certain return from not training. Thus the planner must offer a training wage $\hat{t}$ given by:

$$\hat{t} + a^{+} \geq b \tag{7a}$$

The essence of the discussion of this Section is captured in Equations 6, 6(a) and 7(a) and is summarised in Proposition 1 below

Proposition 1: *The first best solution requires quits to be zero so that the entire gains from acquiring firm specific skills are captured. The optimal investment in training is determined by setting the social marginal benefit equal to the social marginal cost. Trainees have to be paid enough over the two periods to ensure that they join the training programme and the second period wage in the training firm has to be high enough to deter all potential quits.*

Section 3: Training and Long Term Contracts

In this section we analyse the investment in training decision and the quitting decision in the absence of a social planner. The analysis is conducted under two different institutional frameworks. First, we consider the case where legally binding or otherwise credible long term wage contracts can be written. In the second case, we consider what happens when such long term contracts are – for whatever reason - not viable. The training firm offers a wage contract (t,w) where t is the spot wage offered to trainees in period 1 and w the (long term) wage offered to trained employees in period 2. The first case corresponds to a situation where the offer of w (to be paid in period 2) made in period 1 is credible in the sense that an offer of w made in period 1 will result in actual wage of w paid in period 2. In the second case, this will not happen. An ex-ante offer of w to be paid in future cannot be enforced in any way.

If w is the second period wage paid by the training firm, it knows ex ante that a proportion q of its trainees will quit where q is given by :

$$q = (a^+ - w) / (a^+ - a^-) \qquad (8)$$

Hence if the firm invests in n trainees, its total profits Π (revenue less two period wage bill and first period training cost) are given by :

$$\Pi = \alpha n(1-q) - [\ tn + (1 - q)n + (\tfrac{1}{2})c\, n^2] \qquad (9)$$

Substituting (7) into (9), and noting that $\beta = (1-q)\,\alpha + q\,\mu$, yields :

$$\Pi = \beta n - (\tfrac{1}{2})c\, n^2 - E(R)\, n \qquad (9a)$$

When maximising profits, the firm must take into account the participation constraint $E(R) \geq b$. Indeed, since there is no reason why the firm should pay workers any premium , this constraint will be just binding. Hence $E(R) = b$. substituting into 9(a) above yields:

$$\Pi = \beta n - (\tfrac{1}{2})c\, n^2 - b\, n \qquad (9b)$$

The above expression for the firms profits taking full account of the participation constraint is the same as the expression for the social surplus given in (5). Hence the firm chooses the same values as the social planner and first best best is achieved.

Proposition 2: *With viable long term contracts, first best is achieved because the firm chooses exactly the same values viz.* $\hat{n}$, $\hat{t}$, $\hat{w}$ *as the Social Planner.*

However, in the absence of viable long term contracts, the second period wage offer of $\hat{w} = a^+$ is not credible. Workers know that in maximising profits the firm will in effect set two spot wages sequentially. Given a spot choice of t and n in period 1, the firms period 2 profits are given by:

$$\Pi_2 = n(1 - q)(\alpha - w) \qquad (10)$$

Second period profits are maximised by setting the monopsony wage given by:

$$\bar{w} = (\alpha + a^-)/2 < \hat{w} \qquad (11)$$

so long as $\alpha < \alpha_{max} = (a^+ - a^-) + a^+$. The ex-post monopsony power of the firm results in a wage which is too low, and hence induces inefficient quits. This in turn implies that the average productivity of skilled workers $\beta(\bar{w})$ is too low. The ex – ante profits of the firm are given by:

$$\Pi = \beta(\bar{w})\, n - (\tfrac{1}{2})c\, n^2 - b\, n \qquad (12)$$

And hence the firm hires:

$$\bar{n} = (\beta(\bar{w}) - b)/c, \qquad (13)$$

which is less than the social optimum. Thus the firm's inability to offer workers a credible wage which is high enough results in inefficient quitting, which in turn induces the firm to under-invest in training thereby reducing social surplus to:

$$\bar{S} = (\beta(\bar{w}) - b)^2 / 2c \qquad (14)$$

In the context of our model, the second period wage is actually a proxy for all future wages. Hence first best training investment and wage decisions require the presence of complete future labour markets. In most countries, there are very limited possibilities for writing such long term wage contracts. It is much more plausible that it is the monopsony wage and consequential investment decision that will be observed. This discussion, based on (11) to (14) is summarised in Proposition 3:

Proposition 3: *Since long term contracts cannot be easily written, the training firm's wage is set on the basis of its monopsony power resulting in too low a wage, too little training investment and a diminution in social surplus.*

Section 4: Union Power and Efficiency

In the previous section, the firm was able to fully exploit its monopsony power and force trained workers expected returns down to the level of the unskilled wage, viz. b. Hence the firm was able to capture the entire surplus generated by training. However, workers may well realise this and attempt to capture some of the surplus by forming a union. They have every incentive to do so. In this section we explore the implications of union formation.

We assume that the union is formed after the training firm engages n trainees. Thus the union is involved in bargaining with the firm over both first and second period payments. However, the firm retains the "right to manage" by unilaterally choosing the number it wishes to train. Thus the order of events is assumed to be:

First Period

1. Firm hires n trainees
2. Trainees form Union which bargains with firm over first period payment t

Second Period

3. Post training, union and firm bargain over w
4. Quits and production occur.

We assume Asymmetric Nash Bargaining and that the power of the union is exogenously given by $\theta \in [0,1]$. Union power depends on a range of factors - legislative, social and institutional. The union is characterised as behaving so as to maximise the gain to the median voter in the union. In characterising the outcome of the bargaining process, we ensure time consistency holds by solving the second period bargaining problem first.[ix]

Period 2 Bargain:

Let w* denote the bargained second period wage. Trained workers whose outside wage x exceeds w* will quit and leave the union. The outside options of those trained union members who stay in the training firm is uniformly distributed on $[a^-, w^*]$. Thus the outside option of the median union member is given by $x_m = [a^- + w^*] / 2$. Hence the gain to the median member from striking the bargain is given by $(w^* - x_m)$. Under the Median Voter Model this is also the gain to the union - which we denote by U_2. Thus :

$$U_2 = [w^* - a^-] / 2 \qquad (15)$$

The gain to the firm from striking a second period bargain of w* is its second period profits, given that n and t had already been set in period 1. This is given by:

$$\Pi_2 = n(1 - q^*)(\alpha - w^*) \qquad (16)$$

Hence the solution to the bargaining problem is given by :

$$w^* = \text{argmax } B_2 = (U_2)^{\theta} (\Pi_2)^{1-\theta} \qquad (17)$$

i.e.

$$w^*(\theta) = [\alpha + (1 - \theta) a^-] / [2 - \theta] \qquad (18)$$

Comparing (18) with (11), it can be see that $w^*(\theta=0) = \overline{w}$, which simply asserts that if the union has no power , the bargained wage will be the monopsony wage set by the firm. Furthermore from (18) it is clear that the bargained wage increases with union power as $w^*_{\theta} > 0$. As one would expect, increases in union power raise the wage. This has the effect of lowering inefficient quits q* and thereby increasing β^*, the average productivity of trainees. As θ increases from zero, driving up the wage, quits decrease from their maximum (given by $\bar{q}$) to their minimum efficient level of zero when the wage is bargained up to a^+ . This occurs if the bargaining power of the union is given by :

$$\theta^* = [2 a^+ - a^- - \alpha] / [a^+ - a^-] \qquad (19)$$

From the viewpoint of period 2 only, (19) characterises the optimum level of union power because when $\theta = \theta^*$, quits are zero, and β, the productivity of trained labour is at its maximum of α. This does not necessarily mean that $\theta = \theta^*$ is the optimal level of union power. Although quitting inefficiency is minimised at $\theta = \theta^*$, it is not clear that optimal training investment will occur. The power of the union to force up the second period wage may result in cutting the firms profitability so much that it will reduce training investment. To investigate this issue, we need to consider the first period bargain too.

Period 1 Bargain :

When bargaining over the first period payment t, both parties know the value of the second period payment that will emerge from the bargaining process. In the first period, all workers are the same and so the gain to the union is just the rent, r, that it can extract for the typical worker. Obviously this rent r is given by:

$$r = E(R) - b = [t^* + w^*(1-q^*) + \mu^* q^*] - b \qquad (20)$$

where t^* is the bargained value of the first period payment. Since w^* (and hence q^*, μ^*) are known,[x] bargaining over r is equivalent to bargaining over t. The firm's gain is just its ex-ante profits given by (9a). Noting that E(R) = r + b, the firm's gain from bargaining is:

$$\Pi = [\beta^* - (r + b)]n - (½)c\, n^2 \qquad (21)$$

Thus the bargained value of r is given by :

$$r^* = \text{argmax } B(r) = \{r\}^{\theta} \{[\beta^* - (r + b)]n - (\tfrac{1}{2})c\, n^2\}^{1-\theta} \qquad (22)$$

which yields:

$$r^* = \theta\, [\, \beta^* - b - (c/2)n] \qquad (23)$$

The bargained value of t* is then obtained from (20). It is obvious from (23) that for given n, the union extracts a higher rent as θ increases. If θ is zero, then r* is also zero, and we are back at the model of the previous section.

Finally, given that the firm can anticipate the bargained value of r*, it will choose n to maximise profits given by (21). Denoting profit maximising investment in trainees by n*, it follows that:

$$n^* = [\, \beta^* - r^* - b\,] / c \qquad (24)$$

The simultaneous solution of (23) and (24) yields the values of r* and n* whilst the value of w* is obtained from (18). Together these comprise the outcome as a function of θ. For convenience, these are stated below:

$$w^*(\theta) = [\, \alpha + (1 - \theta)\, a^{-}\,] / [\, 2 - \theta\,] \qquad (25a)$$

$$r^*(\theta) = \{\theta / [\, 2 - \theta\,]\}\{\beta^* - b\} \qquad (25b)$$

$$n^*(\theta) = \{[2(1 - \theta)] / [\, 2 - \theta\,]\}\{\beta^* - b\}\{1/c\} \qquad (25c)$$

The question of interest is the influence of θ on n*. Note that as $\theta \rightarrow 0$, $n^* \rightarrow \bar{n}$, and as $\theta \rightarrow 1$, $n^* \rightarrow 0$. Also note that for large θ ($\theta > \theta^*$) , β* is bounded by α but r* continues to rise with θ so that (β* - r*) falls as θ rises beyond θ*. Hence from (24) , n* falls as θ rises as θ rises beyond θ^*. Finally, for small enough b, it can be shown that ($dn^*/d\theta$) < 0 as $\theta \rightarrow 0$. Hence we get :

Proposition 4: *As union power θ increases from zero: (1) the second period wage w^* rises reducing quitting inefficiency; however (2) the rent extraction by the union increases thus cutting into firm profitability ; and (3) the firm responds by reducing its training investment n^*.*

In effect increased union power protects the firm's investment better but at the same time lowers the investment level. What is the net effect on efficiency of these two conflicting implications of increased union power? By substituting (24) into (5) we obtain the social surplus as:

$$S^*(\theta) = [(\beta^* - b)^2 - (r^*)^2] / (2c) \qquad (26)$$

Since c is a constant only the numerator of S^* varies with θ. Let

$$\phi^*(\theta) = [(\beta^* - b)^2 - (r^*)^2] \qquad (27)$$

Then maximising ϕ is equivalent to maximising S^*. From the F.O.C. for maximising ϕ, it follows that $\hat{\theta}$, the optimum value of θ, is given by the solution to:

$$[\beta^*(\theta) - b](d\beta^*/d\theta) = [r^*(\theta)] (dr^*/d\theta) \qquad (28)$$

Furthermore it can be shown that ($d\phi/d\theta$) > 0 for $\theta \rightarrow 0^+$, and ($d\phi/d\theta$) < 0 for $\theta \rightarrow \theta^*$. Hence, by continuity, there exists a $\hat{\theta} \in (0, \theta^*)$ for which a solution to (28) exists. This value of θ maximises social efficiency. At this optimum value of union power, some quits will occur, so it cannot be first best. These results are summarised below.

Proposition 5: *There is a socially optimum level of union power $\hat{\theta}$ at which social surplus is maximised. However, even this optimum level of union power does not replicate first best.*

In effect as union power θ increases from zero the positive effect of reducing quitting inefficiency outweighs the negative effect of reducing training investment. However as union power continues to rise, the negative effect gets stronger whilst the positive effect peters out. Thus a moderate level of union power is socially desirable in the absence of long term contracting possibilities. It should be emphasised that the institution of the trade union is at best a partial substitute for the institution of long term wage contracts. First best outcomes cannot be achieved by the union. Whilst having a union with moderate union power is better than no union, institutionalising union power carries the risk that very powerful unions rent extraction will be so strong that social surplus may fall below the level generated by no union at all. Finally it should be noted that the paradox of increased productivity with falling profitability is resolved. Indeed, the fact that unions rent seeking activities damage firm profitability and investment at the same as increasing productivity, *but at different rates*, is at the heart of the optimum union power result. In the next section , we use numerical simulations to provide some feel for the rates at which social surplus rises and declines with increasing union power.

Section 5: The Impact of Union Power

The main feature driving the results of the model is the productivity gap between trainees who stay with the training firm and those who quit. This gap is attributed to the fact that training programmes typically impart some firm specific skill in addition to general skills. A simple measure of this gap is α - a^+. If α is very small relative to a^+, then the productivity gains from not quitting are small. Indeed should α fall below a^+ , then the optimal number of quits is not zero. In this circumstance, the level of union power which achieves optimal quits will be lower than in the model described above. On the other hand if α is very high, then even the monopsonist firm will set the optimal second period wage of a^+ and choose the optimum level of investment in training.

The major factor determining the results is the level of optimum of union power as determined by (28) above. This a non-linear equation with no closed form solution. Hence we use numerical simulations to illustrate the importance of α on the impact of unionism . We compare optimum unionism both with first best and with no union at all. The two measures we use are the loss from optimum unionism compared with first best and the gain from optimum unionism compared with no union at all. Denoting these measures by L and G they are calculated as follows:

$$L= 100 [(S^*-\hat{S}) / S^*] \qquad (29a)$$

and

$$G = 100 [(S^* - \bar{S}) / S^*] \qquad (29b)$$

We start by choosing a base line for the four parameters a^+, a^-, b and c. In choosing these it should be noted from the solutions above , that w* and r* are homogeneous of degree 1 in the productivity parameters whereas $\bar{S}$, S* and $\hat{S}$ are homogeneous of degree

1 in the productivity parameters and c, the marginal cost parameter. Also from (29) it can be seen that both L and G are homogeneous of degree zero in all the parameters.[xi] Hence the absolute scale of the productivity parameters is not important and neither is the choice of c, the marginal cost parameter.

Accordingly we take as our base line $a^+=40$, $a^- = 20$, b=5 and c = 0. We set the value of α to be in excess of a^+ by 1% to 30% in small steps. [xii]**.** We calculate the changes in optimum union power, the corresponding second period wage and the corresponding change in efficiency as α changes from 1% to 30% in excess of a^+, the upper bound of productivity based on general skills only. The results are summarised in Table 1 below.

From the table it can be seen that increases in α increase the degree of optimal union power albeit slowly. However the consequent impact on G is fairly rapid. Comparing the calculations for w* with $\overline{w}$, the optimal wage premium rises from nearly 5% to 10% as α increases. This is not inconsistent with the actual wage premia that previous research has established. It can also be see that increases in α reduce the loss from unionism compared to first best. In interpreting the table one should note that the numerical results are intended to be illustrative. They highlight the importance of the firm specific component of training. [xiii]

Table 1: The Impact of α on Efficiency

Base Line Parameter Values

a +	a -	delta	b	c
40	20	20	5	0.01

How do Unions Do?

α (% increase over a+)	α (abs. value)	$\hat{\theta}$ opt. union power	w* opt. union wage	r * opt. union rent	$\overline{w}$ wage with no union	$\overline{S}$ Surplus with no union	S* Surplus under Opt. Unionism	$\hat{S}$ First Best surplus	L % Loss from Opt. Union (relative to first best)	G % Gain from Opt. Union (relative to no union)
1%	40.40	0.25	31.66	4.78	30.20	53802	54945	62658	-12.31	2.12
5%	42.00	0.25	32.57	4.98	31.00	58055	59581	68450	-12.96	2.63
10%	44.00	0.30	34.12	6.52	32.00	64082	66170	76050	-12.99	3.26
15%	46.00	0.30	35.29	6.89	33.00	70970	73812	84050	-12.18	4.00
20%	48.00	0.30	36.47	7.28	34.00	78805	82536	92450	-10.72	4.73
25%	50.00	0.35	38.18	9.34	35.00	87676	92479	101250	-8.66	5.48
30%	52.00	0.35	39.39	9.89	36.00	97682	103813	110450	-6.01	6.28

Section 6: Conclusions

We analyse the effects of unions on efficiency in a dynamic context where on the job training is an essential ingredient of the production process. Provided the training programme imparts some firm specific skill in addition to general skills, then in the absence of long term contracts, the training firm will exploit its ex-post monopsony position to drive down the skilled wage below the socially optimum level. It will also under-invest in training. A union acts as a partial counter to this by forcing the skilled wage up thereby reducing the inefficiency of wasteful quitting. This result formally articulates the essential intuition behind the exit-voice model. However, by cutting into the firm's profitability the union lowers training investment even more. This impact of union formation tends to lower the firm's profitability and social efficiency. The paradox of increasing productivity with lower profitability is resolved. Essentially the union not only increases productivity but grabs part of the surplus from training rather than allowing the firm to appropriate the entire surplus.

The overall impact of union power on efficiency is the sum of these two effects - the first (lower quits) being efficiency increasing but the second (lower training investment) being efficiency reducing. It is shown that there does exist an optimum level of union power which maximises efficiency. There is no way in which union power can replicate first best. Note that here a wage premium does not by itself indicate the presence of a distortion which needs removing. Indeed the simulations tentatively suggest that observed wage premia due to unionism are of the order that may not be inconsistent with efficiency maximisation. Certainly, there is no obvious suggestion that further cuts in union power will increase efficiency. However, the model does illustrate the risk of too large a level of union power. Industrial relations regulations need to be carefully framed to avoid the potentially damaging impact of too much union power. Our model is not as optimistic about the economic role of unions as early views on the exit-voice model (such as Freeman and Medoff (1984)) suggested. The traditional route by which unions lower efficiency is present as well.

Finally, we note the importance of the magnitude of the skill gap between unionists who stay in the training firm and those who quit. It remains at present an elusive albeit important piece of information. Only detailed micro surveys can reveal how large this gap - which reflects the relative importance of firm specific skills - is. Further research in this area is needed in order to clarify whether the role of trade unions in the economy is efficiency enhancing. The generalisation of the present partial equilibrium framework with a local union into a general equilibrium framework with several unions which may bargain jointly or in competition with each other would also be a useful addition.

ENDNOTES

[i] Using a similar CGE framework, Devarajan et.al. (1997) show that for Bangladesh and Indonesia, the presence of trade unions amplifies the gains from trade liberalisation.

[ii] For a dissenting view on the importance of exit-voice mechanisms in the UK, see Bender and Sloane(1998).

[iii] In an interesting study, Aghion et.al.(1998) use a limited information seach model to discuss the efficiency issue. They demonstrate that if search effort and effort on the job are unobservable substitutes, then multiple equilibria may exist. They argue that in these circumstances, unions may have a co-ordination role in establishing the Pareto superior equilibrium.

[iv] This conclusions is similar to that of Menezes et.al. (1998)

[v] This section is very similar to Booth and Chatterji (1998)

[vi] There is no obvious reason why first period production of unskilled labour should be zero. This assumption is made for convenience. However, since the "second period" represents the entire future, production in the second period wholly dominates that in the first, and consequently the assumption is harmless.

[vii] The assumption that x has a uniform distribution is not crucial but it greatly simplifies the calculations, especially in section 4 where the unionisation case is discussed. The assumption is not require at all in Sections 2 and 3 as shown in Booth and Chatterji(1998) .

[viii] This effectively amounts to assuming that competitive labour markets prevail amongst non- training firms.

[ix] The equilibrium we calculate is sub game perfect.

[x] Obviously $\mu^* = (w^* + a^+)/2$

[xi] These homogeneity properties are the main advantage of the unifoprm distribution.

[xii] The value of c was chosen so that when α is 5% in excess of a, the optimal size of training pool is plausibly large at 3900 trainees. Small firms are unlikely to provide much on the job training.

[xiii] Experiments with other values for the base line were conducted. For instance , for α = 50, b= 5, c=.01, a mean preserving increase in the spread $[a^+,a^-]$ from [40, 20] to [45,15] reduces the value of optimal union power slightly,and also reduces the value of G from 5.48% to 4.94 %. This and other experiments are not reported in detail because changing the baseline had very small impacts compared to changing α.

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