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Wage-Employment Determination and a Union Tax on Capital: Can Theory and Evidence be Reconciled?

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Abstract

If unions appropriate quasi-rents from relation-specific capital, observed factor prices no longer reflect effective costs. Unionism has effects akin to a partial factor tax on capital. Demand curve settlements need not imply higher K/L among union firms.

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1. Introduction

Are wage-employment outcomes in unionized markets on or off the labor demand curve? If off the demand curve, are outcomes on a vertical contract curve wherein unions have no effect on factor mix (the ‘strong efficiency’ case)? These questions have been the focus of much recent theoretical and empirical work.¹ This research has lent mixed support to off-the-demand curve bargaining models while casting doubt on the applicability of the standard on-the-demand curve model.

In this paper, it is argued that unions capture some share of the quasi-rents that make up the normal returns to long-lived capital. The ‘capture’ has the same economic effects as a partial factor tax on capital. A union ‘tax’ on capital has important implications for the debate regarding wage-employment determination in labor markets. First, the prediction from the demand-curve model that unionization typically increases the K/L ratio no longer follows - even assuming standard technologies, the change in capital intensity is likely to be indeterminate. Second, measured own-firm wage rates include transfers from the tax on capital and may overstate the effective cost of labor to the firm, while at the same time, the effective capital price has risen. Thus, empirical tests of on- versus off-the-demand curve models relying on the comparison of firm employment response to own and opportunity-cost wage rates may be invalid. And third, the conclusion (e.g., Clark, 1984) that the finding of similar K/L ratios among union and nonunion companies supports strong efficiency and the bargaining model does not follow, since an invariant ratio may be fully consistent with wage-employment determination on a labor demand curve, while efficient bargains with a tax on capital imply lower K/L among union companies.²

Below, the likelihood of there being a union tax on long-lived or relation-specific capital is discussed in section 2. Section 3 develops the standard demand curve union monopoly model, with and

¹ Among the more widely-cited articles are McDonald and Solow (1981), Brown and Ashenfelter (1986), MaCurdy and Pencavel (1986), and Abowd (1989). Manning (1987) provides a framework that encompasses both the labor demand and efficient bargain models. Johnson (1990) and A. Clark (1990) present insightful analyses of bargaining over employment, work rules, and factor mix. For a trenchant analysis of empirical tests of the efficient contracts model, see Pencavel (1991). Oswald (1993) provides a relatively complete list of references.

²The finding of a one-for-one tradeoff between unexpected union gains and shareholder losses (Abowd, 1989), although consistent with ex post strongly efficient bargaining, does not rule out ex ante inefficiency in which there is underinvestment in capital.

without a capital tax. We also show how effects similar to those from such a tax can be generated endogenously. In section 4, we summarize outcomes from an efficient bargaining model, with and without the union tax on capital and with different choices for the disagreement point. A final section discusses the implications of this analysis.

2. Union Appropriation of Returns to Capital Investment

Both the standard demand curve and off-the-demand curve models treat the observed union wage rate and rental rate of capital as representing the effective factor prices facing the firm. Compensation of union labor, however, is an outcome of bargaining and includes union appropriation of returns associated with market power and the quasi-rents that make up normal returns to long-lived tangible and intangible capital.³

The union appropriation argument is relatively straightforward. Once relation-specific capital is in place, the quasi-rents that make up the normal returns to capital are vulnerable to capture by union labor with some degree of bargaining power. The firm will voluntarily share some portion of the returns rather than endure a strike and/or shut down. The union tax acts like a wedge between social and post-tax (post-union) rates of return on investment. In response, the firm will reduce its investment until the post-tax rate of return is equivalent to the opportunity cost of funds. Because the life of relation-specific capital is often long relative to the length of a contract or to credible noncontractual commitments by the parties, a cooperative bargaining arrangement that would permit optimal capital investment is unlikely. Although strategies exist to produce incentive compatibility between the union and shareholders (Baldwin, 1983; and, in a broader context, Dow, 1993), underinvestment is likely when long-term relationships are governed by short-term contracts (Grout, 1984).

The argument here is that the union tax on capital raises the effective price of capital to firms, since the subsequent returns must cover the opportunity cost of funds plus a transfer to union labor. The implications of this approach are important. The standard conclusion that unions raise the price of labor

³There is a sizable theoretical literature; see, for example, Baldwin (1983), Grout (1984), and, more recently, Dow (1993). Hirsch (1991) provides empirical evidence of union effects on investment in R&D and physical capital by firms.

relative to capital no longer follows. Unions may increase the effective price of capital as well as labor; their effect on relative factor prices is indeterminate. Moreover, neither measurable labor compensation nor the market rental rate is likely to reflect the effective price of factors. Labor compensation reflects in part a transfer from capital and thus may overstate the effective price of labor; capital costs (e.g., market interest rates) fail to include the union tax on capital and thus understate the effective price of investment. Empirical papers utilizing observable factor prices to test alternative theories of union wage-employment determination, therefore, may be flawed.

An additional implication is that the empirical finding of little union effect on the capital-labor ratio may be more consistent with a demand curve outcome than with efficient bargaining. Union companies operating on a labor demand curve may employ capital-labor ratios similar to nonunion companies because effective relative factor prices are similar. In the long run, union companies reduce both employment and capital investment in the face of union rent-seeking, but there is relatively little distortion in factor mix. Note, finally, that throughout the paper we refer to firms as being either union or nonunion. Where firms include a mix of union and nonunion plants or operating units, the analysis is less straightforward. On the other hand, “mixed” firms may have firm-wide bargaining and small intrafirm and interplant wage differentials between union and nonunion workers. In this case, there is little scope for firm investment responses to take the form of intrafirm reallocations of resources. On the other hand, if capital can be transferred readily within the firm through production and plant location decisions, intrafirm resource reallocations may be an important way in which firms respond to union rent seeking. Mixed firms are not explicitly modeled in our analysis.

3. Noncooperative Outcomes; Settlements on the Demand Curve

In this section, we present a union monopoly model with wage-employment settlements on the labor demand curve. First, the standard case of a union wage increase is examined. Following that, a union tax on capital is introduced. Finally, a noncooperative model is presented where the economic

effects are similar to those from a union ‘tax’, but are generated endogenously.⁴ In addition to supporting the empirical points raised in this paper, this model is of interest in its own right since it provides an analysis of a noncooperative game between firms and unions when firms must invest in specific capital.

A. *The Standard Case*

Let the union (or its representative member) maximize the following utility function:

$$(1) \quad V = WL + W_0(N - L) = (W - W_0)L + W_0N$$

where V is union utility, N is union membership, L is union employment, W is the union wage, and W_0 is the opportunity cost wage.⁵ Maximizing V is equivalent to maximizing $(W - W_0)L$, which is the form in which we write the union utility hereafter. The union maximizes V subject to the following factor demand curve constraints:

$$(2) \quad pF_L(K, L) = W,$$

$$(3) \quad pF_K(K, L) = r,$$

where p is product price, r is the rental rate on capital, and F_L and F_K are the marginal products of labor and capital, respectively. These constraints imply that the firm is a price taker in the product market - this is not essential to any of the conclusions of this paper.

The first order conditions for the maximization problem are:

$$(4) \quad W = W_0 - cpL,$$

where $c = (F_{LL}F_{KK} - F_{LK}F_{KL})/F_{KK} < 0$ from concavity,

$$(5) \quad W = pF_L,$$

$$(6) \quad r = pF_K.$$

Because $W > W_0$, it follows that less labor will be employed at the union wage than would be the case at wage W_0 . K/L will usually be higher since $W/r > W_0/r$.

⁴This model is a natural generalization of the on-the-demand curve case. The firm is required to commit capital before wages are determined. This temporal asymmetry (akin to the Stackelberg duopoly model) is the source the union ‘tax’ effects.

⁵As specified, the union values wages paid to employed members and the opportunity cost wage to members or potential members not employed in the union sector. Alternatively, V could be expressed more simply as rent

B. Noncooperative Settlements with a 'Union Tax'

Now introduce a tax on capital, t , which for simplicity we let be a proportional tax on capital. The union maximand is now

$$(7) \quad V = WL + W_0(N - L) + R = (W - W_0)L + W_0N + R$$

subject to

$$(8) \quad pF_L(K,L) = W,$$

$$(9) \quad pF_K(K,L) = r + t,$$

where R is union tax revenue ($R = tK$). First order conditions (when the union also chooses t) are:

$$(10) \quad W = W_0 - pLF_{LL} - pKF_{KL},$$

$$(11) \quad W = pF_L,$$

$$(12) \quad r + t = pF_K,$$

$$(13) \quad t = -pLF_{LK} - pKF_{KK}.$$

If $t > 0$, then we have lower investment in capital, and a lower capital-labor ratio, than in the standard case which assumes $t = 0$.

How does the combined union wage premium and capital tax affect factor utilization, as compared to the nonunion case? If $W/(r+t) = W_0/r$, implying no distortion in relative costs of labor and capital, and the production function is homothetic, then a noncooperative demand curve settlement results in equivalent capital-labor ratios for union and nonunion companies. *More generally, there need be no a priori presumption that unions raise the price of labor relative to capital and, therefore, no presumption that unions affect the factor mix in a consistent manner.*

How is the capital tax revenue, R , transferred to labor, and is the analysis above dependent on the type of transfer? The analysis to this point assumes the transfer is lump sum, so that the effective wage is W . But even if the transfer is not explicitly lump sum, our reasoning holds since $t > 0$ implies that the union effect on relative factor prices cannot be determined a priori. From our model, we cannot directly

maximization by employed members, with $V = (W - W_0)L$. Similar first order conditions and conclusions will result.

remark on non lump-sum transfers, but the following conjectures are plausible for a dynamic setting, with wages including transfers from capital. Now, even if firms could lower the capital tax R by economizing on labor through opportunistic short-run behavior, they may be constrained from doing so because it would lead to even higher future wages and lower employment that is obtainable by setting current employment based on W . Employers then treat W as the effective wage, while observed compensation, which includes the transfer from capital, overstates the effective price of labor. The lump-sum analysis therefore provides a good *approximation* of wage and factor use determination, even if the tax on capital is paid via an enlarged wage bill.⁶

C. Noncooperative Settlements: Endogenous 'Taxes'

The previous analysis assumes an exogenously given rate of union capture. We now show that this is not essential to the conclusions. The key economic effects continue to hold in a generalization of the model where firms are required to commit capital *before* wages are determined. This fact allows unions to obtain quasi-rents from capital. The problem has the following temporal structure. First the firm chooses a level of capital, then the union announces the wage, and then the firm decides how much labor to employ. We find the solution by backwards induction. In this case, the firm's maximization problem at its first choice is given by

$$(14) \quad \max_K pF(K, \bar{L}) - \bar{W}\bar{L} - rK,$$

where $\bar{W} = \bar{W}(K)$ and $\bar{L} = \bar{L}(K)$ are the solution to the union's problem:

$$(15) \quad \max_{W,L} L(W - W_0) \text{ subject to } pF_L(K, L) = W.$$

Note that the final choice of L by the firm has been encapsulated in the union's problem. The maximization conditions of the union yield

$$(16) \quad \bar{W}(K) = W_0 - pLF_{LL}(K, \bar{L}),$$

⁶ Although not in the direct context of our model, a complementary interpretation has been offered by Joe Stone Bargaining over work-rule restrictions limits employers' discretion over employment, except in response to product demand shifts. In this case, a wage premium on a fixed amount of labor and a tax on capital distributed lump sum to labor may be equivalent.

$$(17) \quad \bar{W}(K) = pF_L(K, \bar{L}),$$

which are solved to get \bar{W} and \bar{L} given K . The firm's initial capital choice problem (with \bar{W} and \bar{L} as functions of K) leads to the following condition:⁷

$$(18) \quad pF_K = r + L \frac{d\bar{W}}{dK}.$$

When the firm hires more capital, it considers its effect on wages, and consequently on the payment to labor. The last unit of K must compensate for r , and also the increase in this payment. This is as it should be. If the union has an incentive to change the wage it calls based on capital decisions, the firm should take this change into account when choosing capital.

The 'tax' generated above would disappear if the union could commit itself to a wage level first. In this case we would have the solution of the standard case outlined in section III-A. These equilibria can be seen in Figure 1. If the union calls the wage rate first, it accounts for the fact that the firm can choose both capital and labor and chooses a wage rate which maximizes its utility along the long-run labor demand (point A). Once capital is in place, however, if the wage commitment were not binding, it would have an incentive to call a higher wage at the equilibrium point B . So, if the wage decision were to be made after capital choice, the firm would not choose capital as at point A . In fact, the equilibrium would be at a point such as C , along new short- and long-run demand curves, $d\bar{q}$ and $D\bar{q}$, reflecting the tax on capital. Note that once we factor in the 'tax' on capital we cannot conclude anything about the capital-labor ratio. C involves, compared to A (when the 'tax' is positive), a lower use of capital and labor, a higher wage rate, and lower utility and profits.

In the case above, there is no open transfer of 'tax' revenues, though the union does attempt to obtain quasi-rents, given the capital choice, by calling a higher wage. When its behavior is factored into a

⁷Standard comparative statics shows that $d\bar{W}/d\bar{K}$ in this equation has the same sign as

$$-pLF_{LK}F_{LL} + pLF_{LLK}F_{LL} - pF_{LL}F_{LK}.$$

Familiar problems can arise with the union's maximization problem when the constraint ($W=pF_L$) is convex. When the constraint is concave, then the condition that $F_{LK} > 0$ and $F_{LLK} < 0$ are sufficient to ensure that $dW/dK > 0$. It thus seems reasonable to expect dW/dK to be positive.

firm's ex ante capital choices, the union will be worse off. When higher capital stocks increase the wage faced by the firm, the firm's decisions are distorted 'as if' it faced a partial factor tax on capital. Again, observed factor prices do not reflect effective costs.

4. Dynamics

The underinvestment result of the previous section relies upon the union's ability to charge a higher wage once specific capital is in place. Foreseeing this, the firm reduces capital until the "post-tax" rate of return is equal to the rental rate. As section III-C illustrates, this outcome (the subgame perfect equilibrium, point *C*, of Figure 1) is worse for both the firm and union. The difficulty here is that promises by the union to call a low wage after capital is installed would not be credible (given the temptation to force point *B* of Figure 1). Repetitions of this game (i.e., repeated bargaining) could change all that: the firm may be able to employ a threat to return to lower levels of capital in the future if the union chooses a high wage now. Is it then possible to sustain *A* as an equilibrium?

To examine this question we consider the infinitely repeated version of the previous game. The firm is assumed to maximize the discounted value of the infinite stream of profits, whereas the union maximizes the discounted value of the stream of one period utilities. Since both the firm and the union prefer point *A*, a folk theorem applies here so that if the players discount the future not at all, or very little, then point *A* can be sustained as a subgame perfect equilibrium of the repeated game.

The literature on repeated games is extensive. An application to union-firm wage-employment determination is Espinosa and Rhee (1989). The discussion below follows their lead in some respects, but there are significant differences. In particular, we restrict ourselves to points on the firm's demand curve for labor and ask whether points on the *long-run* labor demand, which are excluded by the union's inability to commit to a wage, are obtainable in the infinitely repeated version of the game. By assumption, solutions will always be on a short-run labor demand curve. As a simplification, it is also assumed that the union and firm are on a stationary path (i.e., $(K_p W_p L_t) = (K, w, L)$ for all t).

Given K and W , the employment by the firm is determined from the marginal product curve. Suppressing the dependence on K , we denote the labor choice of the firm by $L(W)$. Let \mathbf{d} denote the

union's discount factor, where $\mathbf{d} = 0$ implies complete discounting and $\mathbf{d} = 1$ implies no discounting.

$(K, W, L(W))$, point A in figure 1 is a subgame perfect equilibrium of the repeated game if

$$(19) \quad \Pi(K, W, L(W)) \geq \Pi(K_c, W_c, L_c),$$

$$(20) \quad U(\bar{W}(K), L(\bar{W}(K))) - U(W, L(W)) \leq \frac{\mathbf{d}}{1 - \mathbf{d}} [U(W, L(W)) - U(W_c, L_c)],$$

where $\bar{W}(K)$ is the wage which maximizes utility on the short-run labor demand given K (i.e., subject to $pF_L(L, K) = W$); and (K_c, W_c, L_c) gives the coordinates of point C in figure 1 (i.e., the equilibrium of the one-shot game).

The first condition states that the point $(K, W, L(W))$ on the long-run labor demand schedule should give a higher profit to the firm than the equilibrium of the one-shot game. The second condition requires that the maximum gain to the union from maximizing utility on the *short-run* labor demand (a movement from A to, say, B) should be no larger than the discounted value of future losses resulting from a movement to C . As mentioned above, we have assumed strategies whereby the union's defection from point A in any period (e.g., to B) leads the firm to perpetually choose capital levels implied by point C .

Point A cannot be sustained as a subgame perfect equilibrium for all values of \mathbf{d} . Recall that A is the solution to the maximization of $U(W, L)$ subject to the two constraints: $pF_L(K, L) = W$, and $pF_K(K, L) = r$. Now consider adding also the two constraints presented in (19) and (20) above. When $\mathbf{d} = 0$, signifying a myopic union that completely discounts future wage and employment losses, (K_c, W_c, L_c) is the only path which is sustainable; C will be on the long-run demand curve only when $d\bar{W}/dK = 0$, the 'no tax' case. On the other hand, when $\mathbf{d} = 1$, A will be sustainable. We can describe the dependence of the solution to this maximization problem on \mathbf{d} qualitatively. When \mathbf{d} is small, solutions are not on the long-run labor demand. When \mathbf{d} is close to unity, the solution is point A . As \mathbf{d} is reduced, we first stay on long-run labor demand but with lower levels of capital use (though the solution is no longer a tangency point of a union indifference curve); once \mathbf{d} becomes small enough we move off the long-run labor demand altogether.

The conclusions here qualify our previous results by making the underinvestment result depend

upon d , the union discount factor: for low values of d (a high discount rate) we have underinvestment, but for higher values there is little or no underinvestment. One interesting interpretation of d is as the probability that the firm-union relationship will continue. Then, certainty of continuation corresponds to $d = 1$, certainty of termination to $d = 0$. In the former case, the union will not extract quasi-rents from capital, but in the latter case, with no future relationship to invest in, it will.⁸

5. Efficient Bargaining with a Union Tax on Capital

Space constraints permit only brief mention of models with cooperative wage-employment outcomes and a union tax on capital. As stated previously, the standard strong efficiency case (see footnote 1) without a union tax leads to a competitive factor mix. As shown by Grout (1984) and others, however, union appropriation of the returns to capital results in a reduction in investment and a *lower* K/L ratio. In work not shown (but available on request), we consider a cooperative outcome when the disagreement point is given by the noncooperative solution of the previous section. In this model, the firm recognizes that it can affect the disagreement point of the union by its choice of K . This results in an even stronger underinvestment result than in the standard cooperative model. The important point for this paper is that neither the standard nor our extended efficient bargaining model is consistent with similar K/L ratios among union and nonunion companies.

6. Conclusions

Recent theoretical and empirical work has focused on the ability of unions to tax the quasi-rents that make up the normal returns to long-lived relation-specific capital. This paper shows that a union tax on capital has important implications for the debate regarding wage-employment determination in labor markets. The standard prediction from the demand curve model of a higher K/L ratio no longer follows; rather, the union effect on capital intensity is indeterminate a priori. Moreover, efficient bargaining models with a capital tax imply lower capital intensity in union than nonunion companies. Thus, the empirical finding of similar K/L ratios among union and nonunion companies (e.g. Clark, 1984; Hirsch, 1991) need

⁸ The latter is an extreme form of an end game. See Lawrence and Lawrence (1985) for an application to the U.S. steel industry.

not support strong efficiency and the bargaining model, since an invariant K/L ratio may be consistent with wage-employment determination on a labor demand curve. A higher K/L ratio in union firms is inconsistent with strong efficiency, but is consistent with a negatively sloped contract curve or a demand curve settlement wherein relative labor costs have risen. Finally, it is argued that the rental rate on capital understates its effective price to union companies, while labor compensation that includes transfers from capital overstates the effective cost of labor. Thus, empirical tests utilizing observable factor prices to test alternative theories of union wage-employment determination may be flawed.⁹

Although cooperative jointly maximizing bargaining models have considerable appeal, skepticism as to whether efficient wage-employment determination in unionized markets is the general rule is appropriate. Such skepticism stems in part from the observation that explicit bargaining over employment is not typical (Oswald, 1993), as well as the lack of strong evidence that unionization results in added employment, after controlling for the wage (Wessels, 1991). The arguments provided here also suggest that a rejection of demand curve models is premature. A model incorporating a union tax on capital suggests that a finding of similar capital intensity in union and nonunion firms can be fully consistent with settlements on a labor demand curve. On a broader and perhaps more disturbing note, the difficulty in observing effective factor prices facing firms calls into questions (in this literature and elsewhere) the reliability of inferences based on empirical estimates of cost and factor demand equations.

⁹ Manning (1994) also emphasizes the ambiguity of predictions from standard trade union models, once choice of the capital stock is considered endogenous. He presents a model in which ex post capital-labor substitution is less than ex ante substitution. A possible outcome is that union firms choose an 'inferior' technology that is labor intensive. This increases the labor demand elasticity, lowers the union wage, and increases employment, as compared to the standard union monopoly or 'right-to-manage' models. Baldwin (1983) also emphasizes that maintaining inefficient capital will mitigate union wage demands.

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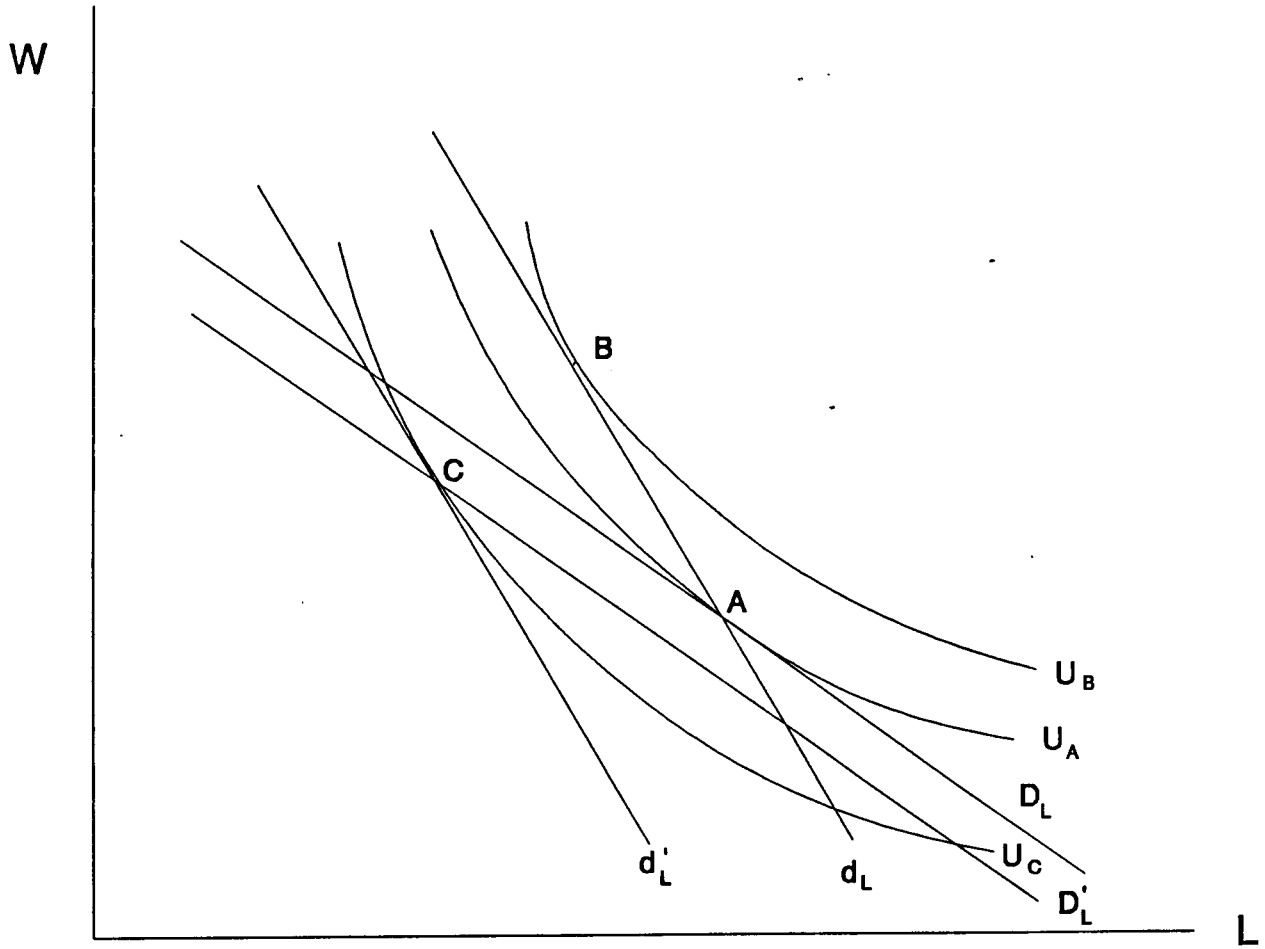


FIGURE 1: Noncooperative Wage-Employment Equilibria With and Without Union Tax on Capital