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This paper contains preliminary findings from research work still in progress and should not be quoted without prior approval of the author.

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I. INTRODUCTION

Most existing models of unionism assume that unions act as simple monopolists in selling labour, optimizing against firms' labour demand curves. Based on this premise, a wide variety of predictions have been made regarding union wage and employment policy, the distribution of unionism in the economy, and the consequences of union wage policies, in a general equilibrium setting, for other sectors of the economy. As well, the welfare and efficiency aspects of these kinds of unions in the economy as a whole are by now quite well understood. Examples of pieces that examine one or more of the above questions for the "monopoly unions" case are Dunlop (1950), Oswald (1982), Johnson and Mieskowski (1970), Lazear (1983), and Grossman (1983). Unfortunately, these monopoly models have a number of important limitations, including a general disregard for entry and exit decisions by firms (it is virtually always assumed that firms earn enough rents for the pure monopoly equilibrium condition to be sustainable), and the assumption that unions and firms pursue a policy which can clearly be improved on by negotiation over employment levels, or by setting non-linear wage schedules, etc.

Recently, interest in models of unionism that do not assume such inefficient monopoly behavior seems to have revived. Such models of "efficient" unions are presented in Leontief (1946), de Menil (1971), Hall and Lilien (1979), and Macdonald and Solow (1981), and are tested empirically in MaCurdy and Pencavel (1983) and Martinello (1984). Unfortunately, however, the implications of these models for questions such as union incidence, general equilibrium, and overall economic efficiency are as yet poorly understood, since all the above models are in a strict partial-equilibrium framework. This leaves unanswered some very interesting questions, such as: If individual unions and firms

arrive at efficient contracts, does the existence of unions have any efficiency effects for the economy as a whole, or are unions' effects purely redistributive?

This paper presents a general equilibrium model of "efficient unions" which explicitly treats entry and exit decisions of firms (or equivalently in our case, entrepreneurs). It derives some interesting predictions regarding the incidence of unionism and the pattern of union-nonunion wage differentials (in our case, by firm size) throughout the economy. It allows for comparative statics to be done on the effects of policy parameters (that affect the costs of unionization, or the costs of fighting a union). Finally, it provides a welfare analysis of efficient unions in the economy as a whole which points out two potentially important welfare effects of unions: (1) resources spent directly in rent-seeking or "rent-defending", and (2) a misallocation of the population between entrepreneurial and production activities, that are not generally noted elsewhere, and may be more important than the standard triangle measure of DeFina (1983), for example.

Section II of the paper sets up the basic model in an economy where there are no unions. Section III introduces unions into the model, and compares the equilibrium with and without unions. Section IV parameterizes the model more fully, solves out a numerical example, and performs some simple comparative statics in that context. Finally, Section V considers some alternative specifications of the model including one which, for comparison, introduces monopoly unions into the present general equilibrium setting, with endogenous entrepreneurship and labour supply decisions.

II. A SIMPLE MODEL OF WAGES AND ENTREPRENEURSHIP

The model we examine has its origins in analyses of firm formation such as Tuck (1954), or Rosen (1982). These models have in common the fact that they endogenize the decisions of individuals to form firms, as well as the structure of these firms, although none of them analyzes unionism. They provide a useful context within which to examine "efficient unionism" (a) because they generate a set of interesting predictions relating variables like unionism and union wage effects to observable structural variables like firm size, and more importantly, (b) because they allow us to pay closer attention to the entry and exit decisions of firms in a general equilibrium setting, which is a key feature of "efficient unions" models (and indeed of properly formulated monopoly union models).

We assume an economy with no capital and a fixed population of risk neutral[1] individuals, which we normalize to equal one. Individuals have a choice of two possible activities: being a worker or being an entrepreneur. All individuals are equally productive as workers and supply one unit of simple labour if they work. Individuals differ in terms of their productivity as entrepreneurs, α, which can be thought of as efficiency units of "entrepreneurial ability". The density of α is given by $h(\alpha)$, and its cumulative distribution function by $H(\alpha)$.

All firms in this economy are run by a single entrepreneur,[2] produce an identical output, and have a common production function given by:

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[1] Risk neutrality is not required until unions are introduced in Section III. Even there it is not of great consequence.

[2] This is a result of the model guaranteed by the concavity of the production function. If the production function were not concave, due, for example, to public goods aspects of managerial decision making, as Rosen (1982) has suggested, then "multi-level" firms with more complex hierarchies might be optimal. This is beyond the scope of the present analysis.

$$F(\alpha, n(\alpha)) \tag{1}$$

where α is the talent of the entrepreneur running the firm and n is the number of workers he or she hires. We assume F is concave, with $F_1 > 0$, $F_2 > 0$, $F_{12} \geq 0$, $F_{11} \leq 0$, and $F_{22} < 0$.

The "profits", or income , of an entrepreneur with ability α are defined as:

$$\pi(\alpha) = F(\alpha, n(\alpha)) - w_n n(\alpha) \tag{2}$$

where w_n is the wage rate paid to all workers in the economy, measured in units of the single consumption good produced. The <u>rents</u> earned by an entrepreneur with ability α are defined as:

$$\begin{aligned} F(\alpha) &= \pi(\alpha) - w_n \\ &= F(\alpha, n(\alpha)) - w_n[n(\alpha) + 1] \end{aligned} \tag{3}$$

which is just profits or income minus the opportunity cost of the entrepreneur's own time.

Clearly, the problem of determining equilibrium in this economy involves dividing the population into workers and entrepreneurs and setting up "firms" that each associate one entrepreneur with a given number of workers. The equilibrium must satisfy three conditions: First, each entrepreneur chooses an n, or "firm size", that maximizes his profits. Second, all entrepreneurs must (weakly) prefer to be entrepreneurs, and similarly for workers. Third, the number of workers hired by all the entrepreneurs must equal the total number of individuals who choose to be workers. These three conditions are presented formally in turn below; together they describe the equilibrium of the economy.

(i) Each entrepreneur's choice of optimal firm size results from maximizing profits with respect to n. This yields the set of conditions:[1]

$$F_2[\alpha, n(\alpha)] = w_n \tag{4}$$

which must hold for all individuals who choose to become entrepreneurs. Differentiating (4) for a given α yields the behavioral responses of an entrepreneur to a change in the wage rate,

$$\frac{\partial n(\alpha)}{\partial w_n} = \frac{1}{F_{22}} < 0 \tag{5}$$

while differentiating (4) with respect to α yields:

$$\frac{\partial n}{\partial \alpha} = \frac{-F_{21}}{F_{22}} > 0 \tag{6}$$

which indicates that more able entrepreneurs will run larger firms. Finally, applying the envelope theorem to (2) implies that

$$\frac{d\pi}{d\alpha} = \frac{\partial \pi}{\partial \alpha} = F_1 > 0 \tag{7}$$

This implies that, for any given wage rate, the profits of an individual as an entrepreneur increase monotonically with α. Thus, equilibrium will involve all individuals above a certain critical level of α being entrepreneurs and all those below it being workers. We call this level α^*, and characterize it below.

(ii) Given the result immediately above, it is apparent that equilibrium selection into worker and entrepreneur status requires only that the marginal entrepreneur earn zero rents, that is:

$$R(\alpha^*) = F[\alpha^*, n(\alpha^*)] - w_n[n(\alpha^*) + 1] = 0 \tag{8}$$

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[1] Second-order conditions are guaranteed by $F_{22} < 0$.

or

$$\pi(\alpha^*, w_n) - w_n = 0 \ ,$$

where $\pi(\cdot,\cdot)$ is the indirect conditional profit function dual to (1). It is easily shown that maximized rents fall as wages increase, and it is also apparent that all entrepreneurs <u>but</u> the marginal ones (with talent α^*) will earn strictly positive rents.

(iii) The "adding up" condition for our economy is simply:

$$H(\alpha^*) = \int_{\alpha=\alpha^*}^{\infty} n(\alpha)h(\alpha)d\alpha \qquad (9)$$

The right-hand side adds up the labour demanded by all the entrepreneurs, which must be equal to the number of workers (the left-hand side). Condition (9) implies that an "across-the-board" fall in $n(\alpha)$ (induced, say, by a rise in wages) would require a decrease in α^*, with more individuals deciding to be workers and fewer choosing entrepreneurship.

Equilibrium in this simple economy is completely characterized by equations (4), (8), and (9). We note four main aspects of this equilibrium in turn here.

First, although equation (4) actually represents a continuum of conditions, the model's equilibrium α^* and w_n can in fact be expressed simply as the intersection of a "demand for workers" and "supply of workers" curve, as follows. First, imagine the continuum of solutions $n(\alpha)$ obtained from (4) for all possible values of α and substitute them into (9). Since <u>each</u> $n(\alpha)$ falls with w_n, this generates a downward-sloping relationship between w_n and α^* which we call the "demand for workers" curve, or $\alpha^* = D(w_n)$, $D' < 0$. Second, consider the behavior of condition (8) when w_n changes; in other words, the

behavior of the marginal entrepreneur's maximized rents when wages change. Profits fall with w_n, so to restore the equality in (8), α^* must rise when wages rise (the marginal entrepreneur will now be a more talented person, as some less able entrepreneurs have decided to become workers). Call this positive relationship between w_n and α^* the "supply of workers" curve, or $\alpha^* = S(w)$. The wage and "occupational choice", α^*, that equilibrates this economy must be at the intersection of $D(w_n)$ and $S(w_n)$ in Figure 1; because $D' < 0$ and $S' > 0$, we know this equilibrium is unique.

Second, the model has a number of implications for the distribution of incomes, rents, and firm sizes, which are easily summarized. First, as Figure 2 indicates, all workers as well as the marginal entrepreneurs get the same wage, w_n, whereas all inframarginal entrepreneurs earn an income, $\pi(\alpha)$, that exceeds w_n. Among those entrepreneurs, it is easy to show that (a) profits increase with talent, α, at a non-increasing rate, (b) rents increase with α at the <u>same</u> rate as profits do,[1] (c) profits and rents both increase with firm size at the same rate, which may be increasing or decreasing,[2] and (d) rents <u>per worker hired</u> (an important quantity in subsequent analysis) behave as follows:

$$\frac{d}{d\alpha}\left(\frac{R}{n}\right) = \frac{1}{n^2}\left\{\frac{dR}{d\alpha}\, n - \frac{dn}{d\alpha} R\right\}$$

$$= \frac{1}{n^2}\left\{F_1 n + \frac{F_{12}}{F_{22}} R\right\} \qquad (10)$$

---

[1] To see (a) and (b), note that $\frac{d^2R}{d\alpha^2} = \frac{d^2\pi}{d\alpha^2} = F_{11} + F_{12}\frac{dn}{d\ell} = F_{11} - \frac{F_{12}^2}{F_{22}}$, which is negative if the production function is concave.

[2] This follows from $\frac{dR}{dn} = \frac{d\pi}{dn} = -\frac{F_1 F_{22}}{F_{12}} > 0$.

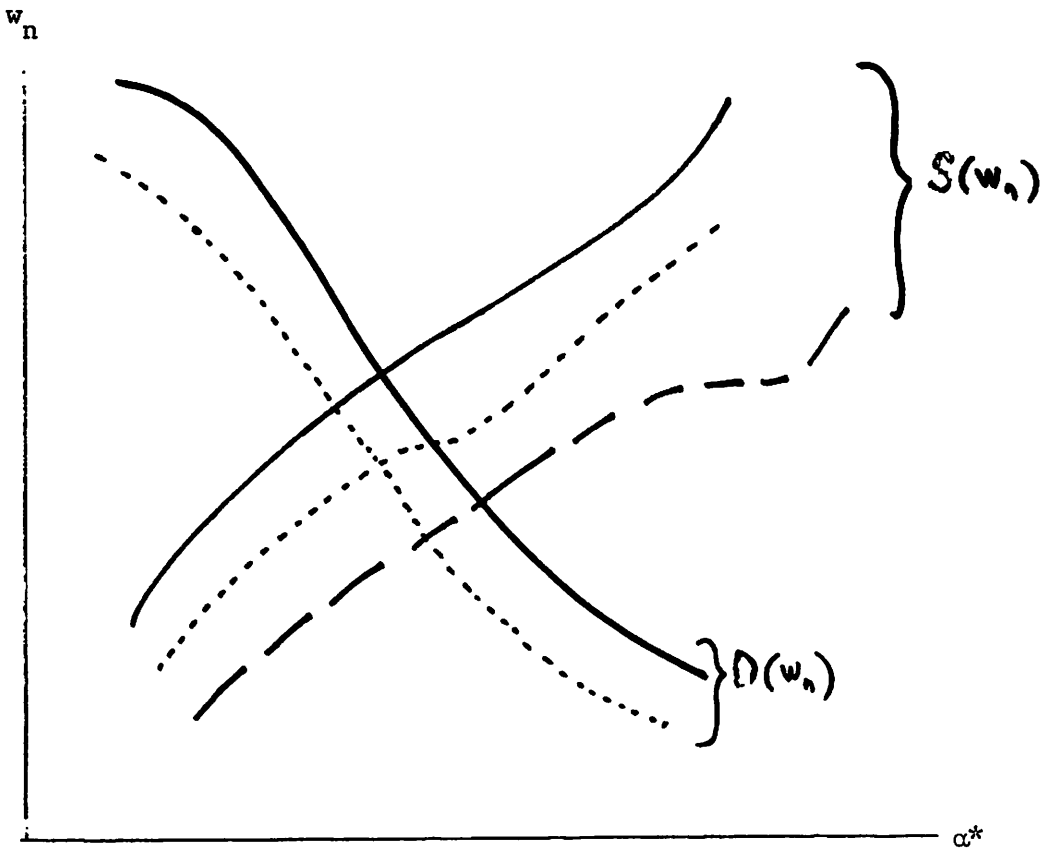


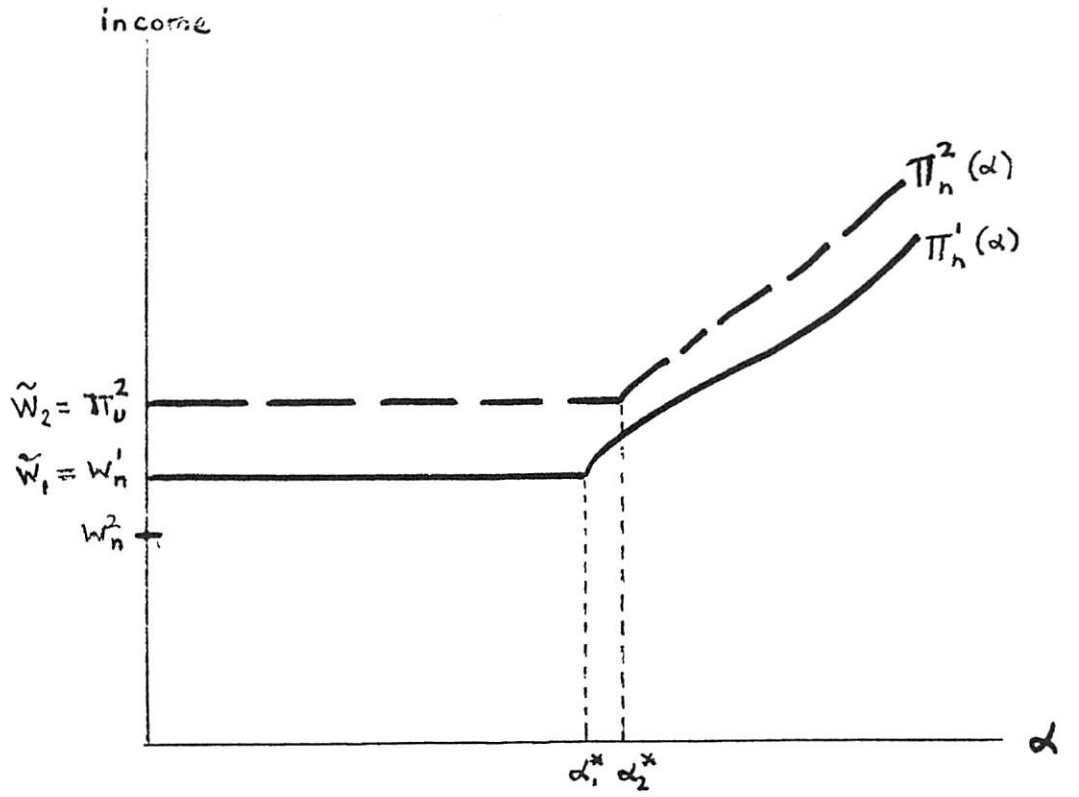
FIGURE 1

Equilibrium (nonunion) Wages and "Occupation Choice" in the Model with and without Unions

model without unions

model with efficient unions

model with monopoly unions



$w_n^1 = \tilde{w}^1$ = expected wage of all workers before unionization

w_n^2 = nonunion wage after unionization

$\tilde{w}^2 = \pi_u^2$ = expected wage of all workers after unionization = profits of unionized entrepreneurs after unionization.

$\pi^1(\alpha)$ = profits (income) of all entrepreneurs before unionization

$\pi_n^2(\alpha)$ = profits (income) of nonunion entrepreneurs after unionization

α_1^* = ability of marginal entrepreneur in nonunion equilibrium.

α_2^* = ability of marginal entrepreneur in union equilibrium.

Note: The union wage varies with the size of firm a worker is associated with.

FIGURE 2

Distribution of Income in the Model With and Without Unions

The first term in the brackets in (10) is positive and the second is non-positive, so (10) indicates that, for entrepreneurs near the margin (R close to zero), rents per worker must increase with α, whereas for more talented entrepreneurs the answer is ambiguous. Whether rents per worker increase with α in general can be seen to depend on whether the elasticity of maximized rents with respect to entrepreneurial talent, $\frac{\alpha}{R}\frac{dR}{d\alpha}$ exceeds the elasticity of labour demand with respect to entrepreneurial talent, $\frac{\alpha}{n}\frac{dn}{d\alpha}$. Finally, we note that the relationship between observed firm size and rents per worker can be expressed as

$$\frac{d(R/n)}{dn} = \frac{d(R/n)}{d\alpha} \Big/ \frac{dn}{d\alpha} = \left(\frac{-F_{21}}{F_{22}}\right) \frac{d(R/n)}{d\alpha} \tag{11}$$

which is always the same sign as $\frac{d(R/n)}{d\alpha}$ above.

A third crucial feature of the model is the dependence of the equilibrium distribution of incomes and firm sizes on the shape of both the production function and the distribution of talent. For example, a greater "complementarity" of α and n, as measured by the magnitude of F_{12}, implies that the distribution of firm sizes will be more unequal and that rents per employee are more likely to actually be <u>lower</u> in the larger firms run by the more talented entrepreneurs than in smaller firms. Also, a change in the population's endowment of skills (say, through human capital formation) changes the equilibrium ratio of workers to entrepreneurs and, with it, the entire distribution of firm sizes.

Fourth, we note that the model generates a socially efficient outcome in the sense that the allocation of individuals to tasks and the distribution of firm sizes that results is the one that maximizes total output produced by this

economy. To see this, simply maximize total output, $\int_{\alpha=\alpha^*}^{\infty} F(\alpha, n(\alpha))h(\alpha)d\alpha$, subject to the factor supply constraint (9). The resulting first-order conditions are the same as (4), (8) and (9) with the Lagrange multiplier on the output constraint substituting for w_n as the shadow price of a worker. This outcome is also Pareto-efficient since, in this simple world, utility is derived only from the single consumption good produced.

III. UNIONS IN THE BASIC MODEL

In this section we relax our assumption that unionization is impossible, and assume instead that workers at any given firm can form a union at an initially uncertain cost, θ.

Unions, in the present model, are assumed to be efficient extractors of rents from employers. That is, by imposing restrictions on the employer's ability to hire nonunion workers and by choosing the correct employment rule, or nonlinear wage schedule, they are able to extract all the rents from a given entrepreneur - i.e., make him indifferent between operating the firm and joining the market for workers himself without reducing the total amount of rents available.[1] This employment policy, unlike monopoly unionism, is an efficient one from the point of view of union members and the firm. Coasian bargaining considerations would lead us to expect that level of employment to be chosen regardless of how the gains from unionization are divided among employees, or of how the surplus is shared between the union and the firm. For convenience we shall however assume, where necessary below, that union rents are shared equally by all workers at a given firm.

More formally, our theory implies that a firm of type α is unionized if $R(\alpha)-\theta \geq 0$. The cost of unionization, θ, as well as the talent of the entrepreneur they are signing up with are assumed to be unknown to workers before they join the firm but known afterwards, so the proportion of type α firms which are unionized is just:

$$p(\alpha) = G(R(\alpha)) \tag{12}$$

where G is the cumulative distribution function of θ. The (net) wages of union workers in those firms will be:

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[1] None of the model's main conclusions is altered if unionization gives workers only a certain fraction of the total rents. An example of such a situation would be where unionization is interpreted only as a "right to bargain" with the employer and this bargaining yields the Nash-Zeuthen solution.

$$w_u(\alpha) = w_n + \frac{R(\alpha)-\theta}{n(\alpha)} \tag{13}$$

where w_n is now the nonunion wage and $\frac{1}{n(\alpha)}(R(\alpha)-\theta)$ are the rents per employee extracted by the union. Equations (13) and (14) together imply that expected (net) wages in all type α firms are:

$$w^e(\alpha) = w_n + \frac{1}{n(\alpha)} \int_{\theta=0}^{R(\alpha)} [R(\alpha)-\theta]g(\theta)d\theta$$

$$= w_n + \frac{1}{n(\alpha)} \mathcal{J}(R(\alpha)) \tag{14}$$

where $\mathcal{J}(R(\alpha)) = \int_{\theta=0}^{R(\alpha)} [R(\alpha)-\theta]g(\theta)\,d\theta$, $\mathcal{J}' > 0$, gives the total expected net rents extracted from a type α firm. Finally, taking expectations across types of firms, we can now express the total expected wage of being a worker as:

$$\tilde{w} = w_n + \int_{\alpha=\alpha^*}^{\infty} \mathcal{J}(R(\alpha)) \cdot \frac{h(\alpha)}{H(\alpha^*)}\,d\alpha \tag{15}$$

which is the relevant quantity for choosing to be a worker or not.

The effect of unions on the equilibrium of the entire economy is easily seen by writing out the conditions that describe it in a parallel form to the model without unions, as is done in Table 1. In equation (1′) of the table, because unions behave efficiently in choosing employment levels, the employment decision maximizes the total amounts produced in the firm with respect to workers' alternative (nonunion) wage. Thus union and nonunion firms with the same α will be the same size in this economy (there are no union disemployment effects on the firm level), and when w_n in the model without unions is interpreted as the nonunion wage, the firm labour demand conditions are the same in both models. Since the adding-up condition (equation 2′) is also

TABLE 1

A Comparison of the Model With and Without Unions

Model

Equation:		Without Unions	With Unions
1')	Demand for Labor in each firm	$F_2(\alpha, n(\alpha)) = w_n$	same
2')	"Adding up" condition	$H(\alpha^*) = \int_{\alpha=\alpha^*}^{+\infty} n(\alpha) h(\alpha) d\alpha$	same
3')	Zero rents of marginal entrepreneurs ("occupation choice")	$\pi(\alpha^*, w_n) - w_n = 0$	$\pi(\alpha^*, w_n) - \tilde{w} = 0$, or $\pi(\alpha^*, w_n) - w_n - \int_{\alpha=\alpha^*}^{\infty} \mathcal{J}(R(\alpha)) \cdot \frac{h(\alpha)}{H(\alpha^*)} d\alpha = 0$
4')	Definition of rents	$R(\alpha) = \pi(\alpha, w_n) - \pi(\alpha^*, w_n)$	same

unaltered, this means that the demand for workers curve in Figure 1 is unaltered by the introduction of efficient unions into the model.

Since the definition of rents (equation (4′) is the same in both models, the only difference between them appears in equation (3′), the "occupation choice" condition, which in the union model is made with respect to $\tilde{w}$, the expected wage of being a worker, inclusive of the cost and benefits of forming unions.[2] This has two implications for the new "supply of workers" curve, which is obtained by substituting (4′) into (3′). First, simple inspection of (3′) reveals that, because $\int_{\alpha=\alpha^*}^{\infty} \mathcal{J}(R(\alpha)) \frac{h(\alpha)}{H(\alpha)} d\alpha$ is always positive, the new supply-of-workers curve must lie everywhere outside the old one, as shown in Figure 1. Second, this new implicit relationship between α^* and w^n is not necessarily monotonically upward-sloping, so the possibility of multiple equilibria may arise--an issue we explore in Section IV.

The equilibrium of the model with unions differs from the equilibrium without unions in the following ways. First, as Figure 1 shows, the new nonunion wage is lower than the old one, and the proportion of the population who choose to be workers is greater. Thus, nonunion workers are unambiguously hurt by the introduction of unions (in contrast to Johnson and Mieskowski, (1970) for example) and interestingly, the effect of unions is to <u>expand</u> overall employment of workers in the economy rather than lower it. Since there are fewer entrepreneurs than before, we know that there are fewer firms but <u>each firm is larger</u> in the union than the nonunion equilibrium and of course the average talent of an entrepreneur is higher; because w_n has fallen, we know that profits

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[2] We can ignore the fact that unions may take away the rents of entrepreneurs here because in effect, the marginal entrepreneur is not unionized.

and rents, which are both measured relative to the nonunion wage, are higher in each firm than before. Thus, nonunion employers gain from the introduction of unions into the economy. Because the marginal entrepreneur, like all (nonunion) entrepreneurs is now earning a higher income (profit) than the marginal entrepreneur before, we know that $\tilde{w}$, the total expected wage of being a worker, is higher than in the nonunion equilibrium. Because w^u varies across firms, however, it is possible (indeed likely) that in some firms with low θ (particularly the smaller ones) union wages are lower than the previous nonunion wage. Thus, some union workers actually may lose as a result of introducing unions into the economy, although on average, of course, union workers must gain, to bring $\tilde{w}$ above the old w_n. In addition, it is apparent from (12) that the percentage of firms that are unionized increases with firm size (an empirical regularity documented by Freeman and Medoff 1983, p. 33, among others), but recalling the results on R/n in (10) and the definition of w_u in (13), the union-nonunion wage differential will not necessarily increase monotonically with firm size. In fact, a number of empirical pieces have reported diminishing union wage effects by firm size (for example Hendricks, 1977). Finally, regarding the efficiency effects of "efficient" unions, it is clear that introducing unions into this economy reduces the total amount of output consumed, for two reasons. First, output produced is no longer maximized by the economy because unionism has distorted the allocation of individuals to entrepreneurial versus production tasks (would-be entrepreneurs become workers due to higher union wages) and making firms larger than they should be. Second, some output is directly wasted in the process of forming unions (the θ_i), which can be thought of as losses due to "rent seeking".

IV. AN EXAMPLE

This section solves out a simple example of the model in order to explain in more detail the effects of unions, do some comparative statics, and examine possible magnitudes of the effects discussed.

We consider the case where the production function is given by:

$$F = \alpha^{1/2} n^{1/2} \tag{16}$$

which generates simple labour demand and indirect profit functions of the form:

$$n(\alpha) = \frac{\alpha}{4w_n^2} \tag{17}$$

$$\pi(\alpha, w_n) = \frac{\alpha}{4w_n} \tag{18}$$

Thus, both firm size and profits are directly proportional to the entrepreneur's talents.

For simplicity, we assume that entrepreneurial talent is distributed uniformly across the population on the interval (0,1), which implies that $h(\alpha) = 1$ and that α^* can be interpreted as the proportion of the population who are workers. Costs of unionization are assumed to be distributed uniformly on the interval $(0, \frac{1}{b})$, so that $g(\theta) = b$, and a higher b implies a lower average cost of unionization ($b = 0$ implies unionization is impossible, and in this case the union model is equivalent to the model without unions).

The (gross) union wage in firm α can be written:

$$w_u(\alpha) = w_n + \frac{\pi(\alpha, w_n) - \pi(\alpha^*, w_n)}{n(\alpha)} = w_n(2 - \frac{\alpha^*}{\alpha}) \tag{19}$$

which implies that, in this case, the increase in rents with firm size outweighs the effect of dividing the rents among more workers, so that union wages increase with firm size, but at a declining rate (they can never be more than

double the nonunion wage). Finally, the proportion of firms of type α that are unionized is given by:

$$p(\alpha) = G[\pi(\alpha, w_n) - \pi(\alpha^*, w_n)]$$
$$= b\left(\frac{\alpha - \alpha^*}{4w_n}\right) \qquad (20)$$

which, of course, increases linearly with α.

Since the solution to the model with unions, even in this simple case, cannot be expressed explicitly, three cases of the model were solved numerically on the computer. The results are shown in Table 2. They demonstrate the expected results that, as unionization becomes less and less costly, entrepreneurship declines, the nonunion wage falls, the expected wage of workers rises, profits of nonunionized entrepreneurs (including the marginal one) rise, all firms become larger, the percentage of firms which are unionized goes up, and the total gross output of the economy falls. In addition, two more interesting results emerge: First, as the cost of unionization falls, the union wage <u>in comparable firms</u> (i.e., with the same α) actually falls. This is because here, the expansion in firm size that occurs outweighs the increase in rents extractable from entrepreneurs. Of course, the average union wage in the economy as a whole is likely to fall as well, since a greater number of less profitable, small firms become unionized. Second, the magnitudes of the changes in gross and net output due to unionism are very different. In fact, the change in gross output is barely detectable, indicating that the output lost due to the decline in entrepreneurship is minimal. The amount of output lost in rent-seeking is much larger in comparison, and amounts to 2.3 percent of total output in the case where unionization is not very costly. Although this result needs to be checked with a more realistic example, it suggests that the major efficiency consequence of unions is in the direct rent-seeking activities they undertake

TABLE 2

Results of Numerical Solutions

	Non-Union Model	Union Model	
	(b = 0) (unionization is impossible)	b = 1 (high cost of unionization)	b = 3 (low cost of unionization)
α^* = proportion of population choosing to be workers	.5774	.5820	.5905
w_n = non-union wage	.3800	.3768	.3712
$\tilde{w}$ = expected wage of workers	.3800	.3861	.3977
$= \pi(\alpha^*, w_n)$ = income of marginal entrepreneur			
$\pi(1, w_n)$ = income of most talented (non-union) entrepreneur	.6580	.6635	.6735
$w_u(1)$ = highest (gross) union wage	-	.5343	.5232
$n(\alpha^*)$ = size of smallest firm	1	1.0248	1.0714
$n(1)$ = size of largest firm	1.7321	1.7608	1.8144
$p(1)$ = proportion of largest firms unionized	-	.2773	.8274
P = proportion of workers unionized	0	.1509	.4495
$\bar{w}_u$ = average union wage	-	.4384	.4302
Q = Total gross output of economy	.4387	.4387	.4386
rent seeking expenditures		.0054	.0156
Q_n Total net output of economy (net of expenditures on union formation)	.4387	.4333	.4230

rather than in the misallocation of resources they cause, and perhaps that government policies which directly limit the amount of these expenditures that both firms and workers can undertake (such as unfair labour practices and restrictions of organizing activity to certain "window" periods) are directed at the main problem with unions.

V. ALTERNATIVE SPECIFICATIONS

This section briefly reports the main results of two alternative specifications of the present model.[1] They consider, in turn, what happens when inefficient, monopoly unions are introduced into this general equilibrium context, and what happens when firms can oppose unions by spending resources themselves on "union busting".

1. Monopoly Unionism in the Model

What happens if we model unions in the traditional manner--as maximizing a utility function subject to the firm's labour demand curve--within the present model? Assume now that unions, wherever they exist, choose a wage, $w_u(\alpha)$, that maximizes the total rents they can extract from the employer, R^u, subject to the employer's demand curve, and the constraint that the employer stay in business. Unions thus solve:

$$\underset{w^u(\alpha)}{\text{Max}} \quad R^u(\alpha) = (w_u(\alpha) - w_n)n_u \tag{21}$$

subject to

$$w_u(\alpha) = F_2(\alpha, n_u(\alpha)) \tag{22}$$

and to

$$\pi(\alpha, w_u) - [w_N + \int_{\alpha=\alpha^*}^{\infty} \mathcal{J}(R^u(\alpha)) \frac{h(\alpha)}{H(\alpha^*)} d\alpha] \geq 0 \tag{23}$$

where the last two terms in (23) give the entrepreneur's opportunity wage. This means that unions raise wages either up to the rent-maximizing level

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[1] More detailed treatments of these alternative models are available upon request from the author.

(from their point of view) or to the employer's shutdown point. Although it is very difficult to solve (21) - (23) for precise union wage policies and their employment consequences , it is easy to see from the fact that (22) is always satisfied with equality, that these unions will, for any given w_n, choose a lower employment level than "efficient" unions or non-union firms. That conclusion, when coupled with the adding-up condition, which is now:

$$H(\alpha^*) = \int_{\alpha=\alpha^*}^{\infty} \{G(R^u(\alpha))n_u(\alpha) + [1 - G(R^u(\alpha))]n_n(\alpha)\}h(\alpha)\,d\alpha \tag{24}$$

implies that, in the monopoly unions model, the "demand for workers" curve is everywhere to the left of that in both the "competitive unions" and nonunion models, as shown in Figure 1.

The "supply-of-workers" curve in the monopoly unions model is given again by the condition of zero profit for the marginal entrepreneur, which is now:

$$\pi(\alpha^*, w_n) - w_n - \int_{\alpha=\alpha^*}^{\infty} \mathcal{J}(R^u(\alpha))\frac{h(\alpha)}{H(\alpha^*)}\,d\alpha = 0 \tag{25}$$

where $R^u(\alpha)$ is the solution to the unions' maximization problem in (21) - (23). Because $R^u(\alpha)$ is always less than $R(\alpha)$--i.e., monopoly unions are less efficient extractors of rent than "efficient" unions--this implies that the "supply-of-workers" curve in the monopoly-unions model lies everywhere to the left of the nonunion "supply-of-workers" curve, but everywhere to the <u>right</u> of the efficient unions curve, as shown in Figure 1 as well.

Introducing monopoly unionism into the model thus has an interesting effect which is apparent from Figure 1. Because unions now have a negative effect on the demand for workers, we can no longer be certain that the

union equilibrium has a smaller percentage of the population choosing entrepreneurship than in the (socially efficient) nonunion equilibrium. All we know for certain is that nonunion wages must fall as a consequence of (monopoly) unionization. It is indeed possible that unions have no effect on entrepreneurship at all, so the division of the population into workers and entrepreneurs is the socially efficient one. The monopoly union equilibrium, however, is not socially efficient since under monopoly unionism, the allocation of workers between firms is distorted.

To summarize the effects of monopoly unionism: If unions behave as efficient extractors of rent from firms, they must necessarily cause an efficiency loss on the social level by depressing entrepreneurship below its efficient level. If instead they behave as inefficient monopolies (as is traditionally assumed), they may or may not distort the entrepreneurship decision at all, but must necessarily cause an efficiency loss by misallocating workers among firms. In both cases, direct losses due to rent-seeking (the θ's) occur as well.

2. Employer Resistance to Unionism

What happens in our model when employers can try to defend the rents they earn by "fighting" unions? Suppose that, instead of workers being able to unionize with certainty at a cost θ, employers are also able to spend resources on "union-busting" services that influence the probability that workers succeed in unionizing a plant. For example, let the probability of unionization be given by

$$p(E^w,E^f), \quad p_1>0, \; p_2<0, \; p_{11}<0, \; p_{22}>0 \tag{26}$$

where E^w and E^f are expenditures by workers and firms respectively in the battle over unionization. In a firm producing rents R, this implies that expected net rents of the two parties are, respectively,

$$W^f = R(1 - p(E^w,E^f)) - E^f \tag{27}$$

$$W^w = Rp(E^w,E^f) - E^w \tag{28}$$

If both parties behave in a Nash equilibrium manner, equilibrium is given by the intersection of the response functions:

$$-Rp_f(E^w,E^f) = 1 \tag{29}$$

$$Rp_w(E^w,E^f) = 1 \tag{30}$$

The expected Nash outcomes to this economic contest over unionization can now be substituted into the present model of unions to generate their general equilibrium consequences. The two most interesting of these, which are fairly intuitive, are the following.

First; it does not necessarily follow from (29) and (30) that unionization will increase with firm size, or R--i.e., without further restrictions, there is no reason to believe that an increase in the stakes of the contest (R) makes either party more likely to win that contest. One can, however, show that if $p(0,0) = 0$ (i.e., if no one does any lobbying, the plant is nonunion with certainty, which seems a natural definition of the employer's initial "property right" to rents), then if unions are to exist at all in the model, they are, in a well-defined sense, more likely to be found in larger firms.

Second, the comparative statics of this new model have some interesting properties, especially when we consider the effects of a policy change, such as the Wagner Act, which increases the cost to employers of fighting unions.

While this will in general increase unionism throughout the economy, with the attendant negative efficiency effects on entrepreneurship, it may have a stronger countervailing direct efficiency gain--a reduction in the total amount of resources devoted to "rent-seeking" and "rent-defending" by both workers and firms. Since "regularization" of the unionization process and elimination of a significant waste of resources consumed in struggles over unionization has been a main objective of North American labour legislation which restricts the lobbying activities both workers and firms may undertake, it may be important to determine if this is true in reality. Of course, even greater efficiency (in the sense of total output consumed) can always be achieved by banning unionism altogether, but with very different distributional consequences.

VI. SUMMARY

This paper has examined some of the behavioral and efficiency consequences of unions which are efficient extractors of rents from employers in a general equilibrium setting. While being the first general equilibrium model, to the author's knowledge, that endogenizes the entry/exit decisions of firms and incorporates efficient union behavior, it is able to generate empirical predictions (for example, the correlation of unionism and firm size) that are broadly consistent with available evidence. As well, it analyzes two important efficiency effects of unionism--on entrepreneurship as well as on rent seeking/defending--that in general are not treated in other models.

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