DO UNIONIZED EMPLOYERS REAPPROPRIATE RENT THROUGH WORSENED WORKPLACE SAFETY?

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While union workers receive higher wages than their nonunion counterparts, recent research suggests that they may also face worse working conditions. Duncan and Stafford [1980] offer evidence that unionized workplaces contain a faster work pace and less freedom for workers to schedule work hours. Fairris [1992] finds evidence of higher injury rates in unionized settings. A number of explanations for these findings are plausible; perhaps the most widely accepted is that bad working conditions are a spur to unionization resulting in higher wages. This paper pursues another possible explanation: employers may respond to union monopoly wages by worsening workplace quality in an attempt to reappropriate some portion of the union-appropriated wage rent.

The rent reappropriation explanation for worse working conditions in unionized settings has received little formal treatment in the theoretical or empirical literature on unions.[1] Employer rent reappropriation can take place only if unions are unable to influence sufficiently some aspect of the employment relation. Union workers typically possess some control over working conditions through a combination of contract language and informal shopfloor bargaining. Whether this influence is sufficient to prevent employer rent reappropriation through worsened workplace quality, and indeed whether employers can benefit from worsened workplace quality even in the absence of such influence, are questions worthy of some attention. My focus in this paper is on employer rent reappropriation through worsened workplace safety.

The paper is divided into three sections. The first is devoted to the theoretical underpinnings of employer rent reappropriation. It spells out the conditions required for newly unionized employers to profit from a worsening of workplace safety when unions lack a direct influence over safety choice. I then empirically test the rent reappropriation hypothesis. Union ability to influence safety levels is accounted for in the empirical analysis. The concluding section discusses the results. While union workers in our sample possess both higher wages and higher injury rates than their nonunion counterparts, rent reappropriation appears to be an unlikely explanation for the differences in safety levels. The empirical results suggest that unionized firms are unable to reappropriate rent through worsened workplace safety.

A THEORETICAL MODEL OF EMPLOYER RENT REAPPROPRIATION

What are the conditions under which an employer will profit from worsening workplace safety in reaction to a union's appropriation of monopoly wage rents? To answer this question, I construct a simple model of the determination of safety in

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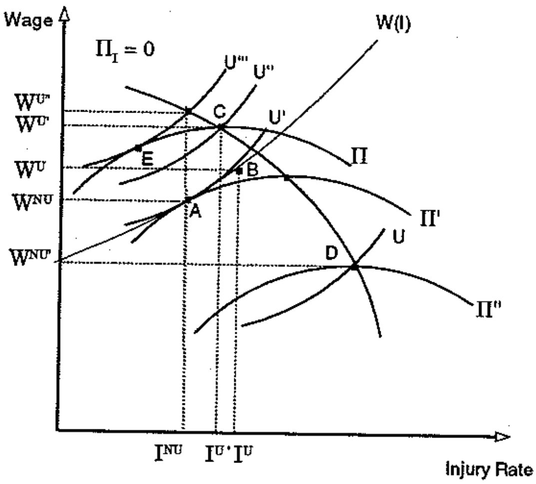
Figure 1



production. Assume that both firm profit (Π) and worker utility (U) are a function of wages (W) and the injury rate (I):

(1) $$\Pi = \pi(W,I),\ \Pi_W < 0, \text{ and}$$

(2) $$U = u(W, I),\ U_W > 0,\ U_I < 0.$$[2]

Wages held constant, increases in injuries bring forth both benefits and costs to the firm. Benefits are the savings on the valuable resources required to maintain a safe workplace, while costs include, for example, increased down-time in production and replacement of a larger number of injured workers. Π_I will be referred to as the marginal "internal" value of injuries to the firm; it does not capture those "external" influences — such as market-determined compensating wages or collectively-bargained contract language — which also affect the firm's choice of safety. Over an initial range of injury rate increases, the marginal internal value of injuries to the firm is assumed to be positive: $\Pi_I > 0$. At some point, however, marginal costs are assumed to exceed marginal benefits so that the marginal internal value of further injury rate increases and becomes negative: $\Pi_I < 0$. The other assumed relationships are standard in the literature [Rosen, 1986]. A set of firm iso-profit curves and worker indifference curves are illustrated in Figure 1.

In competitive labor market equilibrium there is a matching of workers with firms so that workers who, for example, place great value on safety in production are employed in firms that can provide such safety relatively inexpensively. Workers who are less concerned with safety gravitate to less-safe firms that face significant internal costs of providing safety. Equilibrium is reached when workers and firms are matched so that their marginal rates of substitution of injury rates for wages are equal:

(3) $$\Pi_I / \Pi_W = U_I / U_W.$$

An equilibrium wage/injury rate combination (W^{NU}, I^{NU}) for a representative worker and firm is depicted at point A in Figure 1.

In equilibrium, more dangerous jobs will require the payment of a compensating wage differential to workers, the size of which depends on the distribution of worker preferences and firm production techniques in the larger population. Firms wishing to reduce resources devoted to the provision of safety or to alter production in a way that reduces workplace safety will be forced to pay higher wages in order to attract an adequate supply of labor. The compensating payment is an external, labor-market imposed cost to firms maintaining a hazardous work environment. Graphically, this compensating payment is the slope of the curve connecting the points of tangency between the indifference curves of similarly skilled workers and the iso-profit curves of the firms with which they are matched. A representative curve for a group of workers in a competitive labor market, each of whose marginal revenue product in production is W^{NU}, is labeled *W(I)* in Figure 1.

In unionized settings, workers' wages are bid up above competitive levels, and the competitive labor-market imposed compensating payments constraint is not immediately binding on employers' choices of working conditions. Ignore, for the moment, any constraints placed on employers' choices of safety through union contract language or informal shopfloor bargaining. Starting from the old nonunion injury rate (I^{NU}) and the new union wage, and seeing no immediate external costs associated with increased workplace hazards, will a newly unionized employer allow the injury rate to rise in reaction to the union-appropriated wage rent? The simple answer is yes, so long as the marginal internal value of injuries to the firm is positive at the higher union wage and nonunion injury rate level. In Figure 1, this occurs for any wage/injury rate combination to the left of the $\Pi_I = 0$ curve.

In this event, injuries will rise until one of the following constraints impinges on profitable production: (1) the competitive labor market constraint *W(I)* is reached, at which point further increases in injuries, wages held constant, would make it impossible for the employer to attract labor to the firm — an example is point B in Figure 1 with union wage W^U; (2) the marginal internal value of injuries to the firm becomes zero — an example of which is point C in Figure 1 with union wage $W^{U'}$.[3] In the first scenario, the entire union monopoly wage rent is converted into a compensating payment through complete employer rent reappropriation; the unionized workers receive a wage/injury rate combination that is no better than existing competitive labor market standards as represented by the *W(I)* curve. In the latter scenario, only a portion of the wage rent is reappropriated by the employer, and the unionized workers earn a supra-competitive compensation package.

In theory, however, the marginal internal value of injuries to the firm could well be negative at the new union wage and old nonunion injury rate. This is true for union wages above $W^{U''}$ in Figure 1, since the resulting wage/injury rate combinations lie to the right of the $\Pi_I=0$ curve. The increase in the wage raises the marginal internal value of safety to the firm sufficiently to make a reduction in the injury rate profitable at the new union wage. In order for this to occur, wage increases must lower the marginal benefits or raise the marginal costs of maintaining an unsafe work environment. Graphically, this implies a negatively-sloped $\Pi_I = 0$ relation, as illustrated in Figure 1.

Theory does not give us any priors on the effect of a wage increase on the marginal internal value of injuries to the firm. Wage increases may promote the increased mechanization of production which in turn has the effect, let us suppose, of making the workplace intrinsically more dangerous and thereby increasing the marginal value of injuries to the firm. In this case, the firm's $\Pi_I = 0$ relation will be positively sloped. Alternatively, a firm may react to a wage increase by substituting for higher quality labor which has the effect, let us suppose, of rendering down-time in production more costly and the replacement of injured workers more difficult, thereby decreasing the marginal internal value of injuries. The $\Pi_I = 0$ relation is negatively sloped in this case.

We are now in a position to spell out the conditions under which employers have an incentive to worsen workplace safety in reaction to union monopoly wages. If wage increases lead to an increase in the marginal internal value of injuries to the firm (i.e., the $\Pi_I=0$ relation is positively sloped), employers have an unambiguous incentive to reappropriate rent through worsened workplace safety upon becoming unionized. Moreover, the larger the wage rent ($W^U - W^{NU}$), the greater the extent of the injury rate increase ($I^U - I^{NU}$) associated with rent reappropriation.

If wage increases lead to a reduction in the firm's marginal internal value of safety (i.e., the $\Pi_I = 0$ relation is negatively sloped, as it is in Figure 1), the incentive to worsen workplace safety bears a more complicated relationship to the size of the wage rent. Reappropriation of rent through worsened safety will take place for union wages up to a certain point ($W^{U''}$ in Figure 1), but not for wages beyond this level. Moreover, the relationship between the union-nonunion injury rate differential and the union wage rent is quadratic: the extent of reappropriation through worsened safety is positively related to the size of the wage rent at lower levels of rent, but diminishes as the wage rent increases in size beyond a certain point (where the $W(I)$ and $\Pi_I = 0$ curves cross in Figure 1), and becomes negative for higher levels of the wage rent (greater than $W^{U''} - W^{NU}$ in Figure 1).

A newly unionized employer's incentive to reappropriate rent through worsened workplace safety can be ruled out completely only when both the labor-market imposed compensating wage differential is zero (i.e., the $W(I)$ curve has zero slope) and the firm's marginal internal value of injuries falls with the wage (i.e., the $\Pi_I = 0$ relation is negatively sloped). A representative nonunion equilibrium for this case is depicted at point D in Figure 1. A zero compensating payment for dangerous work may occur if workers do not care about workplace safety or if the labor market contains imperfections due, for example, to labor-market segmentation or other rigidities in labor mobility. In this case, nonunion employers will choose levels of safety at which $\Pi_I = 0$. If, in addition, increased wages decrease the marginal internal value of injuries to the firm, union monopoly wages will elicit an improvement in workplace safety by the employer without any effort on the union's part to bring this about.

Thus far, I have assumed that the unionized employer is free to set the injury rate without union influence. In fact, though, unions utilize a variety of mechanisms, both contractual and noncontractual, to ensure safe and healthy workplaces. Contractually-mandated wage premiums for dangerous work, stipulations requiring protective devices on dangerous machinery, and language guaranteeing the existence of joint union-management safety committees combine with more informal measures, such as strong shop steward authority and rank-and-file informal work group practices, to protect union workers from employer attempts to reduce shopfloor health and safety.

However, a union's ability to influence shopfloor conditions is generally weaker than its ability to influence wages. The costs of contracting and enforcing contracts for shopfloor conditions are higher, labor law contains impediments to bargaining over some aspects of production, and informal efforts by workers to regulate their working conditions are typically resisted by employers who claim "managerial prerogative" over all aspects of the production process not covered by contract language [Fairris, 1990].

If a union could influence shopfloor conditions as easily as it can wages, the collective bargaining outcome would yield an efficient solution in which *ex post* marginal rates of substitution of injuries for wages are necessarily equal for the firm and worker (as shown, for example, at point E in Figure 1). If the union has no influence whatsoever over shopfloor conditions, the outcome is inefficient (as shown, for example, at point C in Figure 1).[4] In practice, the outcome is probably somewhere in between. Whether unions have the ability to extract significant wage rents while simultaneously maintaining or even improving workplace health and safety can only be answered empirically.

AN EMPIRICAL TEST OF THE RENT REAPPROPRIATION HYPOTHESIS

I test the employer rent reappropriation hypothesis by exploiting the fact that union wage rents and union-nonunion injury rate differences vary across union workers. The theoretical analysis above reveals that if employer rent reappropriation takes place through worsened workplace safety, the extent of reappropriation will be positively associated with the size of the union wage rent, after controlling for other factors — such as union efforts to control shopfloor conditions — that influence injury rate outcomes across union workers.

Model

I begin by estimating a system of equations characterizing wage and injury rate determination in the nonunion sector. The wage equation is of the following form:

$$ln\ W = w(\mathbf{HC}, \mathbf{DEM}, INJ), \quad (4)$$

where **HC** is a set of worker human capital characteristics, **DEM** is a set of worker and industry demographic characteristics, and *INJ* is the injury frequency rate in the industry.

The injury rate equation is specified as follows:

$$INJ = i(lnW, \mathbf{PREF}, \mathbf{TECH}, \mathbf{DEM}), \tag{5}$$

where **PREF** is a set of variables capturing workers' preferences for safety (such as marital status and level of education), **TECH** is a set of technological and organizational characteristics of production that affect safety (such as plant size and the capital/labor ratio), and **DEM** is a set of worker and industry demographic characteristics.

Using these estimated equations from the nonunion sector, the counterfactual nonunion wage and injury rate are predicted for a sample of union workers. The wage rent (*WRENT*) of union members is their current wage minus their predicted nonunion wage. The injury rate difference (*INJDIF*) is their current injury rate minus their predicted nonunion injury rate. Using these measures, a union-nonunion injury rate difference equation can be estimated for the sample of union workers which incorporates the effect of the wage rent on injuries.[5] The injury difference equation is of the following form:

$$INJDIF = f(WRENT, \mathbf{INFLUENCE}, lnW, \mathbf{PREF}, \mathbf{TECH}, \mathbf{DEM}), \tag{6}$$

where **INFLUENCE** is a set of measures capturing the ability of union workers to influence the level of workplace hazards, and the other determinants are as previously defined. If employers reappropriate rent through worsened workplace safety, the coefficient on *WRENT* should be positive and significant.[6]

The simultaneous determination of wages and injury rates suggests that uncaptured determinants of wages may be correlated with the injury rate and uncaptured determinants of injury rates may be correlated with the wage; thus, two-stage-least-squares estimation of equations (4), (5), and (6) may be appropriate. Also, since selection into the union sector may not be random, conditional on the various factors determining wages and injury rates, the estimated equations may require correction for selection bias. In modeling this selection process and then testing our estimated equations for the presence of selection bias, we account for the possibility that union organization is more likely to occur in industries where working conditions are less safe, and thereby remove any influence this might have on our analysis of union-nonunion injury rate differences.

Data

The worker survey data are from the 1987 wave of the Panel Study of Income Dynamics (PSID). By association with each worker's reported industry and state, a host of industry characteristics were grafted onto the survey data. The sample includes only male blue-collar workers who work full-time in the manufacturing sector and who are heads of households. Variable definitions and sources appear in Table 1.

Table 1
Model Variables

Variable	Description
Wage	the worker's hourly pay.
Injury	the number of lost-work day injuries per 100 full-time workers by 3-digit industry category.
Grade School	a dichotomous variable, equalling 1 if the worker completed grade school, but not high school or beyond; 0 otherwise. (Noncompletion of grade school is the base category for the set of education dummies).
High School	a dummy variable equalling 1 if the worker completed high school, but not a community college program (i.e., associate's degree) or beyond; 0 otherwise.
Comm. College	a dummy variable equalling 1 if the worker possesses a two-year community college degree, but not a four-year college degree or beyond; 0 otherwise.
College	a dummy variable equalling 1 if the worker possesses a four-year college degree or an advanced degree; 0 otherwise.
Experience	the number of years of full-time employment since age 18.
Tenure	the number of months with the present employer.
New Job	a dichotomous variable equalling 1 if the worker has been at his present job (as distinct from present employer) for 3 months or less; 0 otherwise.
North	a dichotomous variable equalling 1 if the worker lives in the north; 0 otherwise. (South is the base category for the set of location dummies.)
West	equals 1 if the worker lives in the west; 0 otherwise.
Crafts	a dichotomous variable equalling 1 if the worker is a crafts worker; 0 otherwise. (Laborer is the base category for the set of occupational dummies.)
Operative	equals 1 if the worker is an operative; 0 otherwise.
Ucoverage	the percentage of the worker's 3-digit industrial labor force that is unionized.
Race	a dichotomous variable equalling 1 if the worker is white; 0 otherwise.
Married	a dichotomous variable equalling 1 if the worker is married or cohabitating; 0 otherwise.
Urban	a dichotomous variable equalling 1 if the worker's SMSA contains a city of population greater than 500,000.
Plant Size	the average number of workers per establishment in the worker's 3-digit industry category.
Cap/Lab	the real gross stock of capital (structures, land, equipment, and inventories) per worker in 1976.
Member	a dichotomous variable equalling 1 if the worker is covered by a collective bargaining agreement and is a member of the union; 0 otherwise.
Refuse	the percentage of union workers in the worker's 2-digit industry category possessing contracts which grant workers the right to refuse dangerous work. (The sample is 1550 collective bargaining agreements covering 1,000 workers or more in effect on or after January 1, 1980.)
Inspect	the percentage of union workers possessing contracts which grant workers the right to inspect safety conditions in production through either a labor-management or union safety committee.
Pay Diff.	the percentage of union workers possessing contracts which grant pay differentials for hazardous working conditions.

All variables are from the 1987 PSID except: *Injury* [U.S. Department of Labor, 1988]; *Ucoverage* [Curme, Hirsch, and Macpherson, 1990]; *Plant Size* [U.S. Bureau of the Census, 1991]; *Cap/Lab* [Kendrick and Grossman, 1981]; and *Refuse, Inspect*, and *Pay Diff.* [U.S. Department of Labor, 1981].

Although data on blue-collar workers in construction, mining, and other non-manufacturing industries were available, the manufacturing sector was singled out for analysis in order to focus on a sample of workers for whom the process of injury rate determination is reasonably homogenous. The general features of production that lead to injuries, and the way in which these factors combine to determine injuries, are likely to be quite different across broad industrial sectors such as manufacturing and mining. Because we wish to account for general features of production whose differences across sample observations are likely to be related to injury rate differences — the capital-labor ratio, for example — it is important that the sample be restricted to individuals who possess a common set of features which determine injury rates in structurally similar ways.

Results

Columns three and four of Table 2 present the coefficients from an ordinary least squares (OLS) estimation of the nonunion wage and injury rate equations.[7] A test for simultaneity bias in the OLS estimation of the wage and injury equations failed to reject the null hypothesis of the absence of bias.[8] A test for selection bias in the OLS estimates of both equations also failed to reject the null hypothesis of the absence of bias.[9] Thus, for purposes of wage and injury rate determination, the injury rate can be taken to be exogenous in the estimated wage equation, the wage can be taken to be exogenous in the estimated injury rate equation, and the union selection process can be taken to be random, conditional on the respective determining variables, in the process of wage and injury rate determination.

The results for the nonunion wage equation follow the predictions of standard theory with one major exception: more dangerous jobs are not associated with higher wages. This result contradicts the theory of compensating wage differentials which posits that dangerous jobs should pay more, all else constant. In the nonunion sector, where competitive forces are presumably more pronounced, this result is difficult to explain. However, other studies have also found evidence of nonpositive (including negative) compensating payments for dangerous work in nonunion labor markets [Dickens, 1984]. While we may have captured the labor market in a state of temporary disequilibrium, similar findings using different data from different time periods lend support to the view that nonunion labor markets may simply fail to generate positive external costs on firms possessing significant workplace hazards.

The estimated nonunion injury equation behaves as expected with one exception as well. Most empirical work on the determinants of injuries suggests that older workers have fewer accidents on the job. In our results the injury rate rises with experience (which is highly correlated with age for male workers, schooling held constant), until roughly thirty years of experience is reached at which point injuries begin to diminish. One explanation for this result is that the data used for this study contain only household heads, and therefore underrepresent young workers who are presumably more prone to risk-taking behavior on the job. Alternatively, since the estimated injury equation in this study contains a greater number of control vari-

Table 2
Estimated Wage and Injury Equation

Independent Variables	Means (Standard Deviations)		Estimated Coefficients (Standard Errors)			
	Nonunion Sample	Union Sample	Nonunion Ln Wage	Nonunion Injury	Union/Non-Union Injury Difference I	Union/Non-Union Injury Difference II
Constant			1.29[b]	10.22[b]	1.18	-0.42
			(0.12)	(1.19)	(4.08)	(4.22)
Ln Wage	2.08	2.39		-1.20[b]	-0.93	0.89
	(0.36)	(0.29)		(0.48)	(2.92)	(3.10)
Grade School	0.23	0.22	0.15[a]	-0.82	0.75	0.57
	(0.42)	(0.41)	(0.08)	(0.59)	(0.69)	(0.59)
High School	0.64	0.71	0.24[b]	-1.22[b]	1.21	1.04
	(0.48)	(0.45)	(0.07)	(0.59)	(0.83)	(0.76)
Comm. Coll.	0.03	0.02	0.40[b]	0.31	-1.32	-1.53
	(0.18)	(0.13)	(0.11)	(1.00)	(1.31)	(1.29)
College	0.04	0.02	0.44[b]	-2.82[b]	2.61[a]	2.25
	(0.19)	(0.15)	(0.11)	(0.68)	(1.51)	(1.49)
Experience	13.74	17.48	0.02[b]	0.14[b]	-0.12[a]	-0.14[b]
	(9.35)	(10.39)	(0.6E-2)	(0.05)	(0.07)	(0.07)
Experience²	275.97	412.97	-0.4E-3[b]	-0.2E-2[a]	0.2E-2	0.2E-2
	(362.21)	(452.38)	(0.2E-3)	(0.1E-2)	(0.1E-2)	(0.1E-2)
Tenure	95.84	151.33	0.1E-2[b]	-0.2E-2	0.1E-2	-1.0E-3
	(92.85)	(105.26)	(0.2E-3)	0.2E-2)	(0.3E-2)	(0.4E-2)
New Job	0.12	0.06	-0.12[b]	0.59	-0.54	-0.63
	(0.32)	(0.24)	(0.05)	(0.51)	(0.77)	(0.76)
North	0.30	0.62	0.07[a]			
	(0.46)	(0.49)	(0.04)			
West	0.11	0.10	0.12[b]	0.89[b]	-0.16	-0.31
	(0.32)	(0.30)	(0.05)	(0.35)	(0.60)	(0.60)
Crafts	0.42	0.33	0.28[b]	-1.30[b]	1.48	1.11
	(0.49)	(0.47)	(0.06)	(0.64)	(1.07)	(1.11)
Operative	0.50	0.58	0.07	-1.62[b]	1.10	1.05
	(0.50)	(0.49)	(0.06)	(0.60)	(0.77)	(0.76)
Injury	5.42	5.37	-0.01[b]			
	(2.76)	(2.39)	(0.6E-2)			
Ucoverage	23.96	36.40	0.5E-2[b]	0.08[b]	-0.03[a]	-0.03
	(13.48)	(16.35)	(0.1E-2)	(0.01)	(0.02)	(0.02)
Race	0.59	0.63	0.8E-1[b]	-0.50[a]	0.57	0.44
	(0.49)	(0.48)	(0.4E-1)	(0.27)	(0.36)	(0.38)
Married	0.83	0.88	0.07	-0.8E-2	-0.18	-0.40
	(0.37)	(0.32)	(0.05)	(0.37)	(0.51)	(0.53)
Urban	0.10	0.23	0.03			
	(0.30)	(0.42)	(0.06)			
Plant Size	86.56	123.46		-0.04[b]	0.02[b]	0.02[b]
	(82.30)	(100.57)		(0.4E-2)	(0.8E-2)	(0.7E-2)
Plant Size²	14244	25311		0.5E-4[b]	-0.4E-4[b]	-0.4E-4[b]
	(29334)	(39314)		(0.1E-4)	(0.2E-4)	(0.2E-4)
Cap/Lab	26.45	31.48		-0.5E-2	-0.6E-2	-0.3E-2
	(17.55)	(20.93)		(0.6E-2)	(0.4E-2)	(0.5E-2)

Table 2 (Cont.)
Estimated Wage and Injury Equation

Independent Variables	Means (Standard Deviations)		Estimated Coefficients (Standard Errors)			
	Nonunion Sample	Union Sample	Nonunion Ln Wage	Nonunion Injury	Union/Non-Union Injury Difference I	Union/Non-Union Injury Difference II
Wage Rent		1.64			-0.07	-0.23
		(2.52)			(0.25)	(0.26)
Member		0.89				-1.06[a]
		(0.31)				(0.61)
Refuse		18.88				-0.7E-2
		(19.29)				(0.9E-2)
Inspect		45.13				-0.01[a]
		(26.78)				(0.6E-2)
Pay Diff.		5.26				-0.8E-2
		(4.15)				(0.04)
N	305	221	305	305	221	221
R^2			.47	.43	.24	.26

a. Indicates significant at the .10 level (two-tailed test).
b. Indicates significant at the .05 level (two-tailed test).

ables than is typically found in the literature, it may well be that older workers are indeed more prone to injuries when doing similar jobs, and with the same level of familiarity, as their younger counterparts.

We can use the estimated nonunion wage and injury equations to predict the wage and injury rate combination that each union worker would possess if he were to join the nonunion sector. We can then compare these to the actual union wage and injury rate outcomes. We find that if our sample of union workers were to move to the nonunion sector their wage would fall by roughly fifteen percent on average and their injury rate would fall by about two percent.[10] This offers further suggestive evidence that union workers possess higher wages but also worse job hazards than similarly situated nonunion counterparts.[11]

Looking beyond the averages, we find that 60 of the sample of 221 union workers receive higher wages but worse safety in joining the union sector — the pattern required by the employer rent reappropriation hypothesis. Thirty union workers would presumably be better off entirely in the nonunion sector, as they appear to suffer both lower wages and higher injury rates than union workers.[12] Roughly 100 union workers possess both higher wages and lower injury rates than their counterfactual nonunion counterparts. The remaining workers trade improvements in safety for lower wages.

We are now in a position to test the employer rent reappropriation hypothesis by regressing the union-nonunion injury rate difference for the sample of union workers on their union-nonunion wage difference and other control variables. Results appear in columns five and six of Table 2.[13] The estimated coefficient on the union wage-rent variable is negative and insignificant in the estimated union-nonunion injury rate difference equation of column five, thus contradicting the prediction of the rent reappropriation hypothesis. A wage-rent squared term was added to the equation to account for the possibility that the relationship is quadratic, as discussed above, but it was found to be insignificant. Thus, employer rent reappropriation through worsened workplace safety does not appear to exist at any level of monopoly wage rent. The other variables in the estimated equation merely reflect differences in the estimated coefficients of these terms across the union and nonunion injury rate equations. For example, unionized workers in larger plants face significantly worsened comparative safety levels because the improvement in safety for larger plants is so much greater in the nonunion sector than in the union sector.

What happens to this result if additional controls are added capturing union ability to influence the level of safety? It is plausible that the lack of a positive and significant relationship between wage rent and the union-nonunion injury rate difference results from bias due to the omission of such controls. Perhaps more powerful unions are able both to appropriate significant monopoly wage rents and to improve shopfloor safety, but employers reappropriate rent through worsened workplace safety, holding union ability to influence safety fixed. If so, accounting for differences in union ability to influence safety would be expected to alter the relationship between the wage rent and the injury rate difference. While capturing such differences in union capabilities is difficult, the results presented in column six of Table 2 offer further suggestive evidence against the employer rent reappropriation hypothesis; the estimated wage-rent coefficient remains negative and insignificant even with the introduction of these new control variables.

Of the four variables that account for differences in the safety protection capabilities of unions, three are quantitative measures of the preponderance of industry contract language governing shopfloor safety, and the fourth is a variable capturing workers' membership status in the union. Contract language requiring greater pay for dangerous jobs appears to have little impact on the injury rate difference. The same is true of the right to refuse dangerous work. Either the size of hazard pay differentials is insufficient to influence employer behavior, or employers may expect that they are unlikely to win lower wages even if shopfloor safety for certain jobs is improved. The right to refuse dangerous work is apparently a right that is rarely invoked.

Inspection rights and membership in the union, on the other hand, contribute to a significant improvement in the union-nonunion injury rate difference. Joint labor-management safety committees or local union committees for the promotion of safety may provide a valuable forum for dialogue and extra-contractual negotiation between workers and management over safety conditions in the plant. Union members appear to receive greater attention from the union on matters of shopfloor safety than do nonmembers. An alternative explanation is that where membership in the union is low, unions find themselves unable to offer significant protection against workplace accidents. The evidence suggests that union attempts to influence shopfloor safety directly meet with only moderate success.

CONCLUSIONS

The results of the empirical analysis in this paper offer virtually no support for the hypothesis that employers reappropriate rent through worsened workplace safety. A closer inspection of the wage and injury regression results for the nonunion sector suggests that this is not very surprising. Theory tells us that employer rent reappropriation is not profitable to unionized firms if labor markets fail to impose compensating wage differentials on nonunion employers and if wage increases lead to a decrease in the marginal internal value of injuries to firms. Both of these conditions appear to hold true.

The absence of a positive and significant estimated coefficient on the injury rate variable in the nonunion wage equation suggests that nonunion labor markets do not impose positive compensating payments on employers with dangerous working conditions, presumably because of market imperfections owing to labor-market segmentation or other rigidities in labor mobility. Thus, a representative nonunion wage and injury rate outcome is best portrayed by point D in Figure 1, and not point A. In the face of a flat $W(I)$ curve, the estimated coefficient on the log wage variable in the injury equation offers suggestive evidence on the slope of the $\Pi_I = 0$.[14] The result suggests that its slope is negative, and thus wage increases lower the internal value of injuries for firms.

Interestingly, these results suggest that unions may well enhance economic efficiency with respect to the wage/injury rate choice of workers and firms. If indeed the nonunion sector displays wage/injury rate combinations akin to that of point D in Figure 1, the outcomes are clearly Pareto inefficient. Workers would be willing to trade lower wages for improved safety, and employers could benefit from such a move as well. Thirty union workers display precisely this pattern of lower wages but improved safety, perhaps through the union's role as a voice mechanism for workers [Freeman and Medoff, 1984; Fairris, 1989]. An additional 100 workers in the sample possess higher wages and improved safety, arguably through a combination of monopoly power and union voice.

A significant number of union workers for whom safety conditions are worse in the union sector remain, and employer rent reappropriation does not appear to be a likely explanation. One area for possible further research is the propensity for workers to organize unions where workplaces are very unsafe. It is conceivable that unions have greater success organizing in dangerous plants but are then unable to reduce hazards significantly once established. I have modeled the selection process determining union status and examined its impact on our findings, only to discover that it has no effect on the major result that union workers face greater workplace hazards than their nonunion counterparts. However, further efforts at accounting for this selection process may yield different results.

Another topic warranting further research is the issue of reporting differences in the injury rate experience between the union and nonunion sectors. If union workers possess safety committees that keep more accurate records of workplace accidents, or if they have generous sick day provisions which allow for adequate recuperation from a workplace accident but also lead to a larger number of reported lost-workday injuries, or if they are simply less afraid to report an injury because their unions can protect them from possible employer retaliation, unionized settings may only appear to be more dangerous than nonunion settings. The unfortunate conclusion of the present study is that the explanation for higher reported injury rates in the union sector is a puzzle that remains to be solved.

NOTES

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1. Employer rent reappropriation is not new to the literature on the economic effects of trade unions. It is the basis for the widely-accepted claim that employers have an incentive to substitute for higher quality labor upon becoming unionized [Lewis, 1963; Hirsch, 1993].
2. Subscripts on variables denote partial derivatives.
3. A third constraint could become binding at W^U if, as injuries rise to the point where the wage/injury combination yields a utility level for workers less than U', costly labor turnover ensues. We ignore this consideration in the present analysis.
4. This is perfectly analogous to the analysis of efficiency and inefficiency in collective bargaining outcomes over wages and employment levels [Farber, 1986].
5. An alternative approach would be to utilize longitudinal data in which workers' union status, wages and injury rates change over time. Fixed effects models have the advantage of controlling for uncaptured worker ability, but the sample size of changers is typically very small. Moreover, this approach may possess significant drawbacks in the presence of sizeable measurement error in the data [Freeman, 1984; Hamermesh, 1989].
6. An earlier version of the analysis of injury rates contained a measure of the workers' compensation income replacement ratio, which has been found to be positively related to injury rates in a number of empirical studies [Chelius, 1982]. Our measure of expected benefits was the percentage of the worker's income received for a total (either permanent or temporary) disability, and varied by state, income, and worker demographic characteristics. It ignored differences in the waiting period to receive benefits and in tax rates, which is important since workers' compensation benefits are nontaxable. Because the injury rate results that included this variable were unchanged from those presented below, and since solving for the counterfactual nonunion wage and injury rate was made much more difficult by the appearance of a complex term involving the wage on the right-hand side of the nonunion injury equation, it was decided to eliminate this variable from the analysis.
7. The injury rate equation is corrected for heteroscedasticity in the error term using White's [1978] consistent estimator of the covariance matrix. I suggest a plausible reason for the presence of heteroscedastic errors in the injury equation later in the paper.
8. The identifying variables for the simultaneous estimation of this system of equations can be discerned from the omitted variables in the specifications reported in columns three and four. Specification tests revealed that the identifying variables were indeed appropriate. These results are available from the author upon request.
9. The instrumenting equation for union status contained the variable "hours worked per week" in addition to the other exogenous variables in the system. In the OLS form of the wage and injury rate

equations, additional identifying variables were *Plant Size, Plant Size*^{2}, and *Cap/Lab* for the wage equation, and *North, West*, and *Urban* for the injury equation. These results are available from the author upon request.

10. Another equally valid measure of the "unexplained" difference in average injury rates between sectors comes from predicting the injury rate in the union sector for the group of nonunion workers in the sample. The mean union-nonunion injury rate difference in this case is 0.44, or roughly eight percent of the nonunion injury rate.
11. It could be claimed that the counterfactual calculation puts an unfairly positive spin on the injury rate experience of union workers in the nonunion sector. Unionization might be expected to increase capital intensity, worker tenure, and perhaps increase the skill level of the work force, all of which are negatively associated with injuries in the nonunion sector. If these variables were endogenous in the analysis, movement to the nonunion sector for a union worker would likely result in lower levels for these variables and therefore higher injury rates. Our measure may therefore overstate the union-nonunion injury rate difference. Offsetting this is the recent finding that health and safety regulation may be of greater benefit to the union sector. Unionized work places are more likely to be inspected by regulators and to be assessed fines for violations of health and safety standards than their nonunion counterparts [Weil, 1991]. They should therefore be safer, all else constant.
12. Note that we have not accounted for fringe benefits differences across sectors, which, if positive as we would expect [Freeman, 1984], could well make this group's pattern of compensation rent and injury experience consistent with the employer rent reappropriation hypothesis. Since union workers do not appear to trade off wages for fringe benefits [Feuille et al., 1981], accounting for such nonmonetary compensation is unlikely to alter the findings of our empirical analysis of the union-nonunion injury rate difference and the role of the union wage rent.
13. In both reported injury rate difference equations a correction was made for heteroscedasticity after tests revealed that such a correction was necessary. Further tests revealed that neither of the estimated equations suffered from either simultaneity or selection bias. Heteroscedasticity in the error term may result from a reporting bias in injury rate statistics. In workplaces where workers have significant power — presumably, those with unions, and those where wages are higher and wage rents are larger — employers may be forced to more accurately report workplace injuries. This will affect the regression analysis by producing heteroscedasticity in the error term, with the error variance being larger for smaller values of the wage. This does indeed appear to be the case. The sum of squares of residuals for an injury rate difference equation using the third of the sample of workers with the lowest wage rent was more than twice the sum of squares of residuals for the third with the highest wage rent.
14. In the absence of the flat W(I) curve, the coefficient on the log wage variable would reflect the slope of the relation representing the locus of tangency points between indifference and isoprofit curves, and would therefore pick up worker income effects on the demand for safety.

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