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EMPLOYMENT DETERMINATION IN THE SWEDISH WOOD INDUSTRY: A test of the labor demand model*

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The paper presents an empirical analysis of employment determination in the Swedish wood industry. The conventional labor demand model is tested against the alternative hypothesis that both wages and employment are subject to bargaining. The labor demand model is not supported by the data. Outside wages consistently influence wages negatively, so it is concluded that the alternative model of efficient bargains provides a better explanation of the results.

1. Introduction

Bargaining models of the labor market have become increasingly popular in recent years. In contrast to the standard textbook case, where wages and employment are determined solely by the equilibrating forces of demand and supply of labor, these models explicitly incorporate the effects of union-firm negotiations. This approach has shown itself to be useful for analyzing problems such as the mechanisms behind wage rigidity and the sources of employment fluctuations. In the bargaining literature, there are basically two competing theories. According to the *right-to-manage* model of Nickell and Andrews (1983), firms and unions bargain over wages, whereas employment is set by the firm. The resulting wage-employment combinations are on the labor demand curve. (This variant is also known as the labor demand model; the two terms will be used interchangeably in the paper.) In the *efficient bargain* model of McDonald and Solow (1981), it is shown that both parties may gain from a contract involving both wages and employment. Firms and unions will settle for an outcome on the contract curve in this case.

In centralized negotiations of the Swedish kind, it is highly unlikely that employment bargaining should occur.[1] However, there remains a distinct possibility that *local* bargaining in Sweden takes employment into consideration. Thus the question of the absence or presence of efficient bargains must be set-

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[1] *As one might expect, no clauses to this effect can be found in the written central agreements between the Swedish Employers' Confederation (SAF) and the Swedish Confederation of Trade Unions (LO). (See LO, 1987.) Oswald (1984) and Oswald and Turnbull (1985), in their surveys of formal contracts in the United States and Great Britain, found little support in favor of the hypothesis of employment negotiations.*

tled empirically. The purpose of this paper is to analyze the implications for wages and employment of the two competing models and to test the conventional labor demand model on Swedish data.

Following Brown and Ashenfelter (1986), our empirical work is based on a structural labor demand equation nested within the efficient bargain model. Brown and Ashenfelter propose a test where significant and negative signs for coefficients representing outside employment opportunities allow them to reject the labor demand model in favor of the efficient bargain hypothesis.[2] We test the labor demand hypothesis, using a similar model, with time-series data on the Swedish wood industry for the period 1950–85. The regressions show that the alternative wage and the consumption wage, but *not* the product wage, influence employment. This result is hard to reconcile with the labor demand view of employment determination, but it is consistent with the predictions produced by the efficient bargain hypothesis.

The paper is organized as follows. In Section 2, the alternative models of wage and employment determination are analyzed. Section 3 contains a discussion of the contract curve and its empirical counterpart as well as the regression results. The final part summarizes the findings.

2. *Theoretical Framework*

We consider two bargaining models of a local union and a firm. Centralized negotiations are abstracted from, so the bargain determines the total wage (and employment) level. The analysis concentrates on to what extent the labor demand and efficient bargain models differ in their predictions regarding wage and employment determination.

[2] *Alogoskoufis and Manning (1991) have suggested a test where the efficient bargains and the labor demand hypotheses are tested against more generalized alternatives. They argue that efficient bargains are a special case of a model of two sequential bargains over wages and employment. Efficiency occurs only when the union has equal bargaining strength over both choice variables. The Alogoskoufis-Manning test hinges on the possibility of finding variables of the employment equation, which affect bargaining power, but neither the firm's profit function nor the union utility function.*

Our first model is of a right-to-manage type, where the firm and the union initially bargain over the wage and the firm then determines employment. Wage and employment outcomes occur on the labor demand curve. The exact position is determined by the relative bargaining strength of the union. If the firm has no bargaining power, the monopoly union model emerges as a special case. The wage is set unilaterally by the union, at the point where the union's indifference curve is tangential to the labor demand curve.

In the second model involving efficient bargains, the firm and the union negotiate over both wages and employment. The parties will settle for a bargain on the contract curve, which joins together a number of Pareto efficient points. The curve is traced out by the tangencies of the indifference curves and the iso-profit curves of the firm.

Turning to the firm's side, suppose that real profits in case an agreement is reached with the union are given by

$$\Pi(\cdot) = \frac{1}{p}[qQ(N) - wN], \tag{1}$$

where p is the consumer price, q is the output price and w is the wage. $Q(\cdot)$ is a production function with labor (N) as the only variable input. Capital is assumed to be fixed and hence is not included explicitly in the profit function. The firm is a price-taker, so output prices are taken as exogenous. In case of a dispute with the union, profits will be Π_0. The neoclassical labor demand function for a profit-maximizing firm may be written as

$$N = N(w/q), \tag{2}$$

where w/q is the product wage. We have $N'(\cdot) < 0$, i.e., a negatively sloped demand curve for labor.

The union's utility surplus from an agreement with the firm is

$$N^{\gamma}[U(w/p) - \overline{U}], \tag{3}$$

where γ is a seniority parameter, U includes the own real wage and is the utility resulting from an agreement and $\overline{U}$ represents the utility in case of no agreement. $\overline{U}$ depends on the workers' income during a wage dispute.[3] It is assumed throughout that U is greater than or equal to $\bar{U}$ and that Π is greater than or equal to Π_0.

The expression in (3) encapsulates two popular specifications of union utility. If γ equals zero we have the seniority model of Oswald (1984). Layoffs are assumed to occur by inverse seniority and the median voter is thus (locally) indifferent to employment changes. This may well be relevant in the present context. According to Swedish labor market legislation, firms should lay off workers in inverse order of employment duration, although this rule can be dispensed with in union-firm negotiations. The well-known utilitarian model is obtained when γ is unity, indicating that equal weights are given to employed and non-employed members. It is seen that union utility in case of an agreement with the firm is, in general, dependent on the level of employment.

We now proceed with a description of the right-to-manage and efficient bargain models and their comparative statics.

In the right-to-manage model, the wage is the outcome of a bargain between the union and the firm. Employment is determined unilaterally by the firm. We adopt the Nash bargaining solution, where the product of the two parties' net gain from an agreement is maximized. This yields

$$(4) \quad \max_{w} \Lambda(\cdot) \equiv [N^{\gamma}(U(\cdot) - \bar{U})]^{\beta}[\Pi(\cdot) - \Pi_0]^{1-\beta},$$

where the parameter β may be regarded as a measure of the union's bargaining strength. The monopoly union model appears as a special case when $\beta = 1$.

[3] *A conflict with the firm may take different forms, which suggests different specifications of »conflict income». If the workers go on strike, the availability of strikers' funds as well as outside employment opportunities are relevant. The latter may be important even if the workers themselves do not search for (temporary) jobs elsewhere, since family members of strikers may try to earn extra income during a conflict. If the workers stay on the job and adopt other measures, such as work-to-rule or go-slow practices, it is natural to think of the income as including the prevailing wage rate.*

The first-order condition reads

$$(5) \quad \psi(w) \equiv \beta\left[\frac{\Pi - \Pi_0}{N(U - \bar{U})}\right][\gamma N_w(U - \bar{U}) + NU_w] + (1-\beta)\Pi_w = 0.$$

In the efficient bargain model both employment and wages are subject to bargaining. In contrast to the previous model outcomes occur on the contract curve and generally not on the demand schedule for labor. We have

$$(6) \quad \max_{w,N} \Omega(\cdot) \equiv [N^{\gamma}(U(\cdot) - \bar{U})]^{\beta}[\Pi(\cdot) - \Pi_0]^{1-\beta}.$$

The first-order conditions are

$$(7) \quad \varphi_1 \equiv \beta\left[\frac{\Pi - \Pi_0}{U - \bar{U}}\right]U_w + (1-\beta)\Pi_w = 0$$

$$(8) \quad \varphi_2 \equiv \beta\gamma\left[\frac{\Pi - \Pi_0}{N}\right] + (1-\beta)\Pi_N = 0.$$

To what extent do the comparative statics for efficient bargains differ from the results in the previous model? Consider the reduced-form results first, summarized in *Table 1*. It is seen that the wage predictions are identical. As for employment, only the effects of the variables β and Π_0 differ; the signs, however, are indeterminate in the efficient bargain model. Thus we are not able to reject the efficient bargain model in favor of a labor demand model with reduced-form estimations on either wage or employment data. The picture is different if we compare the structural labor demand equation in (2) with the employment predictions in the efficient bargain ver-

Table 1. Reduced-form implications of the right-to-manage (RM) and efficient bargain (EB) models.

	Wages		Employment	
	RM	EB	RM	EB
$\Delta\beta$	+	+	–	?
$\Delta\gamma$	–	–	+	+
$\Delta\Pi_0$	–	–	+	?
$\Delta\bar{U}$	+	+	–	–
Δq	?	?	?	?
Δp	?	?	?	?

sion. Recall that the labor demand equation determines employment conditional on the wage. The arguments β, γ, Π_0 and $\overline{U}$ have no effect on employment, whereas the efficient bargain model allows a role for them.

3. *Empirical Analysis*

3.1 *The Empirical Model*

Our purpose in this section is to derive an empirical specification — based on the contract curve equation — for tests of the labor demand model. Before proceeding to a closer examination, we extend the model with a number of variables. First, the wage variables are modified to account for taxes. We define the consumption wage, $w_c = w(1-\tau)/p$, and the product wage, $w_p = w(1+s)/q$, where τ is the income tax rate and s the payroll tax rate. Obviously it is the consumption wage which is relevant to the union and the product wage which matters for firm profits. Second, outside employment opportunities ($\overline{U}$) are assumed to depend positively on the alternative wage ($\overline{w}_c = \overline{w}(1-\tau)/p$) and real unemployment benefits (B), and negatively on the unemployment rate (u).

An expression for the contract curve may be obtained by taking the ratio of (7) and (8). As already noted, the contract curve equates the slopes of the union's indifference curves and the iso-profit curves of the firm. All points along the curve are efficient from the viewpoint of the union and the firm. Introducing the tax variables and rearranging, we get

$$(9) \quad Q_N = w_p + \gamma\theta\left[\frac{\overline{U} - U(w_c)}{U'(w_c)}\right],$$

where $\theta = (1+s)p/(1-\tau)q$. This variable shows the wedge between the real product wage cost to employers and the real consumption wage to workers. The equation shows that employment furthermore is determined by the product wage (w_p) as well as the consumption wage (w_c), and outside opportunities ($\overline{U}$). It should be noted that the labor demand model emerges as a special case when the seniority parameter is zero or if $U = \overline{U}$. Then the labor demand schedule and the contract curve coincide. Much of the econometric work on efficient bargaining relies on expressions like (9). The distinction between the product wage and the consumption wage is, however, rarely observed. (An exception is Christofides and Oswald, 1991).

Introducing the short-hand symbol G for $(\overline{U}-U)/U'$, the total derivative of the contract curve equation (9) can be written as

$$(10) \quad Q_{NN}dN = [1 + (1/w_c)G\gamma]\,dw_p + G\theta d\gamma + \gamma\theta[(\partial G/\partial w_c) - (1/w_c)G]\,dw_c + \gamma(\theta/U')\,d\overline{U},$$

where $\partial G/\partial w_c = [-(U')^2 + (U-\overline{U})U'']/(U')^2 < 0$. (We assume $U'' \leq 0$.) Noting that the wedge, the consumption wage, and the product wage are linearly dependent ($\theta w_c \equiv w_p$), $d\theta$ has been substituted out of equation (10). We can now proceed to the general employment relation

$$(11) \quad N = N(w_p, \gamma, w_c, U),$$

with expected signs $N_1 < 0$, $N_2 > 0$, $N_3 \geq 0$, $N_4 \leq 0$.[4] The intuition behind these results is that if the firm and the union bargain over employment, arguments appearing in the union's objective function must also determine employment. The seniority parameter, the consumption wage, and outside opportunities are part of the union's utility function only. Hence these arguments should not determine employment if bargains are on the labor demand curve, where employment is set unilaterally by the firm.

Log-linearizing and extending (11), for the time ignoring dynamics and trend terms, yields the following empirical specification:

$$(12) \quad \ln N = \alpha_0 + \alpha_1 \ln w_p + \alpha_2 \ln h + \alpha_3 \ln w_c + \alpha_4 \ln \overline{w}_c + \alpha_5 \ln B + \alpha_6 \ln u + \varepsilon,$$

where ε is a stochastic error term. We cannot hope to find a suitable proxy for the seniority parameter (γ), so it is left out of the specification in (12). The equation includes a varia-

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[4] *$N_1 < 0$ requires $(1 + \gamma G/w_c) > 0$, an inequality that is satisfied so long as $Q_N > 0$; note that $Q_N = w_p(1 + \gamma G/w_c)$. The sign of N_3 is in general ambiguous. A sufficient condition for $N_3 > 0$, assuming $\gamma > 0$, is that $-w_cU''/U' \geq 1$, where $-w_cU''/U'$ is the Arrow-Pratt measure of relative risk aversion.*

ble for work hours per employee (h). Work hours are assumed to be exogenous to the firm and the union and α_2 can take either sign, depending on how work hours enter the production function and the union's objective function.

The expected signs of the coefficients in the two models, given a positive γ, are as follows:

The labor demand model:
$\alpha_1 < 0,\ \alpha_2 \gtreqless 0,\ \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = 0$

The efficient bargain model:
$\alpha_1 < 0,\ \alpha_2 \gtreqless 0,\ \alpha_3 > 0,\ \alpha_4 < 0,\ \alpha_5 < 0,\ \alpha_6 > 0$

It is common practice in applied work on employment determination to include time trends and lagged dependent variables. The former are intended to account for capital accumulation and technological change while the inclusion of the latter is warranted by the fact that, in general, it is costly for the firm to adjust its stock of workers. For example, hiring and firing costs are likely to be considerable in the Swedish labor market. The preceding theoretical analysis ignored such considerations for the sake of simplicity. Our regressions in the following section, on the other hand, include time trends and two lagged dependent variables. Standard quadratic costs-of-adjustment assumptions lead to the inclusion of a dependent variable lagged one period. The presence of a dependent variable lagged two periods has been justified by Nickell (1987). His analysis suggests that aggregation over identical firms, differing only in adjustment costs, causes two lags to appear in the employment equation.

3.2 *Empirical Results*

The empirical work makes use of annual data for the number of employed blue-collar workers in the Swedish wood industry (ISIC 33) and covers the period 1950–85. There are good reasons for choosing this industry. First, earlier Swedish estimations of employment equations within the labor demand framework, notably Pencavel (1985) and Pencavel and Holmlund (1988), have typically been concerned with the manufacturing sector as a whole, and more disaggregation obviously entails advantages. Second, the wood industry consists largely of small firms and this implies less scope for monopoly power in product markets and monopsony power in input markets (Holmlund and Skedinger 1990).

Regression results are displayed in *Tables 2* and *3*, each using slightly different empirical specifications. (Definitions of the variables and data sources appear in *Appendix*.) A common feature in all estimations is that the variable for average work hours (h) enters insignificantly. The trend (T) and the lagged dependent variables, however, all have strong impacts on employment. All regressions include two additional trend variables (T^2 and T^3) to allow for the possibility of non-linear effects. Their coefficients are generally significant, but omitted for brevity. The coefficients for the lagged employment variables show an unconventional pattern; the coefficients are rather close in absolute value, indicating that lagged *changes* in employment are important for current employment. The long-run employment response to an exogenous disturbance does not differ much from the short-run impact.

The restrictions implied by the labor demand model are imposed in the first two columns of *Table 2*. In column (1) the coefficient for the product wage (w_p) is small and insignificant, lending no support to the labor demand model. However, the coefficient of this variable may well be close to zero due to some mis-specification of the labor demand model which is not due to failure to account for efficiency. Therefore we ran a number of additional regressions, the results of which are not reported in the tables. These regressions retain the basic format of the equation in the first column of *Table 2* and pertain to two specific reformulations of the neo-classical model. First, consider the possibility that firms in the in the wood industry are sales constrained. During a recession, for example, the constraint may become binding to the firm, fixing employment at some exogenously given level. This allows a role — hitherto ignored — for aggregate demand in employment determination. Second, it may be incorrect to assume firms to be price-takers. Monopolistic competition is possibly a better representation of market conditions in an industry which produces a great deal of non-homogenous output, such as furniture and wooden building materials. Under the assumption that firms practice mark-up pricing over and above marginal cost there arises a second rationale

Table 2. Estimated employment equations. Dependent variable: $ln\ N_t$. Time series, 1950–85.

	(1)	(2)	(3)	(4)	(5)	(6)
Intercept (α_0)	10.538	10.527	10.857	10.601	13.850	14.740
	(5.60)	(5.59)	(7.32)	(6.68)	(7.21)	(4.80)
$ln(w_p)_t$	−0.043		0.059		0.045	
	(0.45)		(0.72)		(0.55)	
$ln(w_p)_t^*$		−0.050		0.110		0.064
		(0.47)		(1.13)		(0.66)
$ln\ h_t$	0.564	0.574	0.368	0.219	0.459	0.406
	(1.51)	(1.52)	(1.20)	(0.63)	(1.49)	(1.19)
$ln(w_c)_t$			2.209		2.272	
			(3.28)		(3.30)	
$ln(w_c)_t^*$				3.345		2.796
				(2.76)		(1.79)
$ln(\overline{w}_c)_t$			−1.813	−2.846		
			(2.86)	(2.55)		
$ln\ B_t$			0.040	0.033		
			(1.50)	(1.15)		
$ln\ u_t$			0.011	0.011		
			(0.46)	(0.47)		
$ln\ \overline{U}_t$					−1.706	−2.176
					(2.68)	(1.54)
T	−0.028	−0.027	−0.045	−0.048	−0.047	−0.049
	(3.53)	(3.45)	(5.66)	(5.45)	(5.76)	(4.93)
$ln\ N_{t-1}$	0.648	0.645	0.446	0.388	0.452	0.429
	(4.36)	(4.30)	(3.44)	(2.65)	(3.50)	(2.99)
$ln\ N_{t-2}$	−0.628	−0.623	−0.546	−0.475	−0.530	−0.507
	(3.78)	(3.68)	(3.79)	(2.90)	(3.82)	(3.33)
$\overline{R}^2$	.932	.932	.960	.955	.956	.955
DW	1.67	1.66	2.40	2.40	1.97	2.00
Durbin test for serial correlation	1.41	1.44	−1.36	−1.25	0.08	0.02
Chow F-test for parameter stability (sample split, 1970)	1.97	1.96	0.78	1.10	0.69	1.36

Notes: The coefficients for T^2 and T^3 are not shown. Estimation is by OLS in columns 1, 3, and 5 and by IV in columns 2, 4, and 6. An asterisk indicates an instrumented variable. The instruments are (in logs): the exogenous variables in the regression plus $(1+s)/q$, $(1-\tau)/p$, the status quo consumption wage, union membership over employment in the wood industry (lagged one period), the number of strikes, and work-days lost due to labor market conflicts. Absolute t-values in parentheses.

for including an aggregate demand variable in the regressions (to the extent that the mark-up varies with demand).

In order to account for sales constraints or imperfect competition conditions, two variables were added to the regressors in column (1) to represent aggregate demand for wood products in Sweden, namely the households' real disposable income (Y) and the number of completed dwellings (H). The latter serves a measure of housing construction to which the wood industry is a large supplier. The estimations show, however, that aggregate demand is not important for our results. Although the coefficients for Y and H are positive they are not significant, and the coefficient for the

Table 3. Estimated employment equations. Dependent variable: $ln\ N_t$. Time series, 1950–85.

	(1)	(2)	(3)	(4)	(5)	(6)
Intercept (α_0)	11.194	15.625	10.422	10.300	13.426	14.014
	(5.71)	(3.38)	(6.57)	(6.15)	(6.62)	(4.21)
$ln\ w_t$	0.182		2.191		2.255	
	(0.82)		(3.09)		(3.12)	
$ln\ w_t^*$		1.861		3.309		2.597
		(1.52)		(2.54)		(1.53)
$ln\,[(1+s)/q]_t$	0.024	0.752	0.019	0.076	0.009	0.025
	(0.21)	(1.39)	(0.20)	(0.66)	(0.10)	(0.21)
$ln\,[(1-\tau)/p]_t$			2.287	3.317	2.350	2.667
			(3.34)	(2.72)	(3.34)	1.68)
$ln\ h_t$	0.809	1.829	0.210	0.112	0.311	0.290
	(1.88)	(1.76)	(0.57)	(0.28)	(0.83)	(0.75)
$ln\,(\overline{w}_c)_t$			−1.795	−2.756		
			(2.81)	(2.42)		
$ln\ B_t$			0.040	0.034		
			(1.50)	(1.16)		
$ln\ u_t$			0.012	0.012		
			(0.51)	(0.51)		
$ln\ \overline{U}_t$					−1.697	−1.988
					(2.64)	(1.36)
T	−0.044	−0.153	−0.036	−0.041	−0.039	−0.041
	(2.67)	(1.89)	(2.73)	(2.80)	(2.77)	(2.46)
$ln\ N_{t-1}$	0.624	0.623	0.439	0.389	0.443	0.431
	(4.18)	(2.36)	(3.35)	(2.65)	(3.38)	(3.00)
$ln\ N_{t-2}$	−0.709	−1.424	−0.492	−0.442	−0.477	−0.469
	(3.93)	(2.42)	(3.08)	(2.53)	(3.00)	(2.84)
$\overline{R}^2$	.933	.790	.959	.955	.955	.955
DW	1.77	1.86	2.42	2.39	1.94	1.95
Durbin test for serial correlation	0.86	0.34	−1.42	−1.27	0.16	0.22
Chow F-test for parameter stability (sample split, 1970)	2.58	0.09	0.68	0.64	0.75	1.25

Notes: The coefficients for T^2 and T^3 are not shown. Estimation is by OLS in columns 1, 3, and 5 and by IV in columns 2, 4, and 6. An asterisk indicates an instrumented variable. The instruments are (in logs): the exogenous variables in the regression plus the status quo consumption wage, union membership over employment in the wood industry (lagged one period), the number of strikes, and work-days lost due to labor market conflicts. Absolute t-values in parentheses.

product wage is not much affected.

In column (2) of *Table 2,* the product wage is instrumented. It is exogenous to the individual firm in the labor demand model, but instrumentation of the wage can be justified because of the possibility of measurement errors. (The choice of instruments is discussed in detail below.) Nevertheless the product wage remains insignificant, so the results again fail to support the labor demand model.

The labor demand restrictions are relaxed in the four right-hand side columns of *Table 2.* The consumption wage and the outside variables are allowed to play a role for employment determination. Examining column (3), it is seen that the product wage has no influence on employment while the consumption wage (w_c) enters with a significantly positive sign. The alternative wage ($\overline{w}_c$) is also significant with a negative impact. Unemployment compensation and the unemployment rate are both of little importance, however, and the former has the »wrong» sign. This result may, in part, be due to the particular variable specifications chosen in the regressions. The unemployment compensation variable, for example, is measured as granted benefits per day and this measure ignores other dimensions which may be relevant, such as coverage, eligibility, and the maximum duration of benefits. Since, in general, the influence of variables on the union side cannot be rejected, it is concluded that the union cares about employment. The implied estimate of the seniority parameter, $\hat{\gamma}$, is thus greater than zero.

Efficient bargaining means that employment and wages are determined jointly, causing the own wage to be endogenous in the employment equation. Both the product wage and the consumption wage variables therefore need to be instrumented. In order to identify the employment equation it is necessary to find at least one variable which affects the own wage but does not influence employment. According to the reduced-form results for efficient bargains in *Table 1*, the wage is determined by, inter alia, the relative bargaining power of the union (β) and the fall-back profits of the firm (Π_0). Since these arguments do not appear in the structural employment equation (12), proxies for them are appropriate candidates for inclusion among the instruments. The selection of instruments in the regressions include membership, relative to employment, in the unemployment insurance fund of the Wood Industry Workers' Union as well as the number of strikes and the number of work-days lost due to labor market conflicts in the aggregate labor market. These variables are intended as measures of union militancy and strength in the wood industry. (There are conceivable instruments for Π_0, too, but data availability is limited). Another suitable instrument can be found by relaxing the assumption implied in equation (3) that all workers leave the firm during a conflict. (See footnote 3.) If some workers stay, their utility will be dependent on the status quo consumption wage, $[\omega(1-\tau)/p]_t$. We define $\omega \equiv w_{t-1}$, which is the wage level of the previous period and this will apply until an agreement is reached with the firm.

Column (4) of *Table 2* displays a regression with the product wage and the consumption wage instrumented. As in the second column the former is hardly affected by instrumentation, but the coefficient of the consumption wage increases considerably in magnitude. It can be noted that the coefficient of the alternative wage also increases in absolute terms. The findings thus confirm our previous result that the efficient bargain model is a closer description of the data than the labor demand model.

Unfortunately, the two own wage variables and the alternative wage are severely multicollinear. This potential problem was handled in two ways. First, by constructing a new variable for outside opportunities. It is defined as $\overline{U} = \overline{w}_c(1-u)8 + Bu$, and the variable should capture the expected daily income (under the assumption of an eight-hour work day) for a worker who is not employed with the firm. Second, by replacing the product wage and the consumption wage variables with their three components: w, $(1+s)/q$, and $(1-\tau)/p$. Consider, to begin with, the results with $\overline{U}$ as a replacement for $\overline{w}_c$, B, and u. These are shown in column (5) of *Table 2*. The coefficient of the outside opportunities variable is close to that of the alternative wage in the third column. Column (6) is the same as (5), with the own wage variables instrumented. Instrumentation yields basically the same picture as in column (3). The performance of the Durbin statistic — it is used to test for serial correlation in the presence of lagged dependent variables — is satisfactory in all regressions.[5] The Chow tests indicate parameter constancy (except in the first two columns).

Let us now turn to the aforementioned regressions with the variables w, $(1+s)/q$, and

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[5] *The DW statistic is biased toward two because of the presence of lagged dependent variables in the regressions; hence the tables also report Durbin's statistic. The test is based on the regression*

$$e_t = \alpha_0 + \alpha_1 e_{t-1} + \beta' X,$$

where e is the residual from the original regression and X is a matrix of the explanatory variables including the lagged dependent variables. The test statistic is the t-value pertaining to α_1. The small sample performance of this test is good, as shown in Dezhbakhsh (1990).

$(1-\tau)/p$. As is seen in the original empirical specification of (12), we may write their coefficients as $(\alpha_1+\alpha_3)$, α_1, and α_3, respectively. *Table 3* presents the same set of regressions as in the previous table, where the new variables are used instead of the product and the consumption wage. The nominal wage coefficient is positive and significant, or close to significant, in the third to sixth columns, as is the coefficient of $(1-\tau)/p$. Contrary to expectation the variable $(1+s)/q$ enters positively, but it never does so significantly. It is noteworthy that the variable relevant to the union, $(1-\tau)/p$, has an impact on employment much greater than the variable expected to be important to the firm, $(1+s)/q$. This result provides little evidence for the labor demand model. As far as the other variables and regression diagnostics are concerned, the findings of *Table 2* remain basically unchanged. The regression in column (2) of *Table 3*, however, is an exception. The coefficient for the dependent variable lagged two periods (N_{t-2}) is smaller than -1, thus violating one of the stability conditions for a second-order difference equation. (See Gandolfo 1980, p. 59.) The coefficients for the lagged dependent variables in the other regressions in *Tables 2* and *3* meet the required stability conditions.

As yet another check for robustness, it was considered useful to experiment a little with additional variables. When the number of man-hours was substituted for the number of workers as the dependent variable, the statistical fit improved somewhat. The (unreported) regressions duplicating *Table 2* disclose that the own product wage variable performs better but still is far from significance, while the two other wage variables remain strongly significant. Moreover, experiments with the dynamic structure, e.g., allowing for a lagged response from the product wage to employment, and the addition of real materials prices to the regressions in *Tables 2* and *3* did not produce any substantial changes in the results.

One noteworthy, and somewhat disturbing, result is the insignificance of the product wage. This variable should be important for employment, regardless of whether it is the efficient bargains or the labor demand model that is appropriate for the wood industry. Since the estimations are sector-specific one might ask to what extent this result applies also to other industries in Sweden. This seems not to be the case; Pencavel (1985) and Pencavel and Holmlund (1988) report a strongly significant negative relationship between employment and wages in mining and manufacturing. This suggests that sectorial differences may be important and, as a consequence, the results regarding the alternative wage in the present study do not necessarily hold in general.

4. Concluding Remarks

In this paper we have examined the right-to-manage and the efficient bargain models. Comparative statics on the reduced forms of the two models revealed that the models do not, in general, give rise to conflicting predictions. The empirical part of the paper made use of a structural employment equation. The regression results stand in sharp contrast to the predictions of the labor demand model and suggest that the efficient bargain hypothesis provides a better explanation of employment determination in the Swedish wood industry. The product wage variable never enters the regressions significantly, whereas both the consumption wage and the alternative wage influence employment. It could not be demonstrated, however, that either the unemployment compensation or the unemployment rate have any effect.

There is at least one other explanation behind the consistently negative impact of alternative wages on employment in our regressions. In the efficiency wage theory it is assumed that the productivity of a worker — or his likelihood of not quitting the firm — is positively related to the relative wage. Employment is then partly determined by the alternative wage, just as in the efficient bargain model, although the sign of the coefficient of this variable can go either way. Our results are thus compatible with efficiency wage models, too. In other words, despite the finding that wages and employment are off the demand curve in the wood industry, this does not necessarily imply an outcome on the contract curve.

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Appendix

Definitions of Variables and Data Sources

$ln\, N_t$	Number of workers in ISIC 33. (SCB1)
$ln(w_p)_t$	Real product wage in ISIC 33. (SCB2, SCB3, SAF)
$ln\, w_t$	Nominal wage in ISIC 33. (SCB2)
$ln[(1+s)/q]_t$	Payroll tax rate (s) divided by output price in ISIC 33. (SAF, SCB3)
$ln[(1-\tau)/p]_t$	Average income tax rate (τ) divided by the consumer price index. (SCB3)
$ln\, h_t$	Average number of work-hours per worker in ISIC 33. (SCB1)
$ln(w_c)_t$	Real consumption wage in ISIC 33. (SCB2, SCB3)
$ln(\overline{w}_c)_t$	Real consumption wage in ISIC 2–3. (SCB2, SCB3)
$ln\, B_t$	Real granted after-tax unemployment compensation per day for workers in ISIC 33. (AMS)
$ln\, u_t$	Unemployment rate. (SCB3)
$ln\, \overline{U}_t$	Expected daily income of workers not receiving employment in ISIC 33. $\overline{U} = \overline{w}_c(1-u)8 + Bu$. (SCB2, SCB3, AMS)
T	Time trend.

ISIC 33 is manufacturing of wood and wood products, including furniture. ISIC 2–3 is mining and manufacturing. The employment variables, N and h, refer to blue-collar workers of both sexes, while the wage variables are measured for male workers only and include all wage supplements (C-wage). Sources are in brackets. The series for N and h have been adjusted to take into account industrial reclassifications occurring in 1952 and 1968.

Sources

AMS	*De erkända arbetslöshetskassornas verksamhet och det kontanta arbetsmarknadsstödet.* Various issues. National Labor Market Board.
SAF	*Hur man beräknar företagets sociala kostnader.* Various issues. Swedish Employers' Confederation.
SCB1	*Official Statistics of Sweden: Industry.* Statistics Sweden.
SCB2	*Official Statistics of Sweden: Wages.* Statistics Sweden.
SCB3	*Statistical Reports.* Statistics Sweden.

The series for the income tax rate (used for computation of the two consumption wage variables, $(1-\tau)/p$, B, and $\overline{U}$) is based on the preliminary tax tables published by the National Tax Board. The tax rate applies to a person working full time with average blue-collar hourly earnings.

A fuller description of the data, including graphical illustrations, can be found in Skedinger (1991, Chapter 3). The data are available on request from the author.