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The Effect of Unionization on Labor Productivity: Some Time-Series Evidence

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This paper presents evidence concerning the effect of unionization on the average productivity of labor using time-series data from the private, domestic sector of the U.S. economy over the 1948-73 period. Aggregate technology is specified by a constant-returns-to-scale, Cobb-Douglas production function which incorporates union and nonunion labor and proxies for both embodied and disembodied technical change. Maximum likelihood estimates of the model indicate that union membership significantly decreased average labor productivity, holding constant the quality and mix of capital and labor and controlling for cyclical effects.

I. *Introduction*

The impact of unionization on productivity has been the subject of numerous recent empirical investigations. These studies have been motivated largely by the argument advanced by Freeman (1976) that unions may *increase* labor productivity by providing efficient collective voice for workers in negotiating workplace characteristics and establishing grievance procedures as well as by "shocking" management into reducing existing X-inefficiency. Alternatively, the traditional, monopoly model of unions hypothesizes that unions *decrease* productivity by reducing managerial flexibility, introducing restrictive work rules, and limiting the use of merit-based compensation. Because of these two conflicting theoretical predictions, empirical evidence must be obtained in order to evaluate the relative importance of these viewpoints.

The empirical literature can be separated broadly into two groups: (1) studies that use an explicit production function approach to examine union effects on average labor productivity and (2) assessments of the effect of union membership on the growth rate of total factor productivity.[1] Within the production function framework, Brown and Medoff (1978) used cross-section, state-by-industry data in the U.S. to obtain a positive and statistically significant union

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[1]For a recent attempt to synthesize the two approaches, see Hirsch and Link (1984).

productivity effect of approximately 22 percent with their preferred estimating equation, which adjusted for labor quality, the capital-labor ratio, and industry and assumed a Cobb-Douglas structure of production. Gollop (1976) employed a four input, transcendental logarithmic (translog) model of technology to analyze the effect of unionization on production possibilities in U.S. manufacturing over the 1947-71 period. Gollop found a significantly negative effect of unionization on manufacturing output but no significant impact on substitution possibilities. Thus, variations in union membership altered the location, but not the curvature, of manufacturing firms' isoquants.

Several studies have examined cross-sectionally the relationship between rates of growth of total factor productivity (TFP) and various explanatory variables, including the degree of unionization. Kendrick (1973) reported a negative effect of union membership on TFP growth, using data calculated over 1948-69 across manufacturing industries. Kendrick and Grossman (1980) updated Kendrick's (1973) earlier study of the relationship between TFP growth and various explanatory variables, including unionization, using data for the 1948-76 period for twenty manufacturing industries. Their results revealed a statistically significant, negative relation between TFP growth and the (1958) *level* of union membership but not a significantly positive impact of the (1958 to 1972) *rate of change* in unionization on growth in TFP. Mansfield (1980) specified the rate of increase in TFP as a function of basic research, applied research, and degree of unionization, among other variables. Using data for twenty two-digit SIC manufacturing industries for the 1948-66 period, he found that unionization significantly decreased TFP growth, a result that was robust across alternative estimating equations. Link (1981) extended Mansfield's (1980) study by distinguishing between company-financed and government-financed basic and applied research expenditures as determinants of the growth rate in TFP. Link reported a negative and significant effect of unionization on TFP growth, using data from fifty-one major manufacturing firms for the period 1973-79. Sveikauskas and Sveikauskas (1982) found no significant effect of the level of unionization on TFP growth among one hundred forty-four three-digit manufacturing industries over 1959-69. Hirsch and Link (1984) specified the rate of change of TFP as a function of both the level of *and* the change in union membership and estimated the model using data from nineteen two-digit SIC manufacturing industries over the 1957-73 period. They found that TFP growth was negatively and significantly related to both the level of and the change in unionization.

Although considerable (albeit contradictory) evidence has been amassed concerning the effect of unionization on productivity, it is noteworthy that apparently no economy-wide, time-series data have been brought to bear on this issue. One advantage of using such aggregate data is that the possibility of confounding price and quantity effects of unionization on value added — discussed by Brown and Medoff (1978, pp. 371-73) — is foreclosed unless variations in union membership affect the aggregate *level* (not just the *distribution*) of product prices. Of course, there are several potential disadvantages — including aggregation and simultaneity biases — that make this approach especially hazardous. Nevertheless, the importance of acquiring information about the impact of unions on aggregate productivity over time would seem to justify a tentative effort along those lines. The purpose of this paper is to present such aggregate time-series evidence.

Section II uses the production function approach to set out a model of the effect of union membership on labor productivity. Section III describes the definitions and sources of data used in the empirical analysis. Section IV discusses the estimation procedure and reports the empirical results. Section V provides a summary and some concluding remarks. To preview the results of this investigation, I find that, for the U.S. private domestic business economy during the period 1948-73, union membership *decreased* average labor productivity, *ceteris paribus*.

II. *The Model*

Following Brown and Medoff (1978), technology is represented by a constant-returns-to-scale (CRTS), Cobb-Douglas production function, which is modified to incorporate union and nonunion labor:

$$Q = AK^{\alpha}(L_n + cL_u)^{1-\alpha}, \tag{1}$$

where Q is the rate of output, A is a technical efficiency parameter, K is capital, α is the elasticity of output with respect to capital, L_n is nonunion labor, L_u is union labor, and c is a parameter that reflects the productivity differential between union and nonunion labor. If $c > 1$, then union labor is more productive, in accordance with the collective voice or X-inefficiency views of unionized production processes. If $c < 1$, then union labor is less productive, reflecting a dominance of the adverse effects on productivity — emphasized by neoclassical views of the labor market — of the restrictive work rules, seniority relationships, and limitations on merit pay that characterize union workplaces. Of course, if $c = 1$, then union and nonunion labor are equally productive, a result of the two effects being either nonexistent or exactly offsetting in magnitude.

Equation (1) can be rewritten as

$$Q = AK^{\alpha}L^{1-\alpha}[1 + (c-1)P]^{1-\alpha}, \tag{2}$$

where $L \equiv L_n + L_u$ is total (nonunion and union) labor, and $P \equiv L_u/L$ is the proportion of total labor unionized. Dividing both sides of (2) by L and taking natural logarithms yields the approximation relation

$$\log(Q/L) \approx \log A + \alpha\log(K/L) - (1-\alpha)(c-1)P. \tag{3}$$

The associated estimating equation is

$$\log(Q/L) = \beta_1 + \beta_2\log(K/L) + \beta_3P + \epsilon, \tag{4}$$

where $\beta_1 = \log A$, $\beta_2 = \alpha$, $\beta_3 = (1-\alpha)(c-1)$, and ϵ is a stochastic error term. The effect of union membership on labor productivity can be examined by conducting a test of the null hypothesis $\beta_3 = 0$ against the two-sided alternative output. Hulten (1979, p. 133) reported that capital's share was approximately 0.42 during most of the sample period, so that $\hat{\beta}_2$ overestimates this by more than one (but less than two) standard deviations. Second, from (3) we have $\beta_3 = (1-\alpha)(c-1)$, so that $\hat{c} = 1 + [\hat{\beta}_3/(1-\hat{\beta}_2)] = -0.795 < 0$. This point estimate seems to imply not only that union labor is less productive than nonunion labor ($c < 1$) but also, from (1), that an additional union worker actually *reduces* output, holding constant the quality-adjusted amounts of capital and nonunion labor. However, the approximate, large-sample standard error of c — calculated from the formula given in Kmenta (1971, p. 444, eq. 11.40) — is 0.758, so that c is not significantly different from zero but is significantly less than one.

To summarize the results, there was a negative and statistically significant effect of union membership on average labor productivity, *ceteris paribus,* in the U.S. economy during the 1948-73 period. Thus, there was no support for the "new" collective voice interpretation of the role of unions as augmenting the productivity of labor.

V. *Concluding Remarks*

This paper has presented evidence concerning the effect of unionization on the average productivity of labor using time-series data from the private, domestic sector of the U.S. economy over the 1948-73 period. Following Brown and Medoff (1978), aggregate technology was specified by a constant-returns-to-scale, Cobb-Douglas production function that incorporated union and nonunion labor and proxies for embodied and disembodied technical change. Estimates of the model obtained by using quality-adjusted data on capital and labor inputs indicated that union membership significantly decreased average labor productivity. The finding of an inverse relationship between unionization and labor productivity contrasts with the cross-section results reported by Brown and Medoff (1978) for U.S. manufacturing. It is consistent, however, with the time-series evidence presented by Gollop (1976) for the U.S. manufacturing sector and the cross-section results presented by Kendrick (1973), Kendrick and Grossman (1980), Mansfield (1980), Link (1981), and Hirsch and Link (1984) concerning the effect of union membership on total factor productivity growth in manufacturing.

The results reported here were obtained with a highly specialized model, and it would be useful to examine the robustness of these inferences to alternative specifications of aggregate technology. For example, experimentation with flexible functional forms (such as the translog) or the use of data on actual research and development expenditures to represent disembodied technical progress might be pursued. Moreover, it might be argued that unionization affects the slope parameters of the production function, as well as the efficiency parameter in the intercept term. This argument would call for the introduction of appropriate interaction terms in the estimating equation. In addition, distributed lag structures or asymmetries (over the business cycle or with respect to increases and decreases in union membership) may characterize more accurately the relationship between unionization and labor productivity. Although an investigation of these and other specification issues is beyond the scope of this study, they would seem to constitute a worthwhile agenda for future research.

Finally, the issue of aggregation bias — always potentially relevant in an economy-wide study — may be especially important in the present context. Private sector union membership is largely confined to manufacturing, construction, and transportation, so that the relative declines in employment experienced by these sectors could produce misleading correlations. However, if the share of union members in total employment is declining primarily because of the decreasing importance in the economy of these traditionally highly organized industries but the emerging (and largely nonunion) sectors are characterized by relatively slow productivity growth, then there would be a bias toward finding a *positive* relationship over time between unionization and labor productivity.

There remains the puzzle of the apparent[5] slowdown of productivity growth since 1973, when the sample period ended. The results of this research imply, however, that the secular *decline* in union membership experienced since that time cannot help explain this alleged slowdown.

[5]Darby (1984) argued that the imposition of price controls biased reported real output in a manner that *overstated* productivity growth during the controls period and thereafter *understated* the growth in output per labor, so that the apparent slowdown is a statistical mirage.

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Unions, wages and productivity: some evidence from UK engineering firms

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Estimates of union wage and productivity effects are derived using primary micro-level panel data for a sample of firms in the UK engineering industry. Union wage differentials of the order of 10% are suggested from the results, whereas union productivity impacts appear to be non-linear with respect to union density.

I. INTRODUCTION

This paper reports estimates of union wage and productivity effects using primary micro-level panel data for a sample of firms in the UK engineering industry. The theoretical arguments in this area are well known, and surveys of the theoretical and previous empirical literature will be found in Hirsch and Addison (1985) and Metcalf (1988). Using micro-level data avoids the aggregation problems leading to bias in some previous work (Stewart, 1983; Geroski and Stewart, 1986). Moreover, the particular micro database at our disposal is richer in firm-specific and contextual variables than that available in other recent UK establishment-level analyses (e.g. Blanchflower, 1984; Blanchflower and Oswald, 1988; Nickell and Wadhwani, 1987; Wadhwani and Wall, 1988). This puts us in an unusually advantageous position to take account of the manifold organizational and industry-level factors that impinge on union wage and productivity effects (Bemmels, 1987).

The sample and data sources are briefly described in the Section II. Section III presents our estimates of union/non-union wage differentials among shop-floor employees, and Section IV reports the results with respect to productivity effects. The conclusions are summarized in Section V.

II. SAMPLE AND DATA SOURCES

The sample covers 52 firms mostly concentrated in SIC groups 310–330 of the UK engineering industry. The relatively narrow industrial distribution of firms helps to normalize for extraneous influences that are not allowed for in our models, though at some cost in terms of the degree of generalization the results will support. The empirical data were collected by interview/survey methods and are in two main parts. One contains undated 'survey' data on a wide range of variables describing qualitative and quantitative dimensions of the firms' internal organization, production methods, labour force characteristics, union presence, market structure and so forth. The second part consists of detailed annual data on inputs and output, and on financial and economic performance for the period 1978–82 inclusive. Pooling across firms over time yields a panel data set with 260 observations which is used throughout the analysis. The variables employed are set out in the Appendix. Further details of the data collection exercise and resulting data base are contained in Cable and Wilson (1984).

III. UNION-WAGE EFFECTS

Following Blanchflower (1984) we estimate the equation:

$$\begin{aligned}\ln WAGE = {} & a_0 + a_1\,MALE + a_2\,UNSKILL + a_3\,SHIFT \\ & + a_4\,OVER + a_5\,PIE + a_6\,PVA \\ & + a_7\,JOBEVAL + a_8\,QUIT + a_9\,WDL \\ & + a_{10}\,LBATCH + a_{11}\,EEF + a_{12}\,SOUTH \\ & + a_{13}\,IMPORT + a_{14}\,UNEM + a_{15}\,LVAT \\ & + a_{16}\,LTOT + a_{17}\,UMC + a_{18}\,NOUNH \\ & + a_{19}\,NOUNS + a_{20}\,UNION\ EFFECT \\ & + a_{21}\,\text{industry dummies} + e\end{aligned}$$

where the variables are defined as in the Appendix. However, we substitute hourly for weekly earnings as the dependent variable on the grounds of its greater relevance both for workers' income–leisure choices and for firms' production

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Table 4. *Production function estimates: split sample*

Independent	Closed shop Eq 1	Closed shop Eq 2	Open shop Eq 3	Open shop Eq 4
LTOT	1.0278**	1.171**	1.0635**	1.129**
LK	−0.0369	−0.032	0.0511	0.044
MH	0.9807**	1.632**	0.6738**	0.561*
IMPORT	−0.0055*	−0.003	−0.0037	−0.002
RATIO	−0.0063	0.020	0.0441**	0.047**
UNSKILL	−0.0037*	−0.004**	−0.0019	−0.032*
QC	−0.0659	−0.002	0.1145	0.122
APPO	−1.0310	−0.957	3.2307*	2.796
TRT	−0.0435	−0.064*	−0.0165	−0.012
PVA	0.0764	0.139*	0.0418	0.039
PART	0.1245	0.054	0.2002**	0.205**
MALE	0.0008	0.001	0.0021	0.002
PIE	0.0012	0.002	−0.0068**	−0.072**
SPAN	−0.0037	−0.004	−0.0169	−0.007
SHIFT	0.0059	0.001	0.0123*	0.017**
LBATCH	−0.3003**	−0.409**	−0.1647*	−0.144
IT	−0.2061**	−0.175*	−0.2569	−0.001
NOUNH	0.0507	0.052	−0.0154	−0.017
MED		−0.044		0.017
LARGE		−0.469**		−0.296
CONSTANT	−5.0104*	−10.860**	−3.7453*	−3.256
Time dummies				
BUSE R^2	0.987	0.964	0.984	0.968

Significant t-values at 5%, 1% are *,**.

Table 5. *Interactions between union presence and internal organization variables*

Variable	Base coefficient	Interaction term
INDEX	0.1388	
SPAN	0.0042	−0.0086 ·
PIE	−0.0043	0.0078**
PVA	−0.1356	0.3299**
PART	0.4288	−0.6428**
QC	0.1873	−0.3304

organization with the index of union presence. These results are presented in Table 5.

Thus there is a positive interaction of union presence with profit sharing and piece rate bonuses, but perhaps more interesting is the strong negative interaction with our variable proxying perceived employee involvement in decision making, *PART* (Cable (1985) gives details of this variable). Participation in closed shop firms serves to reduce productivity performance. A number of interpretations could explain this result. It could be that workers in strong unionized firms positively associate the strength of union bargaining power with perceived influence over decision making. Thus participation in this sense might reflect the ability to frustrate rather than cooperate with management decisions.

V. CONCLUSIONS

Our analysis of the impact of unions on wages and productivity has provided some interesting results. The basic wage equations with alternative union effects predict a wage differential of roughly the same order as other 'establishment' studies, although lower than more aggregated empirical evidence. Most of the other explanatory variables in these equations had plausible signs and coefficients. Some interesting results on the differences in wage determination between closed shop and other firms were revealed.

The evidence on unions and productivity indicates that there is no simple relationship but rather a more complex non-linear union effect. This suggests that moderate levels of unionization can indeed enhance productivity even though our average predicted effect is negative. Our results do, however, indicate that negative effects of unionization are greater in large closed shop establishments. This finding is supported by the results of other recent studies (Edwards, 1987).