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Industrial Conflict, the Quality Of Worklife, and the Productivity Slowdown in U.S. Manufacturing

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Production is human activity. Yet most studies of the productivity slowdown have treated production as a technical relationship between purchased inputs and final outputs [exceptions include Christiansen, 1982; Flaherty, 1985; Gordon, 1981; Kendrick and Grossman, 1980; Naples 1986; Norsworthy and Zabala 1985; Weisskopf, Bowles and Gordon, 1983]. This article explores social as well as technical determinants of the growth of production-worker productivity in U.S. manufacturing. In particular, workplace conflict and industrial accidents are identified as factors affecting the growth of labor per labor-hour and therefore productivity.

Initially productivity is decomposed into two components: labor efficiency, and the ratio of effort to hours hired. Technical determinants of productivity are enumerated. Explanatory variables related to the social relations of production are then developed. Econometric results and their implications follow.

A SOCIAL-RELATIONS APPROACH TO PRODUCTIVITY GROWTH

Labor productivity is by definition the ratio of output to labor-hours. Productivity analyses tend to assume labor-services per labor-hour are fixed by employment contracts. But companies actually contract for workers' potential—their skills, job experience and general capacity to do work. Management must then prevail on employees to perform the desired services. Whether the ensuing labor-management conflict over the work process derives from human nature and the moral hazard of shirking [Lazear, 1981], or from the structure of capitalism which gives rise to alienated labor [Bowles, 1985; Gintis, 1976; Marglin, 1974], remains a subject of debate.

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From either perspective, productivity (P) has two components, output (O) per labor-effect (LE), and labor-effort per labor-hour (LH):

(1) $$P = (O/LE)\ (LE/LH).$$

The first component (O/LE) is similar to technical production-function notions and can be called the labor-efficiency ratio. Increases in this ratio would appear to meet Pareto's criterion: if output increases for a given level of effort, some people can be made better off without worsening another's position.

The second component (LE/LH) may be called the work-extraction ratio, since it represents companies' success in translating labor-potential into labor-services. Once work performance is linked to effort and therefore the quality of worklife, changes in labor effort affect the distribution of social welfare, not only the magnitude of output. Increases in productivity, *ceteris paribus*, are no longer necessarily Pareto-optimal, since they may make consumers and/or employers better off by making employees worse off.

From (1), productivity growth ($\dot{P}$) is the sum of two components.

(2) $$\dot{P} = (\dot{O/LE}) + (\dot{LE/LH}).$$

Assuming, as is usual, that the determinants of each component interact additively, each can be examined in turn.

Determinants of Labor Efficiency—A Technical Model

Three major determinants of the growth of labor efficiency are often included in analyses of the productivity slowdown: capacity utilization, the capital-labor ratio, and the energy crisis.

Productivity growth tends to be procyclical [Boddy and Crotty, 1975; R.J. Gordon, 1979]. Capacity utilization affects productivity because in recessions firms choose to adjust capacity by sacrificing productivity in order to retain (or hoard) labor with firm-specific skills.[1] However, as Walter Oi [1962] made clear in his original analysis of labor-hoarding, this explanation is most applicable to managerial and technical staff, and least so to unskilled and semiskilled production workers.

Peter Clark (1978) and R.J. Gordon (1979) have argued that under conditions of uncertainty it is rational to delay hiring and firing because these incur fixed costs. This uncertainty principle may help explain a slowdown (acceleration) in productivity growth in an early contraction (expansion) [see also Weisskopf *et. al.*, 1983]. It requires that, rather than accumulating inventories that they may not sell in an early contraction, firms choose to carry higher unit labor costs. The rate of growth of capacity utilization is often used as a proxy for this uncertainty effect; it in fact describes a point in the business cycle rather than modeling firm behavior.

The second factor enhancing the efficiency of labor-effort is the substitution of machinery and structures for workers. This is true *a forteriori* for equipment which embodies new techniques. Since it is the flow of capital-services (CS) per worker effort that contributes to a flow of output, the capital stock must be modified by a capital-utilization rate to construct the appropriate capital-labor ratio.

In part, capital utilization (u) depends on the intensity of labor-effort per labor-hour.

Assume that the flow of potential capital-services is directly proportional to the capital stock (K), and that there is a positive relationship between capital-utilization and both labor-intensity and capacity utilization (ϕ) of the form

(3) $$u = B\phi(LE/LH),$$

where B is a constant which translates measurement units. Then the ratio of capital-services (CS) to effort is

(4) $$CS/LE = u(K/LE) = B\phi(LE/LH)\ (K/LE) = B\phi(K/LH).$$

From this equation, the growth rate for the capital-labor ratio depends only on observables: capacity utilization, the capital stock and labor-hours. This specification shows why the growth of capital per labor-hour hired performs well in productivity equations despite the failure to control for hourly labor-effort: work extracted affects both capital utilized and labor-potential utilized.

Third, although rarely attended to before the energy-price shocks of the seventies, non-human energy is also a substitute for labor which enhances labor efficiency. Many analysts have suspected that the oil price increases in particular forced companies to sacrifice some productivity growth in order to save energy and hold down unit costs,[2] especially in sectors in which energy is a larger and labor a smaller proportion of total costs. While some have traced the effect of changes in input prices on productivity growth [Weisskopf *et. al.*, 1983], a more direct test would use the rate of growth of real energy consumption per production-worker labor-effort in manufacturing. Since labor effort is not observable, labor-hours has to be used as a proxy. Therefore this variable will have measurement error, making it difficult to clarify the role played by the energy crisis.

The technical dimension of the model proposed here may be summarized as follows:

(5) $$\dot{O/LE} = f(\dot{\phi}, \dot{\phi K/LH}, \dot{EC/LE}),$$

were EC is real energy consumption.

Determinants of Work Extracted—A Social Model

Because production is a social as well as technical process, the foregoing model is incomplete. Embedded in the employer-employee relationship is a conflict of interests over how and what work is to be done. Furthermore, heightened conflict would be expected to undermine productivity growth. This study distinguishes three indicators of deteriorating social relations of production: strike activity, the quit rate, and the industrial accident rate.

The foremost indicator of industrial conflict is strike frequency.[3] Strikes of themselves disrupt production. But even more, increased strike activity is hypothesized to represent a workforce more willing to advocate and act on its interests in the workplace, constraining the growth of labor per labor-hour.

Strikes are procyclical. Recent research [Naples, 1986] suggests that long swings in unemployment are also negatively related to long swings in strike activity. If industrial conflict did contribute to the productivity slowdown, that slowdown is an endogenous outcome of the very prosperity and high growth rates of the postwar period.

In the 1960s industrial conflict accelerated—total manufacturing strikes rose 42 percent from the late 1950s to their 1974 peak. Working conditions were an increasingly important strike issue (19 percent of all manufacturing strikes for 1963–72 vs. 14 percent for 1954–1962).

Strikes also became less predictable: the proportion of strikes during the term of a contract was high through the sixties (averaging 26 percent), although it fell rapidly after 1972. It has been argued elsewhere (Naples, 1981, 1986) that these changes reflected the unraveling of the postwar structure of industrial relations, which had represented a truce between organized labor and corporate employers. This truce could not be indefinitely sustained because of the basic conflict between labor and management over wages and working conditions.

Strikes are not the only expression of workplace conflict. Such individual actions as quits have also been interpreted as indicating labor unrest and job dissatisfaction (Freeman and Medoff, 1979; Norsworthy and Zabala, 1985). Others (D. Gordon, 1981 and Kendrick and Grossman, 1980) have employed the quit rate or the more indirect cost-of-job-loss (Weisskopf et al., 1983) as a proxy for labor-market conditions. When employers face a high quit rate, they will be more circumspect in relations with employees, more tolerant of lateness, absenteeism, or frequent breaks. Otherwise they have to compete in tight labor markets to hire inexperienced replacements. Individual workers can resist increases in their work load with more impunity and challenge perceived abuses of authority with less fear of being fired.

Quits are largely cyclical; nevertheless, they were secularly low in the fifties, with a minimum of 1 per employee per month in 1958, and reached 2.5 and 2.8 in the late sixties and early seventies, respectively.

A deterioration in working conditions, for instance due to a higher industrial-injury rate, would be expected to undermine peaceful work relations even if neither quits nor strikes increased in response (Naples, 1981, 1986, Weisskopf et. al., 1983). On the shop floor, worker dissatisfaction would take its toll as employees lost their motivation, worked to rule, increased waste, or directly sabotaged production.

The industrial-accident rate rose 28 percent between 1962 and 1970, and by 1979 was almost double the 1962 level (Naples and Gordon, 1981). Denison's (1983) finding that the cost of protecting employee safety and health had a negative impact on productivity growth may reflect an underlying inverse relationship between labor-management conflict over working conditions and productivity growth.

Because one of the causes of a higher accident rate is the acceleration of the production pace, it is possible that the accident rate would be positively correlated with productivity growth. Whether the negative industrial-relations effect predominates over any positive speed-up effects will have to be empirically determined.

Any complete model of the growth of the work-extraction ratio should include the growth of the capital-labor ratio, as some changes in technique save on labor-hours by increasing effort per hour. Thus the social-relations dimension of the model proposed here is as follows:

$$(\dot{LE/LH}) = g(Q, S, A, \phi \dot{K/LH}), \tag{6}$$

where Q is the quit rate, S is strike frequency,[4] and A is the accident rate. The implication is that sustained high level of quits, strikes and accidents leading to worsened industrial relations will steadily erode the growth of labor-effort per labor hour.

The Full Productivity Model—Technical and Social Determinants

While the labor-efficiency ratio (O/LE) and the work-extraction ratio (LE/LH) are unobservable, the sum of their growth rates, productivity growth, is observable. The full productivity model is found by adding equations (5) and (6):

$$\begin{aligned}\dot{P} = (\dot{O/LE}) + (\dot{LE/LH}) &= f(\dot{\phi}, \phi \dot{K/LH}, \dot{EC/LE}) \\ &+ g(Q, S, A, \phi \dot{K/LH}) = h(\dot{\phi}, \phi \dot{K/LH}, \dot{EC/LE}, Q, S, A).\end{aligned} \tag{7}$$

The only remaining unobservable in (7) is LE in the energy-consumption ratio; labor-hours will have to be used as a proxy.

Assuming a direct (linear) causal relationship between the arguments of the function (h) and productivity growth, and substituting LH for LE,

$$\dot{P} = h_0 + h_1 \dot{\phi} + h_2(\phi \dot{K/LH}) + h_3(\dot{EC/LH}) + h_4 Q + h_5 S + h_6 A + e, \tag{8}$$

where e is an error term assumed to be random normal. The hypothesized signs of the coefficients are

$$h_1, h_2, h_3 > 0; h_4, h_5 < 0, h_6 \gtrless 0. \tag{9}$$

[Data sources are provided in the Appendix.]

EMPIRICAL RESULTS

In table 1, equation 1, a simple pre-OPEC model shows a strong role for the capital-labor ratio, and an insignificant $\dot{\phi}$ term. While this throws some doubt on the importance of the uncertainty effect, the rate of growth of capacity utilization will be retained in subsequent equations since others have found its inclusion appropriate. Its insignificance may perhaps reflect the fact that few production workers are hoarded since they are rarely overhead employees.

The addition of the energy-labor ratio does not increase the explanatory power of the equation, and pushes the Durbin-Watson statistic into a suspect range. Predictably, it reduces the coefficient of the capital-labor ratio, since the two are complements. The energy-labor ratio is significant at a 93 percent confidence level; its low level of significance may be due to its collinearity with the capital-labor ratio, or to the foreseen measurement error. Inspection of the residuals from equations 1 and 2 indicates that the underestimation of productivity growth in the 1970s is unaffected by the energy-labor ratio's inclusion. This more direct test of the effect of the oil-price shocks suggest a weaker impact than does Weisskopf's, Bowles' and Gordon's (1983) relative-price variable.

When either industrial-conflict variable (strike frequency or the quit rate) is added alone, it exhibits the expected sign, is statistically significant and increases the corrected R^2. But when both are added, neither is individually significant, although they are jointly significant. This is not surprising since their simple correlation is .81 (Naples, 1981).

To capture the impact of both, an industrial-conflict index (IC) was constructed as a weighted sum of standardized strikes and standardized quits.[5] Its coefficient is significantly negative, and its inclusion eliminates the negative residual for 1974. Also, the energy-labor ratio becomes significant at the 5 percent level in equations 3 and 5. Once industrial conflict has explained variations in hourly labor-effort, the effects of changes in the energy-labor ratio on the growth of labor efficiency are easier to discern.

The final social-relations variable, the accident rate, might *a priori* have a positive or negative coefficent. In equation 6, the net effect of accidents on productivity growth is clearly negative. The Durbin-Watson statistic improves, and the explanatory power of the equation

TABLE 1
Results for Production-Worker Productivity-Growth in Manufacturing, 1951–1980,[1] Annual Data

Equation	C	$\dot{\phi}$	$\dot{\phi K}/LH$	$\dot{EC}/LH$	IC	Strikes	Quits	Accident Rate	$\bar{R}^2$	F	DW	n
1.	.013	.0072	.76						.53	19.0	.91	33
	(3.1)*	(.29)	(6.0)*									
2.	.015	.018	.67	.037					.51	11.4	.71	31
	(3.4)*	(.67)	(5.2)*	(1.50)°								
3.	.044	.018	.68	.042		−.000013			.63	13.5	1.10	30
	(4.3)*	(.76)	(5.9)*	(1.93)⁺		(3.1)*						
4.	.030	.040	.63	.033			−.0074		.61	12.1	.90	30
	(4.3)*	(1.56)°	(5.3)*	(1.46)°			(2.7)*					
5.	.041	.026	.66	.039	−.0043				.63	13.4	1.03	30
	(4.4)*	(1.10)	(5.8)*	(1.80)⁺	(3.11)*							
6.	.052	.028	.62	.017	−.0029			−.0012	.70	14.6	1.27	30
	(5.6)*	(1.31)	(5.9)*	(.79)	(2.12)*			(2.6)*				
6†.		.001	.53	.007	.48			.49				

*Significant at 1 percent level.
⁺Significant at 5 percent level.
°Significant at 10 percent level.
†Mean elasticities (t-statistics in parentheses).
[1]Equation 1 covers 1949–1981. For equation 2, the data for the growth of energy-consumption are only available from 1951. For the other equations, the end of the BLS strike series in 1981 constrained the three-year average of strikes to 1980.

Glossary: $\dot{\phi}$—rate of growth of capacity utilization
$\phi K/LH$—rate of growth of capital-labor ratio, corrected for measurement error
EC/LH—rate of real energy consumption per labor-hour
IC—industrial-conflict index (see footnote 5)

once more increases. The coefficient of industrial conflict does fall about one standard deviation, which is consistent with the expectation that industrial accidents motivate workers to strike and/or quit. This is a reminder that a high level of industrial conflict is not all labor's doing—management may also provoke a disruptive employee-response [Naples, 1987].

Surprisingly, the coefficient of the energy-labor ratio falls by 60 percent from equation 5 to equation 6, despite the fact that its correlation with the accident rate is not high (−.36). It does have the smallest simple correlation with productivity growth of all the regressors in equation 6, which makes it more vulnerable to being undercut by stronger variables. Or the lower coefficient of the energy-labor ratio may reflect the success of the accident rate in explaining the 1975 and 1977–1978 slowdowns in productivity growth: the negative residuals for those three years fall by half when the accident rate is added.

The mean elasticities for equation 6 are listed in equation 6'. As in the standard model, changes in the capital-labor ratio clearly have the greatest impact on productivity growth. But over the full period 1951–1980, industrial conflict and the accident rate contribute almost as much to the explanation of productivity growth as does the capital-labor ratio.

Turning to the productivity slowdown itself, a slightly different interpretation emerges. In table 2, changes in each of the explanatory variables from 1951–72 to 1973–80 are calculated, and using the coefficient estimates from equation 6, table 1, their contribution to the productivity slowdown is estimated. The results are typical insofar as the capital-labor ratio

TABLE 2
Sources of the Productivity Slowdown

Indicator	Change in Yearly Average, 1951–1972 to 1973–1980	Coefficient-Estimate, eq. 6	Contribution to Productivity Slowdown	Percent of Decline Explained
Productivity†	−1.1689			
Capacity utilization†	−0.714948	.028	.02002	1.7
Capital-labor ratio†	−0.40689	.62	.2523	21.6
Energy-labor ratio†	−4.76578	.017	.08102	6.9
Industrial conflict	.18542	−.29*	.05377	4.6
Accident rate	5.8387	−.12*	.70064	59.9
Total			1.108	94.7
Unexplained residual			.061	5.3

†Measured in percentage changes.
*Coefficients for equation 6 are for productivity measured as a decimal. To calculate the change in productivity measured as a percentage change, these were multiplied by 100. Since the other variables were also translated from decimals to percentage changes, no such multiplication was necessary.

cannot explain the bulk of the productivity slowdown, and the energy-labor ratio only explains a small percentage. But the major factor appears to be the deterioration in the quality of worklife that the accident rate represents; the two social-relations variable combined explain almost two-thirds of the productivity slowdown.

CONCLUSION

Inattention to the determinants of the growth of labor per labor-hour leaves out two important causal factors in productivity analysis, industrial conflict and workplace accidents. In particular, their critical role in explaining the productivity slowdown is overlooked. The inclusion of the effect of deteriorating social relations increases the proportion of the variance of productivity growth explained for 1951–1980 by 37 percent above the technical model. Moreover, it reduces the likelihood of autocorrelated residuals and bias. We are reminded that production is a social as well as a technical process.

The seemingly small impact of reduced energy consumption after the oil-price shocks is also clarified by the distinction between labor performed and labor-hours hired. Because the appropriate denominator of the ratio is labor-effort, while only labor-hours can be observed, the variable is subject to measurement error; hence even if it is a factor, its coefficient is hard to perceive statistically.

These findings provide an important addendum to the recent literature on unions' positive impact on productivity levels [Brown and Medoff, 1978, Freeman and Medoff, 1979]. If unions enjoy a successful collective-bargaining relationship, a workable grievance procedure, and higher wages, workers should quit less, and managerial initiatives to increase hourly labor-services should meet with less disruptive resistance. However, if working conditions worsen and labor-management conflict intensifies, the presence of a union should enhance workers' ability to act in their own interests, which may decrease the growth of hourly effort and therefore of productivity. The relationship between unionism and productivity is not an absolute, but depends on the quality of industrial relations [Freeman and Medoff, 1979].

The deterioration in industrial relations discussed here was considered an endogenous outcome of the low levels of unemployment in the postwar era and the contradictions embodied in the postwar pattern of labor-management relations. Given the tendency of both strikes and quits to move inversely with unemployment, the results of this study also point to an endogenous business cycle. In the short run, increases in output lead to increases in productivity growth (the uncertainty effect), but eventually, they lead to more disruptive forms of industrial conflict and lower productivity growth. While further study is indicated, this might explain both the end-of-expansion slowdown in productivity growth and the full-employment profit-squeeze [Boddy and Crotty, 1975; R.J. Gordon, 1979].

APPENDIX

All data are annual series for manufacturing.

(P) *Productivity.* Industrial production, U.S. Board of Governors of the Federal Reserve System, published in U.S. Council of Economic Advisors (CEA), *Economic Report of the President, 1983* (Washington, D.C.: U.S. Government Printing Office (GPO), 1983); production workers on the payroll, U.S. Department of Commerce, Bureau of Economic Analysis, *Business Statistics 1977* (Washington, D.C.: U.S. GPO, 1978), and U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States: 1980, 1982–83* (Washington, D.C.: U.S. GPO, 1981, 1983); average weekly hours of production workers, U.S. Department of Labor, Bureau of Labor Statistics (BLS), *Employment and Earnings, United States, 1909–78,* Bulletin 1312-11 (Washington, D.C.: U.S. GPO, 1979), and U.S. Department of Labor, BLS, *Employment and Earnings* (October 1983), p. 109.

(ϕ) *Capacity Utilization.* U.S. Board of Governors of the Federal Reserve System, published in U.S. CEA, 1983.

(K) *Capital Stock.* U.S. Department of Labor, BLS, as revised and updated by U.S. Department of Commerce, Bureau of Industrial Economics, courtesy Ken W. Rogers.

(EC) *Energy.* Consumption of fuels and electric energy, U.S. Department of Commerce, Bureau of the Census, *Annual Survey of Manufactures,* various years, and U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract,* 1981, 1983; producer price index for energy, *Ibid.,* 1983.

(S) *Strike Frequency.* U.S. Department of Labor, BLS, *Handbook of Labor Statistics, 1975, 1982–83* (Washington, D.C.: U.S. GPO, 1976, 1983), and U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract,* 1983.

(Q) *The quit rate.* U.S. Department of Labor, BLS, *Employment and Earnings, United States, 1979,* and U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract,* 1983.

(A) *The Rate of Disabling Lost-Workday Accidents.* U.S. Department of Labor, BLS, in Naples and Gordon, 1981.

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FOOTNOTES

1. Weisskopf et. al. (1983) suggested that low capacity utilization could hurt productivity growth because plants might operate below planned efficient capacity. But firms can temporarily close less efficient plants while continuing to operate more up-to-date facilities at or above planned levels; this, as the authors observe, would benefit productivity. This stable-productivity strategy would be constrained by high transportation costs for output. The consistently significant and strong results Weisskopf et. al. find for capacity utilization levels despite the weakness of the "planned capacity" explanation suggest that this variable may be picking up the effects of such other cyclical factors as quits and strikes—see below.

2. Martin Baily (1981) first suggested that the energy-price shocks accelerated the obsolescence and scrapping of capital, but was not captured by capital-stock figures. The abrupt slowdown in production-worker productivity growth in 1973–74 was exceeded in magnitude by those in 1966 and 1977–78, which cannot be attributed to an oil-price shock. OPEC increased prices substantially in 1979, yet production-worker productivity-growth recovered some in that year.
3. Kendrick and Grossman (1980) found that the volume of strikes (percent of working time lost to strikes) had a negative effect on total-factor productivity-growth, in a cross-section manufacturing study. This investigation found that strike frequency performed much better than strike volume in explaining production-worker productivity growth.
4. Because the number of contracts open in any year varies, strikes must be averaged over 3 years (the predominant term of union contracts) to create a meaningful indicator. While the number of strikes could also be deflated by the number of contracts open, such data have only been consistently collected for major strikes [of more than 5000 (1000) strikers before (since) 1966] which obviously need not have the same pattern as all strikes. Unaveraged strikes and strikes lagged one year gave substantially the same results as those presented here.
5. Since the mean elasticity for strikes (.795, equation 3) was twice that for quits (.404, equation 4), the industrial-conflict index was constructed as

$$IC = (2(S/\hat{\sigma}_S) + Q/\hat{\sigma}_Q)/3,$$

where $\hat{\sigma}$ is the sample standard-deviation for each variable.

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