Norman was insufficiently cautious. We have seen that some 'revenue function' results are affected by the presence of produced inputs if a positive rate of interest is paid on their value. And such a rate of interest is usually paid.

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

Michele L. Naples*

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 Christianesen, 1982; Flaherty, 1985; Gordon, 1981; Kendrick and Grossman, 1980; Naples 1986; Norsworthy and Zabala 1985; Weisbrot, 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. Exploratory 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 control 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 growing 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.

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

\[ P = \frac{O}{LE} = \frac{LH}{LE} \]

(1)

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 work-life, changes in labor effort affect the distribution of social welfare, not only the magnitude of output. Increases in productivity, cereteris 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:

\[ \dot{P} = \frac{\dot{O}}{LE} + \frac{\dot{LH}}{LE} \]

(2)

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 cyclical [Boddy and Croft, 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 Weiskopf 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 \textit{a fortiori} 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 (\( \alpha \)) depends on the intensity of labor-effort per labor-hour.

**The Productivity Slowdown**

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 (\( \phi \)) of the form

\[ u = \beta(LE/LH), \]

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

\[ \frac{CS}{LE} = uK/LE - \betaLE/LH \quad \frac{K}{LE} = \betaK/LH. \]

From this equation, the growth rate for the capital-labor ratio depends on only 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, 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 [Weiskopf 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:

\[ \frac{O}{LE} = f(\phi, \phiK/LE, HC/LE), \]

were EC is real energy consumption.

**Determinants of Work Extracted—A Social Model**

Because production is 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.1 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 cyclical. 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 1954–1963).
productivity model is found by adding equations (5) and (6):

\[ P = (O/\text{LE}) + (\text{LE}/\text{LH}) + f(Q, S, A, \phi K/\text{LH}, \text{EC}/\text{LE}) \]

\[ + g(Q, S, A, \phi K/\text{LH}, \text{EC}/\text{LE}, Q, S, A), \]

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 (b) and productivity growth, and substituting LH for LE,

\[ P = b_1 + b_2 + b_3(\phi K/\text{LH}) + b_4(\text{EC}/\text{LH}) + b_5 Q + b_6 S + b_7 A + c, \]

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

\[ b_1, b_2, b_3 > 0; b_4, b_5 < 0, b_6 > 0. \]

[Data sources are provided in the Appendix.]

**EMPIRICAL RESULTS**

In table 1, equation 1, a simple pre-OPEC model shows a strong rate for the capital-labor ratio, and an insignificant \( \phi \) term. While this shows 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 unafforded 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 R². 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. 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 coefficient. 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: Annual Data

<table>
<thead>
<tr>
<th>Equation</th>
<th>C</th>
<th>d</th>
<th>EC</th>
<th>L1</th>
<th>LE</th>
<th>IC</th>
<th>Series</th>
<th>Quits</th>
<th>Accident Rate</th>
<th>R^2</th>
<th>F</th>
<th>DW</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>0.013</td>
<td>0.0072</td>
<td>-76.1</td>
<td>(3.11)*</td>
<td>(2.9)</td>
<td>(6.0)*</td>
<td>.51</td>
<td>19.0</td>
<td>91.23</td>
<td>.35</td>
<td>.31</td>
<td>.31</td>
<td>.31</td>
</tr>
<tr>
<td>2.</td>
<td>0.015</td>
<td>0.018</td>
<td>.65</td>
<td>(0.07)</td>
<td>.037</td>
<td>.037</td>
<td>.31</td>
<td>11.4</td>
<td>.71</td>
<td>.31</td>
<td>.31</td>
<td>.31</td>
<td>.31</td>
</tr>
<tr>
<td>3.</td>
<td>0.044</td>
<td>0.018</td>
<td>.68</td>
<td>.042</td>
<td>-.00021</td>
<td>.00002</td>
<td>.03</td>
<td>13.5</td>
<td>.19</td>
<td>.50</td>
<td>.30</td>
<td>.30</td>
<td>.30</td>
</tr>
<tr>
<td>4.</td>
<td>0.039</td>
<td>0.040</td>
<td>.03</td>
<td>.033</td>
<td>.0014</td>
<td>.0014</td>
<td>.03</td>
<td>12.1</td>
<td>.90</td>
<td>.30</td>
<td>.30</td>
<td>.30</td>
<td>.30</td>
</tr>
<tr>
<td>5.</td>
<td>0.041</td>
<td>0.026</td>
<td>.06</td>
<td>.019</td>
<td>-.0083</td>
<td>.0083</td>
<td>.03</td>
<td>13.4</td>
<td>1.08</td>
<td>.30</td>
<td>.30</td>
<td>.30</td>
<td>.30</td>
</tr>
<tr>
<td>6.</td>
<td>0.012</td>
<td>0.052</td>
<td>.02</td>
<td>.017</td>
<td>-.0009</td>
<td>.0009</td>
<td>.03</td>
<td>7.0</td>
<td>14.5</td>
<td>.27</td>
<td>.30</td>
<td>.30</td>
<td>.30</td>
</tr>
<tr>
<td>7.</td>
<td>0.021</td>
<td>0.021</td>
<td>.03</td>
<td>.021</td>
<td>.0012</td>
<td>.0012</td>
<td>.03</td>
<td>7.0</td>
<td>14.6</td>
<td>1.27</td>
<td>.30</td>
<td>.30</td>
<td>.30</td>
</tr>
<tr>
<td>8.</td>
<td>0.021</td>
<td>0.021</td>
<td>.03</td>
<td>.021</td>
<td>.0012</td>
<td>.0012</td>
<td>.03</td>
<td>7.0</td>
<td>14.6</td>
<td>1.27</td>
<td>.30</td>
<td>.30</td>
<td>.30</td>
</tr>
</tbody>
</table>

* Significant at 1 percent level.  
** Significant at 5 percent level.  
*** Significant at 10 percent level.  
\(\beta\) Null statistics (in parentheses).  
\(\delta\) Equation 2 covers 1949–1981. For equation 3, the data for the growth of energy-consumption are only available from 1953. For the other equations, the end of the BLA strike series in 1980 constrained the three-year average of strikes to 1980.

Glossary:  
* \(\beta\)–rate of growth of capital-labor ratio, corrected for measurement error  
\(\delta\)–rate of real energy consumption per labor-hour  
\(\zeta\)–industrial-conflict index (see footnote 5)

...more content...
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 Croft, 1975; R.J. Gordon, 1979].

APPENDIX

All data are annual series for manufacturing.


(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.


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FOOTNOTES

1. Weiskopf 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 capacity-availability effect, could be constrained by high transportation costs for output. The consistently significant and strong results Weiskopf 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.

REFERENCES


The Impact of Sex and Attitudes Upon the Earnings of College Graduates

Richard Raymond and Michael Sernowicz*

Several observations relating to male-female economic differences have been well documented. First, a sizable male-female earnings gap (about 40%) remained roughly constant from 1960 to 1980 and has recently begun to decline. The precise timing and magnitude of the recent improvement in the female position depends upon which earnings series is being examined. [O’Neill, 1985]. Second, female labor force participation has increased rapidly but continues to lag far behind male participation. Third, females continue to be more heavily concentrated in lower paying occupations, although they have made substantial recent progress in gaining entry into many of the higher paying professions [Boyce, 1983].

Model specification relating to sex discrimination in the labor market has proven quite difficult, and the traditional role of women in our society has given rise to an unusual interpretation problem. Some of the more important specification problems are discussed and debated in Kamalech and Polacheck [1982, 1985], Blau and Kahn [1985] and Sowell [1984]. To measure discrimination accurately, it is necessary to separate the voluntary from the involuntary, or forced, economic "choices" which have led to lower earnings for women. If women freely choose lower paying jobs then the resulting male-female earnings differentials are not the result of labor market discrimination. However, if women are forced to accept lower paying positions, then the resulting pay differentials are clearly discriminatory.

Polacheck [1981, p. 68] and Daymont and Andriani [1983, 1984] conclude that sex differences in labor market commitment explain a major portion of the sex differences in earnings in their samples. Other investigators disagree strongly with this conclusion. Corcoran and Duncan "...find that the wage advantages enjoyed by white men cannot be explained solely or even primarily by superior qualifications or more attachment to the labor force" [1979, p. 19]. Similarly, England concludes that Polacheck’s application of "...human capital theory has not generated an explanation of occupational sex segregation that fits the evidence" [1982, p. 369]. England also points out the "...need to investigate the complementary relationships between sex role socialization and market discrimination" [1982, p. 369]. Causation may, of course, run in both directions. Low incomes resulting from labor market discrimination may have led women to eschew the qualifications and attitudes associated with higher incomes. While this contention is intuitively reasonable, the resulting impact is difficult to quantify because the information necessary to model adequately the process of qualification and attitude formulation is often unavailable.

The resolution of this difference in interpretation is obviously crucial. The present study presents evidence bearing on the importance of sex differences in attitudes that contribute to earnings differentials. While the methodology used does not settle the specification issue, the results obtained strongly suggest that attitudinal variables should not be ignored in the earnings equation.

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