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Are union productivity effects overestimated?: evidence from coal mining

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The empirical literature of the influence of unions on productivity is extended by considering the effect in an industry with heterogeneous firms. Recent theoretical papers suggest that, in such an industry, unions will tend to organize the exogenously 'more productive' firms. Thus, a spurious correlation between unions and productivity may emerge. We test this hypothesis by estimating production functions for coal with data from Eastern Kentucky underground coal mines. The aspect of mine heterogeneity that we focus on is the width of the mine's seam of coal. Wider seams increase productivity. Empirically, we find that unions disproportionately organize mines with wider seams and this accounts for the positive relationship between unions and productivity observed in our data. In fact, once seam thickness is accounted for, the estimated effect of unions on productivity is negative.

I. INTRODUCTION

Over the last several years, much research has attempted to clarify the effect of unionism on labour productivity. This empirical work dates back to Brown and Medoff (1978) who estimate a modified Cobb–Douglas production function using two-digit Standard Industrial Classification industry data by state. They find that unionism increases labour productivity by around 22%. This approach has been criticized on several bases. It implicitly assumes common technology between highly aggregated industry observations and may confuse actual output with price effects. Later studies have corrected these shortcomings by employing industry data and using physical output as the dependent variable. These later studies find mixed results. Among those studies finding positive productivity effects are Clark (1980a, 1980b), Allen (1984b, 1986), and Mefford (1986), while Clark (1984), Bemmels (1987), and Mitchell and Stone (1992) have found negative union productivity effects. Boal (1990) finds positive effects for large mines in 1920s' West Virginia coal mine data and negative effects for small mines. Freeman and Medoff (1984), examining the bituminous coal industry, report positive effects in 1965 but negative effects in later years.

Though some shortcomings of aggregate studies have been addressed, studies of union productivity effects continue to maintain the potentially problematic assumption that firms within an industry are homogeneous in endowed productive conditions. Kuhn (1988) analyses unionization in a model of firm formation where managers are different in talent. Similarly, Chezum and Garen (1996) model the extent of union organizing in an industry with heterogeneous firms where some firms are exogenously 'more productive' than others. In both papers, unions organize disproportionately from the more productive firms.

This finding has an important empirical implication. If unions organize the more productive firms, we expect to observe a positive correlation between unionism and productivity. This is not due to the union's ability to affect production but rather due to unions organizing more productive firms. Estimates not controlling for heterogeneous productive conditions across firms will yield positively biased estimates of the union productivity effect.

The contribution of the current study is to account for heterogeneity in productive characteristics in estimating union productivity effects. Quarterly data from 941 coal mines in the early 1980s are used to estimate the effect of unions on productivity. The data contain information on tons of coal output, production manhours, type of extraction processes, and seam thickness. This last variable is our measure of heterogeneous endowed conditions: it is the width of the seam face a coal mine is operating on. Mines

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operating on thicker coal seams are able to produce a greater quantity of coal per manhour employed. It seems natural that unions are more likely to organize those mines located on thicker seams, as these are the more productive mines and are better equipped to survive union wage increases. We estimate the union productivity effect including seam thickness in the production function and compare them to estimates with this effect omitted.

Regarding coal mining, at least three studies explicitly consider union productivity effects: Freeman and Medoff (1984), and Byrnes *et al.* (1988) and Boal (1990). These studies find mixed results. Freeman and Medoff examine tons of coal per worker day over five year increments from 1965 to 1980. They report finding positive effects for the 1965 data.[1] The effect was found to diminish and in 1980 they found negative effects on the order of -14% to -18%. They attribute the changing size and sign of the union productivity effect to changing labour management relations over the time period studied.

Boal examines data from 83 West Virginia coal mines in the early 1920s. He finds that the size of the union productivity effect depends on the size of the mining operation.[2] He reports an estimated union productivity effect of -31% for mines in the lower tail of the input size distribution, and 2% in the upper tail. At the median, the union productivity effect is found to be roughly zero.[3] A major conclusion of the paper is that the union productivity effect depends crucially on the size of the mining operation.

Byrnes *et al.* (1988) give estimates that are most comparable to our own, including a seam thickness variable in their reported regressions.[4] They do not, however, report estimates of the union productivity effect with this variable omitted. They examine data from a panel of 84 Interior surface mines and 68 Western surface mines surveyed over the period 1975–1978. To account for unionization, the authors use a three way classification; nonunionized, unionized but not affiliated with the United Mine Workers of Americal (UMWA), and unionized with UMWA affiliation. Their results indicate that nonunion mines are less productive than unionized mines, and that UMWA affiliation is detrimental to the union productivity effect.

The remainder of this paper is organized as follows. Section II outlines the traditional analysis of the union's effect on labour productivity and then considers the influence of heterogeneous firms within an industry. Leaving out controls for firm heterogeneity in an empirical analysis causes a standard omitted variable bias. If unions organize the exogenously more productive firms, the union productivity effect will be overestimated. Section III describes the data and empirical tests. We use data from underground coal mines in which we are able to identify variations in natural conditions within a mine. We find that unions and mine productivity are positively related but the effect is entirely due to the better natural conditions of union mines. Once this is accounted for, unions have a negative productivity effect. Finally, Section IV concludes the paper.

II. THE UNION PRODUCTIVITY EFFECT

The effect of unionism on productivity typically is viewed as operating through two channels: management effects and union voice effects. Unions may 'shock' management into operating plants more efficiently by tightening standards and monitoring more effectively. This has the effect of increasing labour productivity. However, restrictive union work rules may adversely impact productivity by limiting management discretion.

Union voice operates to increase productivity by increasing worker morale, improving relations between workers, and improving channels of communication between workers and management.[5] Additionally, a higher union wage may induce substitution towards capital or to a higher quality labour force, increasing output per worker. However, this is a spurious union productivity effect as the position of marginal product curves are unchanged.

The studies mentioned above have attempted to control for some of these aspects. Brown and Medoff adjust their measure of labour for quality and still find positive productivity effects as does Allen (1986). Mefford (1986) controls for absenteeism and turnover and finds positive union productivity effects. Bemmels (1987) finds that unions reduce the effectiveness of some management practices leading to negative union productivity effects. Mitchell and Stone (1992) control for output quality and find a negative estimate of the union productivity effect.

Although these studies have added to our understanding of the union productivity effect, none consider the possible differences in productive conditions between firms. This possibility is considered theoretically in Kuhn (1988) and in Chezum and Garen (1996). In these, output is determined by the production function $y = f(L, \alpha)$, where y is output, L is employment, and α is the ability of the firm manager.

[1]Freeman and Medoff (1984, pp. 167–8).
[2]Boal (1990, pp. 398–9). We report estimates based on a translog estimating equation as in Boal's Table 4 on page 399.
[3]Using a Cobb–Douglas specification, he finds a union productivity effect of 9.2% at the median of input size.
[4]The purpose of the Byrnes *et al.* paper is to compare nonparametric estimates with parametric estimates of the union productivity. The authors report that the estimated magnitude of the effect is comparable between the two techniques.
[5]Clark (1980b) finds that employee responses to unionization are not a significant source of gains to productivity at union plants. In contrast to the above argument, Allen (1984a) finds that union workers are more likely to be absent than are similar nonunion workers.

the estimated union effect becomes negative and significant at the 10% level. Adding the interactions between seam thickness and the capital proxies does little to change this result.

We find that when heterogeneous productive conditions are controlled for, unionization lowers coal output by roughly 3.1% per quarter. This compares to a positive estimated effect of 1.5% when these conditions are omitted. Thus, there is a positive bias in the union effect when heterogeneous productive conditions are omitted.

Column 4 presents the results from the most general estimating equation. In this equation, we include a union shift variable and interactions of the union variable with ln(Hours), ln(Seam), and the mining method variables. The results indicate that the linear union term is positive and significant, the union interaction with manhours is negative and significant, and the union interaction with continuous mining techniques is negative and significant. The coefficients on the remaining interactions are not significantly different from zero. It appears that the union effect is positive for low hours but becomes negative as hours increase. To clarify the union effect, we calculate the hours at which the negative effect dominates. Solving for hours, the estimated turning point is approximately 5967 hours.[10] In the sample, the mean hours for the union observations is 23 686 or about four times higher. Further, nearly two-thirds of the union observations have hours greater than 5967 indicating that the union productivity effect is negative for the bulk of the sample.

IV. CONCLUSIONS

We test the hypothesis that union productivity effects are overestimated when controls for heterogeneous productive conditions are omitted. Models in the literature suggest that in an industry with heterogeneous firms, unions are more likely to organize more productive firms. This generates positively biased estimates of the union productivity effect. The estimated union effect confuses the actual union productivity effect with the effect of unions organizing more productive firms.

We employ data from Eastern Kentucky underground coal mines to test this hypothesis. Mines differ on a key natural characteristic; the thickness of the face of the coal seam being mined. Mines operating on thicker seams are naturally better able to mine coal. The data indicate that unions are more likely to organize mines operating on thicker coal seams and that these mines are better able to produce coal. Estimates of union productivity effects incorporating and omitting seam thickness are presented. We find that union productivity effects are upwardly biased by a factor of three. The importance of natural conditions in underground coal mining and their relation to unionism are apparent, and call into question the magnitude of union productivity effects found in earlier studies. The results are certainly strong enough to merit tests employing data from other industries.

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[10]To solve the resulting equation, we set ln(Seam), Continuous, Conventional, and Drill to their respective means.

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THE IMPACT OF UNIONIZATION ON PRODUCTIVITY: A CASE STUDY

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This study examines the effect of unionization on productivity through the use of time-series data on selected establishments in the U.S. cement industry. The analysis combines statistical estimation of the union impact and interviews with union and management officials to forge a link between econometric estimation and the traditional institutional analysis of union policy and management practice. The econometric analysis deals primarily with the problem of controlling for interfirm differences in variables such as the quality of management and also for the possible union impact on labor quality. The case studies are designed to show the specific ways in which unionization affects productivity. The empirical results indicate that unionization leads to productivity gains, deriving in large part from a series of extensive changes in management personnel and procedures.

UNIONIZATION entails fundamental changes in the nature of the employment relationship. In a nonunion setting the rules governing the workplace are largely determined by management, with worker influence limited to an exit from the firm if the implied labor contract is not attractive. Collective bargaining establishes a more direct means of influence through the processes of contract negotiation and administration. These procedures involve workers and the union in setting the terms and conditions of employment, and in day-to-day operations. The literature on collective bargaining is replete with evidence that these procedural changes are accompanied by changes in the substance of the employment relation.[1] The effect on the production process, however, is unclear. Recent analysis of cross-section data on value added per hour worked suggests a positive union-productivity effect.[2] Yet there is very little evidence about the change in productivity within an enterprise after

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[1]The basic reference is Sumner Slichter, James Healy, and Robert Livernash, *The Impact of Collective Bargaining on Management* (Washington, D.C.: The Brookings Institution, 1960).

[2]See Charles Brown and James L. Medoff, "Trade Unions in the Production Process," *Journal of Political Economy*, Vol. 86, No. 3 (June 1978), pp. 355–78, which examines interindustry data. John Frantz has analyzed establishment data on the wooden household furniture industry; see his, "The Impact of Trade Unions on Productivity in the Wood Household Furniture Industry," Honors thesis, Harvard University, 1976.

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collective bargaining is introduced. While numerous case studies have identified changes in the internal operation of the firm after unionization, there has been no attempt to link the institutional information with empirical analysis of the union's effect on productivity. Both kinds of information are essential to a full understanding of the impact of the union.

This paper examines the effect of unionization on productivity through the use of data from the U.S. cement industry. The analysis uses establishment-level data together with interviews of management and union officials to forge a link between econometric estimation and the traditional institutional analysis of union policy and management adjustment. Particular focus in the empirical work is on the problem of identifying both the effect of unionization on productivity in the face of firm-specific effects and adjustments in labor quality. The case studies, and most of the econometric analysis, are based on the experience of six cement plants that changed union status in the 1953 – 76 period. The statistical analysis is designed to provide an estimate of what impact unionization had, while the institutional analysis is intended to shed light on the question of how unionization influenced the operation of the enterprise.

The Analytical Framework

The theoretical connection between unions and productivity has been discussed at length elsewhere and will be summarized only briefly here.[3] In the context of a representative production process in which output is a function of capital and labor inputs, the productivity of labor depends on the capital-labor ratio, the scale of operations, and various institutional factors, such as methods of organization, effectiveness of management, and the motivation of workers. Traditional economic analysis limits the influence of the union on productivity to capital-labor substitution induced by the union wage effect.[4] In that approach, an increase in the capital-labor ratio in response to a rise in the relative wage raises the productivity of labor, but capital productivity declines and the net effect is an increase in costs and misallocation of resources. A second mode of analysis recognizes that unionization is likely to affect methods of organization and other aspects of the internal operation of the firm. If unionization puts pressure on management to improve operations, for example, the production process may yield a larger volume of output for any combination of capital and labor.[5] Of course, the opposite conclusion holds if unionization reduces motivation or otherwise impedes the effective operation of the enterprise.

The effect of unionization on the organizational determinants of productivity depends on changes in the labor contract and on adjustments made by workers and management to new provisions. In most situations, unionization entails a shift in relative power and increased worker control over conditions of work. Freeman has argued that these changes reduce turnover by giving workers a "voice" in the conduct of the firm.[6] A reduction in turnover has clear implications for firm-specific training, the effectiveness of work groups, and produc-

[3] A review of the pre-1970 literature may be found in Derek Bok and John T. Dunlop, *Labor and the American Community* (New York: Simon and Schuster, 1970), pp. 260 – 80. A more theoretically oriented discussion is presented in Brown and Medoff, "Trade Unions in the Production Process," and Kim B. Clark, "Unions and Productivity in the Cement Industry," Ph.D. dissertation, Harvard University, 1978.

[4] The capital-labor ratio is understood to be adjusted for differences in quality. The traditional channel of union influence is discussed in Harry Johnson and Peter Mieszkowski, "The Effects of Unionization on Distribution of Income: A General Equilibrium Approach," *Quarterly Journal of Economics*, Vol. 84, No. 4 (November 1970), pp. 539 – 61; also see the paper by H. Gregg Lewis in Philip P. Bradley, ed., *The Public Stake in Union Power* (Charlottesville: University of Virginia Press, 1963).

[5] This effect assumes the existence of unexploited opportunities to increase profits and is, therefore, closely related to the concept of X-efficiency developed by Leibenstein; see Harvey Leibenstein, "Allocative Efficiency vs. 'X-Efficiency,'" *American Economic Review*, Vol. 56, No. 3 (June 1966), pp. 392 – 415 for an extended analysis.

[6] For a statement of the "exit-voice" model of the union, see Richard B. Freeman, "Individual Mobility and Collective Voice in the Labor Market," *American Economic Review*, Vol. 66, No. 2 (May 1976), pp. 361 – 68.

suggest, in five of the six plants studied an essentially authoritarian management was confronted by a significant shift in power and authority. Previous methods, particularly the manner of handling and dealing with workers, were no longer effective (or, at least, were much more expensive). The evidence suggests that successful management in the union context required new management procedures and practices. Perhaps the most cogent description of the differences in the management process before and after unionization was given by a plant manager who remarked:" . . . before the union this place was run like a family; now we run it like a business."

The major change in plant management uncovered in the interviews was the introduction of a new plant manager and, in some instances, new supervisors. Given the substantial change in the nature of industrial relations, the identification of the old manager with the nonunion regime, and the likelihood that previous management was involved in attempts to block unionization, the change in plant management is not surprising. While retraining permitted many front-line supervisors to make the adjustment to a union regime, training was not a viable option in the case of plant managers. The interviews suggest that a new manager was in some sense a prerequisite for innovation in management methods.

Before the interviews were conducted, changes in management procedure were expected on theoretical grounds to have occurred after unionization. Apart from capital-labor substitution and labor-quality adjustments, the union wage effect creates incentives for management to extract more work effort from a given level of employees. These expectations were clearly realized. As line 2b reveals, the interviews uncovered changes in management methods in all plants. The magnitude of the change varied from situation to situation, with a more professional, businesslike approach to labor relations by front-line supervisors the most common adjustment. In four of the six plants we found attempts to increase work effort and work group efficiency primarily through introduction of formal methods of organizational control. The adjustments in formal control procedures took several forms. In essence, however, they amounted to a system of production goals or targets accompanied by procedures for the review and monitoring of performance. The evaluation often occurred in newly introduced staff meetings, which were used for communication, training, and assessment of conditions and progress. Substantial changes in formal procedures were not introduced in all plants. Yet, even where formal procedures were changed only moderately, the interviews suggest that management monitored work performance and manning requirements more closely.

The evidence summarized in Table 5 suggests that unionization led to substantial changes in management in each of the before-after plants. Not all adjustments noted were observed in all plants, but each plant experienced change in a number of dimensions. The existence of a pattern of management adjustment across plants organized at different points in time suggests that the observed changes are not due solely to general technical change. While technical change may be at work in the processes we observed, it seems clear from the interviews that unionization had a significant independent effect. Our tentative conclusion, therefore, is that an improvement in plant management is one of the key adjustments to unionization. These results may be interpreted as evidence of a modern union "shock effect." The institutional analysis is consistent with a broad range of earlier studies on the effects of unionization and provides a partial explanation of the union effect estimated earlier.

Conclusions and Implications

The examination of collective bargaining and productivity in this study has yielded empirical results on the magnitude of the union productivity effect, and the case studies have provided some insight into the channels through which unions influence productivity. The empirical evidence suggests that in the cement industry unionization has led to gains in productivity of 6 – 8 percent.[35] This finding appears to be rela-

[35]This gain in productivity may be compared to the

tively robust with respect to model specification and adjustments for changes in labor quality and other omitted factors. While the evidence is indicative of productive changes in operations after unionization, the nature of the estimates suggests caution in drawing conclusions about exact orders of magnitude.

Similar caution applies to the institutional analysis. It is clear from the evidence that additional information on worker behavior is needed before definitive conclusions about the union effect may be drawn. It does appear that unionization leads to fundamental changes in the labor contract, which may lead to changes in the behavior of workers and managers. The available evidence, however, provides a reasonably clear picture only about management adjustments. In most of the plants studied we found significant changes in the style and substance of management. Observed changes ranged from introduction of staff meetings to on-line time standards for equipment maintenance. These results support the conclusion that unionization significantly alters the processes of management. Union effects that work through other channels—such as exit behavior and work group effectiveness—are less subject to analysis through interviews, and evidence from the case studies on these effects is essentially weak and inconclusive.

The results of this study have important implications for understanding the function and impact of the union and for questions of organizational change and productivity. The finding that unionization induces an increase in productivity implies that reductions in efficiency that follow capital-labor substitution are offset to some extent by organization effects. Thus, the efficiency effects of the union may be very different from those previously assumed. The question of overall efficiency is, of course, much broader than adjustments made by the firm, and the productivity effect is only one aspect of the overall impact of the union. Moreover, it is likely that the effect of unionization will be different in different situations.

The processes of adjustment observed in the six plants seem to be consistent with evidence from the organizational behavior literature on the determinants of successful organizational change.[36] Without examples of organizational failure, however, it is difficult to draw conclusions about the specific circumstances and policies that lead to successful adaptation. Further research on the process of unionization in diverse industrial settings is essential to a deeper understanding of the problem. Not only might further study sharpen our understanding of the operation and broad consequences of the union, but it might also yield insights into the general processes of organizational change and adaptation and thus contribute to the development of public and private policies to enhance productivity.

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effect of the union on wages. Existing evidence suggests a union-wage effect in this industry of 12 – 18 percent. With labor's share equal to about .43, this corresponds to an increase in overall unit costs of 5 – 8 percent. Thus, in light of the productivity effect of 6 – 8 percent, the evidence is consistent with the view that unionization has had no effect on unit costs. Note that footnote 14 shows that the estimated union productivity effect should be compared with the union wage adjusted for labor's share to determine the net effect on unit costs. It should be noted, however, that the union wage effect may not capture all of the effects of unionization on nominal costs (such as overhead costs) and thus may understate the true impact.

[36]Greiner has suggested that successful changes in organizations involve the presence of compelling internal or external pressure, the intervention of a leader from outside the organization who acts as a catalyst, a thorough re-examination of operations, and problem solving through shared authority or power. While not a reflection of the ideal in all respects, the unionization process in the six plants is broadly similar. See Clark, "Unions and Productivity in the Cement Industry," and Larry C. Greiner, "Patterns of Organization Change," *Harvard Business Review*, Vol. 45, No. 3 (May-June 1967), pp. 119 – 30.

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UNIONIZATION AND PRODUCTIVITY: MICRO-ECONOMETRIC EVIDENCE*

KIM B. CLARK

It is widely agreed that unionization affects the rules and procedures governing the employment relation in organized establishments. The effect of these changes on establishment productivity, however, is unclear. This issue is examined using establishment level data from the U. S. cement industry. A positive union effect on the order of 6–8 percent is found in both cross-section and time series data. Although some caution is in order in interpreting the results, the evidence suggests that unionization can lead to productive changes in the operation of the enterprise.

Trade unions have a perceptible influence on the production process in organized establishments [Slichter, Healy, and Livernash 1960]. Even a cursory glance through a modern labor agreement reveals the depth of union involvement in the operation of the enterprise. Contract provisions extend beyond matters of compensation and promotion to include the introduction of new technology, the assignment of workers to specific tasks, the size of crews, and the amount of work to be performed. Perhaps more important than specific rules, the typical labor agreement establishes a formal system for setting rules and resolving disputes.

With the extent of union interest and involvement in the production process, it seems natural to question the impact of the union on enterprise performance, and in particular on productivity. Yet the question has received little analysis. In the late 1890s and the early 1900s, Marshall and Moore examined the union productivity effect theoretically, but the ideas they advanced were not followed up with empirical analysis [Marshall, 1899, and Bok and Dunlop, 1970]. Without evidence, discussions in the literature rarely rose beyond an inconclusive exchange of opinions.[1] However, in the recent papers by Brown and Medoff [1978], and by Frantz, attempts have been made to provide econometric analysis of the union impact in United States manufacturing.[2] Using value added per manhour to measure pro-

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1. Bok and Dunlop [1970], pp. 260–61, provide a brief summary of this literature.

2. Pencavel [1975] examines productivity and unionization in British coal mining.

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ductivity, both studies find positive union effects. While the evidence is suggestive, the findings rest on untested assumptions about technology and pricing behavior. Since value added has been used to measure output in these studies, what appears to be an output effect may well be a difference in prices. Moreover, possible differences in technology between union and nonunion establishments are not controlled for in the analysis. Brown and Medoff find the empirical results to be very sensitive to assumptions about differences in the parameters of the production process.[3]

This paper extends previous work by relaxing the technology and value added assumptions. The analysis focuses on the effect of unionization on productivity using establishment level data from the U. S. cement industry. The output of a cement plant is measured in physical terms, and data on both union and nonunion establishments permit estimation of the union effect controlling for differences in technology. Furthermore, the availability of time series data on productivity before and after unionization makes possible estimation of the union impact while controlling for firm-specific effects, as well as changes in labor quality. The paper is divided into five sections. After laying out the analytical framework in Section I, the empirical model and the data are briefly described in the second section. Section III presents the basic empirical results, while Section IV contains an analysis of firm-specific effects and quality adjustments. Conclusions are found in Section V.

I. An Analytical Framework

The theoretical description of the production process used in this paper is quite simple. Output is treated as a function of capital and labor input, where capital is presumably adjusted for the effects of depreciation, and labor is measured to reflect variations in quality. Given the level of inputs, output may also depend on organizational and institutional factors; i.e., methods of organization, effectiveness of management, and the motivation of workers. Within this simple framework, labor productivity, defined as the ratio of output to labor input, depends on the capital-labor ratio, the scale of operations, and the various organizational factors.[4]

3. The same is true of the value added assumption. Indeed, Brown and Medoff show that if unions have a wage effect and relative cost differences are fully reflected in prices, the estimated union coefficient identifies only a price effect. See Brown and Medoff [1978].

4. The analysis would be unchanged if framed in terms of total factor productivity. The only difference lies in the treatment of factor shares. See Jorgenson and Griliches [1965].

time the plant was organized (see Clark [1980] for details of the case studies). The average value of D in 1976 was 0.34, with estimates ranging from 0.05 to 0.65. This overstates the proportion of new workers relevant for present purposes, since D should be measured by an average value over the sample period. If the rate of growth of D was constant throughout the union era, then the estimated value at the midpoint of the period would be appropriate. Using the end-point value of D, the estimated quality effect is 0.023, the effect is 0.011 if D is set at its midpoint. Given that these calculations provide upper bounds, the evidence suggests that omission of quality measures introduces at most a small bias into estimates of the union effect in the before/after analysis.

V. CONCLUSION

The empirical evidence in this paper tends to support the view that unionization increases the productivity of otherwise comparable establishments. We found no strong evidence of a negative effect, and the results among newer plants in the cross section and the evidence from the time series comparisons suggest a positive union impact. Given the small number of observations and the size of the standard errors these results should be interpreted with some caution. It does appear, however, that controls for individual firm effects, technology differences, and changes in labor quality have only moderate effects on the magnitude of the union differential. Since the traditional channels of union influence have been held constant, the results capture the effects of unionization that work through changes in the internal operation of the firm.

The finding of a positive union effect in a particular situation does not warrant the conclusion that unionization raises productivity everywhere, always. Indeed, evidence from the coal industry suggests that the deterioration of industrial relations in that industry in the 1970s led to a significant decline in productivity in unionized establishments.[35] It is evident that the union effect in a particular setting will vary with the character of industrial relations. As Marshall argued long ago, the effect of unionization on productivity depends on union policy as well as management adjustment. Research reported here and elsewhere has uncovered positive union effects, but remains incomplete. The task ahead is to identify the actual channels of union

35. These results are based on work in progress by Margaret Connerton, Richard Freeman, and James Medoff.

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Unionization and Firm Performance: The Impact on Profits, Growth, and Productivity

By KIM B. CLARK*

The history of collective bargaining in the United States has been marked by dramatic episodes of confrontation that underscore the change unionization brings to the operation of an enterprise. Yet strikes and lockouts are only the most visible of pervasive differences in the employment relationship in organized establishments. It is well known that a wide variety of changes in the employment contract and adjustments in management procedure followed the wave of organizing begun in the 1930's.[1] In spite of the diffusion of many practices associated with collective bargaining (seniority, grievance systems) recent research has revealed the continuing existence of important differences between union and nonunion establishments in policies governing compensation, exit and entry, dispute resolution, and internal promotion.[2] As Richard Freeman (1980) has argued, these differences reflect the complexity of the employment relation and the potential for collective action to yield a different set of conditions in the presence of substantial information problems. Yet little is known about the effect of these differences on the profitability of the firm.

The large body of evidence on the union wage effect, for example, is not sufficient to establish a union effect on profits. Other changes in the employment contract may lead to firm or worker adjustments which either reinforce or offset the effect of increased wages on costs. The potential negative effects of work rules and protection of malfeasance are well known, but some recent evidence suggests that unionization may also lead to improvements in operations through reductions in turnover and changes in management procedures.[3] These considerations have motivated statistical comparisons of union wage and productivity differentials. Freeman and James Medoff have stated the assumptions underlying this approach quite clearly: "...Unionism may increase productivity in some settings and decrease it in others. If the increase in productivity is greater than the increase in average unit costs due to the union wage effect, then the profit rate will increase; if not, the rate of profit will fall" (1979, p. 81).

As I show below, this inference is only valid under quite restrictive assumptions. In general, it is not possible to infer changes in the rate of return on capital from information on union wage and productivity effects. The impact of the union on a firm's economic performance depends on the wage-setting process, the structure of markets, and the technology of production. Although an analysis of wages and productivity provides useful information about the operation of the firm under collective bargaining, an assessment of the impact of the union on profitability requires a direct examination. Furthermore, evaluating the efficiency consequences of unionization requires analysis of several measures of the firm's economic per-

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[1] The basic reference is Sumner Slichter, James Healy, and Robert Livernash (1960).

[2] A review of these findings is contained in Richard Freeman and James Medoff (1979).

[3] The papers by Freeman, by Charles Brown and Medoff (1978), and myself (1980) are representative

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formance. Unionization works through more than one mediating factor, and the impact of the union on a given measure of firm performance depends on the particular context in which bargaining and production take place. Thus, focus on a single indicator can be misleading.

This paper uses microeconomic data on over 900 product-line businesses to gauge the impact of the union on economic performance. In Section I, relatively simple models of the firm are used to derive a number of hypotheses about the effect of unionization. An important aspect of the analysis is the role of market structure and the institutional context of the wage-setting process. A clear implication of the theoretical analysis is the need to examine several indicators of firm behavior in order to draw inferences about the operation and consequences of collective bargaining. Section II presents an empirical analysis of unionization and interfirm differences in the rate of return on capital, sales growth, and productivity. Section III provides a brief summary and suggestions for further work.

I. A Theoretical Framework

The starting point for the models developed in this section is a single product monopolist with a constant elasticity demand curve and a constant returns production process. Although pure monopolies are rare, analysis of this case is useful because most of the firms to be dealt with in the empirical work face a downward-sloping demand curve and enjoy some barriers to entry. Unionization enters the analysis in two ways. I first treat the collective bargaining process as a problem of selecting a point on the firm's labor demand curve. In this context, the firm is assumed to be free to choose the level of employment and to adjust other decision variables in order to maximize profits. The second treatment of unionization allows the two parties to arrive at a wage-employment combination off the labor demand schedule. In this case, output and input decisions depend on the objectives of the parties and specification of the bargaining process.

The analysis yields results on several measures of firm behavior, but focuses particularly on the rate of return on capital as the basic measure of profitability. While a given firm's objective is to maximize total profits, some way must be found to scale total profits in order to provide a basis for comparison with other (possibly different-sized) enterprises. Because theory suggests that risk-adjusted returns should be equalized across industries and firms, the rate of return on capital has been widely used in empirical work. Other indicators of profitability, including various price-cost margins, have been suggested in the literature and will be examined in turn.

A. *The Monopoly Case*

The firm in this model is a profit-maximizing monopolist facing a demand curve with constant elasticity. For simplicity, the technology is specified to be *CES* with constant returns.[4] The supply of factors is perfectly elastic. Initially, I assume that the only effect

[4]The model developed in this section is a special case, but it illustrates the point that the impact of a union-induced wage increase on the rate of return on capital depends on the parameters of production and demand. Only in the case where the price of output is fixed does the union wage increase have an unambiguously negative effect on the rate of return on capital. This can be seen by expressing the rate of return on capital as

$$\pi/K = [PQ/L - WL/L]/(K/L),$$

and (with the price fixed) calculating the logarithmic differential. This yields

$$d\ln(\pi/K) = (1/(1-\alpha))[d\ln(Q/L) - (1-\alpha)d\ln(K/L)] - (\alpha/1-\alpha)d\ln W,$$

where α is labor's share, and W is the wage rate. Assuming that the changes in these variables were caused by unionization, the term in brackets is the union productivity effect, while the change in the wage is the union wage effect. With no productivity effect, and assuming that unionization raises the wage, the rate of return on capital will fall. If the price is allowed to vary (i.e., if the firm is assumed to have a downward-sloping demand curve), one obtains the same result as given in the text. In general, the direction of the effect also depends on the elasticity of demand and returns to scale.

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competitors, and because little information about competitors is available (for example, the extent to which they are unionized), it is not possible to examine what are essentially industry dynamics. In this case, one is left with suggestive results about the incidence of the union impact on profits and a number of working hypotheses about longer-term effects on competition; the need for further research is clear.

III. Conclusions

This paper has developed a framework for analyzing the effect of unionization on firm performance, and has provided empirical evidence on several indicators, including rates of return on total capital and sales, output growth, market share, productivity and the capital-labor ratio. The analysis provides clear evidence that, on average, unionized firms earn substantially lower returns than nonunion firms operating in comparable technological and competitive environments. It is also evident that other dimensions of performance, particularly, growth and capital-labor substitution, are little affected by unionization in this data. The evidence is thus consistent with a bargaining model of union-firm interaction, in which the union affects the distribution of profits, but has little effect on output, or factors of production.

This characterization of the union's effect has some interesting implications. It explains why unionized firms may survive over long periods of time, and why the owners of capital would be strongly opposed to unionization. The evidence suggests further that the issue of the impact of the union on resource allocation is really a question about the long run. In this data, at least, efficiency effects would seem to derive from differences between firms with and without market power, and from differences between industries. Interpreted literally, the results point to factors which influence the maintenance of union organization, and exit and entry behavior as the key determinants of the union's impact on efficiency. One implication is that research on these problems could benefit from analysis of unionization in specific firms and industries with emphasis on the historical perspective. Such longitudinal analysis, if focused on a period of time long enough to allow for entry and exit, would be a valuable addition to the literature.

These comments are not meant to imply that the questions about the union's impact on the firm which motivated this study have been answered. The analysis is suggestive of a possible interpretation, but it is well to remember that the evidence in favor of the bargaining model is largely negative: the data fails to reject the notion that unionization has no effect on output or factor use. Furthermore, the special nature of the *PIMS* data suggests caution in embracing the bargaining model as generally applicable. Even within the data set there is some indication that the impact of the union may differ in different competitive settings. Further analysis of the impact of the union on the firm, of possible differences in productivity effects by industry, and of the role of the union in competitive dynamics within an industry seems warranted.

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PRODUCTIVITY EFFECTS OF WORKER PARTICIPATION IN MANAGEMENT, PROFIT-SHARING, WORKER OWNERSHIP OF ASSETS AND UNIONIZATION IN U.S. FIRMS

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In this paper we provide our first econometric estimates of the effect of worker participation in decision-making, ownership and profits on productive efficiency. Participation has the potential for exerting several conflicting influences on firm performance simultaneously. As a result both the direction and magnitude of its impact are empirical issues. Previous studies have empirically measured the impact of each of these forms of participation; however, no prior study has controlled for the influence of the other forms. Because of the potential for correlation among these forms of participation, it is possible that omitted variables bias has affected the previous results. Using a new panel data set with simultaneous measures of all four types of participation in U.S. manufacturing establishments, we model participation as disembodied technical change, and estimate production function coefficients for each type while controlling for the others. We use both OLS and instrumental variables in order to guard against potential simultaneity. The IV results indicate that participation in decision-making has a large positive productivity effect while the impacts of unionization and profit-sharing depend upon regression specification. Moderate amounts of indirect worker ownership affect productivity positively, while the estimated effect of direct worker ownership is negative. However, this last result may reflect the industrial concentration of the direct ownership firms in our sample.

1. Introduction

In both capitalist and socialist countries, there has been substantial growth of and increasing interest in participative organizations over the past 20 years. In spite of these developments, there is still relatively little published information on how participatory firms are organized and how they perform. Only recently have there been published results about the effects of increased participation on firm performance,[1] and there remains little solid information

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[1]These include articles in Jones and Svejnar (1982), Defourney, Estrin and Jones (1985), Jones (1985), Jones and Svejnar (1985) and Estrin, Jones and Svejnar (1987).

on whether the effects themselves vary according to the type of firm under consideration or the form of participation. Although many advocates stress welfare aspects of worker participation in justifying supportive intervention, the question of operational efficiency is clearly a crucial and as yet not a completely resolved one. In this paper we provide our first econometric estimates of the effect of various forms of worker participation on productive efficiency.

In section 2, we briefly discuss the main hypotheses about the productivity effects of worker participation in decision-making, ownership and profits and indicate some important considerations in estimating these effects and drawing general conclusions. In section 3, we present our data set which is uniquely suited to analyzing the independent influences of employee participation in ownership, profits and decision-making within the firm, while controlling for degree of unionization. In this section, we also outline our econometric framework for estimating the magnitudes of these effects. In section 4 we discuss our econometric results and in section 5 we draw conclusions.

2. Theoretical approach and hypotheses

As was pointed out in earlier papers [e.g., Jones and Svejnar (1985)], there is at present no tight theory which would yield empirical predictions about the effects of different forms of worker participation on productive efficiency (total factor productivity). The most highly formalized approach to studying the performance impact of non-managerial participation in decision-making, ownership and profit within the firm is that of Jensen and Meckling (1976, 1979), who see participation of any type as always having deleterious effects on firm performance. Jensen and Meckling's analysis is based on the theory of contractual agency relationships. This approach analyzes the effects of primarily explicit contracts specifying the disposition of costs and rewards among principles and agents in the firm. The stipulations of these contracts in large part determine the behavior of agents in the firm. As a result, it is reasonable to formally specify the nature of these intra-firm agreements as an element in the firm's production function.

Much of the work to date has adopted such a production function framework. The particular contribution of Jensen and Meckling's work is to supply a rationale for negative values for the coefficients on the variables which measure participatory elements in the firm's production function.

According to Jensen and Meckling, the object of external shareholders in a corporation is wealth maximization, whereas the object of managers is their own utility maximization. Hence, shareholders must monitor the managers, which is costly. These monitoring costs increase with the number of agents, making a broad dispersion of decision-making rights highly inefficient. It is

[column (1)] or as the presence of a scheme that allows worker participation in wage decisions. However, it becomes insignificant when participation is measured as control over both wage and production decisions. Our results indicate that the presence of various participatory schemes needs to be taken into account when evaluating the effects of unionization. Moreover, since the nature of union activities tends to be different in participatory than in traditional firms [see, e.g., Sockell (1983)] our results suggest that more in-depth institutional research on the role of unions in different types of firms is needed.

5. Concluding observations

Our empirical findings contribute to the growing literature on the effects of employee participation schemes and trade unionism on productive efficiency. Our main findings suggest that firms that offer workers participation in management tend to be more productive ones, ceteris paribus. When controlling for endogeneity of regressors, the impact of employee ownership depends on the amount of ownership. This implies that there is an 'optimal' amount of non-managerial employee ownership (if the goal is solely technical efficiency). Also when controlling for endogeneity the presence of profit-sharing does not appear to affect productivity, in contrast with previous findings. Our results support previous findings on the positive efficiency impact of unionization, but indicate that this result is sensitive to regression specification.

The positive effect of participation in management gives important support to the proponents of these schemes. This is especially so since the existing studies have found the effect to be non-negative but at times insignificant.

The dependence of our results on regression specification and regression methodology implies that omitted variables bias and endogeneity are important issues in the estimation of the impact of employee participation schemes. Our results cast doubt on the validity of some previously achieved results in this area, although we do not claim the results achieved here to be definitive. Rather, we suggest that further study be given to the impact of employee participation with emphasis on covariation in the alternative ways that employees may be included in the organizational structure of the workplace.

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Shared Modes of Compensation and Firm Performance: UK Evidence

Martin J. Conyon, Richard B. Freeman

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This paper examines the use and consequences of shared compensation plans (profit sharing, profit related pay, SAYE schemes and company stock option plans) in a sample of UK workplaces and firms in the 1990s. The use of these plans has increased over time, in part in response to government programs. The evidence shows that companies and workplaces adopting shared compensation practices have had higher productivity than other firms, but the effects vary among programs, suggesting that the particulars matter a lot in aligning shared compensation and work place activities. Consistent with incentive theory, the evidence also shows that firms and workplaces with shared compensation practices have a higher incidence of shared decision-making / information sharing practices.

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EMPLOYEE PARTICIPATION PROGRAMS, GROUP-BASED INCENTIVES, AND COMPANY PERFORMANCE: A UNION-NONUNION COMPARISON

WILLIAM N. COOKE*

This analysis examines whether union representation positively or negatively influences the effectiveness of employee participation programs and group-based incentives in improving firm performance. Examined at the firm level, a model of the independent and interaction effects of participation, profit and gain sharing, and union representation is estimated against data on 841 manufacturing firms in Michigan in 1989. The evidence indicates that employee participation programs contributed substantially more to performance in unionized firms than in nonunion firms, whereas profit and gain sharing programs contributed substantially more to performance in nonunion firms than in unionized firms.

(+)

In response to intensified global and domestic competition, many American companies have sought to improve company performance through more effective use of their work forces. Central to many of these recent efforts are employee participation programs (such as at Xerox and Saturn Corporation) and group-based pay incentives tied to performance (such as at Ford Motor Company and Eggers Custom Plywood). The issues examined in this study are whether or not employee participation programs and group-based incentives have independent and interaction effects on firm performance and how these effects vary across unionized and nonunion companies.

Recent summaries of the literature suggest that both employee participation programs and group-based pay generally (but not always) have positive, albeit modest, independent effects on performance. Very few studies, however, have investigated the potential interaction effects of employee participation (EP) programs and group-based pay incentives on performance, and

*The author, who is Professor of Urban, Labor, and Metropolitan Affairs at Wayne State University, thanks John Delaney, Carol Haddad, Douglas Kruse, David Meyer, and participants in the Labor and Workplace Research Workshop at Wayne State University for valuable comments.

The firm-level data utilized for this study must be purchased from the Industrial Technology Institute in Ann Arbor, Michigan. Copies of the SAS and LIMDEP computer printouts of the various program files, regression estimates, and descriptive statistics used in the paper are available from the author at 3241 FAB, Wayne State University, Detroit, MI 48202 (tel. 313 577-5622).

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the findings of those few studies are mixed. Also, only two recent analyses investigate any differential effects by union status, and then only in regard to EP, and again the findings are mixed. Finally, how the independent effects of group-based incentives and the interaction effects of EP and group-based incentives on performance may differ in unionized companies and nonunion companies has received very little theoretical attention and no empirical analysis. To examine these issues, I develop and test a model using data for 1989 on 841 manufacturing firms in Michigan.

Theory and Hypotheses

Central to a diverse literature is the proposal that employees have untapped knowledge, problem solving and leadership skills, creativity, or effort, which, if tapped appropriately, can lead to enhanced firm performance. Before identifying ways in which union representation positively or negatively influences the performance effects of EP and group-based incentives on firm performance, I briefly summarize the hypothesized performance effects absent any consideration of union status.

Employee Participation Programs and Company Performance

EP comes in many different forms, with no two efforts completely alike. At one extreme are informal or short-lived ad hoc team efforts intended to address specific problems or inefficiencies. At the other extreme are self-directed or autonomous work teams in which employees make most production decisions. In-between these extremes are a variety of employee involvement or QWL efforts in which teams engage in regularly scheduled activities but limited efforts at identifying and resolving problems and inefficiencies. All these forms of EP, furthermore, are bound to differ in more detailed ways as they are structured to meet the specific circumstances of any given site. Because the data base used in the empirical analysis that follows does not provide information on the parameters, general type, or intensity of EP efforts, I do not attempt to develop hypotheses that might apply to the distinctions among EP programs. Instead, the propositions I draw from the literature or develop herein are applicable across all the various forms of EP activities.

At the heart of the basic proposition that EP programs enhance firm performance is the contention that employees generally have more complete knowledge and information about their work tasks and processes than do managers (Levine and Tyson 1990; Miller and Monge 1986) and are in a better position than managers to plan and schedule work, to organize work tasks and work flow, and to otherwise identify and resolve obstacles to achieving optimal performance (Hammer 1988). A second basic proposition is that EP provides employees with greater intrinsic rewards from work than do traditional forms of management. These greater rewards from work increase job satisfaction and, in turn, increase employees' motivation to achieve new production goals (Miller and Monge 1986; Hammer 1988). It has also been proposed that giving workers access to management information increases mutual trust and commitment to organizational goals (Hammer 1988). Hence, employee-supervisor relations improve (Cooke 1990a), employees are willing to be more flexible regarding changes in human resource policies (Delaney et al. 1993), and employees are more inclined to channel their power in positive ways than they otherwise would be (Strauss 1990).

The potential performance gains derived from EP, however, are offset, at least in part, by organizational costs associated with EP. These costs include reorientation and training costs (Cooke 1992) and added transaction costs associated with more decision makers being involved in making workplace decisions and greater required communication between these participants (Levine and Tyson 1990; Kelley and Harrison 1992). In addition, some employees place little or no value on participation and, hence, will not be motivated by such intrinsic rewards (Miller and Monge 1986), and the relaxation of supervisory monitor-

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fixed industry wage patterns (as argued by Zalusky 1990). In nonunion settings, on the other hand, the evidence is consistent with the notion that group-based pay provides a valuable incentive to employees to improve performance. Although there is no direct test of the hypothesis that employees also monitor and sanction shirking employees, to the extent that such behavior is induced by profit or gain sharing, the evidence would suggest that it is more prevalent or effective in nonunion than in unionized settings. Another possible explanation for why profit and gain sharing appear to have substantially different effects between unionized and nonunion firms is that the ratio of variable earnings to fixed wages differs substantially between sectors. Because nonunion employees have a lower average base wage than union employees, the ratio of variable earnings to fixed wages will be higher for them, giving them a significantly greater incentive.

Only in nonunion firms does the combination of work teams and profit/gain sharing yield positive, albeit relatively modest, interaction effects on performance. In nonunion firms, it appears that group-based pay arrangements either generate greater effort from work teams or lead to performance-enhancing modifications in the structure or processes of work team activities. In sharp contrast, the evidence indicates a large negative interaction effect in unionized firms. In unionized firms in which employees are engaged in work team activities, employees appear to be responding negatively to group-based incentives, even though they do not appear to respond negatively to either work teams or profit/gain sharing alone. The theoretical propositions developed above suggest that this negative interaction effect may be attributable to the inherent potential for co-worker monitoring and sanctioning of team members induced by group-based incentives. Monitoring and sanctioning of shirking team members or other employees choosing not to participate, that is, may lead to conflict within the union and, hence, prove counter-productive to creating or maintaining a spirit of cooperation necessary for achieving the full potential of work team activity.

Conclusions

This analysis of survey data on a large sample of Michigan firms in 1989 has produced fairly strong evidence that employee participation programs and group-based incentives yielded substantial gains in firm-level performance—measured as value added net of labor cost per employee—but that these gains differed by union status. Among the various combinations of work teams, group-based pay, and union status, unionized companies with work teams but no group-based pay appeared in 1989 to have achieved the highest level of performance—estimated at 35% higher than comparable nonunion firms without teams or group-based pay.

Four categories of firms appear to have achieved performance levels in the range of 18–21% above nonunion firms without teams or group-based incentives: both unionized and nonunion firms having both teams and group-based pay incentives, and both unionized and nonunion firms with group-based pay incentives but no work teams. Among the remaining firm categories, unionized firms without work teams or group-based incentives appear to have achieved performance levels about 13% higher than both nonunion firms without teams or group-based incentives and nonunion firms with work teams but without group-based incentives.

More generally, the evidence implies that unionized firms, on average, provide a much better environment for tapping the benefits of employee participation programs than do nonunion firms; and, by the same token, nonunion firms generally provide a better environment for tapping the performance incentive effects of group-based pay than do unionized firms.

Given that no other published research has examined the interaction effects on company performance of union representation, employee participation programs, and profit or gain sharing, and given the unique sample and limitations of the data

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utilized in this empirical study, the findings reported here are tentative. The results do raise questions, however, about previous findings based on analyses that have not accounted for the effects on firm performance of employee participation, group-based incentives, and union status.

If we are to truly understand the conditions under which employee participation and group-based incentives lead to enhanced performance, much more research is required. In particular, future research needs to examine the many detailed hypotheses summarized but not tested above, and investigate how the full range of human resource and labor-management practices bolster or limit the intended effects of employee participation and group-based incentives on firm performance.

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