The Last American Shoe Manufacturers: Decreasing Productivity and Increasing Profits in the Shift from Piece Rates to Continuous Flow Production†

RICHARD B. FREEMAN and MORRIS M. KLEINER*

This study examines the economic effects of changes in a group of managerial policies, a key element of which was the switch from piece rate to time rate modes of compensation, in one of the last remaining firms in the U.S. shoe industry in the 1990s. The firm, which we call "Big Foot" (BF), entered the 1990s using a set of human resource policies that included piece rates to motivate workers, which induced relatively high productivity. But, faced with severe foreign competition, it switched to time rates and associated managerial policies, which produced higher profits despite lowering productivity. The reason profits increased is that time rate-related labor management policies reduced labor and other costs by enough to offset a fall in productivity. Data for shoe manufacturing from the Longitudinal Research Data (LRD) files of the U.S. Census show, more generally, that establishments with high labor costs and relatively many nonproduction workers, both of which are associated with management policies that often include piece rates, had lower rates of survival in this period than other establishments. Our finding that labor management policies associated with piece rate compensation can raise productivity but lower profitability is consistent with the broad decline of piece rate pay in advanced economies.

Analyses of firm-based labor policies often examine a particular policy like compensation, or recruitment and selection, or training or promotion, and assign a change in the firm's well-being to this specific

* Richard B. Freeman, Harvard University, NBER, Centre for Economic Performance, London School of Economics; Morris M. Kleiner, University of Minnesota and NBER. E-mail: *mkleiner@hhh.umn.edu.*

† This study was funded by the National Science Foundation and the Sloan Foundation. The authors would like to thank Heidi Aggeler, Neil Chaffee, Carrie Conaway, Hwikwon Ham, Gabe Hanz, John Hauge, Yongjin Nho, and Keith Vargo for their assistance with this study. We also thank participants at seminars at Harvard University, NBER, New York University, University of Illinois, University of Minnesota, and Tel Aviv University for their comments on earlier drafts of this paper.

Industrial Relations, Vol. 44, No. 2 (April 2005).
Published by Blackwell Publishing, Inc., 350 Main Street, Malden, MA 02148, USA, and 9600 Garsington Road, Oxford, OX4 2DQ, UK.

factor. Yet changes in human resource policies seldom occur without other transformations in the firm. The attempt to isolate a particular human resource policy fails to capture that changes in a particular policy occur not on a *ceteris paribus* basis, but *mutatis mutandis* in conjunction with many other practices within the firm. Recognizing this, recent research of the link between firm policies and performance suggests that human resource policies come in bundles of practices that are internally consistent and complementary and that successful changes occur with these consistent policies (Levine 1995; Ichniowski, Shaw, and Prennushi 1997; Ichniowski and Shaw 2003).

A central element to any set of human resource policies is the compensation system, which provides incentives for workers. Different systems are usually accompanied by complementary practices. For instance, piece rates usually require supervisors to monitor quality of output, and to update piece-rate systems as the technology in use changes; whereas time rates induce firms to have time cards, to recruit carefully, and to monitor effort. Because piece rates have clear incentive effects that remove much of the principal agent problem at workplaces, economists, in particular, have a predilection for piece rates (Copeland and Monnet 2002). Important studies in industrial relations have examined companies where piece rates raised productivity sufficiently to be profitable (Harvard Case Study, case 9-376-028 1983; the Safelite case, Lazear 2000), consistent with the anticipated incentive effect.

But the trend from piece rates to time rates in most industries in the U.S. and other economically advanced countries suggests that under modern conditions of production, the disadvantages of piece rates generally outweigh their advantages. The long-term effects of industrial relations policies associated with piece-rate policies at the establishment or firm level have had mixed results, even in the presumably exemplary cases that economists have studied. Lincoln Electric was not able to duplicate the success of its initial plant in any of its take-over, greenfield sites, or in any of its foreign operations (Gibbs 1998). The Safelite Company filed for bankruptcy protection from its creditors in 2000, suggesting that changing to piece-rates alone does not stop firm insolvency. If economists are right that the incentive effects of piece rates make them more desirable, it is the associated policies and practices within the firm that must outweigh these effects to underlie the move to time rates. Associated with the move must be a set of complementary internally consistent practices in other aspects of production and business, ranging from marketing to finance, that raise profitability (Berg et al. 1996; Ichniowski et al. 1996; and Kato and Morishima 2002).

This paper analyzes the impact of changes in human resource policies on a U.S. shoe firm in the 1990s, a key element of which was the transformation from the piece rate method of pay to the time rate modes of compensation and accompanying human resource practices. The firm, which we call "Big Foot" (BF), is one of the last remaining firms in the U.S. shoe industry—a labor-intensive sector faced with intense foreign competition. Consistent with the studies of Lincoln Electric and Safelite, we find that the firm had higher labor productivity with human resource policies centered on piece rate compensation than with time rates and their associated management practices. But we also find that the time rate "regime" reduced enough labor and material costs to offset the productivity advantage of piece rates, making time rates more profitable. In addition, we find that shoe establishments in the Census of Manufacturing with lower labor's share of costs and lower proportions of nonproduction workers—characteristics associated with time rates of pay and policies—had higher chances of survival than other firms.

Piece Rate vs. Time Rate Modes of Compensation

The economics of piece rate and time methods of pay have been studied since Adam Smith and Alfred Marshall (Smith 1937 and Marshall 1961), if not earlier. There is widespread agreement that piece rates induce greater effort than do time rates of pay (Brown 1990) and that wages and production are higher under piece rates than time rates (Seiler 1984; Shearer 1996; Lazear 2000; Paarsch and Shearer 2000; Pencavel 2001). But piece rates also have problems (Roy, 1952, and Brown and Philips, 1986). A standard piece rate system[1] gives workers an incentive to skimp on quality or to use excessive amounts of materials, which requires firms to spend more on supervision or quality control. In addition, workers may be unwilling to share what they learn about the best way to produce for fear that this will lead to a firm-wide increase in productivity that lowers the piece rates. Workers may also take greater risks at the job, raising injuries. Finally, and perhaps most important, firms must adjust piece rates when technology or product lines change or risk having a "demoralized" piece rate system—one where the piece payments are out of line with opportunity costs of labor and where the ability of workers to beat the normal rate may vary widely among jobs (Slichter, Healy, and Livernash 1960). In contrast, firms that pay time rates can change the production process when technology or product lines

[1] By basic piece rate, we mean a piece-rate system that simply relates earnings to number of pieces produced. More complicated systems could weigh other factors, including wastage of material.

change without altering pay. However, firms that use time rates need to develop policies for promotion or layoffs to motivate employees in place of the direct motivation of higher pay with piece rates. They also need supervisors to monitor effort, or to apply factory style continuous flow modes of production, where the effort decision is in large part removed from the worker.

The Piece Rate/Time Rate Decision

Should a firm compensate workers through time rates or piece rates of pay? To assess the economic returns to these two modes of pay consider the following unit cost relationship:

$$\text{Unit costs} = DLC/Q + MP/Q + CC/Q + WC/Q + TC/Q \qquad (1)$$

where DLC is direct labor costs, M is the material used; P is its price, CC is the capital cost, and WC is workers' compensation insurance (or some other cost of injury), and Q is the quantity of output. The term TC/Q refers to the transactions cost of production, by which we mean the amortized cost of changing the mode of production and compensation to meet new market conditions, which is negligible under time rates but considerable under piece rates.

When the firm pays time rates, the direct labor costs are WL, the market or negotiated wage W times person hours worked L. Under the simplest piece rate system, direct labor costs per unit of output is the specified price per piece, W'; and workers earn W'Q'/L' per hour, where Q'/L' is the productivity under piece rates. If direct labor costs are the only factor differentiating costs under piece rate and time rates, the firm will prefer piece rates when $W' < WL/Q$, where Q is the output produced in an hour under time rates. Similarly, if pay is the only factor that affects workers, they will prefer piece rates when $W'Q'/L' > W$. Combining the two terms, we see that workers and firms prefer piece rates whenever $Q'/L' > Q/L$—that is when piece rates raise productivity.[2] The piece rate determines the division of the benefits of the higher productivity.

[2] Another problem with setting piece rates in an incentive system is that it risks engendering employee peer pressures against productivity. Because the firm sets piece rates for the entire group of workers, there is a "free rider" problem. A worker who finds a way to produce more than the others will reduce the piece rate for all workers, including those who do not have those skills or knowledge. She will have no incentive to impart those skills/knowledge as that would simply reduce her pay. But her fellow workers have an incentive to pressure her to produce less. Thus, some workers may try to intimidate their peers to "goldbrick" or produce less than they can in order to maintain a given piece rate standard (Roy 1952). The piece rate system may thus fail to engender the productivity incentives it is designed to produce.

But other practices differ between production under piece and time rates, which affect costs of production and thus preference for mode of compensation. From the workers' perspective, piece rates are a risky form of payment that will require some compensating differential. From the firms' perspective, materials used per unit of output (M/Q) are likely to be higher under piece rates. To produce rapidly, workers want materials on hand. This can lead to a costly inventory buildup. As we observed in the shoe industry, this means piles of leather lying on factory floors (Helper, 2000). Workers will also use materials more wastefully than they would under time rates.[3] And in the rush to produce, workers will risk injuries, raising workers' compensation costs. In addition, piece rate and time rate production differ in important ways in something harder to measure, the transactions cost of production—TC/Q in Equation (1).

The Transactions Cost Of Production

Under time rate methods of compensation and its related human resource policies, the firm can alter what workers do with only minor hassles. By renting workers' time, the firm has the right to assign activities to workers when the production process changes (Simon 1951). But under piece rates, whenever the firm changes the unit of output or process of production, it must adjust the rates associated with each piece produced. If a new technology increases output at the same effort, existing piece rates will produce levels of pay that are out of line with the alternative opportunities facing workers. Workers will gain the quasi-rents associated with that technology, reducing the incentive of the firm to invest in improved technologies.

Analysts have long recognized that the expense of changing the piece rate when production conditions change is a major drawback to piece rate modes of compensation (Slichter, Healy, and Livernash 1960). Some changes in the process or style of output will occur discontinuously, motivating the amortized cost in (1); other changes will occur continuously as workers learn by doing and move to more efficient portions of their learning curve. In either situation, the firm that uses the piece rate system must decide whether to alter or risk having the system become demoralized.

To examine this decision, assume that the firm faces three choices: a) pay workers piece rates and update the piece scale frequently as workers learn

---

[3] Of course the firm could create a more complicated piece system, penalizing the worker for materials wasted, and so on. Many firms do, but it is nearly impossible to write out a contract that fully solves the principal/agent problem with individual piece rates as the main mode of pay.

to do their jobs better or as technology changes; b) pay piece rates but allow the piece system to become demoralized, so that workers earn much of the rent from improved technologies; or c) pay time rates and introduce its associated labor practices. In the past two or so decades, U.S. shoe manufacturers have behaved as if the transactions cost of updating the piece rate system and developing complementary human resource policies are sufficiently high that it is better to allow the system to become "demoralized" and then to eventually switch to time rates than to try to update the system. Changing a piece rate is expensive because it usually requires a quality control engineer or plant official to analyze the precise activities involved when a job changes and to time the worker to determine the appropriate rate. The revision process may also produce acrimony between workers and their firm, as it will alter work conditions and earnings. If workers are represented by a union, as in Big Foot, there may be economic pressure by management to increase wages or give bonuses in order to introduce a new system and its complementary practices and to "buy out" an existing one (Hartman 1969).

In addition, frequent adjustments in a piece system reduce the incentive for workers to improve productivity, weakening the principal benefit of the system consistent with a "rachet effect" (Weitzman 1980). Assume that workers receive W^* for producing base level output S^* and $W > W^*$ for producing $S > S^*$ and that the firm revises the base S^* regularly when $S > S^*$. For simplicity, assume further that the firm revises piece rates by raising the base S^* proportionately to how much workers exceeded the base in the last period:

$$\Delta S^* = \lambda(S(-1) - S^*(-1)), \tag{2}$$

where λ represents the speed of adjustment in the base level. In all periods, the worker maximizes income $W^*S^* + W(S - S^*) - C(S)$, where C is the monetary cost of the disutility producing S units and where the cost function is convex to the amount produced, $C' > 0$ and $C'' > 0$. The incentive for the worker to produce $S > S^*$ depends positively on the piece rate, but the faster the firm adjusts S^* to $S(-1)$, the smaller is the incentive to the worker to exceed S^*, as the revision of the piece rate system reduces the payoff from that level of effort in the future.

Consider a two period case. When the firm does not adjust the piece rate ($\lambda = 0$), the optimizing worker will produce some amount S^m in each period so that $C'(S^m) = W$, with earnings $W^*S^* + W(S^m - S^*) - C(S^m)$ in each period. When the firm adjusts S^* rapidly ($\lambda = 1$), however, producing S^m will no longer be optimal. The worker will earn $W^*S^* + W(S^m - S^*) - C(S^m)$ from producing S^m in the first period but will earn just $W^*S^* - C(S^m)$ in the second period as the firm will have reduced the piece rate so that $S^m = S^*$. The worker would do better to produce less than S^m in the first period in order to prevent this. The worker wants the base in the second period to be lower that S^m in order to gain extra pay. Knowing this, the profit-maximizing firm will choose $\lambda < 1$, and thus allow the piece rate system to become outmoded relative to the potential one-period lag in updating. But even in this case, workers who know that the firm plans to update its piece system will hide what they have learned about improving productivity. Rather than working all out to increase output, they will take some leisure on the job. The more rapid the firm updates its incentive system, the greater will be the tendency for workers to apply their cumulated knowledge to leisure on the job than to production.

In short, the decision by the firm to update a piece system must weigh the direct cost of updating it and the impact updating has on the incentives facing workers against the reduced payments to workers that a reformed piece rate system produces. Given these offsetting factors, the firm picks the most profitable number of updates or speed of updating. If the shoe industry was correct in shifting from piece rate to time rate in the 1980s and 1990s and if other sectors were correct in eliminating piece rates earlier, the cost of updating and revising the piece rate system in shoes must in fact be less profitable than discarding the system entirely in favor of time rates and its complementary labor polices.

The Move from Piece Rates to Time Rates in Shoe Manufacturing

From the beginning of the twentieth century through the 1950s, shoe manufacturing was one of the largest industrial employers in the U.S. Industrial relations researchers including John R. Commons (1909) and George Shultz (1951) analyzed the industry and its use of piece rates.[4] But from the 1960s through the 1990s the U.S. shoe industry contracted massively, largely creditable to reduced tariffs on imported shoes starting in the mid 1960s.[5] Consumption of shoes rose from 735,000,000 pairs in 1966 to 1,219,000,000 pairs in 1996 while domestic production fell from 639,000,000

---

[4] Prior to the Civil War, the largest employer in the U.S. was the shoemaking industry. Prior to World War II, it had slipped to 7th of the 15 manufacturing industries surveyed, but by 1994 it had dropped to 80 of the 98 firms surveyed in the Bureau of Labor Statistics sample, and projections show it declining to 94 of the 98 sample industries by 2010 (Davis 1940 and Jacobs 1997).

[5] Direct tariffs dropped by over 50 percent over a 15-year period. In the 1980s, as a result of the Tokyo Round of Trade Negotiations, tariffs were reduced even further, with low-priced shoes showing the largest reductions in duties (Hufbauer and Elliott 1994).

pairs to 120,000,000 pairs. Between 1966 and 2001, import penetration rose from 13 percent of consumption of shoes to almost 97 percent, with most of the increase occurring between 1976 and 1986. Full-time employment in the sector fell by 88 percent from 233,400 in 1966 to 28,900 in 2001 (Bureau of Labor Statistics, *Industry Wage Survey* 2002).

The big advantage of imports is the cost of labor. Of the top ten exporting countries to the U.S., five are low wage, less developed countries, including Indonesia and China, and the other three are newly industrial countries whose wages in manufacturing are considerably lower than those in the U.S.[6] What makes the cost of labor so important is that the technology for the production of shoes and boots is firmly established and has relatively low capital requirements. Capital includes a sewing machine, hand cutting of leather and material goods, and sole attachment equipment. The skill requirements are hand-eye coordination rather than high levels of education or the ability to use sophisticated computer equipment.[7] But as in other consumer markets, wage costs are not the only elements for success. Hourly compensation for footwear production workers in one major exporting country, Italy, was over 50 percent above that in the U.S. while compensation in another substantial exporter, Spain, was comparable to that in the U.S.[8]

Before World War II, almost 90 percent of workers in the American shoemaking industry were paid under the piece rate system (Davis 1940). Through the 1980s the majority of U.S. shoe manufacturing firms used piece rate methods of pay and related human resource policies as their primary mode of compensation (Bureau of Labor Statistics, *Industry Wage Survey* 1987). But in the face of intense import competition, shoe manufacturers turned increasingly to time rates of pay.[9] By 1997, over three-quarters of employees in the industry were paid primarily by time rates (Bureau of Labor Statistics, *Industry Wage Survey* 1997).

What economic factors leads firms to change from piece rates methods of pay and related human resource policies to time rates and continuous flow manufacturing, as occurred in the shoe industry over this period?

[6] In 1992, hourly compensation for footwear production workers in the US was \$9.41 compared to \$0.50 in China, \$0.19 in Indonesia, \$2.10 in Mexico, and \$2.00 in Brazil (U.S. Bureau of Labor Statistics).

[7] There are economies of scale in the shoe business associated with brand names as shown by the large international firms such as Nike and Adidas in the marketing, production, and distribution system, but there are no such economies of scale in the manufacturing process.

[8] All of these comparisons are based on exchange rates.

[9] We called all of the major shoe manufacturing firms in the U.S. and asked them about their method of pay now and in the 1980s. We were not able to gather information on methods of pay of establishments that went out of business in the interim. For the firms we contacted, approximately 75 percent of the employees were now on time rate methods of pay or group incentives. The ones that were on piece rates were primarily specialty shoes or ones made virtually all by "hand."

The Shift at Big Foot

As we lack data on the benefits and costs of the shift from piece rates to time rates in earlier decades, we seek to answer this question by examining the shift in managerial policies from piece to time rates and associated labor policies in the Big Foot (BF) Shoe Company, which made the shift in the 1990s. BF produces men's work shoes and sports boots in two unionized plants. The firm sells much of its product through its own retail outlets, which makes it sensitive to service at the point of purchase and direct consumer response to its products.[10] However, in 2003 the company agreed with Sears to sell its men's work boots in all the Sears retail outlets.

In the mid 1980s, the firm identified several problems that risked its survival in the face of foreign competition: high workers' compensation expenses; an inflexible production process; a huge work in-process and storage expenses; and a demoralized piece rate compensation system.[11] Consultants recommended that the firm differentiates its product to create niche markets and introduce teamwork and continuous flow methods of production that required that employees know many different tasks, warning that unless the firm lowered costs, it was unlikely to survive. Management thought that the company's piece rate system of production was a barrier to making the necessary changes in production. Seeing the dramatic decline in the footwear industry, the union was willing to go along with policies that might enable the firm to remain viable.

Consistent with the notion that firms change compensation and other practices as a group rather than individually, BF introduced many different human resource policies almost simultaneously with the introduction of the time rate system. We show these changes in Figure 1. They include: a continuous flow manufacturing system, a new safety program that included a self-insurance program that emphasized the importance of reducing accidents and injuries, as well as introduction of time rates. In addition, there were changes in management, with managers who did not want to work with teams and develop the communications and oversight skills required

[10] Incorporated at the beginning of the twentieth century, BF has been run in a highly paternalistic manner in a small Midwestern town. It has had the same international union for more than fifty years and consults and negotiates with the union for any proposed change in compensation policy. The majority of managers in the firm have come up from the shop floor and from the local area, while the family that owns the firm has taken a large role in management.

[11] In 1994, Big Foot opened two new facilities in the U.S. when most of its competitors were moving offshore. The firm believed that it could utilize the facilities to respond to an increased market for shoes made using a particular (cement-soled) technique and pay top wages below those in its Midwestern facilities. These two facilities were shoemaking plants that had been closed recently, and most of the employees were former workers in these plants.

FIGURE 1

Changes in Human Resource Policies at Big Foot Associated with the Move from Piece Rates to Time Rates and CFM, 1990–1995

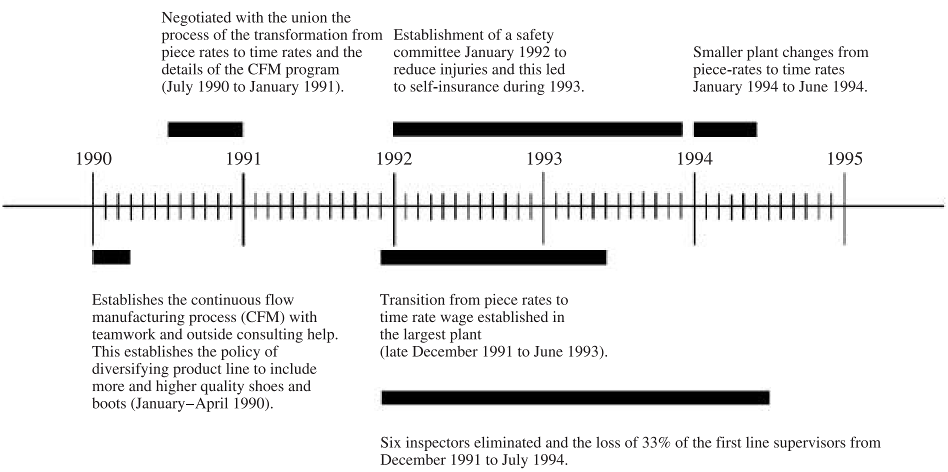

TABLE 1

Base Hourly Rates of Pay for Workers in Big Foot and Base Rates Compared to Actual Pay by Department

	Base (1)	Base and piece for piece-rate workers 1991 (2)	"Red circle" rate all production employees* (3)	New wage 1994 (4)	% Difference between highest and lowest wage in job category: Piece Rate (5)	Time Rate (6)
Cutting Department	10.44	19.96	18.19	10.69	60.36%	34.65%
Prefit and Fitting Department	10.26	17.99	15.71	10.69	67.02%	34.65%
Lasting Department	10.53	21.06	16.26	10.69	57.88%	34.65%
Welt Department	10.72	21.43	19.04	10.69	60.90%	34.65%
Finishing Department	10.32	20.64	18.07	10.69	80.26%	34.65%

Source: Based on company data.
*Wages for workers in column 3 includes some employees who were not receiving piece-rates during the piece rate regime. They were "pushers" who moved raw materials and the final product to its destination.

under the new regime replaced by those willing to learn the new human resource practices. These policies and practices were intended to be complementary with the shift to continuous flow manufacturing.

Columns 1 and 2 of Table 1 show that the piece rate system at Big Foot was indeed out of line with opportunity costs of labor prior to the change.

Big Foot's piece rate system consisted of a low base near the minimum wage in the plant at around $10.00 (column 1) and piece rate pay based on the individual units set by a time-motion study, with some deduction for material wastage. But over the years, process innovation and negotiation with the union created a classic demoralized system. By 1991, workers made some $20 per hour (column 2) on bases of $10 to $11 per hour—far in excess of the cost of production labor in the area, which was closer to the base level. In addition, the firm paid different rates for similar jobs. It paid high rates to some jobs where change had made meeting the standard easy and low rates to some jobs where change made meeting the standard rate hard. Within jobs, there was a huge dispersion in pay, with the highest pay in a job category 30 to 40 percent above the mean wage and the lowest pay in a category 30 to 40 percent below the mean. Employees filed many costly grievances about the piece rate for each unit and for different processes, and had many injuries and accidents as they sought to earn huge premiums. All of these are the characteristics of a demoralized piece rate system and its associated human resource policies. In addition, to maintain the piece rate system, Big Foot purchased large quantities of materials. It employed a group of workers to move around and maintain a large number of racks for work in-process which were waiting for the next job. The company purchased warehousing space for its materials and finished products until demand caught up to production. It employed several supervisors to monitor quality in each plant. Within the factories, workers with high seniority gained job rights that approached ownership of a machine and set of activities.[12] Under the union contract, an injured worker retained a right to their job even when injured, so that management could not easily move another production worker to that job because the move would compromise the job rights of the injured worker.

This system of production made it difficult to introduce more styles and produce the higher quality products that offered a chance of survival in the face of low wage overseas competition. Over two-thirds of Big Foot customers viewed the number of styles at the firm's stores as important or very important to them in their decisions to buy there, according to a 1996 survey. Franchise shoe store owners and company store managers gave a similar reading of the footwear market.[13]

[12] One manager noted that it was not unusual for a production worker to disable their machine so that no one else could use it when they were not at work.

[13] This survey was conducted by a national survey research organization that regularly surveys franchisees and customers for the company.

New Pay and Work Practices

To remedy the problems outlined previously, Big Foot introduced a continuous flow mode (CFM) of manufacturing and changed from a piece rate to a time rate mode of compensation.[14] The firm developed many new lines of shoes based on market demand, a modular form of production in which workers were cross-trained to cut days in-process, and used a just-in-time method of supplying materials to the lines, and the delivery of "hot sellers" in a more rapid manner. The firm began the implementation of the new process in April 1990 in one factory, but it took roughly two and one-half years before all of the plant's lines shifted to CFM. Implementation was sufficiently difficult that Big Foot waited until July 1994 to enforce CFM in a second factory. The difference in timing across plants helps us to differentiate the effects on economic outcomes associated with the change-over from the effects of any general time trend or period-specific developments that affected shoe production.

Making the transformation was difficult. Many supervisors did not support the CFM initiative and some actively worked against it because it meant a reduction in supervisory and inspection jobs. In fact, the firm eliminated six intermediate inspector jobs in each plant when it went to CFM. Thirty-three percent of the company's supervisors and a number of senior managers took early retirement. Many production workers feared the loss of seniority, job rights, and reduced pay. Big Foot negotiated a lower hourly wage system for new hires but agreed to "red circle" the wages of all current production workers. They would base their new hourly wage on their piece rate earnings for the 26 weeks previous to their department's shift to CFM, rather than at some multiple of the lower hourly wage scale for new hires-creating a two-tier wage system. Column 3 in Table 1 shows the "red-circled" rates for workers by department while column 4 shows the new time rates. Wages for new employees were barely half the wages paid during the piece rate regime. Columns 5 and 6 show the difference between the highest and lowest rates within departments under the two systems of pay. Consistent with previous research, there is much greater disparity in pay under piece rate than under time rates.[15]

---

[14] In a phone survey of major shoe making firms, we found that BF was among the last group of major firms in the industry to switch its method of pay to time rates. This creates a potential selectivity bias in our analysis of that firm: perhaps BF did not make the switch to time rates because it benefitted less than the firms that made the jump to time rates earlier. If this is the case, our estimates of the effects of the switch on profits at BF may understate the advantage for the typical survivor in shoe manufacturing.

[15] The finding that dispersion of pay is lower under time rates than piece rates is ubiquitous (see Seiler (1984); Shearer (1996); and Lazear (2000)).

The firm had other problems in making the transition to continuous flow manufacturing. Failing to anticipate that productivity would fall sharply with the move to time rates, management had to schedule its production workers for as much as 10 hours a week overtime work. And it never fully implemented the modular production, so many workers did not move from job to job during the day as originally planned. Still, by the end of the 1990s, Big Foot's managerial operations and pay for workers were different than at the outset of the decade. Labor costs were considerably lower. Following the transition in managerial policies, there was a dramatic drop in grievances by union members and in worker compensation costs And BF increased the number of shoe styles from 106 in 1985 to 187 in 1996, more than doubling the number of new styles introduced per year from six during the piece rate regime to 13 in the time rate regime. From 1990 to 1997, the percentage of shoe sales as a result of the top 10 styles dropped by 20 percent as new styles took a larger part of sales. However, these changes resulted in more errors in the production of shoes. The learning curve for new production lines resulted in more shoes that were not of sufficient quality to be sold at the retail price, and were sold to wholesalers as factory seconds.

Production Outcomes

To assess the effects of the change from piece rate to time rate on production, we estimate a Cobb-Douglas production function using monthly company data for the two plants. Our dependent variable is the log of the monthly average number of shoes produced per day.[16] We relate this to management's "scheduled production" per day which the industrial engineers in the company determined several months in advance of actual production. This value takes into account the capital requirement in the production of shoes, materials, anticipated number of employees per month, and upcoming technology factors, but does not necessarily include any unanticipated differences in employee effort or productivity shocks. Our regressions also include a monthly time trend. We focus on the coefficients on three time dummy variables that reflect the compensation/production regime under which the firm operated:

[16] We account for factory seconds in our analysis through the average price of shoes sold per month. Shoes that were factory seconds were sold at half the normal wholesale price. If shoes were of poor quality, they were discarded and did not count toward monthly production of shoes.

D1 for the transitional period when the plant was making the switch (*transition effect*);

D2 for the "after" period when it was paying workers time rates (*time rate effect*); and D3 for the period when the firm announced that wages would be red-circled based on their piece rate pay in that period (*full effort effect*).

In plant 1, we date the transition effect as occurring from January 1994 to June 1994; in plant 2 we date the transition effect as occurring from December 1991 to June 1993. In plant 1, the after period occurred from July 1994 and in plant 2, from July 1993 through our final data point July 1997. In both plants we date the full effort effect as occurring from July 1990 to July 1991.

Rows 1 and 2 of Table 2 show our production function estimates for the pooled sample of the two plants under two specifications.[17] In the specification in row 1, the dependent variable in the production function is the logarithm of the ratio of actual production to planned production. This constrains the coefficient on logarithm on planned production to be unity in the production function and thus focuses attention on whether or not actual production deviated from the production that management intended in a period. The coefficient on the logarithm of employment reflects any extra output from workers beyond what management expected. In the row 2 specification, we relax this constraint and estimate the coefficient on planned production, treating planned production as an index of all inputs except for labor. This specification gives coefficients that look much like those in a standard Cobb-Douglas production analysis. The sum of the coefficients on planned production and on employment sums roughly to unity, implying constant returns to scale, and their magnitudes reflect the differential importance of labor and other inputs in costs.

The key variable for assessing the shift from piece rate to time rate is the "Time Rate dummy", which takes the value 1 for the period after the change to time rates in each of the two plants. The row 1 regression gives an estimated −0.03 effect from the change from piece rate to continuous flow manufacturing. The row 2 specification gives an estimated coefficient on the time rate dummy of −0.06, which is more than three times its standard error. This implies that productivity was about 6 percent higher under piece rates—an estimate that is somewhat lower than those found in earlier studies of piece rates. One reason is that our productivity is calculated not only for the workers at the machines whom the piece rate incentivizes, but for

[17] We delete observations with missing values for particular months.

TABLE 2

REGRESSION ESTIMATES OF THE EFFECT OF CHANGES IN PRODUCTION AND COMPENSATION ON THE OUTPUT, COSTS AND PROFITS FOR BIG FOOT COMPANY, 1986–1997

Independent variables	Time rate effect	"Full effort" effect	Transition period	Ln production employees	Ln planned pairs	R^2	Number of observations
Shoe production							
Ln production/planned production	−0.03 (0.02)	0.13 (0.02)	−0.002 (0.013)	0.04 (0.02)	—	0.27	250
Ln production	−0.06 (0.02)	0.11 (0.02)	0.005 (0.012)	0.27 (0.05)	0.74 (0.06)	0.96	250
Cost of production							
Ln labor's share of revenue	−0.31 (0.06)	0.11 (0.06)	0.09 (0.05)	−0.05 (0.06)	—	0.36	240
Ln material's share of revenue	−0.16 (0.06)	0.05 (0.06)	0.10 (0.05)	0.04 (0.06)	—	0.08	240
Profitability							
Ln quasi-rents share of revenue	0.28 (0.07)	−0.05 (0.07)	−0.08 (0.05)	0.003 (0.07)	—	0.32	220
Ln Quasi-rents/Shoe	0.26 (0.08)	−0.03 (0.08)	−0.13 (0.06)	−0.01 (0.08)	—	0.14	220

SOURCE: Based on company's data. Standard errors are in parenthesis.
NOTES: The regressions include a monthly time dummy. Plant B includes a plant dummy. Estimates using a Kernel smoothing technique produced similar results.

total employment, including workers who move materials around the plant and supervise production lines.[18]

Both the row 1 and row 2 specifications give a large statistically significant positive coefficient to the full-effort dummy variable. Because this dummy isolates the period when the firm told workers that their productivity would determine pay for the duration of their employment, the implication is that under normal piece rates, productivity is considerably below the productivity that workers reach by giving their full effort. One possible reason suggested by our earlier analysis is that workers reduced effort under the normal piece rate system because they worried about potential changes in piece rates. This disappeared during the full effort time period because the firm was committed to paying time rates in the ensuing period. Another likely reason is that workers put in special effort over this period, working at above normal rates in order to get high red-level rates afterwards. Our data do not allow us to differentiate these two factors. In either case, management did not realize that the full effort level of productivity was not sustainable under time rates, and anticipated higher "scheduled" production over the ensuing period than in fact occurred.

Cost and Profit Outcomes

Big Foot did not, of course, introduce these managerial policies to lower productivity. It introduced them to reduce labor and material costs, and to allow the firm to introduce new products easily so that it could raise profits. To see if the shift to time rates and other policies reduced costs, we regressed labor's share of revenue and the material share of revenue on the same dummy variables as in our production function analysis. The coefficient on the time rate dummy variable in row 3 shows a huge drop in labor's share of revenues when workers were paid by time rates. Looking at the raw data, we find that in the main plant, the ratio of labor cost to sales fell from around 17 percent in the late 1980s to below 13 percent in the mid 1990s. Part of this drop is associated with lower wages paid to the new entrants and part related to the fact that improvements in productivity no longer translated into higher pay at outmoded piece rates. Row 4 shows a substantial

[18] One manager reported a huge drop in productivity in his plant from 1.51 shoes per hour per person before the move to time rates to 0.81 pairs, followed by a subsequent rise to 1.3 pairs per hour. But under the piece rate system 25 percent of production workers were movers who did not work directly to produce shoes so that the 1.51 pairs per hour figure represents the productivity of only 75 percent of the production worker population. The movers of the old system now produce shoes 1.3 pairs per hour represent the work of 100 percent of the production worker population.

but a smaller drop in the materials' cost share of revenues with the advent of time rates, which reflects the change in incentives. Big Foot no longer stocked leather on the plant floor and workers spoiled less material than they had when they worked under piece rates.

To see how the switch to time rates altered profits, we have calculated quasi-rents for the firm, where we define quasi-rents as total revenues minus labor costs and material costs. Row 5 shows that quasi rents per dollar of sales increased substantially with the introduction of time rates of pay. Row 6 shows that quasi-rents per shoe also increased substantially. The cost savings from introducing time rates overwhelmed the modest loss in productivity associated with time rates. Thus, the company's bottom line improved, despite reducing productivity, with the consequence of increasing Big Foot's chances for surviving despite foreign competition.[19]

A Counterfactual Analysis

We use other data from the firm to examine three routes by which Big Foot increased profitability from the shift to the CFM manufacturing: increased revenues from increasing the number of styles, lowered costs by reducing non-production worker supervision, and savings in worker's compensation insurance costs. We simulate how BF might have operated had it maintained its piece rate mode of pay in 1996, by which time the firm was fully operating its time rate system.

Table 3 shows the results of this counterfactual simulation. Consider first what revenues might have been in 1996 if the firm maintained its piece rate mode of pay. Based on our regression model, we estimate that the company would have had 6 percent higher receipts as a result of higher productivity (assuming that the shoes would be sold at the market price). This would have added \$8,105,000 additional revenues (see the line for higher output from piece rates in Table 3). But the firm would have introduced fewer new styles of shoes, which would reduce revenues. To estimate the contribution of the new styles to revenues, we obtained data from the company on the average sales of a new shoe line. Multiplying this by the additional number

[19] We have also obtained data on employee attitudes before and after the change. Prior to the change in 1992, the majority of employees reported positively on cooperation between departments; problems with coworkers; an overall job satisfaction measure. During the 1993 transition period, satisfaction levels take a huge drop. Satisfaction rose from 1993 to 1995, following the full implementation of time rates of pay and the CFM system, but it remained at levels below those under piece rate. In 1997, another company conducted their employee survey, and they suggested some improvement in overall satisfaction levels.

TABLE 3

Simulated Counterfactual of Change from Piece Rates to Time Rates in both Big Foot Plants (in Thousands of 1996 Dollars)

	Actual with time rate in $	Simulation if Big Foot had maintained piece rate in $
Revenue from sales[1]	$135,091	$137,624
Higher output from piece rate[2]	0	8,105
"Lost" product lines from piece rates[3]	0	−5,572
Labor costs[4]	19,551	23,396
Cost of non-two-tier wage system[5]	0	2,054
Extra monitoring under piece rates[6]	0	538
Material costs[7]	50,461	56,426
Worker's compensation[8]	365	1,641
Total revenues minus costs	64,714	56,161

[1]This is the wholesale price of shoes times shoes produced in 1996.
[2]Productivity under the piece rate system is estimated from a regression of the log of actual output on the log of the output management intended in a period, the log of the number of production employees, a dummy variable for the years 1990–1991, the "red circle period," and a dummy variable for the time rate period. The dummy variable for the time rate period is −0.06, implying that under piece rates, productivity would be 6 percent higher.
[3]The difference in sales from adding seven fewer new products under piece rates relative to time rates estimated from Big Foot records on the average sales from new products. We estimate that the sales per new product averaged $796,000.
[4]In 1989, the ratio of labor costs to revenues was 0.17, so our 1996 counterfactual estimate is simply 17 percent of the estimated revenues in 1996.
[5]Annual salary of all leavers from the firm minus the annual salary of all new employees since the transition to time rates, 1994.
[6]Marginal cost of monitoring which is the number of inspectors under piece rates versus time rates. All inspectors were eliminated in the move to time rates.
[7]Material costs simulated in 1996 estimated by the 1989 ratio of material costs to revenues of .41.
[8]Estimated by average worker compensation costs under piece rates versus time rates, using Big Foot records.

of new shoe lines introduced under the time rate system minus the number introduced under the piece rate system, we estimate that the firm would have lost $5,572,000 in revenues had it continued to use piece rates and its related human resource policies (as reported in the line "lost" product lines in Table 3). This indicates that 69 percent of the higher productivity of piece rates and its related policies were offset by the loss of revenue resulting from the adverse effect of piece rate production on the number of styles.

On the cost side, we assume that the labor and material costs would have had the same proportion to revenues in 1996 under piece rates as they had in 1989, the last year before the firm tried to introduce time rates. On the basis of our Table 2 regressions, this is a very conservative estimate of the savings in labor cost. The labor costs line in Table 3 shows that this implies that the labor costs would have been considerably higher in 1996 than the actual cost under time rates. Next, we use company payroll records to estimate the part of the savings in labor costs to the implementation of the two-tier wage system; and the part that is the result of the elimination of the six supervisors in each plant who monitored workers. The lower pay to new hires has a considerably greater effect on savings than the reduced supervisory cost. But the bulk of the savings results from paying fixed wages that do not vary with production. The line "material costs" in Table 3 shows that the move to time rates saved material costs modestly. Here we estimated what material costs would have been in 1996 under piece rates by multiplying the ratio of material costs to production value in 1989 to production value in 1996. We estimate that material costs would have been $56,426,000 in 1996 had the firm maintained its piece rate mode of pay. Finally, we record average workers' compensation insurance rates under both methods of pay. Because workers' compensation costs can vary greatly from year to year as a result of the randomness of injuries, here we use the average of WC costs from 1986 to 1989 to represent costs under piece rates and the average of costs from 1990 to 1996 to represent costs under CFM. Again, there were costs savings from the changes in the policies implemented by management that included time rates of pay.

The final line in Table 3 estimates the "net profitability" for BF from the change to time rates. By our assessment, the shift to time rates lowered labor's share of cost at Big Foot and reduced other costs by enough to increase the economic surplus available to the firm by more than $8.5 million, despite the higher productivity under piece rates. Because the firm changed many aspects of its operation during the period, lost experienced managers and workers, and hired new lower wage workers,[20] however, neither our counterfactual nor regressions give the *ceteris paribus* effect of a switch to time rates or continuous flow manufacturing. Rather, the estimates show the effect of the change in production and labor practices associated with these innovations taken as a group. This, we would argue, is in fact the relevant *mutatis mutandis* comparison as Big Foot never intended to change one aspect of its operations in isolation from others but rather hoped to make them complementary as a group.

The Industry Picture

To what extent does the experience of Big Foot illuminate the broad industry patterns of change in the shoe sector?

To see to what extent our firm-based analysis fits with developments in the shoe industry more broadly, we extracted data on all establishments in

[20] There was little turnover or new hires from the transition to piece rates to the end of 1997, so that about 90 percent of the production employees were the same at the end of the period as in the earlier period.

TABLE 4

Characteristics of Establishments in the Shoe Industry, 1967–1992

Year	1967	1972	1977	1982	1987	1992
Exit and entry						
1. Number of plants	766	622	523	482	317	267
2. Percent in given year that survive to 1992	0.11	0.16	0.19	0.25	0.54	1.00
3. Number who entered/remain in given year to 1992 productivity and pay	183	168	168	149	96	—
4. Sales per worker ($000)	64.9	68.3	67.9	68.2	76.7	89.5
5. Value added per production hour ($)	21.0	22.0	22.3	23.3	24.3	30.2
6. Total earnings per worker (in $000)	20.6	21.9	20.3	19.0	20.4	20.6
7. Hourly pay ($) Labor cost shares	9.11	9.44	8.76	8.12	7.85	7.92
8. Labor's share in sales	0.32	0.32	0.3	0.28	0.27	0.23
9. Labor's share in value added	0.59	0.59	0.57	0.53	0.5	0.44

Source: Tabulated from Census LRD files.

By construction, the number of plants in row 1 (initial number in the specified year) minus the number of plants that died by 1992 from this cohort found by taking the percent who died in row 2 plus the number of plants in row 3 (the additional plants who entered post the specified year) sums to the number of plants that survived through 1992.

men's and women's shoes SIC (codes 3143 and 3144) in the Longitudinal Research Data (LRD) files of the U.S. Bureau of the Census. The LRD provides evidence on the exit and entry of establishments over time that allows us to assess the effect of productivity and cost factors on survival. But the LRD does not have data on the key variable of concern, the mode of compensation at establishments.[21] As we know that in the 1960s, most firms used piece rates, and that by the 1990s most firms used time rates, and that firms that use piece rates employ greater supervisory personnel, however, we can still make some inferences from these data.

Table 4 shows how exit and entry of establishments altered the U.S. shoe industry. Row 1 records the number of establishments in each year of the Census of Manufacturing, when the count of establishments is relatively complete. Row 2 shows the percentage of establishments in existence in each of the years that survived through 1992. For example, 11 percent in the 1967 column shows that only 84 of the 766 plants in the 1967 Census were still operating in 1992. Using these data, we estimate that U.S. shoe establishments had an average compound annual death rate that began at 8.5 percent per year and then rose to 11.6 percent. Row 3 shows the number of new establishments that entered the industry over this period. Adding the

[21] The LRD was created by the Census to provide an establishment-level data from the Bureau's Survey of Manufacturers. It contains information on shipments, value added, employment, wage bills, materials, and inventories for all manufacturing establishments with more than 250 employees and a subsample of establishments with fewer employees in all years except the years when the census conducts its Census of Manufacturers every five years.

TABLE 5

THE EFFECT OF EXIT, ENTRY, AND WITHIN-ESTABLISHMENT ADJUSTMENTS ON EMPLOYMENT IN THE SHOE INDUSTRY, 1967–1992

Change in employment	–122,708			
As a result of establishment	–132,317			
As a result of new entrants	15,857			
As a result of within plant adjustment	–6,248			
Characteristics of firms	Labor's share		Sales/employee	
	1967	1992	1967	1992
Firms that left	0.324	—	63,000	—
Firms that entered	—	0.275	—	75,000
Firms that survived	0.289	0.206	72,000	100,000

SOURCE: Tabulated from Census LRD files.

number of establishments that died and those that entered to the number in the base years gives the number existing in 1992.[22]

The next section of Table 4 examines productivity and pay in the industry. Row 4 shows that sales per employee increased by 1.3 percent per year. Row 5 shows a slightly faster rise in value added per production worker-hour of 1.5 percent. Row 6 shows that the real average annual earnings for all employees were roughly constant over the period while row 7 shows that real hourly earnings of production workers fell by 15 percent. The last part of the table shows the key cost variable in our analysis, the share of labor in revenues as measured through labor's share relative to sales and to value added. In both cases, labor's share of revenues fell by about 25 percent. From our estimates for Big Foot, this is about what we would expect for an industry shifting its managerial policies and using a bundle of human resource practices to reduce labor costs and increase its productivity in order to maintain its viability in the face of stiff foreign competition.

Between 1967 and 1992, the Bureau of Census, Census of Manufacturers estimates summarized in Table 5 that full time employment in shoe manufacturing fell by more than 122,700 jobs. The prime factor driving the drop in employment was the exit of plants from the industry. Indeed, the fall in employment as a result of closures accounts for more than 100 percent of the 1967–1992 decrease in employment. Entry of new plants brought some jobs into the industry, whereas declines in employment within firms have made only a modest impact on total employment. Table 5 also shows that

[22] Our results are consistent with the death rates of shoe factories over the past hundred years. For example, the annual death rates for shoe factories during the first half of this century was about 10 percent, which is similar to our estimates gathered through the LRD for the 1960s through the 1990s (Davis 1940).

TABLE 6

Estimates of the Effect of Labor Costs on the Probability of Survival in the Shoe Industry, 1967–1992

	Logistic estimates	
	(1)	(2)
Log labor's share	−0.83 (0.35)	−1.33 (0.46)

the firms that exited had 12 percent higher labor shares in 1967 than those that survived through 1992. The survivors' lowered their labor shares by 29 percent– 0.083 points from .289 to .206. Firms that entered, by contrast, had relatively high labor share, presumably because they were largely involved in high-skill niche production. Sales per employee show a similar pattern.

Given the critical role of plant closure in the adjustment of the shoe industry to foreign competition, we next consider the economic factors that affected firm survival in the industry. To do this, we estimated logistic equations of the probability of survival for the 1967 cohort of establishments as functions of labor's share of costs in 1967 and the proportion of workers who were nonproduction employees in 1967. Establishments with high labor share of cost and high nonproduction shares of employment are more likely to operate under piece rates than other establishments. If our analysis of Big Foot generalizes, these establishments should be more likely to close than other establishments. Table 6 gives the coefficients from our logistic curve analysis. Column 1 shows that establishments with a high labor share of revenues were the most likely to exit the industry. Column 2 shows that establishments with more nonproduction workers were also more likely to close down. Workplace systems of pay, like piece-rates, that needed relatively many supervisors or monitors to maintain quality of production presumably did worse than those that managed (for whatever reason) to get by with fewer such personnel.

Conclusion

Economists and industrial relations analysts often stress that productivity is raised in modes of compensation that give workers immediate incentives to work hard, such as piece rate pay, relative to time rates of pay. But piece rates and other forms of incentive pay are often accompanied by complementary practices that can raise costs in other areas of operation or otherwise offset the impact on productivity on profits. Our within firm analysis shows that the higher productivity associated with piece rate pay was insufficient to make piece rates and its complementary managerial policies economically desirable in the shoe industry. Because piece rate pay raises nonlabor costs and workers' compensation, requires additional monitoring of workers, and makes it expensive to adjust to changing styles, time rates have come to dominate the U.S. shoe sector.

The similarity between our results and those of Dunlop and Weil (1996) in the textile industry and Ichniowski, Shaw and Prennushi (1997), in the steel industry suggests that firms facing foreign low wage competition must concentrate on high-quality niche production and must change products rapidly through continuous flow manufacturing to survive. In such a setting, piece rates are less valuable than time rates, although individual productivity is higher under piece rates.[23] In addition, we have found evidence that workers do not give "full effort" with piece rates, presumably because workers fear that the firm may change the rates to make it more difficult to earn premiums. Thus, managerial policies that rely on team work and group effort has resulted in time rate pay dominating workplaces in the U.S. and in other advanced economies.

References

Berg, Peter, Eileen Appelbaum, Thomas Bailey, and Arne L. Kalleberg. 1996. "The Performance Effects of Modular Production in the Apparel Industry." *Industrial Relations* 35:356–73.

Brown, Charles. 1990. "Firms' Choice of Method of Pay." *Industrial and Labor Relations Review* 43:165–82.

Brown, Martin, and Peter Philips. 1986. "The Decline of Piece Rates in California Canneries, 1890–1960." *Industrial Relations* 25:81–91.

Commons, John R. 1909. "American Shoemakers, 1648–1895, A Sketch of Industrial Evolution." *Quarterly Journal of Economics* 26:39–84.

Copeland, Adam, and Cyril Monnet. 2002. "The Welfare Effects of Incentive Schemes." University of Minnesota, Working Paper.

Davis, Horace B. Shoes. 1940. *The Workers and the Industry.* New York: International Publishers.

Dunlop, John T., and David Weil. 1996. "Diffusion and Performance of Modular Production in the U.S. Apparel Industry." *Industrial Relations* 35:334–55.

Gibbs, Michael. 1998. "Lincoln Electric." *Personnel Economics for Managers: Instructors Manual*, pp. 4–5. New York: John Wiley and Sons.

Hartman, Paul T. 1969. *Collective Bargaining and Productivity.* Berkeley, CA: University of California Press.

Harvard Case Study. 1983. "Lincoln Electric Company." Boston, MA: Harvard Business School.

Helper, Susan. 2000. "Economists and Field Experiments: You Can Observe a Lot Just by Watching." *American Economic Review* 90:228–32.

Hufbauer, Gary C., and Kimberly A. Elliot. 1994. *Measuring the Costs of Protection for the United States*. Washington, DC: Institute for International Economics.

[23] Another study that used a before and after research design was Hartman's examination of the productivity effects of the reduction of restrictive work practices in West Coast long shore and shipping firms in the 1960s in response to rapid technology changes and competitive pressures (Hartman 1969).

Ichniowski, Casey and Kathryn Shaw. 2003. "Beyond Incentive Pay: Insiders' Estimates of the Value of Complementary Human Resource Management Practices." *Journal of Economic Perspectives* 1:155–78.

———, ——— and Giovanna Prennushi. 1997. "The Effect of Human Resource Practices on Productivity: A Study of Steel Finishing Lines." *American Economic Review* 87:291–313.

Ichniowski, Casey, Thomas Kochan, David Levine, Craig Olson, and George Strauss. 1996. "What Works at Work: Overview and Assessment." *Industrial Relations* 35:299–333.

Jacobs, Eva. 1997. *Handbook of U.S. Labor Statistics, Employment, Earnings, Prices, Productivity and other Labor Data*. Lanhen, MD: Bernan Press.

Kato, Takao, and Motohiro Morishima. 2002. "The Productivity Effects of Participatory Employment Practices: Evidence from New Japanese Panel Data." *Industrial Relations* (October): 487–520.

Lazear, Edward P. 2000. "Performance Pay and Productivity." *American Economic Review* 90:1346–61.

Levine, David. 1995. *Reinventing the Workplace*. Washington, DC: The Brookings Institution.

Marshall, Alfred. 1961. *Principles of Economics, 9th Edition*. London: Macmillian for the Royal Economic Society.

Paarsch, Harry J., and Bruce Shearer. 2000. "Piece Rates, Fixed Wages and Incentive Effects: Statistical Evidence from Payroll Records." *International Economic Review* 41:59–92.

Pencavel, John. 2001. *Worker Participation: Lessons from the Worker Co-ops of the Pacific Northwest*. New York: Russell Sage Foundation.

Roy, Donald. 1952. "Quota Restriction and Goldbricking in a Machine Shop." *American Journal of Sociology*: 427–42.

Seiler, Eric. 1984. "Piece Rate v. Time Rate: The Effect of Incentives on Earnings." *Review of Economics and Statistics* 66:363–76.

Shearer, Bruce. 1996. "Piece-Rates, Principal-Agent Models, and Productivity Profiles." *The Journal of Human Resources* 31:275–303.

Shultz, George P. 1951. *Pressures on Wage Decisions: A Case Study in the Shoe Industry*. London: John Wiley and Sons.

Simon, Herbert. 1951. "A Formal Theory of the Employment Relationship." *Econometrica* 19:293–305.

Slichter, Sumner H., James Healy, and E. Robert Livernash. 1960. *The Impact of Collective Bargaining on Management*. Washington, DC: The Brookings Institution.

Smith, Adam. 1776 [1937]. *Wealth of Nations*. New York: Modern Library Edition.

U.S. Department of Labor, Bureau of Labor Statistics. 1987. *Industry Wage Survey: Men's and Women's Footwear*. Washington, DC: GPO.

———. 1996. *Employment and Earnings.* Washington, DC: GPO.

———. 2002. *Industry Wage Survey.* Washington, DC: GPO.

Weitzman, Martin. 1980. "The 'Ratchet Principle' and Performance Incentives." *Bell Journal of Economics* 11:302–8.