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ABSTRACT

During the last 150 years, shoe manufacturing in the U.S. has gone from one of the largest employers in manufacturing to one of the smallest, yet some firms have survived and remained profitable. This study examines the role of changing methods of compensation in shoe manufacturing, in a sector that faces severe import competition. During the 1970s - 1990s, most firms in the industry shifted from piece rate to time rate modes of compensation as a strategy for survival. Using longitudinal establishment data files, we find wide variation in labor input usage and in labor's share of sales among establishments in the sector, with establishments having high labor shares of cost disproportionately likely to close down over time; and a widening range of labor input usage in production associated with the widening U.S. wage structure. Using data for a simple manufacturer, "Big Foot," we find that the shift to time rate methods of pay was part of a move toward continuous flow methods of production, with job rotation and rapid changes in work tasks to introduce new styles. The switch reduced productivity, but brought offsetting cost savings in the form of lower workers' compensation insurance costs, smaller inventories, lower monitoring costs, and lower hourly wages, and made it easier for the firm to introduce new shoe styles. On net, the shift to time rates lowered labor's share of cost at the company and increased the economic surplus available to the firm.

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"A good boot is worth all the art in the world."—Mikhael Bakunin

At the beginning of the Twentieth Century one of the largest industrial employers in America was shoemaking, and several of the most influential studies on the development of the economics of industrial relations focused on this industry (Commons, 1909)[1]. One of the unique characteristics of the industry was its tradition of piece rate methods of pay. Just before World War II almost 90 percent of workers in American shoemaking were paid through a piece rate system (Davis, 1940). Through the 1980s, the majority of U.S. shoe manufacturing firms used piece rate methods of pay (Bureau of Labor Statistics, Industry Wage Survey 1987). But as firms closed in the face of intense import competition and new plants did not open, the surviving shoe manufacturers turned increasingly to time rates of pay. By 1997, over three-quarters of employees in the industry were paid primarily by time rates in an industry that had declined dramatically.[2]

Why did firms throughout the industry change practices that had been in place for decades? Do time rates offer a competitive edge to firms facing low-wage foreign competition despite the likely higher productivity with piece rate incentives? What is that competitive edge?

To answer these questions, this paper uses establishment data from the Census and Survey of Manufacturers and internal company data from a major U.S. shoe firm, which we will call "Big Foot" (BF), that switched from piece rate to time rate compensation in the 1990s.[3] Section one describes the decline of the U.S. shoe industry and reviews briefly the advantages and disadvantages of time rate and piece rate modes of pay. Section two examines some of the factors associated with the collapse of shoe manufacturing in the U.S. Section three gives a case history of the change from piece rate to time rate in BF and assesses the effects of that change on productivity and profits.

We find that in the industry as a whole:

1. There was a wide variation in labor input usage and in labor's share of sales among establishments, which affected the plant's probability of survival in the face of low-cost foreign competition. Establishments with high labor shares of cost were disproportionately likely to close down, whereas by itself high wages did not increase the probability of closing down.

2. The range of labor input usage in production rose over the period, as the widening U.S. wage structure allowed some low-wage establishments to remain in business.

For the company-level analysis of Big Foot, we find that:

3. The shift to time rates was part of a move toward continuous flow methods of production, with job rotation and rapid changes in work tasks to introduce new styles and "just in time" products to retail stores. It reduced labor productivity, though even under piece rates normal productivity was considerably below the productivity that workers can reach by "full effort." But time rates of pay brought offsetting advantages: lower workers' compensation insurance costs; smaller inventories; lower monitoring costs; lower wages, fewer grievances over wages during the labor contract; and an increased number of new styles of shoes.

4. On net, the shift to time rates lowered labor's share of cost at Big Foot and increased the economic surplus available to the firm. Though Big Foot was one of the last group of firms to shift to time rates, the shift was an economically sensible response to market conditions.

Our analysis parallels the work of Dunlop and Weil on the introduction of modular production in the textile industry, another low wage sector facing severe import competition.

The similar response of the two sectors suggests that in highly competitive industries subject to low-cost foreign competition, modular modes of production with time rates of pay offer a competitive edge to firms compared to piece rate systems.[4] Still, given the productivity advantage of piece rates, we surmise that some form of group incentive system or gain sharing might provide the "last American shoe manufacturers" with greater staying power in the market.

1. The Economic Situation in the American Shoe Industry

The U.S. shoe industry has contracted massively since the 1960s. The vast majority of firms closed in the face of foreign competition, due in large part to a dramatic reduction in U.S. tariffs on imported shoes starting in the mid-1960s. 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). Standard mass produced shoes in the U.S. had to meet the "world" price of shoes in an industry with high labor costs and standard technology. The survival of firms depended on their ability to differentiate their product, create niche markets, and quickly deliver high demand products to retail stores.

Table 1 provides a capsule picture of the decline of the U.S. shoe sector and of men's footwear except athletic.[5] The table shows that while U.S. consumption of shoes increased significantly from 1966 to 1996, domestic production fell by over 80%. Full-time employment in the sector fell from 233,400 in 1966 to 46,100 in 1996. In the men's footwear, except athletic, the decline of employment from 1978 to 1995 was 38%. The reason for the drop in U.S. output and employment was a huge growth of imports. Between 1966 and 1996, import penetration changed from 13% of consumption of shoes to over 90%, with most of the increase occurring between

1976 and 1986. A major factor in the 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 (LDC), including Indonesia and China which constitutes over 60% of all shoes sold in the U.S.; three are newly industrial countries (NIC), whose wages in manufacturing remain considerably below those in the U.S. What makes low wage foreign competition so strong 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 good hand-eye coordination rather than high levels of education or the use of sophisticated computer equipment.[6] But, as in other consumer markets, wage costs are not the only elements for success. The hourly compensation for footwear production workers in one major exporting country, Italy, is over 50 percent above that in the U.S. while compensation in another substantial exporter, Spain, is comparable to U.S. compensation. In the 1990s, U.S. shoe firms maintained 10% of the domestic market, and some firms, like Big Foot, not only survived but expanded.

Until the mid-1980s, over half of the American shoe making companies paid their workers with piece rate methods of pay. With increasing foreign competition, American firms looked to ways of using "total quality management" to enhance their competitiveness. This method of production requires teamwork and continuous flow methods of production. It requires that employees know many different tasks rather than just one. 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.

Piece Rates vs. Time Rates of Pay

The study of piece rate and time methods of pay has a long tradition in economics dating back to Adam Smith and Alfred Marshall. Analysis points out pluses and minuses to each method of payment from both the firms' and workers' perspective. The main plus from piece rates is that they induce workers to work harder than do time rates of pay, which should increase both output and pay, potentially benefitting labor and capital (Brown 1990). Consistent with this prediction, most studies show that wages and production are higher under piece rate than time rate modes of pay (Seiler (1984) Lazear (1996); Shearer (1996); Paarsch and Shearer (1996)). But piece rates have problems also. Workers have an incentive to skimp on quality and use excessive amounts of materials, inducing the firm to spend resources on quality control that are not necessary under time rates. Because workers insist upon having the materials needed to produce their pieces, firms often stockpile more materials than under time rates. In addition, workers may take greater risks at the job, which raise injuries and the expenses. But perhaps the biggest disadvantage of piece rates is the problem of readjusting rates and tasks when the technology or production process changes. Under time rates, wages per hour remain the same, and management can simply reassign workers to different tasks. Under piece rates, the firm must either adjust the rates with each change in production or risk having a "demoralized" rate system: where the piece payments are out of line with opportunity costs of labor.

To assess the economic benefits of time rate and piece rate modes of pay consider the following unit cost relation:

(1) Unit Costs = DLC/Q + MP/Q + Capital/Q + ALC/Q + TC/Q

where DLC is direct labor costs, MP is the material M used times its price P, Capital is the capital cost, and ALC is auxiliary labor costs (such as workers' compensation insurance), and where Q is the quantity of output. The term TC/Q refers to the transactions cost of production, by which we mean the cost of changing the mode of production to meet changes in market conditions. Under time rate modes of pay direct labor costs per unit of output are just WL, where WL is the market wage times person hours worked. Under the simplest piece rate system, direct labor costs per unit of output is just W', where W' is the specified price per piece. Workers earn W per hour under the time rate system and W'Q'/L' under the piece rate system, where Q'/L' is the productivity under piece rates. When the only factor differentiating costs under piece rate and time rates is direct labor costs, the decision to choose piece or time modes of pay is simple. All else the same, the firm prefers piece rates when $W' < WL/Q$. All else the same, workers prefer piece rates when $W'Q'/L' > W$. Combining the two terms, we see that both workers and firms prefer piece rates whenever $Q'/L' > Q/L$. The extent to which workers or the firm prefers piece rates to time rates will vary with the piece rate, which determines the division of the benefits of higher productivity. If we add an equation that links the gain in productivity from piece rates to the piece rate itself, we bound the possible division of benefits: the larger the gain from productivity associated with higher piece rates, the higher will be the observed rate.

But not everything else is the same under piece rates and time rates. From the workers' perspective, piece rates are a riskier form of payment, requiring some compensating differential.

From the firms' perspective, the choice of piece and time rates can affect the other terms in the unit cost equation. As noted earlier, two of these terms are likely to be higher under piece rates. The MP/Q is a basic inventory or quality issue. The earnings of piece rate employees depends on their having the material for production on hand, which creates an inventory buildup costly to the firm. In the shoe industry, this means piles of leather for shoes lying on factory floors. In addition, under a simple piece system, workers may have little incentive to economize on the use of materials without other complicating financial incentives. The principal auxiliary labor cost on which we will focus is worker occupational injury insurance: this will be higher under piece rates as worker effort intensifies and employees risk injuries to produce more. We do not expect much difference in the capital requirements for piece rate or time rate methods of production, though there may be such changes associated with particular workplace technologies.

The most interesting term in (1) is the transactions cost of production. Under time rates, the firm can alter what workers do with only minor hassle. The firm has bought the workers' time and has the right to tell the worker what to do when the production process or work activities change. But under piece rates, whenever the firm changes the style of output or process, it must adjust the rates associated with each piece produced. Since learning new processes may reduce short-term output and earnings, workers will need some additional compensation during that period. If the new technology increases output at the same effort, pay may get out of line with the rewards to alternative opportunities and the workers rather than the firm may gain the quasi-rents associated with that technology. The expense of changing the piece rate under changing production conditions has long been recognized as a key drawback to piece rate production.

Why Not Update the Piece Rate System?

Since piece rates give workers an incentive to produce more, the question naturally arises as to why Big Foot (and presumably the other shoe manufacturers who switched to time rates) decided to jump to time rates rather than trying to reform their piece systems.

To examine this question, consider a firm that chooses among three alternative modes of compensating workers and operating its workplace:

P1) The firm pays workers piece rates and updates the piece scale as workers learn how to do their jobs better, and as the firm introduces new modes of production.

P2) The firm pays workers piece rates but allows the piece system to become outmoded, so that workers earn way above their next best alternative.

T) The firm pays time rates.

US shoe manufacturers behaved as if these three options fit the following inequality

(2) $\pi(P1) < \pi(P2) < \pi(T)$

where $\pi(x)$ refers to the profits to the firm of each of them.

Most of this paper is concerned with the right-hand side inequality—the reasons why Big Foot (and the rest of the American shoe industry) found time rates to be more profitable than an outmoded piece rate system. But, for a complete analysis, we must also understand why firms allow a piece rate system to become "demoralized" rather than continually updating it. By updating a piece rate system, the firm can potentially gain a larger share of quasi-rents.

There are three problems with updating a piece rate system.

First, it costs money to update piece rates when technology, or in our case, the style of shoes, changes. Call F the fixed cost for any change in the piece rate system. The more frequently the firm changes the number of styles workers produce, the more expensive it is to keep the piece system up to date. The cost of revising a piece system can be substantial. A quality control engineer or other plant official must time the worker to determine the appropriate rate, and the revision process may produce acrimony between workers and the firm.

Second, the faster the firm reforms a piece system, the smaller is the incentive to workers to produce as much as they can. Assume that the piece system is defined in terms of the number of units S produced above some base level S* and that the firm revises S* regularly as workers produce $S > S^*$. For simplicity let $\Delta S^* = \lambda(S(-1) - S^*(-1))$, where λ represents the speed of adjustment in the base level, and $S^* = S^*(-1) + \Delta S^*$. In a single period the worker maximizes:

(3) $U = a\bar{s} + p(S - S^*) - C(S)$, where C is the utility cost of producing S units, and where $p > a$, the amount of income from producing the base level. (Workers that produce less than the base are likely to be fired, so the condition for employment will be $a\bar{s} - C(\bar{s}) \geq U$ (next best alternative)), where $S^* \geq \bar{s}$.

Substituting, we obtain

(4) $U = a\bar{s} + p[(S - \lambda S(-1) - (1 - \lambda)S^*(-1)] - C(S)$

The incentive for the worker to produce $S > S^*$ depends on p and on the speed with which the firm updates its piece rate system. The faster the adjustment of S* to S(-1), the smaller is the piece rate incentive. Each increase in output in the past raises the base level and thus reduces the payoff from that level of output in the future.

For instance a worker might produce S^m amount when $\lambda = 0$ in each of two periods and gain utility of $[a\bar{s} + p(S^m - S^*)] - C(S^m)] + 1/(1 + r) [a\bar{s} + p(S^m - S^*) - C(S^m)]$, where r is a discount rate. But with $\lambda = 1$, producing S^m would not be optimal, since in the second period, S* would equal S^m. The incentive to produce more in the current period would be lower as well because more production today reduces future utility. Thus, the worker would produce less in both periods. For the firm, it would choose some profit-maximizing λ, that in our case of Big Foot was 0, which allowed the piece rate system to become outmoded. In the literature on planned economies, the reduction in the incentive effect due to updating incentives based on past performance is known as the "ratchet effect." Weitzman analyzes the situation in terms of a present value optimization and shows that indeed output is less for larger λ (Weitzman, 1980).

Another problem with setting piece rates in an incentive system is that it risks engendering employee peer pressures against productivity. Since 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 her peers will reduce the piece rate for all workers, including those who do not have her skills or knowledge. She will have no incentive to impart those skills/knowledge since 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.

The third problem in updating a piece rate system is that there is a significant information asymmetry about the "potential level" of production. Workers learn on the job about how best to produce, and will always be ahead of the firm in knowing the potential level of production. Like tax lawyers, they find "loopholes" in the piece system faster than (the IRS) firms can correct them. Hence, when the firm updates its piece system, workers will have an incentive to "hide" their knowledge by taking leisure on the job rather than by increasing output. The firm cannot observe leisure on the job whereas it gets full information about potential production by observing actual output. We can model by making the cost term in the utility analysis depend on cumulated units produced as well as on current units, per learning-by-doing models. The "loophole effect" exacerbates the ratchet effect: 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 sum, the decision to update a piece system must weigh the direct cost of updating the system, the reduced incentive effect, and increased incentive for workers to take leisure on the job from a reformed system against the lower labor cost that a reformed piece rate system produces. Update frequently and you lose some of the incentive effect of a piece rate system. Update infrequently and the firm loses potential quasi-rents. Weighing 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, the loss of incentives from rapid updating of the piece rate system and the cost of updating must have been sufficiently high to make revising the piece rate system less profitable than allowing the system to become outmoded.

2. Survival in a Collapsing Market

In this section, we use data from the Census Bureau's Longitudinal Research Database (LRD) to examine the characteristics of surviving and dying establishments in the shoe industry over time. 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 sub-sample of establishments with fewer employees in all years except the years when the Census conducts its Census of Manufacturers every five years.

We use Salter's (1966) classic model of the utilization of different production techniques in a competitive market to guide the analysis. This model highlights two aspects about production in a sector: the range of variation in practices among establishments due to the vintage of capital (and other factors); and the role of labor costs in determining that range of variation. When productivity varies greatly among establishments, exit and entry of establishments becomes a critical way for the market to adjust to shocks and substitute capital for labor. When prices fall or wages rise, establishments with high labor costs or labor/output ratios are scrapped, while new establishments enter with low labor requirements. The result is a change in sectoral productivity and labor costs even when individual establishments operate with relatively fixed-labor usage coefficients. While Salter focused his analysis on how new technologies affect a sector, the model is a general one. We apply it to the shoe industry where the competitive pressure comes from increased price competition from imports rather than from new technologies.

To examine changes in the population of establishments in the shoe industry, we extracted all establishments in the LRD in SIC codes 3143 and 3144, men's and women's shoes. For the years ending in 2 or 7 we have a complete census. In intermediate years, we have establishments covered in the Survey of Manufacturers. Table 2 provides some detail on our data set. Column 1 shows the number of establishments in each year of the Census, when the count of establishments is relatively complete. Column 2 shows the percentage of establishments that were in existence in each of the Census of Manufacturing years that had survived through

1992. Column 3 gives the average compound annual death rate of establishments: it begins at about 8% per year and rises to nearly 12%. Since even in a declining industry some new establishments enter, this does not give the number actually in existence in 1992. Columns 4 and 5 show the number of extant establishments that died between the specified census year and 1992 and the number of new establishments that entered the industry. Added to the number of establishments in the base year, these figures sum to the number existing in 1992. Our results are consistent with the death rates of shoe factories for more than the past hundred years. For example, the annual death rates for shoe factories during the first half of this century was about 10%, which is similar to our estimates gathered through the LRD for the 1960s through 1990s (Davis,1940). The overall decline in employment and the number of shoe plants we found in the LRD is therefore largely due to the decline in the number of new entrants. Given the structure of the U.S. shoe industry, new foreign plants seem to be able to produce shoes more efficiently than American firms based largely on a relative labor cost and productivity basis.

Table 3 records measures of productivity—sales and value added in 1992 dollars per hour worked and labor's share of sales and value added in the shoe industry; average compensation for all employees; and hourly wages for production workers in constant dollars from 1967 to 1992. Productivity per worker has increased by 1.3% per year while valued added per production worker-hour increased by 1.5%. Earnings for all employees have been constant over the period while hourly wages for production workers fell by 15%. The share of labor in sales and value added fell by about a quarter.

Given the huge decline in the number of establishments, changes in employment have occurred almost exclusively by plant closures. The upper panel of Table 4 shows that the fall in employment due to closures account for over 100% of the 1967-1992 and 1972-1992 falls 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. The lower panel of the table shows that the firms that left the industry had lower productivity and higher shares of labor in cost than those that survived, while the new entrants had lower productivity and higher labor's shares in 1992.

Underlying the averages in Table 4 is a wide range of variation in labor input coefficients or productivity among establishments. Figure 1A shows the distribution of productivity in shoe firms in 1967 and in 1992 and gives sales per employee-hour worked and hourly earnings for "best practice" firms (those at the upper decile of the productivity distribution or wage distribution); "worst practice" firms (those at the bottom decile of the productivity or wage distribution), and the mean for the firms. Consistent with the Salter model, there is huge variation in the productivity—*sine qua non* for an analysis that makes entry and exit conditions critical factors in how an industry adjusts to changing market conditions. Some of the variation in productivity is due to different technologies and vintages, per the Salter model: even within a technologically stable industry, there are different techniques for production. Some of the variation is also due, however, to the variation in products within the SIC sector: some firms produce high-quality items or specialty products, like cowboy boots or moccasins; while others compete more directly with low-priced imports.[7] Initially, we anticipated that the dispersion of productivity among firms would decline, as the low productivity firms would be pushed out of the market. In fact, the opposite seems to have occurred. The top decile of firms nearly doubled their productivity while productivity in the bottom decile actually fell. How could this be?

One factor that permitted low productivity firms to remain in business is the fall of real earnings among low paid American workers. Figure 1B shows considerable variation in hourly earnings of production worker in the shoe sector and, what is perhaps more striking, increases in earnings inequality among establishments. From 1967 to 1992, hourly pay actually increases for workers in the highest paying decile of firms, while hourly pay drops by 13 percent for the median firm and by 24% for the lowest decile of firms. To some extent the wider dispersion in productivity was sustained by the widening distribution of wages in the industry.

What factors contributed to survival in the shoe industry?

We do not have information on the mode of compensation for firms in the LRD, so our analysis is limited to examining the relation between survival in the sector and the share of labor costs. Table 5 presents linear probability and logistic equation estimates of the probability of survival for the 1967 cohort of establishments as functions of labor's share of costs and sales per employee and earnings as of 1967. Column 1 shows that firms with greater labor productivity had a better chance of surviving than other firms. Column 2 finds that firms with higher earnings also had only a slightly higher chance of survival, possibly because higher earnings are associated with labor skills and niche production of higher quality shoes. Column 3 shows that combining the productivity and earnings figures together, establishments with high labor costs are most likely to have exited the industry. Column 4 shows that establishments with more non-production workers were also more likely to close down; this may reflect piece rate systems of pay in which firms needed relatively many supervisors or monitors to maintain quality of production.

3. Assessing the Change to Time Rates at Big Foot

We turn next from the industry as a whole to the situation of a single firm, the Big Foot Shoe Company—one of the last American shoe manufacturers. BF produces men's work shoes and sports boots in four shoe production facilities in the U.S.—two unionized plants in the Midwest and two nonunion plants in southern border states. 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. Incorporated at the beginning of the twentieth century, BF is an old firm that 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. These characteristics make BF similar to the famous Lincoln Electric Company Case Study which promoted the virtues of piece rates as a method of developing a high productivity and profitable manufacturing establishment (Lincoln Electric Company, 1983). Because of its close link to its community, BF is more committed to producing shoes domestically than most of its competitors and has kept the heart of its production operation in the U.S. By contrast, its chief U.S. rival went from producing 2/3rds of its product domestically to producing 2/3rds offshore. In 1998, another major U.S. shoe firm, Bass Shoes of Maine, closed its U.S. facilities.

The paternalistic link between the firm and the community also created a conservative business culture that made BF one of the last group of firms in the industry to scrap its piece rate mode of compensation. While most other domestic shoe firms have opted for time rates of pay and cutting edge technologies and production processes to offset labor costs, Big Foot did not start planning to change its mode of compensation and organizing production techniques until the mid-1980s and did not begin the shift to piece rates in its Midwestern facilities until 1992.

The Decision to Change

The decision to change mode of operating and paying workers was motivated by cost pressures from imports. In the mid-1980s, the company developed a three-pronged strategy for cutting costs and maintaining its U.S. production base: (1) to improve workplace safety and reduce workers' compensation costs; (2) to transform the production and compensation process; and (3) to expand U.S. production at lower labor costs by purchasing southern facilities.[8] For the purpose of this study, the critical decision was to move to time rates of pay and continuous flow manufacturing. The decision followed the report from a major consulting firm that highlighted several problems for Big Foot's survival: high workers' compensation expenses; an inflexible production process; a huge work in-process and storage expenses; and a demoralized compensation system. The consultant argued that the company's dependence on the piece rate system of production undergirded each of these problem areas.

Under the piece rate system, a production worker's seniority gained him certain job rights within the production process, that approached ownership of a machine and set of activities.[9] Workers in certain areas of the plant had an incentive to work rapidly and produce many units, which resulted in many injuries and accidents. Under the union contract, the injured worker retained a right to his or her job even when injured, so that a production worker could not be readily moved to another production job because that would compromise the job rights of another. Thus, Big Foot not only lost a valuable production worker but also lost that production job while that employee remained unable to return to their job.

Under its existing mode of operation, Big Foot produced a large number of a few lines of shoes regardless of whether or not a demand existed to meet that production. It purchased large quantities of materials and employed a group of workers to push 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 product until demand caught up to production.

The piece rate system with which the company operated had, according to management, become largely outmoded. The piece rate pay consisted of a low base near the minimum wage in the plant and variable pay based on the individual units produced and approved by BF, with some deduction for material wastage. Originally, the rates were set by a time-motion study, but over the years process innovation and negotiation with the union made management unhappy with the plan. Piece rates seemed too high: Table 6 shows that in the mid to late 1980s, workers made on the order of $20 per hour on bases of $10 to $11 per hour — a huge differential far in excess of what the firm desired -- the signature of a piece rate system that has become outmoded. And seemingly similar jobs were paid at widely variant rates, some easy jobs received high rates while harder jobs, where it was almost impossible to meet the standard rate, were valued at a lower rate. Employees filed many grievances complaining about the piece rate for each unit and for different processes. Figure 2 shows that the variation of wages within major job categories was much greater under piece rates than under the time rate system that the firm later introduced, where variation is measured as the deviation of the highest and lowest wages from the average for the job category. The finding that dispersion of pay is higher under piece rate than time rate modes of production is ubiquitous (see Seiler (1984); Lazear (1996); Shearer (1996)).

Finally, management felt that to meet market demands it had to introduce more styles and produce higher quality products, which a time rate mode of pay and new way of organizing work could facilitate. Company documents indicate that profits per pair were higher for lines of shoes than for existing lines. A 1996 national survey of stores and consumers reported that the number of BF styles are important/very important for over two-thirds of their customers, franchise shoe store owners, and company store managers. In fact, BF greatly increased the number of shoe styles it produced from 106 in 1985 to 187 in 1996. The number of new styles introduced per year was from six during the piece rate period to 13 in the time rate period. As a result, from 1990 to 1997, the percentage to total shoe sales due to the top 10 styles dropped by 20% as new styles grabbed a larger part of the companies overall sales. Furthermore, the transition to time rates allowed BF to produce smaller "runs" of differentiated shoes, and quickly replenish them at their retail stores to meet customer preferences.

The Change

To remedy the problems outlined above, Big Foot sought to introduce a continuous flow mode (CFM) of manufacturing with workers paid time rates instead of piece rates. The CFM plan included the introduction of a number of new lines of shoes based on market demand, a modular form of production in which workers would be cross-trained and days in-process would be cut dramatically, and a change to a just-in-time method of supplying materials to the lines. Essential to the success of the CFM initiative was replacing the piece rate method of compensating production workers with time rates.

Implementation of the CFM process began 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, and began in July

1994 in a second factory. Coincident to introducing the CFM process, Big Foot negotiated a new, and on average much lower, hourly wage system for all new hires. Finally, under the new system BF was able to eliminate six intermediate inspector jobs in each Midwestern plant.

Making the transformation was difficult. The company told supervisors that the ultimate result of CFM would be to eliminate supervisors, with the result that many supervisors did not support the CFM initiative and some actively worked against it. Thirty-three percent of the company's supervisors and a number of senior managers took early retirement. Some members of the management team believe that the company is still recovering from this loss of shoe making expertise. While the company tried to prepare the production workers for the change, many employees feared the loss of seniority and job rights and reduced pay. To assuage wage fears, the Company 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. In addition, management did not appreciate that there would be as sizeable a drop in pairs of shoes per hour produced by production workers.[10] As a result, management did not hire as many new production workers as it needed and had to schedule its production workers for as much as 10 hours a week overtime work.[11] Finally, BF was not able to fully implement the modular production that is so important to the optimal performance of the CFM process, and many workers do not move from job to job during the day.

But errors and problems notwithstanding, by the end of the 1990s decade, BF operated and paid workers in a very different way than it did at the outset of the decade, which allows us to analyze the effects of the change on productivity and profits using internal company data. With the switch from piece rates to time rates,. the number of grievances per employee dropped on pay-related issues, indicative of a new pay and work regime.

To assess the effects of the change from piece rate to time rate production, we use two strategies. First, we use time-series regressions to estimate the effect of the changeover on key variables. In these regressions, we include a monthly (or yearly) time trend, and two time dummy variables: one for the transition period when the plant was making the switch and one for the "after" period when it was paying workers time rates. The coefficients on these dummy variables provide us with estimates of the effect of transition and of the introduction of time rates on the outcome variables, conditional on other factors in the regressions.

Because the firm changed many aspects of its operation during the period, however, and lost experienced managers and workers, and hired new lower wage workers,[12] the analysis does not isolate the ceteris paribus effect of a switch to time rates or to continuous flow manufacturing, as if those were separable changes. Rather, it provides information on the overall effect of the change in production and labor practices associated with these innovations taken as a group. In addition, it is important to recognize that since BF's two midwestern plants introduced time rates at different times, the transition and time rate dummies are not simply month/year dummies. Because operations in the two plants are closely linked by distance and product lines, we have also estimated the time series models for both plants taken as a single entity.

Our second form of analysis is to specify a particular counterfactual situation for the firm. We use company data to assess how BF might have operated in 1997 had it maintained its piece rate mode of pay, including some qualitative data that is not readily amenable to a regression-based production function model, to contrast potential 1996 piece rate based costs and receipts with 1996 time rate based costs and receipts.

Production and Costs

Figure 3 presents monthly production and cost data from company files on the main plant in the BF system that shows the type of time series variation in key variables from 1986 to mid-1997. The data contains workers' compensation insurance costs, inventory costs, price data, productivity data, and profitability. Panel A shows that during the 1980s piece rate payments, workers' compensation insurance costs ranged from $20,000 to $80,000 per month in current dollars, averaging half a million dollars over the year. Workers' compensation costs drop substantially after the shift to time rates. Exclusive of the one $80,000 injury cost, costs average less than $10,000 per quarter. Even with the one huge expense, they average $15,000—one-third the costs under the piece rate system.

Panel B records the deviation of output in the plant from the level that management planned or expected. Positive deviations imply increased labor productivity while negative deviations imply reduced productivity. The June 1990 to June 1991 huge positive deviation in productivity reflects workers' responses under piece rates to the chance to lock in a higher time rate of pay following the change, and thus is evidence that even under piece rates, normal productivity is considerably below the productivity that workers can reach by "full effort" suggesting that "goldbricking" due to the ratchet effect is considerable under piece rates.[13] During the transition, and thereafter, productivity fell to more normal levels vis-à-vis planned productivity, though with substantially more periods of negative variance from the plan.

Panel C records data on inventory "savings," defined as the difference between the cost of holding leather and other materials and a benchmark the company uses as a standard. It shows a substantial improvement in inventory savings in the piece rate, transition, and time rate periods. Roughly inventory savings rise from some $2000 in the before period to $8000 in the after period. The company attributes the improvement to modular production and just-in-time inventory processes introduced with the time method of payment.

Panel D shows an upward trend in shoe prices measured in 1997 dollars. This increase is not due to inflation but rather to the upgrading of the firm's product line and its increasing concentration in high quality niche market work shoes. Panel E shows rough stability in the firms' definition of profits per pair over the entire period, with profits per pair falling during the transition period but possibly trending upward in late 1996.

Table 7 gives the result of our production function estimates of the effect of time rate compensation on the total number of shoes produced and on receipts, holding fixed the firms "scheduled production," capital, number of employees, number of new shoe styles, the period of extra effort, and an overall time trend variable for the main Midwestern plant. We delete observations with missing values for particular months. All of the regressions are based on time series data covering the period before, during, and after the transition from piece rates to time rates. The key variable is the "Time Rate" dummy, which takes the value 1 for the period 1994 through 1997 and 0 for the earlier period. As noted results using various time series smoothing approaches found similar results.

In column 1 we have set the coefficient on scheduled production at 1 to focus on what the firm looks in its own decision making the variation of actual over scheduled production. Since management plans take account of the capital available, capital should have little impact on the regression, as turns out to be the case. The regression shows a modest adverse effect from the change from piece rates to time rates. In column 2 we free up the coefficient on scheduled production and obtain a modestly higher estimated adverse effect of time rates on productivity. Note also that the "full effort" dummy variable for the period when workers could lock in a higher time rate of pay following the change is significant and positive, particularly in the main plant.

Table 8 gives regression estimates of the effect of the change to time rates on costs and profits. Column 1 shows a huge drop in labor's share of revenues in the time rate period. In the main plant, the ratio of labor cost to sales fell from around 20% in the late 1980s to below 15% in the late 1990s. Part of this drop is associated with lower wages paid to the new entrants who received about half the $20 per hour or so that experienced workers made under piece rates. There was a smaller drop in materials' cost share of revenues. Given these changes, it is not surprising that quasi-rents per dollar of sales and per shoe pairs sold rise. By contrast the labor and material shares did not fall in the period of "full effort" in the main plant and rose in the pooled sample. Labor and capital inputs have no effect on the quasi-rents. In sum, these calculations indicate that the change to the time rate system improved the company's bottom line and thus increased its chances for surviving.[14]

An Alternative Counterfactual Analysis

Table 9 presents productivity and profitability information on the before and after effects of the transition to time rates using a different form of analysis. Here we use equation (1) to form a counterfactual to assess the various components of the firms' financial situation from the change. We estimate that had the company maintained piece rates it would have had modestly lower receipts. This is based on an estimated 6% higher receipts due to higher productivity (we assume that the shoes would be sold at the market price), using the regression result in table 7 panel B, but four percent lower revenues due to fewer new styles introduced, and the higher receipts earned by new styles. We estimated the value of introducing new styles by multiplying the average sales of a new shoe line from company records by the difference in the number of new shoe lines under the time rate and piece rate systems.

On the cost side, we assume that the labor and material costs would have been in the same proportion to revenues in 1996 as they were in 1989, the last year before any movement to time rates were attempted in the plants. The labor cost estimates are considerably lower under time rates. Part of this is due to a reduction in monitoring costs as the company abolished the jobs of six supervisors in each plant who did monitoring under piece rate, and a larger part is due to the implementation of a two tier wage system. We estimated material costs for the counterfactual by multiplying the ratio of material costs to production value in 1989 to production value in 1996. The next row shows the average workers' compensation insurance rates under both methods of pay. Here we find a significant savings from time rates. The following row gives the inventory costs of materials under both systems; since the firms keeps smaller inventories under time rates, we estimate a modestly higher cost had it operated under piece rates in 1996. The final row gives our estimate of the "net profitability" for the BF company resulting from the change to time rates. By our assessment the cost saving resulting from moving from piece rates to time rates increased net profits.

Conclusion

So how does a firm survive in an industry faced with low-cost foreign competitors when both the U.S. and foreign firm have access to similar technologies and where US and foreign workers are similarly adept at operating that technology?

In the shoe industry, the answer is that most firms do not survive. But those that do, seemingly must concentrate on high-quality niche production, producing many new styles. In such a setting piece rates are potentially less valuable than time rates, even though individual productivity is higher under piece rates. The similarity between our results and those found by Dunlop and Weil (1995) in the textile industry suggest that in highly competitive industries subject to heavy low-cost foreign competition, the ability to react to changing markets and produce high quality products may require the adaptability of time rate methods of pay. The compensation question that the BF experience does not illuminate is whether or not a well-designed group incentive scheme—profit sharing of some form—together with time rates might improve productivity without losing the firm the cost savings from time rates.

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ENDNOTES

1. Prior to the Civil War the largest manufacturing employer in the U.S. was shoemaking. Prior to World War II, it had slipped to 7th of the 15 manufacturing industries surveyed, but by 1994 it had dropped to 80th of the 98 manufacturing industries included in the Bureau of Labor Statistics sample, and projections show it declining to 94 of 98 in the first decade of the next century (Davis, 1940 and Jacobs, 1997).

2. 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% 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."

3. During a series of plant visits to find out about employee involvement information, we visited BF's major plant and were surprised to learn about this change. The firm agreed to provide us with information under a confidentiality agreement.

4. Another relevant 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 longshore and shipping firms in the 1960s in response to technology and competitive pressures (Hartman 1969).

5. We pay particular attention to this sector because the firm we study, Big Foot, produces mainly men's shoes.

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

7. In addition, however, some of the variation is due to measurement error in the LRD data.

8. 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.

9. One manager noted that it was not unusual for a production worker to disable his/her machine so that no one else could use it when he/she was not at work.

10. One reason for this is that workers were working at "above normal" rates during the six months preceding the transition in order to get high red-level rates afterwards, and management did not realize that this level of productivity was not sustainable thereafter. Thus, the formula that management used to determine its "scheduled" production was biased upward over the period. Another reason is that the firm did not appreciate the extent to which moving from piece rates to time rates would affect productivity.

11. 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% of production workers were movers who did not work directly to produce shoes so that the 1.51 pair/per/hour figure represents the productivity of only 75% of the production worker population. The movers of the old system now produce shoes 1.3 pair/per/hour figure represents the work of 100% of the production worker population.

12. 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.

13. Note that by promising workers that high productivity will give them a fixed red-circle rate, the incentive to produce less than one in order to keep the company from lowering piece rates in the future is eliminated.

14. We have also obtained data on employee attitudes before and after the change. In 1992 prior to the change, 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 1. The Decline in U.S. Shoe Manufacturing.

PANEL A. Consumption and Imports (000s of pairs)

	1966	1976	1986	1992	1994	1996
Total U.S. Consumption	735,063	786,298	1,182,739	1,118,222	1,241,768	1,218,897
Imports	96,100	369,814	940,774	974,179	1,101,268	1,098,864
Import Penetration Rate	13.1%	47.8%	80.2%	87.1%	88.7%	90.2%

PANEL B: Employment and Numbers of Plants

All Shoes	**1966**	**1986**	**1992**	**1994**	**1996**
Total Full-time Employment	233,400	89,700	63,800	62,100	46,100
Net Openings of Plants in Year Cited		-64	-7	-19	-12
Cumulative Net Openings Plants, 1966		-614	-736	-759	-783
Men's Footwear, except athletic	**1978**	**1986**	**1992**	**1994**	**1995**
Total Employment	66,280	39,410	29,547	27,747	25,368
Number of Establishments	277	229	202	210	216

PANEL C: Hourly Compensation for Footwear Production Workers in 1992 in U.S. Dollars for the Top Ten Importing Countries

LDCs		**NICs**		**DCs**	
Brazil	$2.00	South Korea	$3.33	Spain	$8.90
China	$.50	Taiwan	$3.70	Italy	$14.99
Indonesia	$.19	Hong Kong	$3.38		
Thailand	$1.50				
Mexico	$2.10				
U.S.	$9.41				

Source: Footwear Industries of America and Bureau of Labor Statistics. *Employment and Earnings*, Bureau of Labor Statistics.

TABLE 2. Numbers of Establishments in the Shoe Industry, 1967-1992.

Year	*# of Plants*	*% Surviving to 1992*	*Annual Death Rate*	*# Plants Died to 1992*	*# Who Entered / Remain Base Year to 1992*
1967	766	11%	.085	682	183
1972	622	16%	.088	523	168
1977	523	19%	.105	424	168
1982	482	25%	.129	364	149
1987	317	54%	.116	146	96
1992	267	—	—	—	—

Source: Tabulated from Census LRD files.
By construction, the # of plants in column 1 (initial number in the specified year) minus the number of plants in column 4 (plants that died by 1992 from this cohort) plus the # of plants in column 5 (the additional plants who entered post the specified year) sums to the number of plants that survived through 1992.

TABLE 3. Economic Characteristics of Shoe Manufacturers, 1967 to 1992 (In Constant $).

YEAR	*# Obs*	*Sales Per Worker ($000)*	*Value Added Per Production Hour ($)*	*Labor's Share* *In Sales*	*Labor's Share* *In Value Added*	*Total Earnings Per Worker (in $000)*	*Hourly Pay*
1967	766	64.9	21.0	0.32	0.59	20.6	9.11
1972	622	68.3	22.0	0.32	.59	21.9	9.44
1977	523	67.9	22.3	0.30	.57	20.3	8.76
1982	482	68.2	23.3	0.28	.53	19.0	8.12
1987	317	76.7	24.3	0.27	.50	20.4	7.85
1992	267	89.5	30.2	.23	.44	20.6	7.92
% Δ 1967-92	-65%	38%	45%	-28%	-25%	0	-15%

Source: Tabulated from Census LRD files. Dollars are constant 1992 dollars

TABLE 4. The Effect of Exit, Entry, and Within-Establishment Adjustments on Employment in the Shoe Industry, 1967-1992.

Change in Employment	-122,708
due to establishment	-132,317
due to new entrants	15,857
due to within plant adjustment	-6248

Characteristics of Firms	*Sales/Employee*		*Labor's Share*	
	1967	*1992*	*1967*	*1992*
Firms that left	63,000	—	.324	—
Firms that entered	—	75,000	—	.275
Firms that survived	72,000	100,000	.289	.206

Source: Tabulated from Census LRD files.

TABLE 5. Estimates of the Effect of Productivity and Labor Cost on the Probability of Survival in the Shoe Industry, 1967-1992.

1967 Variables	*Linear Probability Estimates*			
	(1)	*(2)*	*(3)*	*(4)*
Log Sales / Employment	.07 (.02)	.06 (.02)		
Log Earnings		.05 (.05)		
Log Labor's Share			-.06 (.02)	-.11 (.04)
Log of Non-production/Production Workers				-.04 (.01)
Constant	-.24 (.09)	-.34 (.13)	.0007 (.028)	-.65 (.18)
R^2	.02	.02	.01	.05
	Logistic Estimates			
Log Sales / Employment	1.00 (.30)	.81 (.35)		
Log Earnings		.89 (.75)		
Log Labor's Share			-.83 (.35)	-1.33 (.46)
Log of Non-production/Production Workers				-.52 (.19)
Constant	-6.82 (1.26)	-8.70 (2.04)	-3.64 (.45)	14.13 (3.01)
Log Likelihood	-172.99	-172.29	-175.63	-145.99

Source: Tabulated from Census LRD files.

TABLE 6. Base Hourly Rates of Pay for Workers in BF and Base Rates Compared to Actual Pay by Department

CPI-adj wage adj by piece rate index*	*Base*	*Base and piece for piece-rate workers 1991*	*Lockin 1994 - all production employees*	*New Wage 1994*
CUTTING DEPARTMENT	*10.44*	*19.96*	*18.19*	*10.69*
PREFIT AND FITTING DEPARTMENT	*10.26*	*17.99*	*15.71*	*10.69*
LASTING DEPARTMENT	*10.53*	*21.06*	*16.26*	*10.69*
WELT DEPARTMENT	*10.72*	*21.43*	*19.04*	*10.69*
FINISHING DEPARTMENT	*10.32*	*20.64*	*18.07*	*10.69*
SOLE DEPARTMENT	*10.02*	*20.04*	*17.16*	*10.69*

* within a department jobs had considerable variation.

TABLE 7. Regression Estimates of the Effect of Changes in Production and Compensation on Output for BF Company, 1986-1997.

	ln Pairs of Shoes	*ln Pairs of Shoes*
(A) *Main Midwestern Plant*		
Time Rate Effect	-.04 (.03)	-.05 (.037)
"Full Effort" Effect	.12 (.02)	.11 (.024)
ln Prod Employees	.04 (.01)	.36 (.13)
ln Capital	.006 (.03)	.003 (.023)
ln Planned Pairs	1.0	.70 (.09)
R^2	.34	.92
Number of Observations	122	122
D.W.	1.60	1.68
(B) *Both Midwestern Plants*		
Time Rate Effect	-.06 (.02)	-.09 (.02)
"Full Effort" Effect	.04 (.01)	.03 (.01)
ln Prod Employees	.03 (.02)	.33 (.06)
ln Capital	.004 (.01)	.004 (.02)
ln Planned Pairs	1.0	.66 (.06)
R^2	.15	.96
Number of Observations	244	244
D.W.	1.41	1.50

Source: Based on company's data. Standard errors are in parenthesis.

Notes: The The regressions include a monthly time dummy, the number of styles and change in styles produced on a yearly basis, and a dummy variable for the transition period in the move to time rates. Panel B includes a plant dummy. Estimates using a Kernel smoothing technique produced similar results.

TABLE 8. Regression Estimates of the Effect of Changes in Production and Compensation on Costs and Profits for BF Company, 1986-1997.

	Labor's Share of Revenue	*Material's Share of Revenue*	*Quasi-rents Share of Revenue*	*Quasi-rents / Shoe*
(A) Main Midwestern Plant				
Time Rate Effect	-.56 (.09)	-.11 (.14)	.43 (.12)	.29 (.13)
"Full Effort" Effect	.01 (.00)	.09 (.09)	.01 (.07)	-.02 (.08)
ln Product Style	-.73 (.21)	.24 (.34)	.10 (.31)	.04 (.20)
ln Capital	-.04 (.05)	-.06 (09)	.01 (.07)	.16 (.08)
R^2	.55	.07	.41	.20
Number of Observations	117	117	107	117
D.W.	1.78	2.03	1.92	2.00
(B) Pooled Sample of Plants				
Time Rate Effect	-.18 (.05)	-.14 (.06)	.22 (.07)	.23 (.08)
"Full Effort" Effect	.12 (.02)	.07 (.05)	-.06 (.05)	-.03 (.06)
ln Product Style	.03 (.06)	.03 (.07)	.00 (.08)	.02 (.09)
ln Capital	-.25 (.05)	-.05 (.06)	.07 (.06)	.00 (.07)
R^2	.48	.08	.33	.15
Number of Observations	238	238	218	218
D.W.	1.42	2.00	2.00	2.16

Source: Based on company's data.

Notes: The regressions include a monthly time dummy, number of styles and change in styles produced on a yearly basis, and a dummy variable for the transition period in the move to time rates. Panel B includes a plant dummy. Estimates using a Kernel smoothing approach produced similar results.

TABLE 9. Simulated Counterfactual of Change from Piece Rates to Time Rates in Both BF Plants. (in thousands of 1996 dollars)

	Actual With Time Rate	*Simulation IF BF had maintained piece rate*
Dollar value of total product[1]	$135,091	$137,624
Higher output from piece rate[2]	$0.00	$8,105
"Lost" product lines from piece rates[3]	$0.00	$5,572
Labor costs[4]	$19,551	$23,396
Cost of non two-tier wage system[5]	$0.00	$2,054
Extra monitoring under piece rates[6]	$0.00	$538
Material costs[7]	$50,461	$56,426
Worker's comp[8]	$365	$1,641
Extra inventory cost from piece rates[9]	$0.00	$73
Total product minus costs	$64,714	$55,550

[1] Direct Value of Total Product (DVTP) defined as wholesale price 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 total assets, the log of the number of production employees, number of styles produced in the year, a dummy variable for the years 1990-91, the "red circle period," and a dummy variable for the time rate period 1992 to July 1997. 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 7 fewer new products under piece rates relative to time rates estimated from BF records on the average sales from new products. We estimate that the sales per new product averaged 796 thousand dollars.

[4] In 1989 the ratio of labor costs to DVTP was 0.17, so our 1996 counterfactual estimate is simply 17% of the estimated DVTP 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.

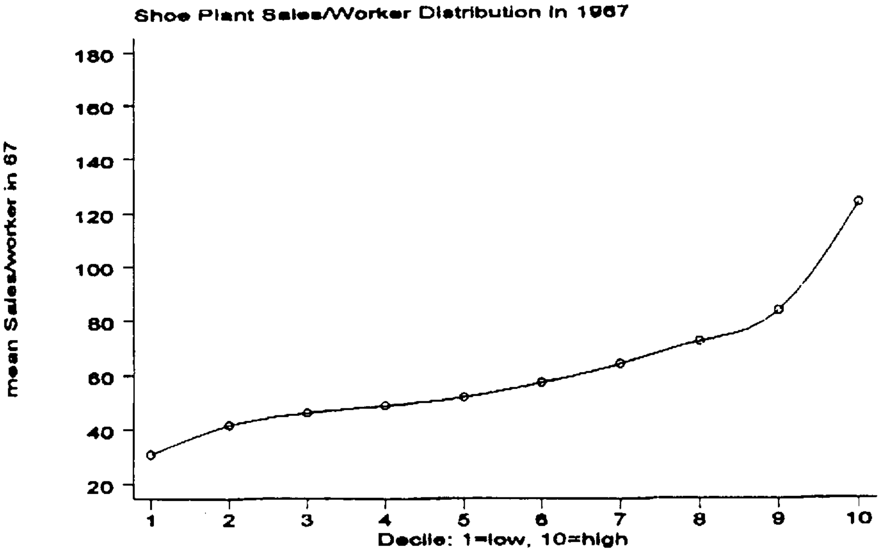
[6] Marginal cost of monitoring which is the number of inspectors under piece rates versus time rates. All inspectors were eliminated in the move to time rates.

[7] Material costs simulated in 1996 estimated by the 1989 ratio of material costs to DVTP of .41.

[8] Estimated by average worker compensation costs under piece rates versus time rates, using BF records.

[9] Marginal cost of maintaining inventory under the piece rate system relative to time rates.

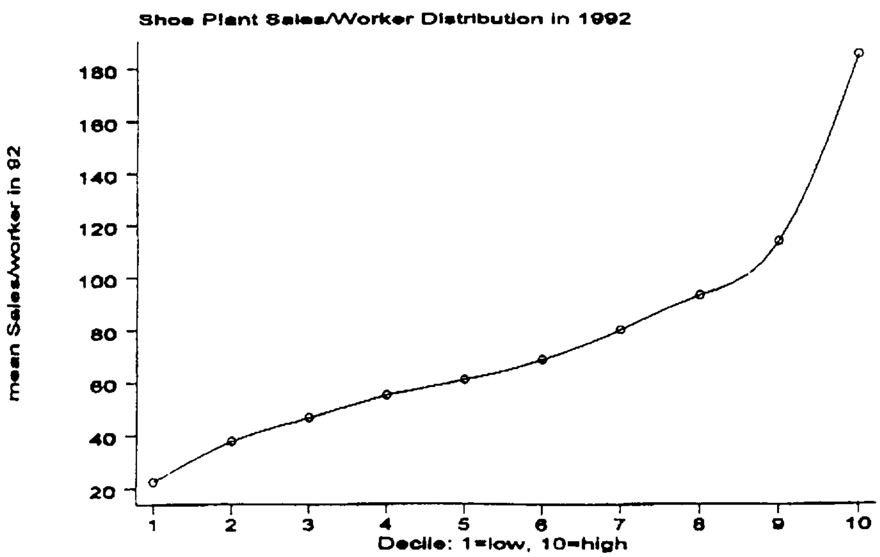
FIGURE 1A. The Distribution of Sales Per Worker in 1967 and 1992.



Sales Per Worker in thousands of constant $

	1967
Best Practice (top decile)	122.6
Average	64.9
Worst Practice (bottom decile)	30.6

1967 Distribution of TVS/E

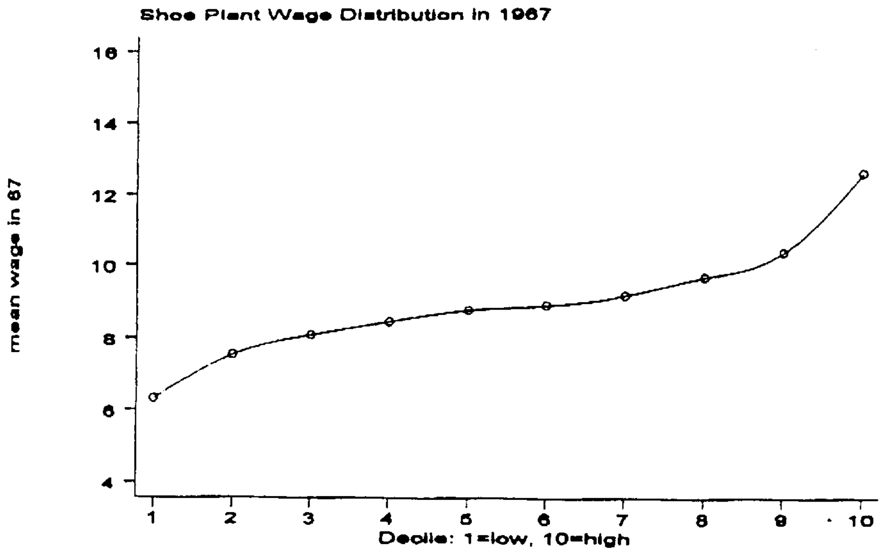


Sales Per Worker in thousands of constant $

	1992
Best Practice (top decile)	185.1
Average	89.3
Worst Practice (bottom decile)	22.4

1992 Distribution of TVS/E

FIGURE 1B. The Distribution of Hourly Wages of Production Workers in 1967 and 1992.

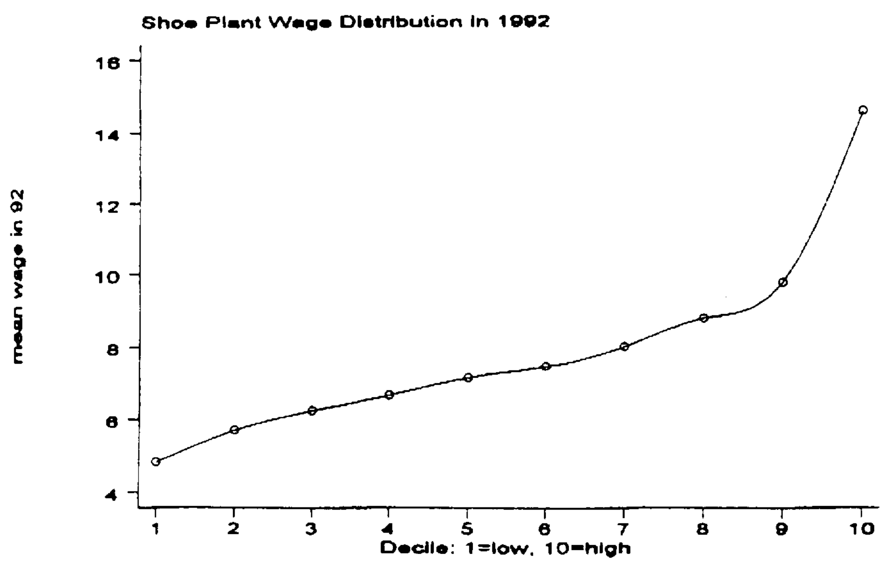


Hourly Wages in constant $

<u>1967</u>
12.54
9.11
6.32

Highest Paying (top decile)
Average
Lowest Paying (bottom decile)

1967 Distribution of Prod. Wages



Hourly Wages in constant $

<u>1992</u>
14.54
7.92
4.83

Highest Paying (top decile)
Average
Lowest Paying (bottom decile)

1992 Distribution of Prod. Wages

FIGURE 2. Variation in Wages from the Mean Wage, by Job Category Piece Rate Versus Time Rate (BF).

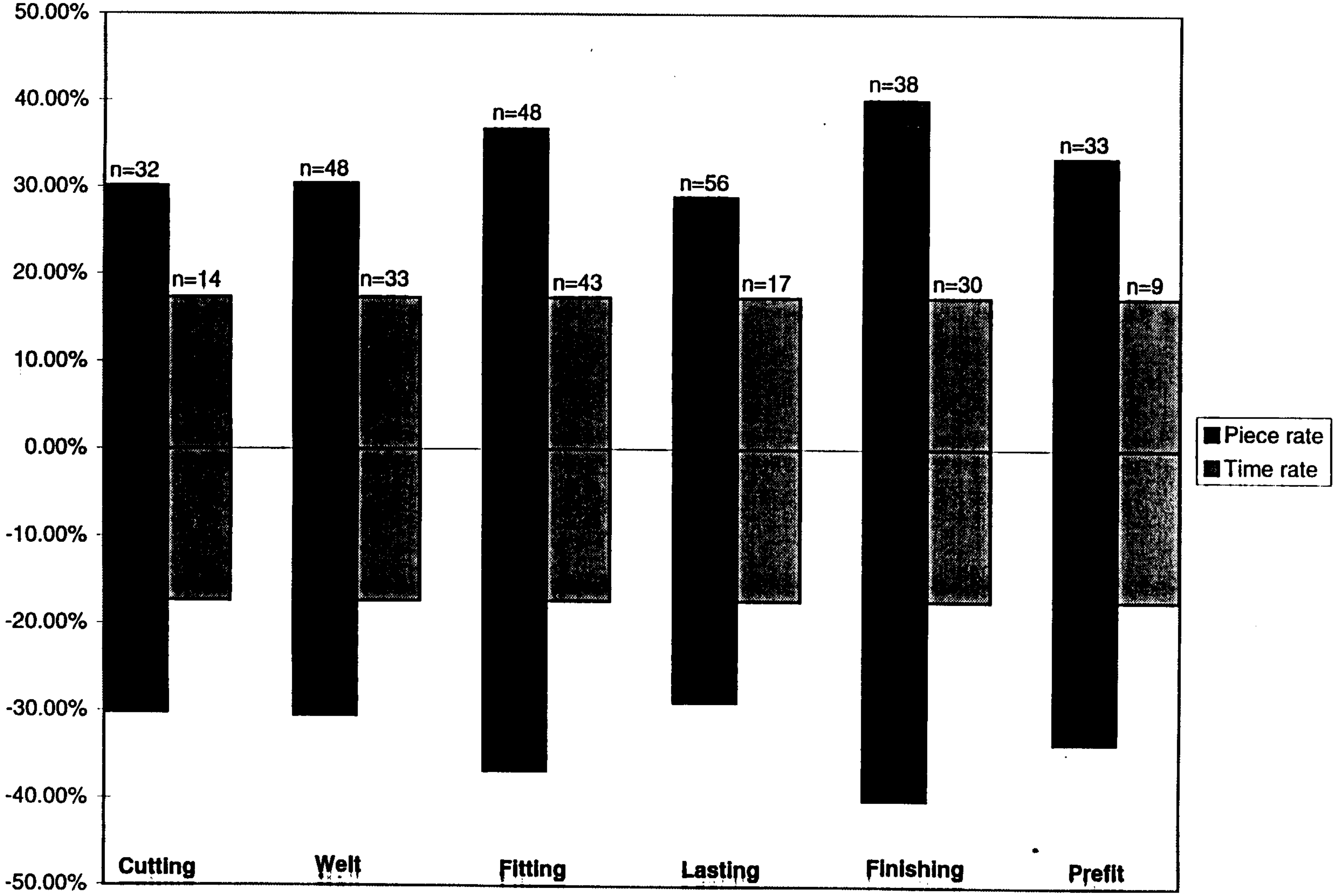
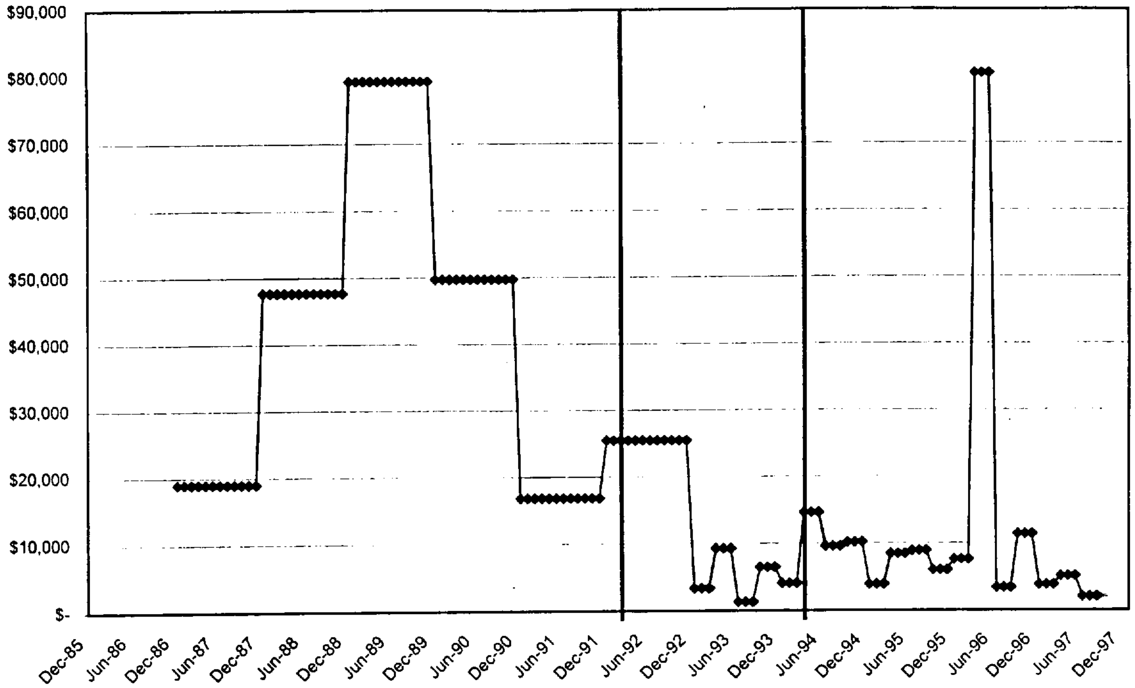


FIGURE 3

Panel A

Workers Comp Cost



Panel B

Percent Variance from Planned

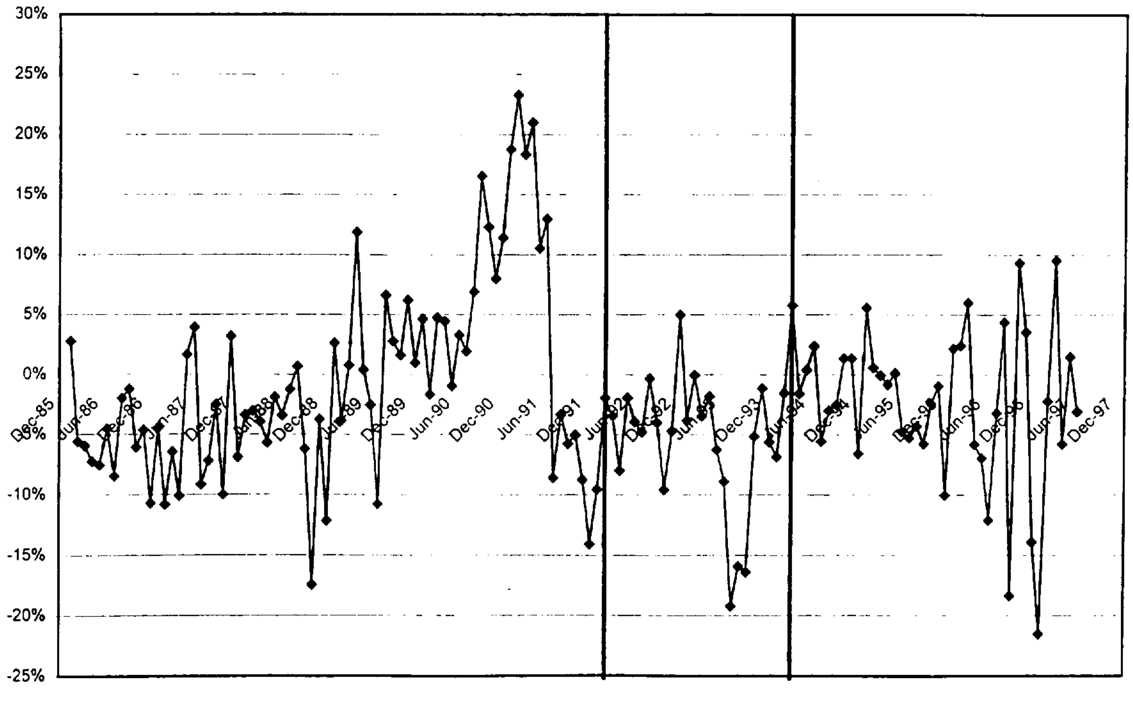
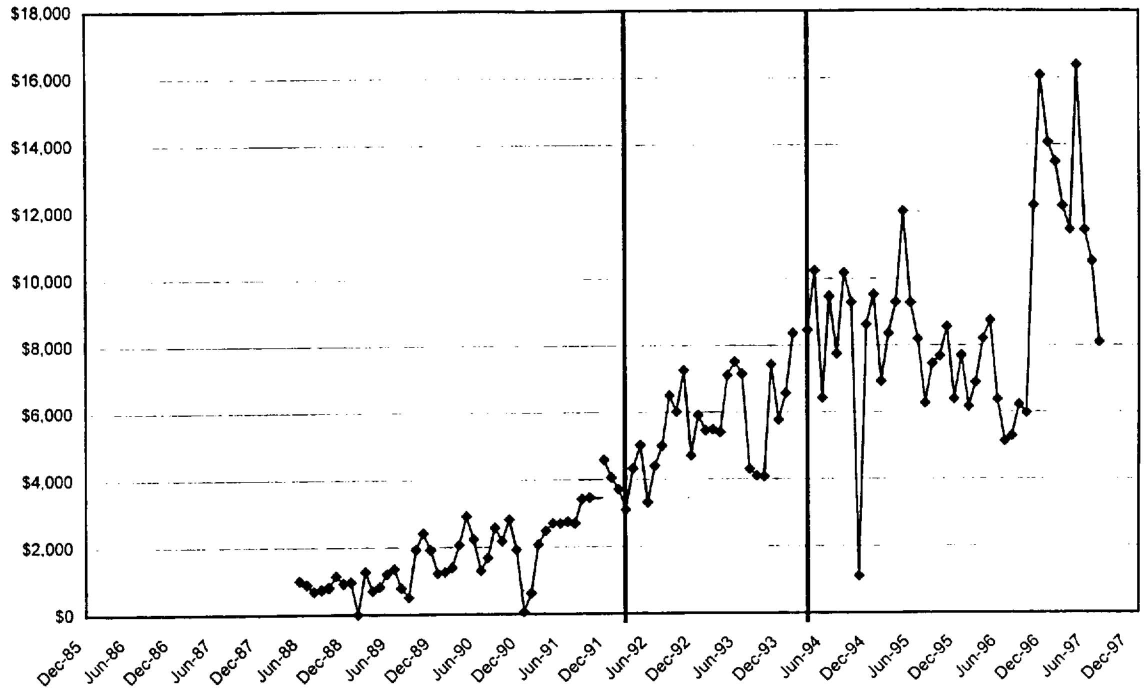


FIGURE 3

Panel C
Inventory "Savings"



Panel D
Price

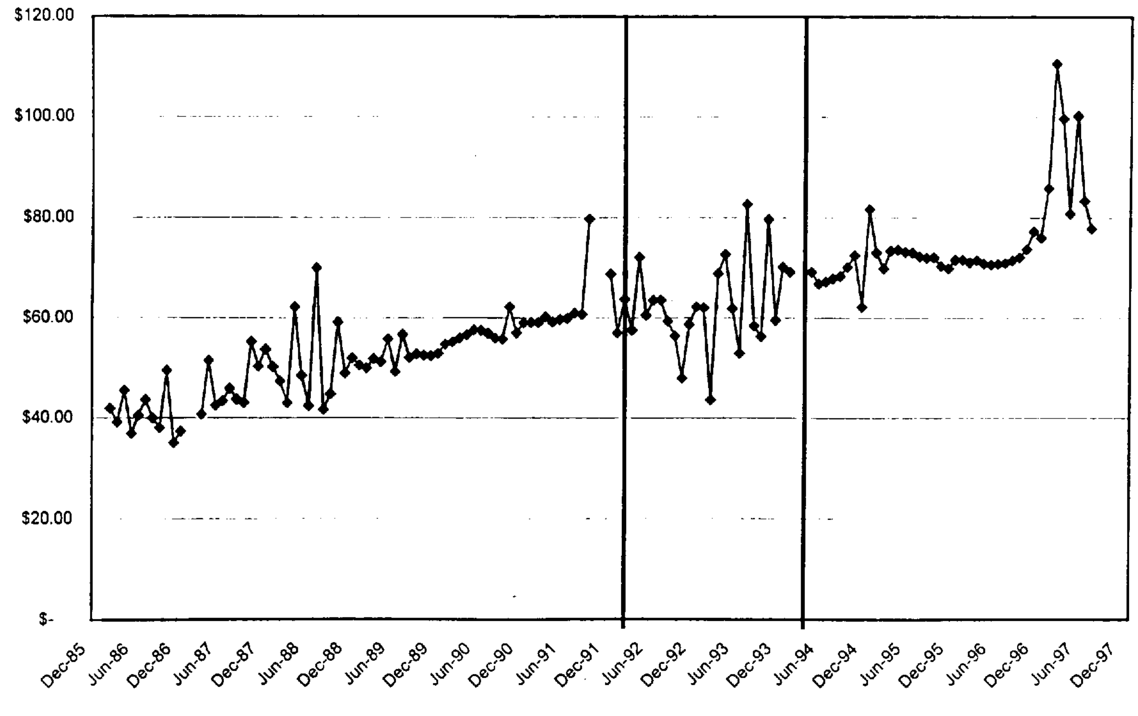


FIGURE 3

Panel E
Profit Per Pair