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Vertical dilemmas

Piece-rate incentives and credible commitments

WITH JACK KNOTT

> The important result is the moderate level of reward and compliance in equilibrium, even though both individuals would be better off with a high degree of reward and a high degree of compliance. The Pareto optimal result is not achieved because both superior and subordinate have an incentive to break away from it. The supervisors quite naturally have an incentive to give less than the maximum reward to the subordinates, and the subordinates quite naturally have an incentive to float through their work situation with less than 100 percent effort.
>
> Miller (1977: 50)

While it is necessary to delegate authority to individuals with specialized knowledge, that very delegation opens the door to incoherent organizational action. What is needed, therefore, is an incentive system that will encourage organizational specialists to use their knowledge in the coherent pursuit of organizational goals. An ideal incentive system will overcome information asymmetries and team production externalities, transforming an organizational social dilemma into an organizational "invisible hand." An incentive system should harness individual self-interest in pursuit of organizational goals.

Most hierarchies make little attempt to use their compensation systems to overcome the temptation of team members to shirk. Only 22 percent of U.S. workers feel that there is a direct connection between their effort and how much they are paid, despite the fact that 61 percent want their pay to be tied to their performance (Lawler 1987: 69–76). Most U.S. employees are paid on the basis of a flat wage fixed on the basis of seniority, rank, education, or another nonperformance variable; and firms that supposedly link pay to performance do a very poor job of establishing the link. Studies of "merit-based" compensation show that most people are ranked "above average"

and that the differences in pay for superior performance are neglible (Lawler 1971; Baker, Jensen, and Murphy 1988).

How do rational individuals respond to an absence of a pay–performance link? Clearly, a wage system creates no special incentive for employees to increase their productivity. Individuals on a flat wage get no extra earnings when their output increases. Why do most profit-maximizing firms fail to establish a clearer link between pay and performance?

This chapter and the next two chapters will address this question in depth, arguing that the most fundamental reason for the failure to use incentives is the inevitable limits of any incentive system. Information asymmetries, monopoly, and team externalities make it impossible to reconcile hierarchical dilemmas by means of incentives. Self-interested behavior by employees in responding to incentives, and by employers in creating incentive systems, leads to inefficient firm outcomes. Incentive games in hierarchies constitute what I call a "vertical dilemma."

COSTLY EFFORT AS INFORMATION ASYMMETRY

Many conflicts in organizations stem from the fact that individual employees bear some private costs. Economists typically assume that each individual has an upward-sloping marginal cost-of-effort function in which earlier units of effort are less costly than later units; the individual finds that installing the first hub-caps on automobiles is less painful than installing the thousandth or millionth.

Why should additional units of labor be more costly to the individual? Effort involves the expenditure of energy; we have all been programmed by evolution to seek high-energy inputs (such as those with a high sugar content) and to avoid high-energy outputs (such as twenty-four hours of wind sprints). If individuals found wind sprints as intrinsically rewarding as sugar consumption (and vice versa), they would run an energy deficit and die. The first levels of effort, like jogging the first three or four miles, may be less costly, or even enjoyable. Nevertheless, any activity undertaken for a long enough time becomes monotonous, tiring, and eventually painful. Consequently, the assumption of upward-sloping marginal effort supply curves is probably the safest assumption economists make.

Although we may assume that unit effort costs are increasing, they cannot be directly observed by anyone other than the individual, any more than can the benefits of consumption. The unobservability of effort costs constitutes an information asymmetry in the market of labor. The latter part of this chapter deals with the strategic importance of this information asymmetry.

The forcing contract

Assume that one employee, with an upward-sloping marginal effort cost function, is employed by one employer. What would happen if the employer *knew* precisely the nature of the employee's effort cost function? This knowledge would be of great value to the employer. With it, he could calculate the level of subordinate effort that exactly maximized the potential profit: It would be the level of effort that maximized revenue less the effort cost of the employee.

As a simple illustration, suppose that the employee's marginal effort cost (MC) in the production of a certain number of units of some good Q were as follows:

$$\mathrm{MC} = c + 2dQ.$$

The good could be sold by the employer at a fixed market price of p. Then the profit available to the firm would be maximized at the quantity at which $p = c + 2dQ$. In the absence of external job opportunities, the manager could conceivably achieve almost the entire surplus by means of a forcing contract. The forcing contract would pay the employee a total salary slightly in excess of the employee's total cost of effort at the efficient quantity, if and only if the employee supplied the efficient quantity of the good; otherwise, the employee would be paid nothing and would be fired. Presented with this choice, the employee would barely prefer to provide the efficient quantity of effort and would leave the employer with almost all of the surplus generated by that effort.

If the employee did have alternative job opportunities, as a result of a relatively free labor market and low job mobility costs, the minimum payment in the forcing contract for efficient levels of effort would have to be just larger than those available alternative payments, corrected for the costs of quitting and moving to another job. These alternatives would cut into the amount of profits available to the employer, without changing the form of the forcing contract.

Despite the fact that employee effort costs are ultimately private information, employers can, in stable situations, make educated guesses about what they are. Many firms hire a large number of industrial engineers, or time-and-motion study experts, who make educated guesses about what the efficient levels of effort must be. The more stable the technology and the more well known it is, the better these guesses will be.

As a result, those firms with the best information about employee effort costs may use something like the forcing contract. When the employee comes on the job, she is given a detailed description of the tasks that are expected of her. She is also told that if she fails to perform the task as described, she will be fired.

Limitations of the forcing contract

This kind of forcing contract works reasonably well when a given set of conditions apply. First, the costs of monitoring the detailed behavior of each subordinate must be reasonably low. Since the subordinate is in no way internally motivated to perform the task, it is to be expected that he will shirk at every opportunity.

Second, the job must be relatively stable. If the job changes frequently, the employee must be assigned a new set of detailed instructions, and perhaps trained to perform them, again with little or no motivation. Even more important, every time the task changes, the employee's personal effort cost function may have to be recalculated to determine exactly the optimal level of effort. This last point reemphasizes the fact that employees' effort cost functions are ultimately unknowable.

For the vast majority of tasks in real-world organizations, the conditions just stated do not hold. For any skilled job, it is impossible to specify ahead of time the exact order and technique involved. This is certainly true of white-collar jobs such as teaching and engineering, where the required technology is "inside the head" of the person hired to do the task. This is also the case for most skilled blue-collar jobs, for the same reason. Welding, dye making, carpentry, and plumbing are all tasks in which the technology is intrinsic to the individual job holder, rather than handed to the job holder in the form of an extensive job description.

Even for jobs in which the basic requirements can be specified, firms normally require of employees exceptional behaviors at appropriate times. Even the most elaborate contract for a welder or a salesperson cannot specify the appropriate response in all contingencies. Local conditions change, and employees must be able to respond instantaneously with the appropriate adjustment of the machinery or sales pitch.

This fact makes it is necessary to motivate, rather than program, the worker. In some organizations, an "incentive" contract, which is keyed to the performance of the worker, is the customary solution. This requires less extensive monitoring, less specification of expected behaviors, less coercive hierarchy, and less information by superiors about subordinate effort costs.

THE PIECE-RATE CONTRACT: THEORY AND EXPERIENCE

The piece-rate contract pays the employee an amount based on the number of units, or pieces, the employee produces. Under such a contract, the supervisor is largely freed from the burden of enforcing detailed rules and regulations on increasingly resentful employees. Rather, the supervisor is, ideally, a neutral person who measures individual output and pays accordingly. If the employee's performance drops, the supervisor need make no comment – the drop in performance carries its own punishment. If the

employee deviates from standard operating procedures, he can himself determine whether such innovation was worthwhile or costly in terms of his own performance and pay. The theory of the piece-rate system is that it should align the self-interest of employees with organizational goals.

An incentive wage system has been advocated for a long time. Frederick Taylor, the father of scientific management, wrote an article titled "A Piece Rate System: A Step Toward Partial Solution of the Labor Problem" (1895). Ironically, it was advocated as a system that would make both workers and owners better off, but it was opposed by both sides (Nelson 1975: 53). Unions felt it would be an insidious way to get more work out of employees for less pay, while owners felt it diminished their authority. Overall, it was one of the least frequently adopted features of scientific management at the turn of the century (74–8). Nor has its use increased dramatically over this century. One reason for this has been the recognition that piece-rate systems often do not work as planned.

Most research on the piece-rate contract has revealed that implementing the system is fraught with problems. The problems were first, and perhaps best, illustrated by the cases discussed in sociologist William Whyte's classic study *Money and Motivation* (1955).

Whyte detailed the experiences of a graduate student named Donald Roy, who worked in a steel fabrication plant as a drill press operator. The incentive system at the plant was a standard variation of the piece-rate system. For each job, there was a "price" set by the industrial engineers, or "time-study men." Workers' individual earnings, in the upper range, were fixed by how many "pieces" they produced at this price. However, they were guaranteed an hourly rate of $.85 an hour, which set the lower bound of compensation. If the pieces they produced did not yield a level of pay that was greater than their guaranteed minimum, that was termed "not making out." If the pieces they produced yielded a level of pay that was greater than the minimum, that was known as "making out."

As might be guessed, this resulted in a great deal of strategic behavior on the part of the employees. If they felt that the "price" for their particular task was so low that they could never "make out," they had no incentive (beyond the threat of being fired) to produce anything at all. This was known as "goldbricking."

Goldbricking was, of course, a result of the guaranteed minimum pay rate. More interesting was a phenomenon known as "quota restriction," which was widespread within piece-rate organizations. Quota restriction occurs when a price is set high enough that it is relatively easy and in the self-interest of the employee to make out, earning more than the guaranteed minimum. But employees were very careful to limit how much they earned because of the widespread understanding that, if they earned too much, the time-study men would reevaluate the job and lower the price. Roy reported the following interaction:

> Jack warned me that the Methods Department could lower their prices on any job, old or new, by changing the fixture slightly or changing the size of drill. According to Jack, a couple of operators (first and second shift on the same drill) got to competing with each other to see how much they could turn in. They got up to $1.65 an hour, and the price was cut in half. And from then on they had to run that job themselves, as none of the other operators would accept the job. (Whyte 1955: 23)

Similar social pressure to restrict output exists in a great many piece-rate organizations. Nor was Jack's warning unfounded. Managers habitually gave in to the temptation "to cut the rate so the wage earners, though producing more, would earn approximately what they had under day work" (Nelson 1975: 45). The problem was such that employers themselves urged one another to exercise self-restraint in cutting piece rates, so that employees would have no reason to engage in quota restriction. "Employers who gave the situation serious thought soon came to the conclusion that the solution lay in two areas: more care in rate fixing and a guarantee against rate cutting" (45).

The piece-rate system, which was intended to bring the simple rationality of market exchange inside the firm, now seems much more complicated. Employees threaten one another so that they do not work as hard as they can; employers warn one another not to engage in self-interested profit maximization. What role do threats and warnings have in what is supposed to be a simple payment scheme that relies on individual self-interest to motivate employees? Is this kind of behavior rational?

A MODEL OF PIECE-RATE GAMING

The inefficiencies and gaming of the piece-rate system can easily be understood in the context of a simple Stackelberg game. A Stackelberg game, unlike other games, assumes that one player, the leader, "moves" first, after which the follower chooses a maximizing, self-interested response.

In the piece-rate game, the leader may be thought of as management, which selects a piece-rate level. After this, the employee (follower) decides how many pieces to produce. These two decisions can be charted on the vertical and horizontal axes of a graph, as presented in Figure 5.1. What are the preferences of the two sides for the outcomes in this space? Figure 5.1 shows sample "indifference curves" for both employer and employee. That is, a given indifference curve for the employer connects sets of outcomes (outputs and piece rates) that produce exactly equal levels of profit for the employer, assuming that the employer can sell any quantity produced at a constant market price p. For simplicity, we assume that the only variable cost is the wage of the employee. Therefore, the profits of the leader are simply $(p - w)\,Q$, where w is the piece rate and Q is the quantity of pieces produced. This yields indifference curves (or, more properly, iso-profit curves) like those shown in Figure 5.1. As the lines indicate, the leader gets

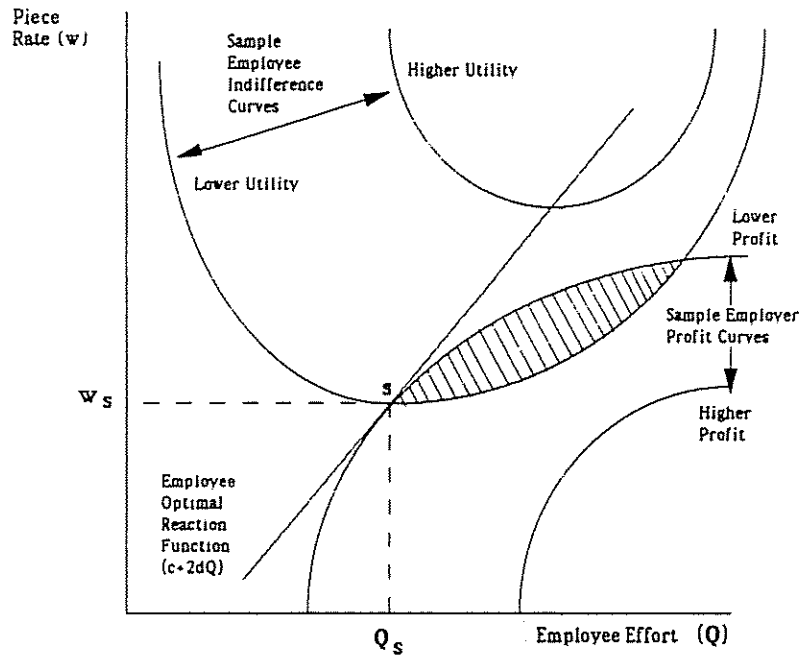

Figure 5.1. The Stackelberg equilibrium in a piece-rate game.

the most profit in the lower-right-hand corner, where she is able to sell a large number of pieces that are procured at a low piece rate.

Similarly, a given indifference curve for the employee connects all those points that generate a constant level of net benefit, where net benefit is defined as total wages less the (psychic) cost of production. The employee is assumed to have an increasing marginal cost of effort given by

$$\mathrm{MC}(Q) = c + 2dQ.$$

The follower's net benefit, then, is the difference between the wages earned (wQ) and the total cost of effort (which is $cQ + dQ^2$). These assumptions yield indifference curves in the effort–wage space as shown. The employee is best off working moderately hard at high wage rates.

For any given piece rate, the follower can easily determine the optimal number of pieces to produce by producing until the marginal cost of effort exactly equals the wage. This means that the employee reaction function shown in Figure 5.1 indicates the employee's optimal number of units to be produced for any given wage rate. For any point on this line, the employee's indifference curve will be tangent to the horizontal line (piece rate), indicating that the employee can achieve no higher level of net benefit by producing more or less.

If the employer chooses any possible piece rate, the employee will therefore select the level of effort given by the effort supply curve in the graph. The employer's maximization problem is therefore constrained by this line. Which point on the effort supply curve yields the most profits? The leader's maximizing choice will be determined by the point of tangency between the reaction line and the highest possible iso-profit line. This is shown as point *S* in Figure 5.1.

This outcome is a Stackelberg equilibrium. Given the wage rate associated with point *S*, the employee has no incentive to produce more or less. The employer has no incentive to change the piece rate, as any other piece rate will result in lower profits. It is a stable outcome. However, is it efficient?

Clearly, it is not. The employee's indifference curve through *S* is tangent to a horizontal line, while the employer's indifference curve through *S* is tangent to the upward-sloping marginal effort cost line. Therefore, the two players' indifference curves through *S* must cross that point. There must be a region in which both the employee and the employer can be better off. The region is given by the shaded area interior to both indifference curves through *S*. This area consists of outcomes in which the employee works harder than he has any incentive to do, given the employer's piece rates, and in which the employer sets a higher piece rate than she has any reason to do. In other words, every such Pareto-preferred point is unstable. The fact that both the employee and the employer can perceive that there are piece-rate–effort level combinations that would make both sides better off accounts for the frustrating feeling of underefficiency that permeates the literature on piece rates.

Employee misrepresentation

What theoretical possibilities are open to employees under such a system? One possibility is strategic misrepresentation of the employee response curve. Suppose, for instance, that employees decide not to work as hard, at any piece rate, as they would if they were to maximize their net benefit. This would seem, by definition, to be irrational. But such a strategy, systematically and uniformly held to, would force the employer to respond to quite a different reaction function, as shown in Figure 5.2.

If the employer were forced to respond to the reaction as shown in the figure, her profit-maximizing response would be to set wage rate w_T rather than w_S. This would result in a (pseudo-) Stackelberg equilibrium of point *T*. This would not necessarily be more efficient than the original Stackelberg equilibrium; in fact, it would be less efficient in this case. However, it would result in a sizable redistribution of surplus from the employer to the employee.

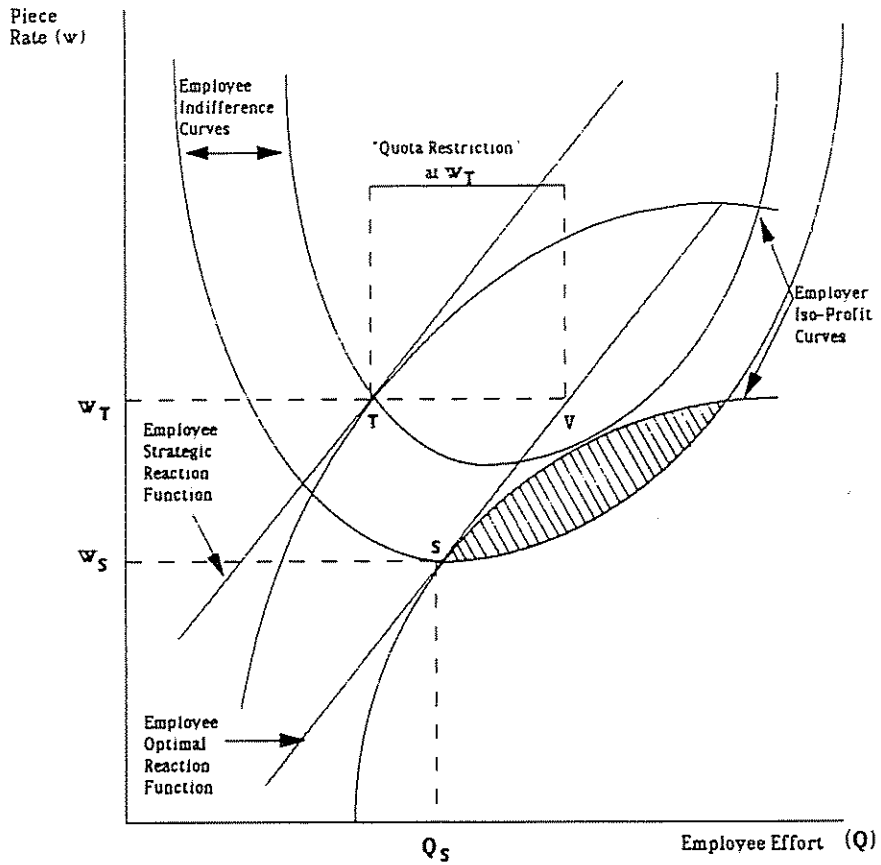

Figure 5.2. Redistribution of gains in employees' favor caused by misrepresentation of the employee reaction function.

What would it take to achieve outcome *T* instead of *S*? It would require employee self-control because, at the higher "pseudo-equilibrium" piece rate, individual employees could benefit by producing off the misrepresented reaction curve at point *V*. Doing so, however, would reveal to the employer that the false reaction function was in fact false and would encourage the employer to cut piece rates. Outcome *T* could not be maintained without quota restriction.

Group norms and quota restriction

The employees who were trying to engage in quota restriction in order to maintain outcome *T*, especially those working different shifts on the same machine, would realize that any one person's demonstration of productiv-

ity could spoil the strategy for all. Consequently, the individuals in a work group would be in a prisoners' dilemma, in which each worker would, in the short run, face a temptation to work *harder* than the level of effort indicated by the misrepresented reaction function; the group benefits of outcome *T* could be maintained only through the sanctions available to the small work group. These norms are clearly illustrated by Donald Roy's experience:

> From my first to my last day at the plant I was subject to warnings and predictions concerning price cuts. Pressure was the heaviest from Joe Mucha, a day man on my machine, who shared my job repertoire and kept a close eye on my production. . . . Joe Mucha advised: "Don't let it go over $1.25 an hour, or the time-study man will be right down here! And they don't waste time, either!" . . . Jack Starkey spoke to me after Joe left. "What's the matter? Are you trying to upset the applecart?" (Whyte 1955: 23)

At Roy's plant, group norms sanctioning quota restriction were 100 percent effective. The distribution of the earnings made by different individuals during Roy's time there was truncated, with more than 60 percent of the employees making out and more than 50 percent earning in the range of $1.25 to $1.34. However, *no one* dared to earn more than the socially acceptable $1.34 rate. There were no "rate busters"; "such behavior was distinctly frowned upon and men who violated the group's standards would at least be ostracized from the group if not more severely punished" (Whyte 1955: 21–4).

The effort bargain

Not only could quota restriction be used to maintain favorable piece rates, but the strategies described in the Stackelberg game were used to raise unfavorable prices. One such situation involved Jack Starkey and Ed Sokolsky, who were assigned the task of making hinge bases. This task was known as a "stinker," with a price of twenty-three cents. As a result Ed, Jack, and the other workers on the task engaged in a deliberate slowdown in an attempt to raise the price. "Ed and Jack asked for a price of 38 cents. Ed said that they could turn out 3 an hour, but, until they got a decent price, they were turning out 2 an hour" (Whyte 1955: 24). The techniques used to enforce this slowdown were imaginative:

> Ed seems to have constant trouble with his jig, a revolving piece attached to the side of the table. Two disks seem to stick together, and Ed is constantly (every day or so) using the crane to dismantle the jig (a very heavy one). He sands the disks and oils them, taking several hours for the cleaning operation. Steve [the foreman] saw the dismantled jig again tonight and bellowed, "Again?" Steve does not like it. (Whyte 1955: 25)

The slowdown, which began in December, was wearing on the individuals involved by May. One worker complained that Jack had turned out

twenty-eight hinge bases in one day. "That's too many, nearly 3 an hour. He'll have to watch himself if he expects to get a raise in price." It was not until August that the workers won a raise in piece rate from twenty-three cents to twenty-eight cents. At this rate, they still felt they could not make out and continued to restrict output. In the end, the final price was thirty-one cents per unit, and the employees turned in almost four pieces an hour, for hourly earnings of $1.20 (Whyte 1955: 25–6).

Management's resources

Management, of course, was not powerless in this effort bargain. First of all, it tried to encourage individuals not to give in to social pressure, so that effort costs could be more accurately determined. One new man, Orvis Collins, reported that the introductory talk the factory superintendent gave each new employee was basically intended to encourage competition among the workers, as a way of fighting quota restriction norms. "He told us about how the piecework system was set up so that nobody could hang on anybody else's shirt tail. He said it was every man for himself" (Whyte 1955: 11).

In addition to this basically exhortatory technique, management has another method for fighting effort restriction norms – time and motion studies. The strategic importance of this is to provide independent information about the levels of output workers should be able to achieve. In Whyte's study, group norms for misinforming the time-study man were fully as important as group norms concerning goldbricking. Starkey, an old hand, briefed Tennessee, a newcomer:

> "If you expect to get any kind of a price, you got to outwit that son-of-a-bitch! You got to use your noodle while you're working, and think your work out ahead as you go along! You got to add in movements you know you ain't going to make when you're running the job! Remember, if you don't screw them, they're going to screw you!"
>
> "I don't see how I could of run it any slower," said Tennessee. "I stood there like I was practically paralyzed."
>
> "Remember those bastards are paid to screw you," said Starkey. "And that's all they got to think about. They'll stay up half the night figuring out how to beat you out of a dime. They figure you're going to try to fool them, so they make allowances for that. They set the prices low enough to allow for what you do."
>
> "Well, then, what the hell chance have I got?" asked Tennessee.
>
> "It's up to you to figure out how to fool them more than they allow for." (Whyte 1955: 15)

Consequently, Starkey was one of the heroes of the plant; he was a man who knew how to burn up a drill whenever the time study men asked him to pick up the speed (he used touched-up drills):

> Ray knew all the tricks! I used to have to laugh at the way he got up a sweat when they were timing him. He'd jump around the machine like a monkey on a string,

> with the sweat just pouring off him! His shirt used to get soaking wet, and he'd have to wring it out afterwards! And when they finished timing him, he'd stagger away from the machine a little, like he'd given everything he had in him. . . . I never did see Ray sweat a drop when he was actually running a job; he was always about 40 pounds overweight, the laziest guy I ever did see. (Whyte 1955: 17)

The gaming in the piece-rate system thus centers on the issue of information asymmetry, with managers never being quite sure what the employee marginal cost of effort functions are and employees systematically trying to protect that information asymmetry (Kilbridge 1960). As Starkey told Tennessee:

> "Remember those guys don't know their ass from a hole in the ground as far as these machines are concerned. When they tell me to speed up to about what I figure I can run the job, I start to take my apron off, and tell them, 'All right, if you think it can be run that fast, you run it!' They usually come around." (Whyte 1955: 16)

This kind of strategic misuse of information is not unusual. On the contrary, as psychologist Ed Lawler (1987) has noted:

> Employees engage in numerous behaviors in order to have rates set in such a way that they can maximize their financial gains relative to the amount of work that they have to do. They engage in behaviors such as working at slow rates in order to mislead the time study expert when he or she comes to study their job. They hide new work methods or new procedures from the time-study person so the job will not be restudied. In addition, informal norms develop within the organization about how productive people should be with the result that the workers themselves set limits on production. Anyone who goes beyond this limit may be ostracized or punished. . . . In summary, piece-rate plans often result in an adversarial relationship between those on the plan, and those designing and administering the plan. The result is that both sides often engage in practices designed to win the game or war at the cost of organizational effectiveness. (70–1)

This description by a psychologist is of interest because he is clearly trying to portray the piece-rate game as a social dilemma. Employees are, he believes, engaged in "maximizing" behavior; both sides try to "win the war at the cost of organizational effectiveness." The simple piece-rate system engenders the kind of conflict between individual rationality and group well-being that hierarchies were designed to eliminate.

WHEN DO PIECE RATES WORK? A COMMITMENT MODEL

The reality of piece-rate hierarchies often bears little resemblance to the ideal – motivating employees to high levels of effort and providing employers with the valuable information about effort costs necessary to make efficient decisions. Are there any instances of piece rates working the way they are supposed to? What conditions might allow that to occur?

The basic problem with piece rates is that employees believe that employers will inevitably adjust piece rates downward in response to high salaries. Employers are aware that this is the problem, and consequently are aware,

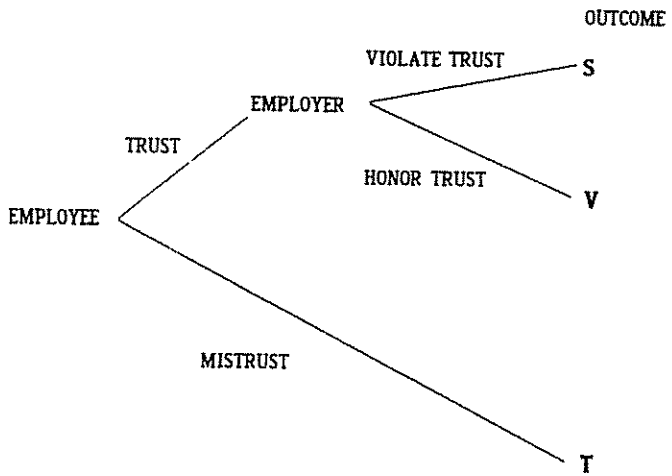

Figure 5.3. The piece-rate game as a commitment problem. Employer's outcome ranking: $S > V > T$. Employee's outcome ranking: $V > T > S$. (Refer to Figure 5.2 for a graph of these outcomes; T represents a Pareto-suboptimal Nash equilibrium.)

at an abstract level, that the solution is to make a credible commitment not to lower piece rates to keep payments comparable to the going day rate – in other words, to offer "a guarantee against rate cutting" (Nelson 1975: 45).

But visualizing the solution to the piece-rate dilemma is not the same as implementing it. The problem is captured by a simple game-theoretic model called the "commitment problem," due to Kreps (1984). In the commitment problem, as shown in Figure 5.3, an employee has a choice of trusting or not trusting the superior. In the piece-rate context, to "trust" means to reveal fully the employee reaction function rather than engage in quota restriction. To "mistrust" means to engage in quota restriction, which in terms of Figure 5.3 would result in outcome T.

If the employee trusts the superior, the superior has a choice of honoring or violating that trust. Again, in the context of the piece-rate game, to "violate trust" means to use the information revealed by the employee to cut piece rates to a minimum, while firing excess employees generated by the full effort of employees. This can be regarded as outcome S. To "honor trust" means not to lower piece rates in response to a good effort by employees and to provide some security against employees working themselves out of a job, which is pictured in Figure 5.3 as outcome V.

The superior has an incentive to violate that trust, which would leave the subordinate worse off than if he failed to trust the superior. Consequently, the subordinate refuses to trust the employer, which results in outcome T. But this leaves both worse off than outcome V, the outcome available if the subordinate were trusting and the superior were trustworthy.

In this game, the superior could visualize that both would be better off if she could commit herself to honoring the employee's trust. However, such a commitment would not be credible since it would not be in the superior's self-interest to keep the commitment once the employee had chosen to give the superior the opportunity to live up to the commitment. The problem is how to produce a commitment that is credible.

In the context of the piece-rate game, employers may realize that both sides could be better off if they, the employers, could credibly commit themselves to not cutting the piece rates. But the difficulty is finding an appropriate way to bind themselves to that commitment, since employers inevitably have an incentive to lower piece rates once employees trust them by revealing effort costs. Labor contracts cannot be written to specify piece rates for specific jobs, since the jobs themselves are constantly changing. Roy reported, "Jack warned me that the Methods Department could lower their prices on any job, old or new, by changing the fixture slightly or changing the size of the drill" (Whyte 1955: 23). Thus, there is no outside agency like the courts to enforce a commitment by the employer to a specific piece rate.

Furthermore, not only would a legal challenge to a change in piece rates be expensive, but it would have little chance in the courts, where the "business judgment" rule protects the rights of employers to make such adjustments based on their responsibility to shareholders to use their best business judgment.

Even if the commitment problem with respect to particular piece rates were solved, the same general problem would arise with regard to long-term employment. If employees were to exert themselves under a given piece-rate system, productivity would increase; employees could then expect that employers would have an incentive to fire a proportion of the employees as a result of these productivity increases. It would seem that, for piece rates to have the desired effect on productivity, employees would need assurances about continued employment.

A failure of commitment

One striking example of the strength of the pressures generating a "no trust – no honor" equilibrium is provided by Alex Bavelas and George Straus in their classic work *Money and Motivation* (1955). The Hovey and Beard Company manufactured toys, and one group of women had the job of painting them. At one point, the firm switched from hand painting to a technology based on an endless chain of hooks, from which individuals would remove toys, spray paint them, and replace them on the hooks. This change in technology was accompanied by a piece-rate bonus and a learning bonus, which was intended to motivate an eager and effective response to the new technology. However, production levels were far below those the

company had anticipated. The women complained about the speed of the chain of hooks, the messiness, and the poor ventilation.

The foreman, with encouragement from a consultant, agreed to a meeting with the eight workers. After hearing their complaints, the foreman had several talks with engineers and the plant superintendent, who were skeptical of the women's complaints. After a while, however, the foreman succeeded in obtaining fans to alleviate the ventilation problem. The women were elated and spent a great deal of time deciding on the right locations for the fans. Their morale and production went up, and discussions with the foreman continued.

Encouraged, the foreman continued the process of negotiation on other issues and finally managed to get permission for an experiment in which the women would control the speed of the hooks. The women experimented with varying the speed, making it somewhat lower early in the morning, for instance, and setting it at its highest point in the middle of the morning. Once again, morale went up and production increased. After the women got control of the speed of the hooks, their production was up to 50 percent above that expected before the new technology went into effect. Their earnings were higher than expected due to the piece-rate bonus and the learning bonus. In fact, the women were earning more than some of the skilled workers in the plant, who complained vigorously to management. Cost accountants were no doubt complaining that the wages paid to these women were way out of line with those the firm paid for comparably skilled jobs and were much higher than the women could get for comparable jobs in different firms.

The plant managers now faced the common temptation of all managers who use a piece-rate bonus plan to increase output. Now that the women were working hard, their earnings were up. The information that was needed about possible production levels had been obtained. Profits would be even higher if production were kept at the current level and the piece-rate bonus reduced. This would not only increase profits, it would also decrease the political hassle caused by paying the women more than the skilled male workers in the plant.

As a result, the managers revoked the learning bonus and the workers' control over the speed of the hooks. Production dropped immediately, and within a month six of the eight women quit. The foreman, who had in effect represented the management to the workers, felt aggrieved and left for another job as well.

Piece-rate success through commitment: Lincoln Electric Company

The short-term temptation to use information gained from highly motivated employees under the piece-rate system to keep wages low can be over-

whelming. Nevertheless, a few tantalizing cases of successful piece-rate management suggest that the problems of credible commitment are not impossible to overcome.

The Lincoln Electric Company is a highly successful manufacturer of arc welders located in Cleveland. It is a small company with a record of constant productivity improvements that allowed it to squeeze General Motors out of the arc-welding business and maintain a large market share in an old-fashioned, low-technology industry (Baldwin 1982: 50).

The key to Lincoln's success is that its employees, unlike those at most other piece-rate companies, are convinced that their employers will neither lower piece rates nor fire excess workers if they work their hardest, earn high wages, and increase productivity. The managers of Lincoln Electric know that this is the key to their own success. One said:

> When we set a piecework price, that price cannot be changed just because, in management's opinion, the worker is making too much money. Whether he earns two or three times his normal amount makes no difference. Piecework prices can only be changed when management has made a change in the method of doing that particular job and under no other conditions. If this is not carried out 100 percent, piecework cannot work. (Fast 1975: 4–5)

The employees at Lincoln Electric, unlike those at Roy's piece-rate company, accept that policy as a fact, and are highly motivated and productive. Productivity has been twice that of other manufacturers since 1945. Wages (including bonuses) averaged $44,000 in 1981 (Baldwin 1982: 50); by 1988, individual earnings were more than $80,000 for hard workers who didn't mind working overtime (Posner 1988: 95). Employees engage in little or none of the strategic misrepresentation of effort cost functions that is typical of most piece-rate plants, and there are no reported norms against rate-busting.

On the contrary, it is generally recognized that workers have an incentive to improve the technology in small and large ways:

> If he can re-arrange his work space or tasks to get a job done faster, he is free to do so – and will pocket more money. The company doesn't object if someone figures out a way to beat the times figured into the piecework rates, since the higher volume will spread overhead costs over more pieces. The worker will get rich, but so will the company. Or the worker could turn in a suggestion for restructuring the job, losing the piecework windfall but gaining bonus points in return. Bonuses, awarded for teamwork and reliability, average something close to 100% of base pay in most years, but vary widely from worker and worker. (Baldwin 1982: 52)

The management constantly has to withstand a temptation that other firms give in to. For example, when the economy heads down, there is pressure to reexamine whether employees are getting paid too much. This pressure is likely to be accentuated by the fact that the employees have nice cars, earn more income than comparably skilled employees in the same urban area, and at times even make more than managers. Shareholders can point

out that, in any given year, dividends could be higher if piece rates were simply adjusted downward to make salaries more comparable to those of other firms in the region. But all of these pressures are steadfastly withstood by Lincoln Electric, unlike Hovey and Beard.

Furthermore, employees have a job guarantee, despite the fact that demand for arc welders is highly responsive to business cycles. Founder James Lincoln clearly understood the incentive effects of this guarantee:

> Laying off the worker because of slackening of business is death to efficiency. No worker will strive for efficient production when his very efficiency will throw him out on the street that much sooner, and no sane man would expect him to do so. Naturally, he will strive to spin out the job as long as he can, by any means he can think of. Anyone else in his place would do the same thing, including the manager, who now, because of habit, follows the program of laying off when work is slack – or whenever it is more convenient for the manager than accepting responsibility would be. (Lincoln 1961: 80)

During the deep recession in the early eighties, this policy was strained to the limit, when every market the company sold in collapsed and overall revenue fell 40 percent. The company trained some production people to sell, and put others on maintenance crews, and refused to fire anyone. Hourly earnings were cut in half, but the company managed to make a profit even during the worst year of the recession, and so the company paid dividends as usual and paid bonuses to employees that averaged 55 percent of salaries (Posner 1988: 96).

The managers at Lincoln Electric are in effect honoring the trust that employees have vested in them by revealing private information about maximal effort levels. How a firm like Lincoln Electric manages to commit itself credibly not to exploit this trust, and how it manages to convey this commitment to the employees, is the primary topic of the last third of this book. For now, it is sufficient to point out that solving this problem of commitment goes far beyond the simple mechanical process of setting incentives and monitoring effort.

CONCLUSION: BEYOND PIECE-RATE INCENTIVE CONTRACTS

The piece-rate story is a simple one, but it nevertheless provides insight into the effort bargaining that characterizes labor–management relations at a good many firms. It raises the possibility that the Alchian and Demsetz solution to team shirking – efficiency through hierarchical monitoring and incentives – will not be easily achieved. Even though managers may have the expertise of time-and-study engineers at their disposal, the self-interested behavior of employees and managers under the institution of the piece-rate contract leaves them far short of the potential efficiency gains from hierarchy. Both subordinates and superiors could be better off if sub-

ordinates worked harder and superiors fixed higher piece rates than either side has an incentive to do on its own. Self-interested behavior in the hierarchy leads to a vertical social dilemma.

While the analysis of piece rates is a valuable way to introduce the question of efficient incentive setting, the next step is to ask whether there is not a more efficient incentive system. The next chapter undertakes a more general review of incentives and contracts. The fundamental discovery is that information asymmetry, monopsonistic behavior by employers in labor markets, and team production externalities combine to confound the search for hierarchical efficiency in incentives.

While it is easy to construct an incentive system in the absence of information asymmetry, monopoly pricing, or team production externalities, this simply tells us that hierarchies work well under the same conditions that promote market efficiency. The problem is discovering incentives that insulate hierarchy from the deleterious effects of team production externalities, monopolistic exchange, and information asymmetry.