Worker Payments and Incentives: A Classroom Experiment

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Abstract

This classroom experiment demonstrates the effects of time-based pay and output-based pay on worker behavior and productivity. Students will discover that workers paid a piece rate per unit produced will have incentives to work harder, but will sacrifice quality for increased quantity of output. In addition, workers will self-sort into jobs with different payment systems based on expected productivity and effort. Last, while labor costs per unit at firms offering output-based pay are generally lower than those at other firms, students will understand some of the reasons why this method of payment may not be widely used across occupations and industries.

One of the most important economic concepts students must learn is an understanding of how individuals respond to incentives. This is a classroom experiment designed to demonstrate how alternative systems of labor payment alter worker behavior. Students (production workers) are offered an opportunity to be paid based on output or based on the amount of time they spend at work. While I typically use this experiment in labor economics courses, it could be used in any principles of microeconomics or intermediate microeconomics course when discussing the role of incentives in determining behavior.

The experiment is based on the commonly used "widget" experiment that is generally performed in microeconomics courses to demonstrate the diminishing marginal returns of labor (Neral, 1993).[1] In the widget experiment, workers are added to a production line with one stapler. The product produced is a paper that is folded and stapled. As students are added to the production process, the stapler becomes a bottleneck and the marginal product of labor rapidly falls.

This new experiment provides each worker with a stapler and a stack of paper so that each worker has his or her own work station. Thus, the amount produced in each period is no longer limited by diminishing returns and is solely dependent on the worker's ability and effort. To demonstrate the effects of incentives on effort, the workers can elect to work for two different firms offering alternative payment schemes: a piece rate or a straight hourly wage. Lazear (1998) suggests that these alternative payment systems can be used to induce workers to self-sort, thus revealing their expected productivity levels to the firms. In addition, workers who are paid based on output have an incentive to put forth more effort than those paid a straight wage per hour. Last, when worker pay depends on output, the quality of the good produced may suffer. All three of these predictions can be demonstrated using this experiment.

The Experiment in More Detail

Each student is provided a stapler and a stack of paper (I use strips of paper that are 8.5 inches × approximately 3 inches). At the start of each production period, it is announced that there are two firms that are offering the students employment: one which pays workers a fixed wage per time period and one which pays workers a fixed amount per unit of output produced. These rates are announced and each student individually selects the firm for which he or she wishes to work.[2] Production of widgets occurs for an allotted time period. To produce a widget, the student must fold the paper into thirds and then staple each end. At the end of the period, output is counted and workers are paid. For workers who choose time-based pay, their wages are simply equal to the specified rate regardless of output. For workers who choose output-based pay, their wages are equal to the piece rate specified multiplied by the number of widgets produced. Only widgets that are fully completed are counted.

A trial run is performed so that students can gauge their productivity levels. The experiment is then repeated with different wage or piece rates. Students may change employers at the beginning of each period. As the wage rate falls or the piece rate rises, students will move from choosing time-based pay to choosing output-based pay. It will be the more productive students who choose to work for the firm that pays its workers on a piece-rate basis.

After the trial run, the first round is played. After the output has been counted, it should be noted that the productivity of the workers paid on a time basis is lower than the output of the workers receiving piece rates. It is then announced that the firm offering a straight wage must reduce its costs because it is having difficulty competing with other widget producers. Therefore, the wage is reduced while the piece rate remains the same. Students then make a choice of employer and round two begins. Some of the workers who had previously chosen to be paid a straight wage will move to the employer offering a piece rate. This will in general be those workers who are the most productive, leaving those least productive at the firm offering time-based pay. The average production per worker at this firm will be even lower than it was in the first round, prompting another wage reduction. The experiment can be repeated as many rounds as the instructor chooses (or until all students move to the employer offering output-based pay).

Several points will become clear during the experiment. First, the students will self-sort due to the different incentives inherent in these two payment schemes. This choice will be based on the student's knowledge of his or her ability to produce widgets along with the amount of effort he or she is willing to provide. Second, workers who are employed at the firm offering time-based pay will put forth less effort than their counterparts at the other firm. This will be most noticeable for workers who shift from one employer to another between rounds. Third, the quality of the widgets produced will vary between the two firms. The workers who are being paid a piece rate will focus on the quantity of output, and will produce widgets that are in general inferior (e.g., uneven folds, crooked staples) to those produced by workers who are paid on a time basis.

If the instructor wishes, an additional round may be played where quality guidelines are instituted at both firms. Under this scenario, piece-rate workers are paid only for the units of output that meet the guidelines. This will lower the number of students who choose to work for the firm offering output-based pay, along with the total number of widgets produced and the total value of earnings.

Results

This experiment was performed in a class of ten students in an upper-division labor economics elective course.[3] Each round lasted 30 seconds. Table 1 shows the results for each round. The initial salary was $0.50 per 30-second period (a wage rate of $60 per hour!) and the piece rate was $0.07 per unit produced. Before the trial period, seven students opted for time-based pay, while the remaining three chose to be paid per widget produced. After gaining some information on their own productivity, three workers switched employers. Two students who had initially chosen to be paid based on output switched to time-based pay, while another moved in the opposite direction. The first round was then played. Total output fell in both firms between the trial round and the first round. There are several likely explanations for this. Workers employed on a time-basis no longer had any incentive to put forth great effort. They already had played the trial round to gauge their productivities. In addition, two workers who didn't feel productive enough to continue being paid on an output-basis joined this firm, possibly pushing productivity down further. Total production of widgets at the firm offering output-based pay also declined because the number of employees fell from three to two, but average productivity at this firm rose.

At the start of the second round, it was announced that the firm paying workers on a time basis must reduce the wage it offered to $0.40 because its costs per widget were too high to compete with other widget producers. Students were then given another chance to switch employers. Two workers moved from this firm to the other which pays on an output basis. At the end of the second round of 30 seconds, output was again counted. The total number of widgets produced by workers being paid a straight wage fell for two reasons. First, there were fewer workers at that firm. Second, average product also fell. This likely means that the workers who left this firm after the first round were among the more productive workers employed there. While labor cost per widget did decline slightly (6.25 percent) between rounds 1 and 2, it did not decline as much as the wage rate (10 percent).

At the end of the second round, it was announced that the managers of both firms were instituting a quality control policy. It required that all widgets be folded neatly (with edges lining up) with both staples parallel to the papers' edges. Any widget that did not meet this specification was discarded and, in the case of the workers who were paid on an output basis, was not included in the calculation of pay. After this announcement, one worker moved from output-based pay to time-based pay. As a result of the quality controls, output and average productivity fell at both firms while labor cost per widget rose. None of the three workers receiving output-based pay earned as much as he or she could have under a straight wage.

Discussion Questions

At the end of the experiment, I used the remaining class time to discuss the results. This discussion centered around the questions listed below (along with the general conclusions drawn by the students in italics). I also followed up the experiment by including a short-answer essay question concerning the incentives of these two alternative forms of worker pay on the midterm exam.

1. How did you decide for which employer you wished to work?

Most students suggested that they predicted how many widgets they could produce in the time period allowed and then chose the employer for which their earnings would be greatest. One student, however, was honest enough to indicate that he chose time-based pay because he "didn't want to work that hard."

2. For those of you who switched employers, why did you decide that one payment system was better than the other? Did this decision benefit you?

Students said that the driving determination of switching employers was to maximize earnings. After the trial period, those who found that they were less productive than expected moved to time-based employment, while one found she was more productive than expected and moved to output-based pay. Workers with borderline productivity levels (between 6 and 8 widgets) all *moved to output-based pay once the fixed wage per period dropped. Each student was happy about his or her move, except those who felt it necessary to move back to time-based pay once the quality control standards were instituted.*

3. If these were two competing firms, what would you expect to happen over time? Why?

   The majority of students understood immediately that the firm paying the workers on a time basis would have trouble competing with the firm paying its workers a piece rate. Output per worker was higher and labor cost per widget were much lower at the firm offering output-based pay. However, a couple of students pointed out that this result is dependent on the importance of the quality of the good produced. Firms paying a piece rate generally end up with lower quality widgets unless standards are created. Such standards lower the productivity of the workers.

4. Why did quality differ across the two firms?

   Students who were paid a piece rate responded that they only cared about the quantity of widgets produced per period, not the quality.

5. What was the effect of the quality control standards? Which firm's workers were affected more?

   The quality standards reduced worker productivity at both firms, but affected those paid on an output basis more. The workers who continued to choose being paid a piece rate all expressed regrets concerning that choice once quality standards were instituted.

6. If paying a piece rate works so well at increasing worker productivity, why don't more firms do this?

   At first, student responses seemed to focus solely on the issue of quality. However, after talking about piece rates in general, they noticed that this scheme can only work when an employee's production output can be measured. This led to a discussion of the difficulties involved in this type of measurement for most occupations.

Conclusions and Suggested Extensions

This is an experiment that allows students to understand a variety of concepts that are important in economics: incentives, self-sorting, and productivity. When this experiment was performed in a labor economics elective course, students gained a better understanding of how alternative payment systems can (1) influence the amount of effort an individual is willing to put forth, (2) determine which types of workers may apply at particular firms, and (3) affect the quality of the product produced.

There are a couple of issues that instructors should consider if they choose to use this experiment in their own courses. First, because every student needs his or her own stapler, it can be time consuming to gather the necessary supplies.[4] Second, if the instructor wants to use a cash payment to simulate real life, it can get costly. However, limiting the number of student participants, rounds, and time period in each round can keep the cost relatively small.[5] Course points could be used in place of cash. For example, the total compensation earned by the student could determine his or her score on an in-class homework assignment. Or, extra credit points could be assigned to the worker with the highest compensation through all of the rounds.

In addition, there are numerous ways in which this experiment could be extended. The experiment could be improved by including some discussion of the costs of monitoring worker output (in the case of output-based pay or quality control). This could possibly be demonstrated by the instructor taking an exaggerated amount of time to count or check the quality of the widgets produced. The instructor could also hire and pay a student to count the output for the workers earning output-based pay. This allows students to see an additional reason why paying piece rates may not be superior to paying a straight wage: it is costly to measure and examine worker output.

Another possibility is to provide one student the use of an electric stapler. This student could simply be chosen at random, but it would be more interesting to allow students to bid for the use of the electric stapler each period (with the winner paying the bid price out of wages for that period). This extends the analysis to include the effects of capital improvements on worker productivity and earnings.

Alternatively, one or two of the staplers could be “booby-trapped” – by only having a small number of staples inside. Staplers could then be passed out to students on a random basis ultimately leading to a discussion of the risk to a worker of accepting output-based pay; sometimes, output is not fully determined by the worker’s effort and can be affected by forces beyond the worker’s control.

Last, the instructor may want to institute a minimum level of output for time-based workers. In the real world, workers are expected to meet certain productivity levels, and may be let go if these expectations are not met. This will also change the incentives involved in the choice of employer for the students. Those preferring time-based pay because they wanted more leisure may reverse this decision once this minimum effort level is announced.

Regardless of the approach taken, the experiment allows students to see first hand the role of incentives in the work place. This means that the experiment can be relevant for any microeconomics course (principles or intermediate) or a labor economics course. In addition, students will come away with more familiarity of possible options they may face later in the labor market, from jobs that pay straight commission to those that pay an hourly or annual salary. At the very least, they will be more prepared to anticipate the reasons why employers may differ in the ways in which they pay employees and the effects of these payment schemes on worker outcomes.

References

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Notes

[1]Examples of similar experiments can be found in Bergstrom and Miller (1997), Hazlett (1999), and Mason (2001).

[2]I used cash to pay the students. Therefore, it is important to keep the promised wage and piece rates small and the time period short to limit the cost of the experiment. An alternative system would be to pay students with extra credit points or to use this as a graded assignment with the students' scores relative to their earnings.

[3]This experiment is ideal for small class sizes. However, it could also be used in larger classes if a sample of 10-12 students is chosen to demonstrate the effects of these two payment schemes. Alternatively, teams of two workers could be created as a production unit. Instructors may wish to alter the payments offered to workers or the time in each round to keep the cost of the experiment low.

[4]I simply borrowed staplers from many of my colleagues. An alternative may be to use paper clips in lieu of staples; instructors may find it to be easier to bring a box of paper clips to class rather than 10 to 12 staplers.

[5]The cost of the entire experiment was between $10 and $11.

Table 1
Experiment Results

	Rate	Number of Workers	Total Output	Average Product	Labor Cost per Widget
Trial Round[a]					
Time-based pay	$0.50 per period	7	30	4.29	$0.12
Output-based pay	$0.07 per unit	3	22	7.33	$0.07
1st Round					
Time-based pay	$0.50 per period	8	25	3.13	$0.16
Output-based pay	$0.07 per unit	2	16	8.00	$0.07
2nd Round					
Time-based pay	$0.40 per period	6	16	2.67	$0.15
Output-based pay	$0.07 per unit	4	30	7.50	$0.07
3rd Round (Quality Standard)					
Time-based pay	$0.40 per period	7	11	1.57	$0.25
Output-based pay	$0.07 per unit	3	18	6.00	$0.07

[a]Workers were not paid during the trial round.