

WORKER PAYMENTS AND INCENTIVES: A CLASSROOM EXPERIMENT¹

Linda S. Ghent²

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. The paper concludes with several suggestions for extending the experiment to expand its illustrative value in a variety of economics courses.

Key Words: incentives, wages, productivity

JEL Classification: A22, J33

Introduction

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).³ 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

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² Professor and Chair, Department of Economics, Eastern Illinois University, Charleston, IL 61920

³ Examples of similar experiments can be found in Bergstrom and Miller (1997), Hazlett (1999), and Mason (2001).

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. In addition, this experiment can be extended in several ways to introduce the concepts of capital investment, risk, uncertainty, and mobility limitations.

The Experiment in More Detail

Each student was provided a stapler and a stack of paper (I used strips of paper that were 8.5 inches \times approximately 3 inches). Production of widgets occurred for an allotted time period in each round (30 seconds). To produce a widget, the student must fold the paper into thirds and then staple each end. At the start of each production period, students were told that there were two firms offering them employment: one paying workers a fixed wage per time period and one paying workers a fixed amount per unit of output produced. The initial salary was \$0.50 per 30-second period and the piece rate was \$0.07 per unit produced. After these rates were announced, each student individually selected the firm for which he or she wished to work.⁴ At the end of the period, output was counted and workers were paid. For workers who chose time-based pay, their wages were simply equal to the specified rate regardless of output. For workers who chose output-based pay, their wages were equal to the piece rate specified multiplied by the number of widgets produced. Only widgets that were fully completed were counted.

A trial run was performed so that students could gauge their productivity levels and choose the firm for which they wanted to work. The experiment was then repeated with different wage or piece rates. Students were given the opportunity to change employers at the beginning of each period.⁵ The comparative productivity in each firm determined the subsequent relative wage and piece rates; if average production was lower in the time-based firm, the wage rate paid by that firm was lowered in the next round so that the firm could continue to compete with the firm paying the piece rate.

In the second round, the hourly wage was reduced to \$0.40 while the piece rate remained the same. Students were allowed to move to a different employer if they wished. At the end of the round, output was again counted.⁶

At the end of the second round, an announcement was made that the managers of both firms were instituting a quality control policy. This 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 the announcement, students opted for the employer of their choice and the round began. Afterward, output was examined and then counted.

The experiment was followed by a discussion about the results and its application to several concepts discussed in the course. The experiment and discussion took approximately 20 minutes to complete.

⁴ 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.

⁵ If no students opt for either of the two firms, adjustments in the two wages should be made so that there are two groups and comparisons can be drawn.

⁶ The experiment can be repeated for as many rounds as the instructor chooses.

Expectations

If we assume that students are interested in maximizing their earnings, we can make several predictions regarding their behavior during this experiment. First, students will self-sort into jobs 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, the average productivity of the workers paid on a time basis will be lower than that of the workers receiving piece rates, prompting wage reductions in later rounds. When the time-based wage is reduced, 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 previous round, resulting in an additional reduction in wage. Last, without any quality control restrictions, 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.

Results

This experiment was performed in two sections of 10 and 14 students in an upper-division labor economics elective course.⁷ Table 1 shows the combined results for each round. Before the trial period, 17 students opted for time-based pay, while the remaining seven chose to be paid per widget produced. After gaining some information on their own productivity, four workers switched employers. Three 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. Average productivity fell in the firm paying a time-based wage between the trial round and the first round. These workers no longer had any incentive to put forth great effort. They already had played the trial round to gauge their productivities. In addition, three workers who did not feel productive enough to continue being paid on an output-basis joined this firm, possibly pushing productivity down further. At the same time, average productivity in the firm offering output-based pay rose.

At the start of the second round, the firm paying workers on a time basis reduced 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. Four workers moved from this firm to the other that paid on an output basis. At the end of the second round of 30 seconds, output was again counted. Average product fell again. 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 (20 percent).

A quality control policy was instituted at the start of the third round. After this announcement, two workers moved from output-based pay to time-based pay. As a result of the

⁷ 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.

quality controls, average productivity fell at both firms while labor costs per widget rose. None of the seven workers receiving output-based pay earned as much as he or she could have under a straight wage.

Table 1: Experiment Results

	Rate of Pay	# Workers	Total Output	Average Product (st. error)	Labor Cost per Widget
Trial Round^a					
Time-based pay	\$0.50 per period	17	78	4.59 (0.23)	\$0.11
Output-based pay	\$0.07 per unit	7	52	7.43 (0.30)	\$0.07
1st Round					
Time-based pay	\$0.50 per period	19	61	3.21 (0.15)	\$0.16
Output-based pay	\$0.07 per unit	5	41	8.20 (0.37)	\$0.07
2nd Round					
Time-based pay	\$0.40 per period	15	41	2.73 (0.18)	\$0.15
Output-based pay	\$0.07 per unit	9	68	7.56 (0.29)	\$0.07
3rd Round (Quality Standard)					
Time-based pay	\$0.40 per period	17	27	1.59 (0.12)	\$0.25
Output-based pay	\$0.07 per unit	7	43	6.14 (0.26)	\$0.07

^aWorkers were not paid during the trial round.

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.⁸ Second, a form of incentive must be provided. 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.⁹ 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.

There are numerous ways in which this experiment could be extended. One possibility would be to account for the costs of monitoring worker output (in the case of output-based pay or quality control). This could be demonstrated with 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 option 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.

The instructor may also 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.

Last, rather than reducing time-based wages due to low productivity, students with the worst record of productivity could be terminated. Mobility difficulties (such as some wait time between jobs) might also be used to make the experiment more realistic.

Regardless of the approach taken, this 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.

⁸ I simply borrowed staplers from many of my colleagues. An alternative may be to use paper clips in lieu of staplers; instructors may find it to be easier to bring a box of paper clips to class rather than 10 to 12 staplers.

⁹ The cost of the entire experiment was between \$10 and \$11 each time it was performed.

References

- Bergstrom, Theodore and John H. Miller. 1997. *Experiments with Economic Principles*. New York: McGraw-Hill.
- Hazlett, Denise. 1999. *Economic Experiments in the Classroom*. Reading, MA: Addison Wesley Longman.
- Lazear, Edward P. 1998. *Personnel Economics for Managers*. New York: John Wiley & Sons, Inc.
- Mason, Paul M. 2001. "A production and cost experiment for use in the principles of microeconomics." *Classroom Experiments* 10(Fall): 13-20.
- Neral, John. 1993. Widget production in the classroom. *Classroom Experiments*, 2(Spring): 7-8.