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Wage levels and method of pay

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The traditional literature on method of pay distinguishes workers who are paid time rates from those who are paid piece rates. The theory predicts that the piece-rate workers will earn more, and empirically they do. A simple generalization is to divide time-rate workers into two groups: those whose wage depends on their supervisor's ratings and those whose wage does not. Theory predicts that the workers whose pay is linked to supervisor ratings will earn more than the other time-rate workers. Wage data for workers in over 3,000 manufacturing establishments show they do not, and several simple explanations fail to resolve this empirical puzzle.

1. Introduction

■ Apart from a rapidly growing literature on executive compensation,[1] the empirical evidence on the consequences of alternative ways of linking pay to performance is limited. The nonexecutive literature is dominated by comparisons between the wages of workers paid piece rates (where pay is tied closely to what is produced) and those of workers paid time rates or salaries.

Suppose the cost of measuring a worker's output in order to pay piece rates is a constant θ, but output q varies with worker ability. A competitive piece-rate firm pays $q_i - \theta$ to worker i. Other firms do not measure each worker's output, and they pay each of their workers S. High-q workers find that $q_i - \theta > S$ and opt for piece rates; low-q workers opt for time rates. In equilibrium, S is equal to the mean of q among workers who choose time rates. Since *each* piece-rate worker earns more than S, piece-rate workers as a group earn more than S, and so the model predicts that piece-rate workers will earn more than those paid under time rates (Lazear, 1986).[2] This prediction is verified empirically (King, 1975; Pencavel, 1977; and Seiler, 1984). The model also predicts that piece rates will be less common where the monitoring cost θ is higher. There is evidence for this prediction, too, though it is somewhat less consistent than the evidence for the wage prediction (Brown, 1990).

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[1] For surveys, see Ehrenberg and Milkovich (1987) and Rosen (1990).

[2] Lazear also considers models in which output depends on effort rather than ability, and shows that the same conclusion holds.

The idea that the wages of time-rate workers do not depend on their (individual) output is a fair simplification for some workers—often, but not exclusively, in union settings—but it is well wide of the mark for many blue-collar workers and a clear majority of clerical workers (Cox, 1971; Bureau of National Affairs, 1981). They, like readers of this article, have their pay tied to a supervisor's evaluation of how much they produce.

Considerable realism is gained from extending the model to allow three wage-setting schemes: piece rates (with its tight link between pay and what is produced), standard rates (where pay depends on one's job category and perhaps seniority, but not performance), and merit pay (which links pay to performance, but not as strongly as piece rates does, since output is not measured as precisely). In Section 2 I outline the model; it predicts that wages of merit-pay workers should fall between those of piece-rate and standard-rate workers. In Section 3 I describe the data—for blue-collar workers in 3,000 establishments in ten industries and over 200 narrowly defined occupations—from the U.S. Bureau of Labor Statistics Industry Wage Survey. Sections 4 and 5 present the basic results and some further experiments. It turns out that standard-rate workers receive lower wages than piece-rate workers receive, but merit-pay workers receive the lowest wages of all. In Section 6 I offer some thoughts on how this puzzle might be resolved, but also on the difficulty of doing so.

2. A model with three methods of pay

■ The model that motivates the empirical work in this article maintains the basic structure of the piece-rate versus time-rate literature. Workers in a particular labor market differ in the amount they produce per period, q. They are assumed to know how productive they are, but such information is costly for firms to obtain. By spending more per worker for monitoring, the firm can obtain a more accurate reading of each worker's output.

A firm using piece rates (P) measures each worker's output and ties wages to measured output. A firm using merit pay (M) does not measure each worker's output directly, but links workers' pay to their supervisors' ratings.[3] Firms using standard rates (S) do not tie wages to job performance.

If measurement errors under the alternative systems are uncorrelated with true productivity, then the more reliable the available indicator of productivity, the greater weight the indicator will receive, and the greater the difference in expected wages between workers with a given difference in true productivity (Aigner and Cain, 1977; Lundberg and Startz, 1983; and Garen, 1985). The expected wage of a worker with (true) marginal product or "ability" q is $w_j = a_j + b_j q$, $j = P, M, S$, and $b_P > b_M > b_S$. Competition raises a_j for each method until the zero-profit constraint is just satisfied. This model represents a slight generalization of earlier articles in that b_S need not equal zero and b_P need not equal one;[4] the real point, however, is adding the "in-between" merit-pay category.

Knowing q_i, each worker i chooses the method of pay that offers the highest expected wage. As a result, only the envelope of the three wage schedules is observed. Given the ranking of the b's and the assumption that $q > 0$, if all three systems are to attract some workers, it must be the case that $a_S > a_M > a_P$. (See Figure 1.)

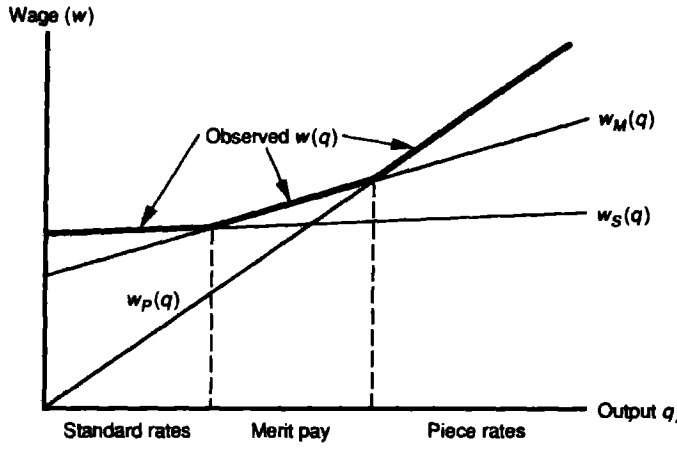
Figure 1 both reproduces the key conclusion of the previous literature on piece rates and highlights the consequences of explicitly introducing merit pay. The tight link between pay and performance offered by piece rates is attractive to the best workers, and those who choose piece rates earn more than those who do not. However, because merit pay offers a

[3] Merit pay may take the form of "contests" in which each worker's pay depends on his merit rating relative to everyone else's, as in Nalebuff and Stiglitz (1983).

[4] One might, for example, allow future promotions to depend on performance under all three regimes, so that from a longer perspective $b_S > 0$. Moreover, even under piece rates, some dimensions of performance (e.g., helping new workers) remain unmeasured, so that measurement of performance is imperfect and $b_P < 1$.

FIGURE 1

STANDARD-RATE, MERIT-PAY, AND PIECE-RATE FIRMS



more significant tie between pay and performance than standard rates, the same logic leads to the prediction that workers who choose merit-pay systems earn more than those who opt for standard rates.[5] The former prediction has been confirmed in the literature, but the latter has never been tested.

3. Data

■ The data analyzed in this article are from the Bureau of Labor Statistics Industry Wage Survey (IWS). The bureau surveys establishments in selected industries to get information about both the establishment and individual workers in selected occupations. Manufacturing industries are more likely to be included than those outside manufacturing. Within manufacturing, the survey often studies industries with significant fractions of workers covered by collective bargaining. Small establishments (usually those with fewer than 20 or 50 workers) are excluded, and larger establishments are oversampled.

The key information collected by IWS and not available elsewhere is the proportion of production workers in each establishment who are paid according to each of ten "methods of pay." Five time-rate categories are identified: The first is (1) single rates, in which "the same rate is paid to all experienced workers in the same job classification."[6] The next three are all range-of-rate plans, in which "the minimum, maximum or both of these rates paid experienced workers for the same job are specified"; within the range, wages of individual workers may depend on (2) merit, (3) length of service, or (4) a combination of merit and service. The fifth is (5) individual determination, in which, "in the absence of a formal rate structure pay rates are primarily determined by the qualifications of the individual." Five incentive-pay categories are also identified: (1) individual piece rates, (2) individual bonus

[5] The model in the text takes worker productivity as given and hence ignores effort. However, in a companion article (Brown, 1990) I consider a model in which output depends on effort and workers differ in the disutility associated with a given level of effort. Figure 1's conclusions continue to hold. An extension is to allow an alternative to participating in the market in question, with alternative wages an increasing function of q. Wage maximization by workers may lead workers in some quality ranges to prefer that alternative; but for those who remain, the ranking of Figure 1 remains valid.

[6] Experienced workers may be paid above or below the single rate for "special reasons," but such payments are "exceptions."

plans, where bonuses are for "production in excess of a quota or for completion of a task in less than standard time," (3) group piece rates, (4) group bonus plans, and (5) commissions (which are essentially irrelevant for production workers).[7]

The "single rate" and "range of rates–seniority" categories are standard-rate methods. The "range of rates–merit" and "individual determination" categories are merit-pay methods.[8] "Individual piece rates" and "individual bonus pay" correspond closely to the piece-rate system in the theory. "Range of rates–combination" straddles the boundary between merit pay and standard rates. "Group piece rates" and "group bonus pay" probably belong with the other incentive-pay methods;[9] fortunately, these two categories are fairly rare in the industries studied here.

IWS also records a more standard set of establishment characteristics: four-digit SIC industry, union coverage, employment,[10] region, and metropolitan location.

In addition to the characteristics of the establishment, IWS obtains information about individual production workers in "studied" occupations. Roughly 30 occupations are chosen in each industry based on the number of workers in the occupation (in that industry) and to reflect the range of jobs at different pay levels in the industry. For each worker in these occupations, IWS determines the worker's hourly wage rate,[11] sex, whether paid by incentive or time rates, and occupation. The IWS occupational classification scheme is much more detailed than those used in surveys of individual workers; for example, truck drivers are subdivided according to the type (size) of truck they drive, and weavers by the type of loom they operate.

The IWS thus provides establishment-level information on the importance of each method of pay for production workers, but for individual workers it distinguishes only between those paid time rates and those who receive incentive pay. Consequently, in establishments that use both standard rates and merit pay, one cannot determine which method applies to an individual time-rate worker. This ambiguity, and the sheer scale of our IWS sample (over 3,000 establishments) led to aggregating individual worker data to the establishment level—i.e., using the establishment as the unit of analysis.

In this article I analyze data for ten industries: nonferrous foundries, paints and varnishes, textile dyeing and finishing, industrial chemicals, cotton textiles, wool textiles, men's and boys' shirts, plastics, wooden household furniture, and fabricated structural steel. The industries were selected to have significant union and nonunion sectors (see Freeman (1982)).[12] There is substantial diversity in the methods of pay used by establishments in these industries, and while unionized establishments are more likely to use standard rates, there is substantial variation within industry apart from that due to differences in unionization (Brown, 1990). The piece-rate shares in these industries are similar to those in the broader set of IWS industries (Seiler, 1984), except that industries with 60% or more paid piece rates are underrepresented.

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[7] The quotations are from a standardized description that is reproduced in the appendix to each industry's report.

[8] This usage differs slightly from that used in compensation textbooks, where merit pay means range-of-rate systems in which position in the range depends on merit reviews (and perhaps seniority) and thus usually would not include a less formal "individual determination" system (Schwab and Olson, 1990).

[9] As the size of the group grows, group incentives might be expected to provide less incentive. Unfortunately, the size of the group under group-incentive plans is not available.

[10] The IWS data tape had employment coded in eight size categories. These were converted to a continuous variable by assigning to each category the mean establishment size (for the establishment's four-digit industry) using data for 1977 from U.S. Department of Commerce (1979), Table 1B.

[11] The hourly wage includes piece rates and production bonuses but excludes annual nonproduction bonuses and premium pay for overtime, holidays, and shiftwork.

[12] These are the same industries analyzed by Freeman (1982), with the addition of men's and boys' shirts (which Freeman deleted because he was focusing on non-piece-rate pay).

TABLE 1 **Wage Equations**
Dependent Variable: Mean ln(hourly wage)

	Mean Standard Deviation	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sample	all	all	all	all	all	all	union	nonunion
Union	.47	.080	.054	.054	.059	.058		
	(.50)	(.006)	(.006)	(.006)	(.006)	(.006)		
Establishment size	4.84	.031	.027	.027	.025	.025	.019	.035
	(1.15)	(.003)	(.003)	(.003)	(.003)	(.003)	(.004)	(.004)
Wage-weighted occupation index	1.34	1.036	1.038	1.034	1.046	1.043	1.228	.860
	(.24)	(.052)	(.051)	(.051)	(.051)	(.051)	(.080)	(.063)
Proportion female	.29	−.184	−.191	−.191	−.195	−.195	−.188	−.207
	(.32)	(.016)	(.015)	(.015)	(.016)	(.015)	(.025)	(.019)
Metropolitan area	.72	.055	.060	.061	.059	.060	.069	.058
	(.45)	(.007)	(.007)	(.007)	(.007)	(.007)	(.011)	(.008)
Northeast	.24	.082	.084	.082	.082	.080	.069	.086
	(.43)	(.008)	(.008)	(.008)	(.008)	(.008)	(.013)	(.011)
North Central	.22	.110	.107	.103	.108	.104	.094	.113
	(.42)	(.009)	(.008)	(.008)	(.008)	(.008)	(.013)	(.011)
West	.19	.084	.085	.084	.084	.083	.113	.045
	(.39)	(.008)	(.008)	(.008)	(.008)	(.008)	(.013)	(.011)
Single or range-seniority	.47		.066	.068			.070	.043
	(.46)		(.007)	(.007)			(.010)	(.009)
Single or range-seniority/combo	.61				.066	.070		
	(.45)				(.007)	(.007)		
Individual incentive or bonus	.12		.103		.117		.098	.093
	(.25)		(.016)		(.017)		(.025)	(.021)
All incentive methods	.14			.100		.116		
	(.27)			(.014)		(.014)		
N	3216	3216	3216	3216	3216	3216	1526	1690

Note: All equations include dummy variables for four-digit industry (21).

4. Method of pay and wages

■ The model developed in Section 2 (summarized in Figure 1) predicts that $\bar{w}_P > \bar{w}_M > \bar{w}_S$, where each mean is calculated over the "selected" samples of workers actually working under that method of pay. (The subtler prediction that those who work under one method would earn less if they worked under some alternative requires good indicators of individual worker quality, and hence cannot be tested with the IWS.)

The wage-rate regressions in Table 1 use the establishment as the unit of observation. The dependent variable is the mean ln (hourly wage) in the establishment, calculated over all workers in studied occupations. I include several independent variables not highlighted in the model of Section 2. There are dummy variables for industry (21 four-digit industry dummies), region (3), Standard Metropolitan Statistical Area, and unionization. Also included are ln (establishment size) and the proportion of the establishment's workers (in studied occupations) who are female.[13] Finally, I include an index that uses the industry's

[13] Forty-three establishments that had no studied workers or did not indicate which such workers were female were deleted from the sample.

average ln (wage) in each occupation to weight the establishment's actual occupational distribution, to measure the skill demands of the establishment's technology. For an establishment k in industry i, the index is

$$[\sum_{j=1}^{J} N_{jk}\bar{W}_{ij}]/\sum_{j=1}^{J} N_{jk},$$

where N_{jk} is the number of workers in occupation j in the establishment, and $\bar{W}_{ij}$ is the mean ln (wage) of all workers in industry i and occupation j. The mean wage, proportion female, and occupation index are computed over all of the establishment's studied workers, all of whom are production workers. On average, there are 140 studied workers per establishment.

Column 1 of Table 1 shows a "traditional" wage regression, with these variables included but none reflecting methods of pay. The results are reassuringly unsurprising. Wages are higher in unionized establishments and in larger ones, and in establishments that use more skilled and more male workers. The coefficients of the dummies for region and metropolitan area show the expected pattern of higher wages outside the South and inside metropolitan areas.

The remaining columns of Table 1 add various ways of measuring the proportion of the establishment's production workers who are paid standard rates (single rates, range of rates–merit, and perhaps range of rates–combination) and incentive pay (individual incentive and bonus pay, and perhaps group incentive and bonus). Fortunately, the conclusions are quite robust to the alternative ways of grouping the method-of-pay variables, and so can be summarized easily. Establishments with larger proportions of incentive-pay workers have higher wages, in line with earlier studies. The estimated premium is 10% to 11%. Establishments that make greater use of standard-rate pay also pay higher wages—the premium is about 7%—and this is true even controlling for establishment size and unionization. Thus, instead of $\bar{w}_P > \bar{w}_M > \bar{w}_S$, as suggested by Section 2, we observe $\bar{w}_P > \bar{w}_S > \bar{w}_M$.

Column 7 makes it clear that the same relative ranking persists when we focus exclusively on nonunion establishments.[14] Regressions using samples defined by industry, not shown in Table 1, show that this relative ranking is general, not confined to one or two industries.[15] Heteroskedasticity-consistent standard errors (White, 1980) are very similar to those in the table; weighting the observations by the number of studied workers in each establishment also produced similar results.

5. A closer look

■ An important issue for interpreting Table 1 is the correctness of the aggregation by which the ten methods of pay in the IWS are collapsed into the three methods (two explicit, one omitted "reference" method) in the table. To address this issue, I included as variables the proportions of workers paid by each of the less aggregated methods (with "individual determination" as the omitted reference category). These unconstrained results strongly supported the groupings in Table 1: the coefficients were

[14] Since unions are known to compress rather than expand wage differentials within establishments, it is surprising that the coefficient of the occupation index is larger for union than for nonunion establishments. This may simply reflect unions' "levelling up" low-wage workers more in establishments where the average worker is more skilled. In any case, constraining the coefficient of this index to equal −1 in both the union and nonunion samples left the method of pay coefficients virtually unchanged.

[15] When the sample was divided according to two-digit industry, there were seven subsamples. The coefficient of the standard-rate dummy was positive in all seven samples, and statistically significant in five. The coefficient of the incentive pay dummy was positive in six industries, and statistically significant in five.

$$\begin{bmatrix}\text{single rates .11 (.01)}\\ \text{range of rates–seniority .08 (.01)}\end{bmatrix}$$ standard rates

$$[\text{range of rates–combination .05 (.01)}]$$??

$$\begin{bmatrix}\text{range of rates–merit .02 (.01)}\\ \text{individual determination .00 (base)}\end{bmatrix}$$ merit pay

$$\begin{bmatrix}\text{group bonus .12 (.03)}\\ \text{group incentive pay .10 (.05)}\\ \text{individual bonus .15 (.03)}\\ \text{individual incentive pay .13 (.02)}\end{bmatrix}$$ incentive pay

Thus, these unconstrained estimates show that the groupings in Table 1 are indeed grouping methods of pay with similar effects on wages.

While the description of the various methods of pay used by the IWS strongly suggests that those labelled "merit pay" provide a more serious link between pay and performance than those labelled "standard rates," the unexpected finding that $\bar{w}_M < \bar{w}_S$ calls for a double-check on this presumption. Because we do not observe q_i—indeed, the model assumes that even the firm often cannot afford to do so—any such double-check must be indirect. One bit of indirect evidence concerns the relationship between within-establishment variation in wage rates and method of pay: we expect more such variation for merit-pay establishments than for those that pay standard rates (and more still for those that use incentive pay)—unless the variance of q_i is largest in standard-rate establishments, and this dominates variation in pay-performance sensitivity. Using regressions similar to those in Table 1, but replacing mean ln(wage) with the standard deviation of ln(wage) and the ln(wage)-weighted occupation index with one that measures the standard deviation of ln(wage) the establishment would have if it paid each worker the mean of ln(wage) in his/her narrow occupation, we find that merit-pay establishments do indeed have significantly more wage variation than standard-rate establishments.

In principle, the theory sketched in Section 2 deals with compensation rather than the wage rate per se. While the IWS has dummy variables indicating the presence or absence of a range of fringe benefits (such as pensions), there is no obvious way to convert these indicators into a dollars-per-hour metric. However, the IWS also provides information on vacation[16] and holidays, so one can measure the fraction of a workyear (260 days) the workers in an establishment are actually at work. Letting

$$\text{timeoff} = (\text{holidays} + \text{vacation days})/260,$$

the logarithm of the wage per hour worked is equal to

$$\ln[\text{wage}/(1 - \text{timeoff})] = \ln(\text{wage}) - \ln(1 - \text{timeoff}) \simeq \ln(\text{wage}) + \text{timeoff}.$$

However, compared to merit-pay workers, timeoff is about .3% higher (statistically significant) for standard-rate workers, and virtually identical for incentive-pay workers. Consequently, the standard-rate coefficients using the logarithm of wage per hour worked would be slightly larger than those in Table 1.

One might object that, in Table 1, too much is being held constant. Differences in the

[16] The IWS vacation data are presented separately at different levels of seniority. I convert these to an overall average using distributions of workers by tenure by industry from Sekscenski (1980).

ability level in the firm's workforce are the result of different choices of method of pay, and they should not be held constant when computing average wages for each method. Specifically, one might argue that the proportion female should be excluded (if it is capturing differences in on-the-job training between men and women), or that the skill index is inappropriate (if one interprets the model as a model of the market for blue-collar workers rather than workers in a narrow occupation). In fact, however, deleting these controls had little effect on the method-of-pay coefficients. The largest change was in the equation analogous to column 4 of Table 1, where the coefficient of the standard-rates variable fell to .040 (.008).

If one accepts the message of Table 1 that $\bar{w}_P > \bar{w}_S > \bar{w}_M$, the result can be read as characterizing either wages of workers who are paid by each method or wages in establishments in which each method predominates. This issue can be pursued in a limited way with the IWS data.

Suppose the wage of worker i in establishment j is equal to

$$w_{ij} = \beta_0 + \beta_S \bar{S}_j + \beta_P \bar{P}_j + \gamma_S S_i + \gamma_P P_i + \alpha X_i + \delta Z_j + e_{ij}.$$

The β's reflect the effect of being in establishments that use particular methods of pay, and the γ's reflect the impact of the individual worker's own method of pay. The regressions in Table 1 take establishment means for all variables, and hence identify $\beta_S + \gamma_S$ and $\beta_P + \gamma_P$. Alternatively, because the IWS identifies individual workers as time-rated (standard rate or merit pay) or incentive-paid, we can compute separate means for time- and incentive-paid workers in each establishment and the (within-establishment) difference in these means,[17]

$$\bar{w}_P - \bar{w}_T = \gamma_P - \gamma_S[\bar{S}/(1 - \bar{P})] + \alpha(\bar{X}_P - \bar{X}_T).$$

Thus, within-establishment differences in principle identify the effects of individual workers' method of pay, by in effect differencing out the establishment effects.

The within-establishment differences obviously can only be calculated for establishments that use both time rates and incentive pay for some of their workers in studied occupations—only a quarter (820 observations) of the original sample. Equations like those in columns 2 and 4 of Table 1[18] showed those receiving incentive pay again earning about 10% more than those receiving merit pay, but the premium for standard rates is only about 1% (standard error = .017). Both of these method-of-pay differentials are essentially unchanged by differencing, suggesting that they are associated with individual rather than establishment-level method of pay. But because the standard-rate premium is so much smaller in this subsample, this experiment doesn't tell us much about the 7% standard-rate differential in Table 1. In any case, we have no evidence that $\bar{w}_M > \bar{w}_S$.

6. Conclusions

■ The basic idea of this article can be stated simply: Treating "merit pay," where individuals' wages are set based on supervisors' judgmental ratings, as an intermediate case between standard rates and piece rates, how well do the simple comparisons of the time-rate/piece-rate literature generalize?

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[17] Notice that $\bar{S}_T$, the proportion of time-rated workers who are paid under standard rates, is the proportion paid standard rates divided by the proportion paid time rates, and the latter equals the proportion not under incentive pay.

[18] These columns use the definition of incentive pay that corresponds to the one used by IWS to classify individual workers as time- or incentive-paid.

The model predicts that the average wages of those working under merit pay would be less than the wages of those working under incentive pay, but greater than the wages of those paid standard rates. Empirically, merit pay was *not* an intermediate case in this sense: these workers consistently received lower wages than either the standard-rate or incentive-pay workers. The finding that workers whose pay depended on their supervisors' evaluations earned less than those whose pay did not appears to be robust, both in the sense of being statistically significant well beyond conventional levels and in the sense that it holds among nonunion as well as union firms and across industries (at least for the set of manufacturing industries studied here).

Modifying the theory presented in Section 2 to account for this unexpected finding requires some delicacy. One needs to modify the result in Figure 1 comparing standard-rate and merit-pay workers, while maintaining the empirically confirmed result that incentive-pay workers are the best paid.

The model presented in Section 2 emphasized self-selection by workers who differ in ability. While replacing "ability" with "effort" does not change the basic conclusions as long as workers continue to self-select method of pay (Brown, 1990), real-world firms do not passively allow workers to join and remain with the firm. Instead, they employ selection procedures at entry and discharge those who pass the selection procedures but are nevertheless unsatisfactory. Would more aggressive selection by firms explain the unexpectedly low wages of merit-pay workers?

A standard-rate firm that could not use more output-related compensation schemes—either because it would have to pay too much for a sufficiently accurate system of merit review or because it was constrained by collective bargaining—would have incentives to screen workers intensively, since its gain from increasing worker quality by Δq is $(1 - b_S)\Delta q$ (which is greater than $(1 - b_M)\Delta q$). But if standard-rate firms do substitute more careful preemployment estimation of q for on-the-job measurement of q, these preemployment estimates ought to be reflected in within-firm wage differentials—which, under standard rates, they are not.

The threat of discharge would require that the firm offer nondischarged workers a higher wage; but because such a threat would allow the firm to obtain a given level of effort and spend less on monitoring, a higher wage would be feasible. Intuition suggests that discharges are likely to be most important for standard-rate employers, since wage penalties for their shirkers are limited or nonexistent, and that adding in discharges leads to the prediction that such employers would pay higher wages than they would without discharges. Whether they would pay higher wages than merit-pay firms (but less than piece-rate firms) is unclear.

In any case, the fact that production workers in establishments using merit pay earn less than workers in establishments using standard rates is clear from the data, and explaining this remains a challenge for future research.

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