

# The Future of Personnel Economics

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January, 2000

This research was supported in part by the National Science Foundation.

## Abstract

Personnel economics has grown over the past twenty years to become a major branch of labor economics. Beginning primarily as a theoretical field, recent empirical analyses have provided support for earlier theories. Personnel economics is distinguished from traditional personnel analysis in that it is economics. As such, personnel economists assume maximizing agents, invoke the concept of equilibrium, and focus on economic efficiency.

Although much has been learned, many important questions remain. For example, are worker wage profiles dependent on individual attributes or is the firm more important in determining wage growth? Why are executives so highly paid and why does the pay take the form that it does? Why has the use of stock and stock options grown and why is stock sometimes given even to lower level employees? How can cross-country differences in pay patterns be explained? Does variable pay provide better incentives than do fixed hourly wages? Under which circumstances is one form of compensation used over another? These questions and others are investigated and some conjectures are offered.

Personnel economics is defined as the application of microeconomic principles to human resources issues that are of concern to most businesses. The field, now about twenty years old, arose for three reasons. First, those of us who were teaching standard labor economics to business students encountered a disinterested audience. Business students believe that labor supply and demand, unemployment, investment in education, and other topics, which are of primary concern to labor economists, are almost irrelevant to their future business careers. Their boredom with what we had to sell signaled that a change in the product might be warranted. Second, the issues studied by human resources specialists were of interest to economists, but the approach taken by the non-economist was unsatisfying. It was loose, unfocused, *ad hoc*, and lacked the general, rigorous framework to which economists have grown accustomed. The economist's reaction was to enter an industry where it was believed rents existed. Third, the technology of economics changed. As a result of some breakthroughs, particularly those dealing with agency and contract theory, economists were better equipped to tackle problems that had evaded them in the past.<sup>1</sup>

Personnel economics is an attempt to look inside the black box. It is an imperialistic attempt by economists to do what Alfred Marshall (1890) said that "economists do not do." Marshall's famous statement that it is not the economist's business to tell the brewer how to brew beer has not been adhered to when it comes to personnel economics. Personnel economists are attempting to do precisely that; namely, to use the tools of economics to understand and sometimes even to guide practitioners and consultants in their trade.<sup>2</sup>

This essay will attempt to do three things: first it will describe the philosophy of personnel economics and point out the differences between personnel economics and personnel. Second, it will argue that personnel economics is real; that is, that personnel economics is useful in helping us to understand factual behavior in the real world. Third, since personnel economics is a young and growing field, it will discuss a number of new questions and issues in hope of inspiring others to join the field.

## **Personnel Economics or Personnel?**

Like other sub-fields of economics, personnel economics differs from other social sciences in three ways. First, personnel economics assumes that the worker and the firm are rational maximizing agents. Constrained maximization is the basic building block of all theories in personnel economics. Our empirical analyses in the field are attempts to test models that are based on maximizing behavior. Even when evidence suggests that the theories are wrong, we do not drop the assumption of maximization. Instead, our approach is to think more carefully about the nature of the model set up, but not about the rationality of the individuals making the choices. Economists are rarely willing to assume that individuals simply do not know what they are doing. The economic approach allows for imperfect information, transaction costs, and other intervening variables which make things somewhat more complicated, but the essence of personnel economics is to assume that behavior is determined primarily by the interaction of the agents and not by forces beyond their control. The success of personnel economics is in large part a result of simply assuming maximization because doing so allows the analyst to express complicated concepts in relatively simple, albeit abstract, terms. The language of economics allows the personnel economist to remove complexity. Details may add to the richness of the description, but the details also prevent the researcher from seeing what is essential.

In many respects, this is personnel economics' main selling point. The typical human resources text is verbose and short on general principle. Indeed, many books eschew generalization, arguing that each situation is different. The economist's approach is the opposite. Rather than thinking of each human resources event as separate, the scientific method that economists use places a premium on finding the underlying general principle and on downplaying other factors.

The second feature that distinguishes personnel economics from other forms of human resource analysis is that personnel economists focus on equilibrium. Like the physical sciences, almost all theories in personnel economics are consistent with some notion of

equilibrium. For example, workers in firms are assumed to react in a particular way where each side generally takes the actions of the others into account. When this is done, a particular equilibrium results, which, again, assists in making very specific predictions about outcomes in the real world.

Third, efficiency is a central concept of personnel economics. Adam Smith's early notion of the invisible hand makes its way into personnel economics. Individuals who maximize their own utility and interact with firms that maximize profits generate behavior that usually makes both parties better off. When efficiency suffers, say, as a result of moral hazard problems that arise in the agency literature, the economist pushes the analysis to another level, asking what actions might firms and/or workers take to alleviate such inefficiency. Taking this further step assists in making better positive predictions and also normative prescriptions for the business student.

Much of personnel economics is quite consistent with old style labor economics. Agency theory concentrates on inducing workers to put forth effort and bears a very close resemblance to the theory of labor supply. There are two differences. First, labor supply usually refers to hours of work or the proportion of the population that is in the labor force. In the case of personnel economics, much of the discussion focuses on effort. Hours worked is merely one metric of effort. Second, because the focus is on effort, the inability to observe effort is central to much of the discussion. The tension between the interests of the workers and the firm, although present in the study of labor supply, is more problematic when effort is considered because firms cannot simply pay on the basis of observable input or output.<sup>3</sup>

Personnel economics differs from personnel in that, as in all branches of economics, there is no free lunch. Firms hire workers in a competitive labor market and cannot simply take advantage of them. Workers cannot be induced to do things that they do not want to do without appropriate compensation, either in the form of money or some other non-monetary reward. Furthermore, personnel economics is willing to express all compensation in terms of money, even if money is not the only or most important factor in compensation.

Non-monetary factors can be expressed in terms of money simply by finding its monetary equivalent through a standard hedonic approach.<sup>4</sup>

In an analogous vein, personnel economists think in terms of substitution, where other human resources specialists do not. For example, most firms have a benefits department that is distinct from the compensation department. In most firms, compensation is defined specifically to include monetary remuneration only. There is no explicit recognition of trade-offs, and non-economists frequently think in terms of providing some market level of each job attribute rather than thinking in terms of a total package of utility.

To see how economists differ from industrial psychologists and organizational behavior

scholars, consider the following paragraph from O'Reilly and Pfeffer (2000):

Moreover, the fact is that economics is not very helpful in managing people. This is because the fundamental economic theory of motivation is based on assumptions of effort aversion (people will not expend effort unless paid to do so), opportunism (people, in the pursuit of their own interests, will often misrepresent their true preferences and engage in guile and deceit), and a lack of goal alignment (employees in organizations have different agendas than the owners and, therefore, incentive systems need to be designed to force people to do what is right for the good of the organization). In the economists' view, people are assumed to be lazy, dishonest, and at odds with the goals of the managers.

Although each of these assumptions may be valid in a specific situation, or for a particular individual (for instance, when managing economists themselves), none is likely to be right in most settings with normal human beings. Worse, if you begin by designing systems to protect against the small minority, you end up by alienating the majority. Yet, under economic logic, managers are encouraged to operate as though these implicit assumptions are always and everywhere true. Managers are encouraged to carefully design monitoring systems to check on people so that employees don't misbehave; to define jobs in ways that reduce individual autonomy and maximize standardization to increase the efficiency with which employees can be selected and monitored; to craft systems that rely on money (either current or deferred compensation) to ensure that employees put in a fair day's effort; and to otherwise ensure that management can check and control the behavior of subordinates.<sup>5</sup>

The criticism of the economic approach that is discussed in the preceding two

paragraphs reflects deep differences in the way that economists and non-economists think about motivational issues and human resources in general. First, consider the statement that people are assumed to be lazy, dishonest and at odds with the goals of the managers. It is true that economists make this assumption, but they do so about behavior on the margin. It is the marginal behavior that is of interest to economists, and to personnel economists in particular, because the things that people want to do, do not require motivation. For example, many people take pride in their work and are willing to perform many tasks even in the absence of compensation. Most of us would continue to do some of our research and teaching even without pay. Few of us would choose to teach five courses per semester voluntarily. Firms are willing to pay to get workers to do things that they otherwise would not do because those activities have value to the firm. It is not that people are assumed to be lazy, but rather that, on the margin, they are pushed to the point where the chosen task becomes a "bad" rather than a "good." This is a proposition of equilibrium and one that others who study personnel ignore.

To see the point more clearly, refer to Fig. 1. Indifference curves are shown as solid U-shaped curves, where initially courses taught are a "good." An individual would be willing to give up some salary to be able to teach additional courses. But this changes at around three and one-half courses, where additional courses taught become a "bad," and must be compensated. The zero profit iso-profit curve is the dotted curve shown with an upward slope. It slopes upward because universities are willing to pay higher wages if a professor will teach additional courses, which courses generate revenue for the university. The equilibrium is at Point A. At that point, there is a tension between what the universities would like the professors to do and what the professors would choose to do if left on their own. The movement from three-and-a half to four-and-a-half courses can only be induced by additional compensation. Even if every single professor in the school had these preferences, it would still be the case that all the interesting action is in the range of preferences where people are "lazy" and have goals that are at odds with those of the managers. Indeed, from the point of view of understanding behavior at either the normative or positive level, only the

upward-sloping portion of the indifference curve is relevant. None of the variation observed in the market is placed in the downward-sloping portion because universities are willing to pay more salary to get more courses taught. Similarly, if one were to give advice to managers about how to induce professors to "do the right thing" it would not be about getting them to move to three-and-a-half courses, since individuals would go there voluntarily. The part over which there is contention and interest is the movement from three-and-a-half courses to four-and-a-half courses. Personnel economics, unlike organizational behavior or industrial psychology, recognizes this point and states it in a clean, precise fashion.

Beyond this basic point, O'Reilly and Pfeffer state that personnel economics encourages managers to "carefully design monitoring systems to check on people so that employees do not misbehave."<sup>6</sup> Again, this is only a result of equilibrium. Most employee behavior is in line with the interests of management and shareholders, but that is not the part that needs addressing. It is only the part of employee behavior that is at odds with the interests of management and shareholders that needs to be considered. As before, all of the variation occurs in the range where there is tension between managers and workers, not in the range where interests are aligned. Incidentally, the outcome does not necessarily result in strict monitoring systems. Sometimes the equilibrium is one where behavior is self-enforcing. For example, allowing taxi drivers to be full residual claimants induces them to behave appropriately with no monitoring at all. It is the job of personnel economics to describe situations under which complete freedom is an appropriate incentive structure that serves both parties well.

To be fair, non-economists are more sanguine about understanding taste variations among agents than are most economists. If one knew which factors changed the shape of the indifference curves to make work more palatable, then tastes would be a variable that would require explaining and could be manipulated. Some of social and industrial psychology deals with precisely this: the attempt to understand preferences or manipulate them in ways that benefit the firm or the larger society. Unfortunately, neither the theory nor empirical analyses

has been very satisfactory.

A final example drawn from another paper<sup>7</sup> illustrates well the difference between the way psychologists and economists think about a problem. Consider the issue of labor mobility. Schkade and Kahneman (1998) claim that despite the common perception that living in California is pleasant, their study finds that, as measured by responses to a particular survey, Californians are no happier than are non-Californians. Let us ignore potential criticisms of the study that might argue that utility and statements about utility are subjective. Let us assume instead, as Schkade and Kahneman propose to show, that utility is an objective and quantifiable concept. Even so, the result that psychologists consider anomalous and inconsistent with utility theory would be thought of by a personnel economist in quite a different way. Because we focus on equilibrium, we would argue that the marginal person outside of California can be no less happy than the marginal person who lives in California. Wages, housing prices, and other living and working conditions adjust to make this so. The existence of free mobility ensures that happiness must be equated for the marginal individual across locations. Wages and prices adjust to bring this about in equilibrium. The fact that California is a pleasant place to live does not mean that everybody in the world rushes to live in California. As a result of its amenities, land prices in California rise to make the marginal individual indifferent between living in California and living elsewhere. Economics makes sense out of what seems to others to be puzzling behavior. This is the strength of economics in general and of personnel economics in particular.

### **Personnel Economics is Useful**

This section argues by way of a number of examples that personnel economics helps us understand human resources practices in business and also gives us a way to make normative statements. Some examples follow.<sup>8</sup>

#### *2.1 Worklife incentives*

My first paper on personnel economics was published in 1979. The initial purpose of the paper was to explain mandatory retirement, but the main contribution was that of

suggesting that deferred compensation could serve as a motivator. I argued that young workers are paid less than their worth and older workers more than their worth in order to provide appropriate incentives over the life cycle. The basic idea can be explained as follows.

A worker can choose to work at a high level of effort or he may shirk, putting forth a low level of effort. A worker who works at a high level produces output given by the  $W$  profile in Figure 2. If he shirks, his output is  $V'$ . The  $de$  curve is the value of the worker's alternative use of time, in this context most easily thought of as the value of his leisure. Time  $T$  is the date of voluntary and efficient retirement. If workers received compensation  $V$ , they would choose to retire voluntarily at time  $T$ , because that is the point at which the alternative use of time just equals the worker's marginal product or payment.

Consider two schemes,  $W$  and  $V$  where  $W$  is constructed such that the present value of the  $W$  path from 0 to  $T$  equals the present value of the  $V$  path over the same period. With perfect capital markets, workers would be indifferent between paths  $W$  and  $V$  if all else were equal, but all else is not equal. Consider a worker who is being paid according to  $V$  and is nearing time  $T$ . At that point, the incentives to shirk become overwhelming. On the day before  $T$ , the worker may either work at the high level of effort or he may shirk. If he shirks, the worst thing that can happen is that he is fired. If he is fired, he does not receive wage  $V$  during the next period, but he does get to enjoy the value of his leisure, which is equal to his wage  $V$  at time  $T$ . Nothing is lost by shirking. If instead the worker were paid  $W$ , things would be different. Under such circumstances, shirking allows him to enjoy the value of his leisure  $de$  next period, but he forgoes wage  $W$ . Since  $W$  is set such that it is well above  $V$  at time  $T$ , a worker would forfeit quasi-rents by shirking. Thus, a sufficiently steep  $W$  profile induces workers to perform at a higher level of effort than they would were they paid their marginal product at each point in their careers.<sup>9</sup>

The key prediction of this model is that wages rise more rapidly than marginal

product. There was some early corroboration of this idea. Medoff and Abraham (1980) used subjective performance data and found that wages rose more rapidly with tenure than performance scores. Their work has been criticised as being less-than-definitive because the subjective ratings might reflect overall ability, relative position within job, or some other factor that was not well-correlated with productivity levels. The theory begged for quantitative productivity measures to prove the case.

Spitz (1991) had more objective data. She was able to examine the productivity of supermarket retail clerks and found that their productivity did not rise as rapidly with experience as their wages.

A dataset from an American company, Safelite Glass, allows a detailed examination of the relation between experience-earnings and experience-productivity profiles. Safelite is the nation's largest autoglass installer, headquartered in Columbus, Ohio. Safelite has a very sophisticated information system and keeps detailed machine-readable records of weekly output for each installer in the company. The data used cover the period from January, 1994 to July, 1995. During the period, Safelite switched from paying installers hourly wages to paying piece rates. Piece rate compensation is an alternative to career motivation schemes, so most of the discussion in this section will focus on the period during which workers were paid time rates. More will be said about the time rate / piece rate distinction below.

The data on output per week and compensation per week were used to estimate the relation of both productivity and pay to tenure. Table 1 reports the results that are unambiguous. Irrespective of the specification, the tenure coefficient in the pay regression is always higher than the tenure coefficient in the output regression.

Two equations are estimated. One is the standard log of earnings (pay-per-day) on tenure and tenure-squared. The other has the same right-hand variables, but uses actual daily output as the dependent variable.<sup>10</sup> The key result is that tenure has a greater effect in the wage regression than it does in the output regression.<sup>11</sup> Using the coefficients from the hourly wage regime, Fig. 3 shows the slopes of the two estimated profiles. The estimated

diagram (figure 3) resembles the predicted diagram (Fig. 2) in that the slope of tenure in the earnings regression is steeper than that of the productivity regression.

The model is estimated in a number of different ways. Fixed effects are included, dummies are omitted, and a different definition of tenure is used. The results are unchanged: tenure has a greater effect on pay than on output.

## 2.2 *Input or output-based pay?*

General discussions of compensation involve the distinction between paying on the basis of input or paying on the basis of output. In Lazear (1986), the choice of compensation scheme is explored and a discussion of incentive and selection issues is provided. At the heart of much of personnel economics is the discussion of response to incentive.

Incentive responses are difficult to test. In order to do so, it is necessary to observe workers in two different situations and compare the outcomes. But this presents two problems. First, in most circumstances only one scheme is likely to be observed for each worker if optimality obtains. Second, in the context of salaries and piece rates, the major reason for choosing input-based pay is that some or all components of output are not perfectly observable.<sup>12</sup> This is problematic because it is difficult to test a theory in which the predictions are about components that cannot be observed.

Sometimes, it is possible to test behavioral predictions by examining related factors that are observable. In rare cases, however, the researcher is presented with data that are well-suited to the purpose and allow direct testing of the theory. Recently, a number of cases of this sort has arisen.<sup>13</sup> I have personally been the fortunate recipient of what is, for the purpose of testing whether workers respond to incentives, perhaps the best of the available datasets. A change in management induced an autoglass firm to switch from paying hourly wages to paying piece rates. The available data set provides detailed information on each worker's output of autoglass installed, both before and after the change to piece rates. This allows testing of the theory set out in Lazear (1986).

This case is instructive not only because it reveals the importance of compensation

policy in affecting productivity, but because it demonstrates the power of economics in explaining the real world. The predictions that come from the theory are quite precise and are borne out by the evidence.

The theory emphasizes two effects of compensation scheme choice: incentives and sorting.<sup>14</sup> A simple diagram, taken from Lazear (1999b), illustrates both mechanisms and the predictions.

Safelite gradually switched its workforce from an hourly wage payment structure to piecework over about a one year period between 1994 and 1995. Autoglass installers were previously paid hourly wages. They were moved to a system of payment by number of units of glass with a minimum hourly wage guarantee. If the piece rate pay fell short of what the worker would have earned under the old system, he was paid according to the old hourly wage formula.

Implicit in every hourly wage offer is a required minimum standard of effort or output. Firms do not continue to pay workers who do not meet some minimum standard. Safelite's plan guaranteed  $W$  to anyone who would have earned less than  $W$  under the piece rate, and paid the piece rate to all of those whose compensation by the piece rate formula would have exceeded  $W$ . The scheme used is

$$\text{Compensation} = \max [W, be - K]$$

Here,  $W$  is the guaranteed wage,  $b$  is the piece rate based on number of units of output,  $e$ , and  $K$  is a constant term to satisfy the individual rationality constraint. The situation is shown in Fig. 4.

Indifference curves shown in the diagram represent individuals with different tastes or abilities. Low-ability workers have steep indifference curves because additional effort must be compensated by large increases in income. Solid indifference curves are those for relative low-ability workers and dotted indifference curves are those for higher ability workers.

The hourly wage schedule is shown by the function that starts at zero, becomes vertical at  $e_0$  and then horizontal at point A. The piece-rate-with-guarantee schedule is the

same, except that compensation rises with output above  $e^*$ , as shown by the upward sloping segment.

If workers are offered the hourly wage schedule, then everyone chooses point A since there is no value to working at higher levels of effort. But high-ability workers choose to move from A to B when offered the piece rate schedule with a guarantee. The least able remain at point A. There are three implications.<sup>15</sup>

First, average effort does not decrease and generally increases when the firm switches from hourly wages to piece rates. As long as some workers put forth enough effort to be in the piece rate range, then average output rises. This is the incentive effect associated with moving from hourly wages to piece rates.

Second, average ability of the work force increases because the ability of the lowest-quality worker does not change as a result of the switch in compensation scheme, but the ability of the highest quality worker rises. Now, some workers who were previously unwilling to work at Safelite because hourly wages were too low, given their ability and alternatives, now find that the piece rate allows them to work harder and receive more from the job. The least-able worker is indifferent between the two schemes. Switching to piece rates has the effect of improving retention and recruitment of high quality workers. This is the sorting effect.

Third, variance of worker ability and output rises after the switch to piece rates. Even if underlying ability levels did not change, variance in productivity would rise because some workers remain at A, whereas others work in the piece rate range, with output levels exceeding  $e^*$ . This, coupled with the fact that the maximum ability level increases under a piece rate implies that the increase in output variance becomes even greater. The evidence on these points is presented in Table 2, which comes from Lazear (1999b). The two main points can be summarized as follows:

1. Overall productivity increased about 44% (an increase in the log of 0.368) as a result of the switch from the hourly wage contract to piecework.

2. The increase can be split into two components. Because individual workers can be followed and their output can be measured before and after the switch, the incentive effect can be taken out. It is defined as the increase in output for a given worker after the switch to piece rates occurred, averaged across all workers. This amounts to a log increase of 0.197, or a 22% increase in productivity for the average worker, as shown by the coefficient in the second row of Table 2.

The sorting effect shows up most clearly in the coefficient on new regime. New regime is a dummy equal to individuals who are hired after the piece rate scheme has been implemented

throughout the firm. Note that these individuals are 0.243 log units more productive than the corresponding individuals who are not hired under the new regime. Although there is some evidence that separation rates for high-ability people fell slightly after the switch to piece rates, the strongest effect on selection seems to have occurred through the hiring of individuals who were higher-output producers than the ones whom they replaced.

### *2.3 Tournaments*

Another form of incentive compensation depends on a worker's relative performance rather than his or her absolute performance. The earliest statement of incentives based on relative performance is Lazear and Rosen (1981). The analysis featured there has come to be called "tournament theory." The essence of tournament theory is that individuals can be motivated simply by comparison with their peers or by comparison to some standard. The basic idea is that compensation is fixed in advance and depends on one's relative position in the firm. The larger the spread between the "winner" and "loser," the greater are the incentives. There is an optimal level of incentive that is the result of trading off the value of additional effort against the compensation necessary to induce workers to supply that level of effort. At some point, increasing the spread raises the equilibrium effort and disutility from it works to such an extent that it is better to settle for a lower amount of effort rather than to pay workers enough to induce them to perform.

Tournament theory has a number of testable implications, some of which have already been validated in the literature. One type of test examines the underlying structure of compensation to see whether it is consistent with tournament theory. A good recent example of such a study is Eriksson (1999)<sup>16</sup> Another literature tries to examine whether the hypothesised effects of spread on effort are actually found in the real world. Some of these look at sports tournaments. Ehrenberg and Bognanno (1990) is a fine example. Fernie and Metcalf (1999) look at jockeys and their performance as performance relates to pay. Outside the sports arena there are two examples. One is a series of studies by Knoeber (1989) and Knoeber and Thurman (1994), who examine the supply of chickens in a tournament-like environment. Another, by Drago and Garvey (1998), finds evidence of tournament-like behavior in Australian firms. All of these papers provide consistent evidence of the effect of spread on output and are very much in line with hypothesized tournament behavior.

One can look at the importance of relative performance more directly. To do this, data were acquired from a large financial service firm that had approximately 42,000 employees at the end of the sample period in 1994. Information is available on all employees in the firm from the period 1986 through 1994, not only those who were present throughout the entire period. The file consists of a series of snapshots of the payroll data on the same date of each year. This data set provides information on individual performance ratings done by the supervisors annually. The ratings take on numerical values between zero and five and can be used to make relative comparisons. For the purposes here, the reference group is defined as a job-year; that is, each year of the job the average score on the performance evaluation is computed. So, for example, all Secretary IIs in 1991 would form one comparison group and the mean performance score for those individuals would be computed. Then, a variable that measures the difference between an individual's personal performance score and the mean for his or her job is computed. This variable is called "difference in performance." The tournament model predicts that those with high relative performance in their job are the ones most likely to be promoted. The job is relevant because all individuals competing at the same

round of the tournament, should, *ex ante*, have the same estimated ability. At the empirical level, the job-year has been used as the group. All individuals in the same job title in a given year are assumed to be in the comparison group for the purposes of this analysis. Deviations from the mean of that group in a given year define relative performance.

The results of the estimation are reported in Table 3, where the probability of promotion is posited to depend on absolute and relative performance scores. As is clear from Table 3, "difference in performance," defined as the difference between the absolute level on the performance rating and the job-year mean is more important than the absolute level of performance in determining promotion probability. (The standard deviation of the level of performance is 0.61 whereas that of the difference is 0.50. The means are 3.48 and zero, respectively. The probability of promotion is 0.20.) Two individuals, A and B, who each receive, say, 4s on their evaluations are only equally likely to be promoted if the mean for their comparison groups is the same. If individual A is in a job where the average score is 3 and B is in a job where the average score is 2, then B is 6 percentage points more likely to be promoted than A. The six points are almost one-third of the average promotion rate per year, so the effect is quite large. These findings are supportive of the tournament view of promotion. Note that the analysis is done using firm-based data, which allow the relative comparisons to be made.<sup>17</sup>

#### 2.4 *Salary Compression*

Whenever any part of compensation is relative, a large spread between the wages of "winners" and "losers" results in a competitive, rather than cooperative work environment. For this reason, firms and workers may choose to adopt a more compressed wage structure.<sup>18</sup>

Compression must be defined relative to something and the appropriate metric is productivity. Again, the Safelite data permit an examination of productivity directly. Since there is also detailed information on compensation, it is possible to examine the relation between compensation and productivity to assess the amount of compression.

The Safelite data are not ideal for this purpose because the pay compression argument

has its greatest force when individuals work together in teams. To the extent that installers are working individually, there is much less motivation for using a compressed pay structure. Still, it is instructive to examine the Safelite data.

The data are split into two regimes. Data are examined from the period when workers were paid hourly wages and from the piece rate period. The hourly wage period would appear to be more relevant because the piece rate structure, almost by construction, implies that compensation and productivity are matched. Once a firm chooses to base pay on the piece, it has moved away from pay compression, so the only question would be "Why does the firm choose to pay on the basis of output?" But this is not quite true. Because the firm has choice over the piece rate formula, wages can be compressed even under piece rates. For example, if compensation is given by

$$\text{Pay} = a + \beta e$$

where  $e$  measures output, setting  $\beta=0$  and  $a$  equal to some positive number would result in completely compressed pay; a straight salary structure. As  $\beta$  goes to 1, the correlation between pay and productivity increases.

Table 4 presents some data on wage and productivity variation. First note that the amount of variation in wages is always less than the amount of variation in productivity. This is true both in absolute terms and relative to the means. At some level, this result is almost guaranteed during the hourly wage period. Since the hourly wage does not change from day to day, even as hourly output in units varies, it is necessarily the case that productivity variation will exceed wage variation at least on a hourly basis.

The kind of variation that is of more interest is variation across workers, rather than variation for a given worker over time. To get at this, fixed effects on output were computed from the fully specified regression used in Lazear (1999b), which relates log of output to month and year dummies, tenure variables, a piece rate dummy, and interaction effects. Fixed effects on wages were computed from an analogous regression with log of pay-per-day as the dependent variable.

Again, the result is the same. The amount of variation in output-fixed effects exceeds that in wage-fixed effects.<sup>19</sup> Interpersonal variations in output are larger than interpersonal variations in compensation. As before, this is true for the whole sample period and also for each regime taken independently.

The results of Table 4 are clear evidence of pay compression relative to productivity. They may or may not support the view that firms compress wages so as to bring about more harmony at the workplace. There is a fundamental difficulty in testing the latter proposition. In order to provide evidence on this point, it is necessary to be able to observe individual output so that output can be compared to productivity. But when individual output is observable, it is less likely that team production and cooperation are important. As a result, the evidence presented should be viewed as consistent (but not conclusive) proof that firms compress wages to foster cooperation.

## *2.5 Peer Pressure*

Kandel and Lazear (1991) analyze the effects of peer pressure on output. It is possible to evaluate the effect of peer pressure by comparing the change in output of individuals who never produced enough to be in the piece rate range to the change in output to those who do make it into the piece rate range.

Let us define two groups of workers. A dummy variable,  $L$ , for low output, is set equal to 1 if a worker never averaged more than four units-per-day for any month during which he was employed. The piece rate range does not start until a worker has produced at least 4.5 units, so these workers probably assumed that they would be earning the guaranteed hourly wage. In terms of Fig. 4, they are the workers who should have chosen to be at point A.

The fixed-effects regression reported in Table 3 (row 2) was re-run on two groups separately; namely, those having  $L=1$  and those having  $L=0$ . To determine whether there is implicit pressure on those who are not affected directly by the piece rate structure, it is only necessary to compare the effect of switching from hourly wages to piece rates across groups.

Because the group with  $L=1$  is never in or very close to the piece rate range, there should be no direct effect of the switch on those workers.

The results are reported in Table 5. Workers who are or have potential to be in the piece rate range experienced an average increase in output of 0.55 units. Those who never reached (or were close to reaching) the piece rate range experienced an increase in output of 0.32 units. The model as illustrated by Fig. 4, taken literally, implies that there should be no change in output for those who are going to be out of the piece rate range. Workers should choose either to be on the upward sloping segment of the compensation schedule or to locate at point A.<sup>20</sup>

Workers who are out of the piece rate range probably increased their effort level because they sensed that  $e_0$ , the minimum acceptable output, depended on what other workers were producing. Since the output of others went up substantially, the low-output workers may have felt compelled to increase their output. This is best interpreted as the effect of peer pressure. Because the increase in output is associated directly with the actual switch to the new compensation scheme and not merely with the announcement that a switch is going to occur, it seems reasonable that the increase among the low output workers results when they see others' outputs rise. The rise in peer output makes more credible the implicit increase in  $e_0$ .

The conclusion of this section is that personnel economics provides a series of theories that have normative value, but more important, that are borne out by real-world observation. In the past, economists have been limited in testing the theory of personnel economics because the appropriate data have not been available. Recent data acquisitions, some of which have actual productivity information reported, have made it possible to test the theories and to provide verification or refutation of them. At least from the limited data available so far, it seems that there is good evidence that worklife incentives incorporated in upward-sloping wage-earnings profiles, tournament style incentives, pay compression theories and peer interaction effects find support in the data. Furthermore, simple models that

predict how switching from payment by input to payment by output will affect worker behavior are confirmed.

### **3. Issues for the Future**

As a result of the changes that have taken place at the theoretical level and of the recent availability of new firm-based data, personnel economics can address issues that were ignored in the past. In this section a sample of issues that remain unresolved are presented, both at the theoretical and empirical levels.

#### *3.1 Intrafirm Mobility*

The main advantage of firm-based data is that analyses can be done that require understanding the relation of one worker to other workers within the context of the firm. For example, in order to understand whether most of an individual's wage growth is associated with idiosyncratic components that are person-specific, or whether it is associated with general phenomena that affect the firm as a whole, it is necessary to have data on the experiences of all workers within the given firm. One might put the question as "Are wages determined by outside competitive labor pressures or does a rising tide lift all boats?" There are currently a number of data sources that will allow these hypotheses to be distinguished. Sweden collects data on all workers in manufacturing establishments and these data are available from the period of 1970 to 1991 on a quarterly basis. In future work, those data will be used to test the hypothesis. But it is possible to use the financial services firm data to get a preliminary idea of the importance of within-firm transition. One such analysis was presented in Lazear (1999a).

The transition matrix shown in Table 6 enables us to answer these questions. Columns reflect quintiles in earnings in 1994. Rows reflect quintiles in earnings in 1990. Thus, the entry of 457 with 5.09 under it in row 1, column 2 is interpreted as 457 individuals or 5.09 percent of the total sample consisted of individuals who were in the lowest quintile in earnings of 1990 and in the second lowest quintile of earnings in 1994.

It is obvious that the lowest-level individuals tend to move up in the firm. This is

simple arithmetic. They cannot move down so they either all remain in the same quintile or some move up. In fact, conditional on remaining with the firm for the period, half of the individuals who were in the lowest quintile in 1990 have moved up by 1994.

Within-firm mobility can be measured in another way. The cells above the diagonal all reflect upward mobility. Those on the diagonal reflect no movement out of the quintile. Those below the diagonal reflect downward mobility. It is useful, therefore, to look at the proportion in each category.

The results are that 57% stayed in the same quintile, but 43% moved out of their quintile during the four year period. Twenty percent of the initial sample moved up at least one quintile and 23% moved down at least one quintile. There is a great deal of upward and downward mobility in this firm. This is not surprising, given the rapid growth during the period. But the same pattern is observed when the transition matrix for 1986-90 is examined. In this earlier period, not shown on the table, 61.6 percent remained in the same quintile; 17% moved up and 21.4% moved down.<sup>21</sup> The fact that more move down than up suggests that new hires come in at higher wages or levels than incumbents and their position erodes over time.

Perhaps a more important point is that the chances for moving up and down in this firm are substantial. Since most personnel economics models postulate the necessity for internal reward or punishment, it is encouraging to see that mobility is common. Were all workers locked into a particular position, most of the theories that discuss schemes for addressing moral hazard would be suspect.

The transition matrix can be used in a large variety of ways, but in the analysis just presented there is a major defect; namely, it refers to the experience of only one firm. In the Swedish data set, mentioned earlier, and in those from Finland and Norway, a large number of firms can be examined so that general patterns can be described and related to underlying characteristics of the firms and workforce. The data set from Denmark has the advantage that it includes the entire labor force and not just those involved in manufacturing, so that

intersectoral mobility can be analyzed.

### 3.2 *Are Executives Paid Too Much?*

Many of the unresolved questions in personnel economics revolve around the issue of whether pay practices are rational. Most obvious, both in the popular press and to some extent in the academic literature, is the question of whether CEOs and high-level executives are overpaid. Over-pay must be defined first of all, because in a tournament context pay today does not necessarily relate to productivity today. The same is true if work-life incentives operate because high-level executives tend to be more senior workers in the firm than those who would be in the part of the life cycle during which quasi-rents are being earned.

Some of the empirically-observed growth in CEO pay in the U.S. over the past twenty years reflects *ex post* rather than *ex ante* increases, to the extent that a large fraction of CEO pay has taken the form of stock options. *Ex post* compensation is related to market performance, which has been exceptional during the 80s and 90s. This aside, there is some evidence that even *ex ante* pay where stock options are valued at Black-Scholes, American CEO compensation still seems too high, given the behavior of other countries and of other workers within the United States. The question, then, is whether this reflects market forces or some enhanced ability of managers to transfer rents from shareholders and other workers to themselves. This begs the question, however, as to why this growth would have occurred. Presumably, managers were always greedy. Why are they better able to exercise their desires now than they were in the past?

It is certainly interesting to know about differences in levels of CEO pay, especially across countries. Perhaps more interesting, though, is whether the form of CEO pay matters. Fernie and Metcalf (1999) and Lazear (1999b) and find that the form of compensation can have dramatic affects on production worker productivity. It is possible that the same is true for CEOs.<sup>22</sup>

### 3.3 *Re-pricing Options*

Related to this is the issue of re-pricing of stock options. Often, after a significant decline in the price of stock, which renders an executive's option significantly out of the money, the options are re-priced; that is, the exercise price is lowered so as to make the option valuable again. The logic often given for the re-pricing is that the move is necessary in order to restore the incentive effects of the option value. This logic is valid, as shown by the following model.

First note that in most respects, stock is a special case of stock options. A stock option is an option to buy a share at some exercise price  $K$ . If  $K$  were set to zero, then the value of the stock would always be higher than the exercise price and the owner of the option would always exercise it; that is, the stock option would always be "in the money." This is equivalent to saying that the holder of the option owns the stock with certainty.<sup>23</sup> It is useful to think of stock this way. Then, we can always think in terms of options and simply determine the optimal exercise price. A price of zero is the special case that implies the granting of stock.

Now we will derive the expression which gives the value of a simplified option to a risk-neutral holder. Consider an option that can be exercised on one day and one day only sometime in the future. Suppose that current value of the stock is  $V$  and the exercise price is  $K$  and  $e$  is a random variable that reflects the change in the value of the stock between now and the exercise date. Let the discount rate be zero. Then the expected value of the stock option is

since the stock option is not exercised unless  $V + e > K$ , or equivalently, when  $e > K - V$ .

For a given strike price, increasing the value of the firm,  $V$ , increases the value of the option by the probability that the option is in the money. That is,

$$\frac{\partial Z}{\partial V} = (V+K-K-V) f(K-V) + 1 - F(K-V)$$

(2)

or

$$\frac{\partial Z}{\partial V} = 1 - F(K - V) \quad (3)$$

which is greater than zero. The first term of (2), which reflects the increased likelihood of being in the money, drops out because at the point where the individual is more likely to be in the money, being in the money has no value. The second term, which survives, reflects the fact that a one dollar increase in the value of the firm means one dollar to the option holder every time the option is in the money, which happens  $1 - F(K - V)$  of the time.

It is this point that generates the logic behind the repricing of stock options. If a manager's option is far out of the money, the option has little value and the incentive effect is small. The manager has greater incentives to increase  $V$ , the higher is the probability that the option is in the money. The value of the option is given by the following equation:

$$Z = \int_{K-V}^{\infty} [V - K + e^{-e}] f(e) de \quad (1)$$

money. Although providing a rationale for repricing of options, repricing creates other incentive problems. If the manager knows that the option will be repriced, he will not put forth as much effort initially. There are two at least partial solutions to this problem. One is to index to exogenous changes in stock prices (i.e., market events) that do not reflect manager activity. An alternative is to allow repricing, but to charge the manager a fee each time repricing occurs. The fee, which depends on the amount of repricing, assists in aligning initial incentives, and the repricing ensures that *ex post* incentives are correct. The fee and repricing pattern that provides optimal incentives can be worked out.

Personnel economists still do not have a clear understanding of why stock and options are given at all in light of such large free rider effects. It would seem that bonuses that relate more directly to a manager's contribution would provide better incentives than stock or stock options. Options, however, do provide leverage and allow some offsetting of effort-damping free rider effects.

This can be seen in the following example. A share of stock is currently worth  $V$  and

will be worth  $V+e$  on the date at which an option can be exercised. Suppose that there are two possibilities for  $e$ : good luck, in which case,  $e = 1$ , or bad luck, in which case  $e = -1$ , each of which occurs with probability  $\frac{1}{2}$ . Suppose further that if the manager puts forth the anticipated effort,  $V = \$10.00$ . Then, since the expected value of  $e$  is 0, the stock price would be  $\$10.00$ , reflecting that half of the time the firm's value would be  $\$11.00$  and half of the time it would be  $\$9.00$ .

An option with a strike price of  $\$10.50$  would be worth  $\$0.25$  because the option is in the money half of the time and when it is in the money, it returns  $\$11.00 - 10.50$  or  $\$0.50$ . Thus, forty options at an exercise price of  $\$10.50$  are equivalent to one share of stock (stock being an option with an exercise price of zero).

Now, suppose that the CEO can do something to raise the value of each share by  $\$0.01$ . If the CEO owned one share of stock, he would take the money-saving action if and only if it had a personal cost of less than one cent to him. Suppose instead that he had been given forty options with an exercise price of  $\$10.50$ . Initially, this has value equivalent to that of the one share of stock. Raising the value of a share of stock is now worth  $\$0.20$  as opposed to the  $\$0.01$  because the option will be in the money half of the time and when it is, each of the forty options returns  $\$0.51$  instead of  $\$0.50$ . Options provide leverage and allow the CEO to capture more of the return. As such, options offset free rider effects.

Personnel economics provides a starting point for understanding variable pay, including the granting of stock and stock options, not only to managers but to employees much further down in the organization. Many questions remain unanswered.

### 3.4 *Cross-Country Comparisons*

All the previous theory was quite general and does not speak to the differences in CEO pay across countries. The large expansion of American CEO pay relative to that of other countries has attracted particular attention. As mentioned earlier, part of this is merely a question of timing, in that *ex post* and *ex ante* returns are somewhat different. The "beta" on American CEO compensation seems to be higher than that on compensation of CEOs in other

countries. Because of the nature of the compensation contract, American CEO pay varies more with market conditions than does the pay of Asian and European CEOs. An important question is "Why should this be the case?" We do not have good theories to explain the specific composition of managerial compensation, although earlier work in personnel economics has laid the groundwork for such discussion. Still, little application has been made of these theories, and this remains fertile ground for research.

### 3.5 *Input- or Output-based Pay?*

The choice between variable compensation and fixed compensation was explored in Lazear (1986), but our understanding of both the theory and data have progressed since then, and it is certainly worth re-examining some of the questions. In Lazear (1999b), an auto glass company that switched its compensation from hourly wages to piecework is studied and effects of the switch are documented. The nature of that switch, however, and why it came about are not so clearly understood. In the earlier (1986) paper, I made the point that piecework is more desirable where workers are heterogeneous. But that point was discussed in the context of sorting and selection and not in the context of effort. The casual view is that piece rates are necessary to motivate effort and that hourly wages are an ineffective motivator. This is sometimes tied in with the language of "high-powered" and "low-powered" incentives, a distinction that I find misleading and uninformative. Piece rate pay is thought to be a high-powered incentive because it directs a worker's effort specifically to output. But it is also true that hourly wages are high-powered in another sense, and that argument is presented here.<sup>24</sup>

Hourly wages provide incentives because no firm tolerates workers on hourly wages whose output (or effort) falls below some minimum acceptable standard. In Fig. 4, that level was shown as  $e_0$ . In this range, incentives may be extremely "high powered" when the workers' alternatives are poor. Around the standard of  $e_0$ , a decline in output brings about termination. As a result, hourly wages, coupled with a minimum standard, can act as a powerful incentive device. If a firm wants to increase the level of output, it could simply

raise  $e_0$  and pay a correspondingly higher wage to compensate for the additional effort required.

To see this more formally, let the worker's utility function be given by

$$U = \text{Income} - A \cdot C(e) \quad (4)$$

where  $C(e)$  is the homogeneous part of the cost function with  $C', C'' > 0$ . Since  $A$  measures ability, individuals with higher levels of ability have lower costs of producing any given level of output,  $e$ .<sup>25</sup>

Were workers homogeneous and output or effort observable, it would be straightforward to implement the efficient level of effort using hourly wages and an output requirement. Given the utility function in (4), the efficient level of output is  $e^*$ , such that

$$C'(e^*) / A = 1$$

because the marginal value of a unit of output is normalized to be 1. The firm could simply require that workers produce at least  $e^*$ . Then the firm would set the wage,  $W$ , such that

$$W = C(e^*)$$

so that workers would be willing to work. Again, "high powered" incentives would be provided and all would be efficient under the hourly wage structure.

The reason that firms move to variable pay is not that hourly wages are "low powered" incentives, but rather that hourly wages do not motivate effort well when workers are heterogeneous. The problem is that the minimum standard and corresponding wage that is right for one group of workers is not right for another group. Thus, the firm must choose a standard and wage that is the best compromise, which creates inefficiencies.<sup>26</sup> The lowest-quality worker is forced to produce more than the efficient amount of output because

the firm cannot discriminate between low- and high- ability workers. In its attempt to set a standard high enough for the high-ability workers, it must force low-ability workers to work harder than they would optimally work. It is also true that high ability workers put forth too low an effort level.

It is recognition of this problem that pushes a firm to use variable pay. Variable pay allows those individuals who want to put forth additional effort to be compensated, whereas those who prefer lower levels of effort and lower levels of compensation can also be accommodated at the same firm. It is the ability to deal with heterogeneity of effort choice that gives variable pay an advantage over fixed pay. It is not the fact that variable pay creates higher-powered incentives per se.

Despite the fact that the choice of compensation scheme affects the type of workers who choose to work at the firm, researchers have concentrated more on effort than on sorting in the discussion of compensation schemes. Sorting and selection were discussed early in Salop and Salop (1976) and in Lazear (1986), but the topic has not received the attention deserved. The desire to motivate effort cannot be the reason behind all compensation choices because the implications of such theories are inconsistent with observations from the real world. Rather, some observable phenomena seem more consistent with selection and sorting than with effort inducement.

One argument for using variable pay is that it causes a manager to "put his money where his mouth is." It may be advantageous for a particular manager to induce investors to put money behind a project that has negative expected profits. To the extent that the manager can receive higher compensation in this employment rather than in his alternatives, he would be motivated to inflate the expected profitability of the product when talking to potential investors. A compensation contract that is contingent on profitability can induce managers to be more truthful and can assist investors in selecting profitable opportunities.

This is the approach used by venture capitalists, where the investor may insist that an inventor take almost all of his compensation in the form of contingent pay, and perhaps even

insist that he put up a significant portion of his own wealth. Unless the enterprise is profitable, the manager does worse than he would were he to simply take standard compensation at the value of the alternative use of his time. If the project turns out to be profitable, however, the manager is better off. This structure induces truth-telling, as can be seen more formally as follows.

Suppose that a manager has a known outside value of time at  $W$ .<sup>27</sup> Then he will accept a job that offers a variable pay scheme

$$\text{Variable Pay} = a + bp$$

where  $p$  is profit whenever

$$a + bp \geq W .$$

If  $a$  is set equal to  $W$  and  $b$  is set arbitrarily small, but positive, then the manager will accept the job offer if and only if  $p \geq 0$ , which is the condition that maximizes investor's profits. The scheme induces truth-telling and it is efficient. Capitalists obtain perfect information; the manager accepts the job for every positive profit project and rejects the job for every negative profit project.

The implications of the selection view of compensation are quite different from the implications of incentives. The pure incentive story implies a coefficient for  $b$  of one, at least in its simplest form. Of course, risk aversion, bankruptcy limitations and multi-agent problems may keep  $b$  from reaching one in reality. The sorting argument, on the other hand, suggests a very small coefficient of  $b$ . In the purest case,  $b$  can be set arbitrarily close to zero. In the real world,  $b$  is rarely found to be anywhere close to one and is much closer to zero. The well-known paper by Jensen and Murphy (1990) and the revision by Hall and Leibman (1998) both find coefficients on managerial compensation that is far from one.<sup>28</sup>

Another argument for giving options to workers is that they bind the worker to the firm because the options are not vested. Although this may be true, options are not the only form of deferred compensation that can be non-vested. Any non-vested deferred compensation binds a worker. There is no reason to make it as risky as an option.

Furthermore, it is not generally efficient to bind a worker to the firm in an artificial manner. Workers should stay only when their value exceeds the value of their alternatives. Binding workers is efficient only when there is a great deal of firm specificity.

Whether selection and retention incentives are the explanation for the pattern of variable pay observed remains to be decided. Furthermore, the extension of variable pay down to lower level employees in the firm caused problems for all three possible explanations. Neither incentives nor retention seem particularly applicable to these lower-level employees, nor is it likely that lower-level employees have a great deal of information about the firm's profitability.

#### **4. Conclusion**

This essay has attempted to explore three themes. First, personnel economics is similar to personnel in that it is interested in the same subject matter and questions. Personnel economics differs from personnel in that personnel economics assumes maximizing agents, equilibrium and efficiency and thereby derives cleaner, more concise and probably more accurate answers than those supplied by the older literature.

Second, personnel economics is well-grounded in reality. The personnel economics literature is now large. Although the majority of it consists of theory, new empirical work is being added at a rapid pace and most of this work provides support for the theories that have been offered earlier.

Finally, personnel economics induces researchers to ask new questions. It is a rich area for future investigation. Although much has already been done and the foundations have been laid, many more questions remain unanswered. Because the issues explored by personnel economics are both interesting and relevant to the economics and business communities, the field is likely to grow at a rapid pace.

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### Footnotes

1. Early papers in the agency literature include Johnson (1950), Cheung (1969), and Ross (1973). Contract theory grew out of macroeconomic inquiries, reflected in papers by Baily (1977), Azariadis (1983) and Gordon (1990). Finally, Alchian and Demsetz's (1972) important work on monitoring helped frame the discussion.
2. This is the theme of a general essay that I have written entitled "Economic Imperialism" Lazear (2000).
3. This is what my paper discussing the choice of payment of salaries and piece rates was about. "Salaries and Piece Rates," Lazear (1986).
4. See Rosen (1974).
5. O'Reilly and Pfeffer (2000).
6. O'Reilly and Pfeffer (2000).
7. See Lazear (2000).
8. The next section draws directly from Lazear (1999).
9. Actually, a discrete payment after retirement is necessary to prevent shirking in the last moment on the job. See Akerlof and Katz (1989) for a good discussion of this point.
10. The period is a month so that the figures are the average daily figures in a given month. The reported coefficients are estimated only on the period during which workers are paid hourly wages. This is the regime in which the upward sloping profile would be expected to be used to generate incentives.
11. Output is measured in windshield units, whereas pay is in dollars. In order to make them comparable, windshield units had to be converted to a dollar value. In order to do this, it was assumed that workers were paid their value of marginal products over a ten year work life. Thus, the value of a windshield was chosen to set present value of the pay equaled the present value of output over a ten-year period. The results are insensitive to assumptions about the length of the work life.
12. See Baker (1992).
13. See Fernie and Metcalf (1999), Paarsch and Shearer (1996), Prendergast (1999).
14. The sorting approach was suggested earlier in another context by Salop and Salop (1976).
15. The formal derivation of this material is contained in Lazear (1999b).
16. See Tor Eriksson (1999).

17. The same qualitative results are obtained for wage growth instead of promotion as the dependent variable. Furthermore, using rank on the performance evaluation, rather than the deviation from the mean, has the same type of effect on determining promotion in a linear probability model with job-specific fixed effects.
18. See Lazear (1989).
19. The mean of the fixed effects differ (slightly) from zero for two reasons. First, only individuals who have values of fixed effects on both output and wages are included in the table, whereas each regression includes all individuals who have values only for the variables in that regression. Second, the weighting is different because Table 4 computes the mean of each individual's fixed effect and does not weight by the number of observations used in computing each fixed effect.
20. Note that the coefficients in Table 5 are the effect only of the switch to piece rates. Thus, output of low output workers increased by 0.32 units net of all other effects when the store in which the individual worked switched to piece rates. Since this is net of any time dummies, the 0.32 is not the effect of improvement in general conditions at Safelite in general.
21. The number who move up does not equal the number who move down because quintiles are defined relative to those in the firm at a point in time. In theory, all could move up if every new entrant came in at a salary below those of the incumbents and there were a large enough number of new entrants.
22. CEOs are selected in large part for their willingness to put forth high levels of effort. Thus, the elasticity of CEO effort to compensation may not be so high. Of course, the value of incremental CEO effort may be much higher than that for production workers.
23. There are a couple of differences, however. An owner of an option does not receive dividends on that stock until he becomes an actual owner of the stock. Furthermore, the owner of an option does not have voting rights. But the option owner might have tax reasons to avoid exercising the option early. In the U.S., options are not taxed as income until they are exercised.
24. The language of "high-powered" incentives is somewhat vague. When applied to real situations, it becomes somewhat unclear. For example, Fernie and Metcalf (2000) find that it is the ratio of actual performance pay to total pay, rather than the ratio of potential performance pay to total pay that affects behavior. This seems inconsistent with the usual language, where the power of incentives generally relates to the level of the performance pay coefficient, not to the amount of received performance pay.
25. The words "output" and "effort" are used interchangeably. It is always possible to redefine  $C(e)$  such that one unit of effort, say, measured in calories burned, produces one unit of output.
26. The formal derivation of this point is contained in Lazear (2000).

27. A more complete analysis is contained in Lazear (1999c) and is summarized in Lazear (2000).
28. There are other pieces of evidence that are also consistent with sorting that seem to suggest that incentives may not be the whole story. For example, Yermack (1995) argues that the kinds of stock options found in most compensation plans are inconsistent with the view that options are provided for incentive reasons.

**Table 1**

**Pay and Output Regression**

<b>Variable</b>	<b>Output Regression Coefficients (Standard Errors in Parentheses)</b>	<b>Pay Regression Coefficients (Standard Errors in Parentheses)</b>
Constant	.605 (.051)	4.49 (0.01)
Tenure	.0047 (.0036)	.0604 (.0011)
Tenure Squared	-.00087 (.00018)	-.00174 (.00006)
Number of Observations	14394	14496
R <sup>2</sup>	.02	.31

Note: Both regressions include dummies for month and year. The regressions are run only for the period during which workers were paid hourly wages.

**Table 2**  
**Regression Results\***

\*Dependent Variable: ln (Output-per-worker-per-day)

<b>Reg. #</b>	<b>Dummy for PPP person-month observation</b>	<b>Tenure</b>	<b>Time since PPP</b>	<b>New Regime</b>	<b>r-sqr.</b>	<b>Description</b>
1	.368 (.013)				.04	Dummies for month and year included
2	.197 (.009)				.73	Dummies for month and year; worker specific dummies included (2755 individual workers)
3	.313 (.014)	.343 (.017)	.107 (.024)		.05	Dummies for month and year included
4	.202 (.009)	.224 (.058)	.273 (.018)		.76	Dummies for month and year; worker specific dummies included (2755 individual workers)
5	.309 (.014)	.424 (.019)	.130 (.024)	.243 (.025)	.06	Dummies for month and year included

Standard errors are reported in parentheses below the coefficients. 29,837 Observations

**Table 3**  
**Logit Estimates of the Probability of Promotion**

<b>Variable</b>	<b>Coefficient</b>	<b>Marginal effect on probability</b>	<b>Standard Error</b>	<b>Z</b>
Performance Score	.0312	.005	.0219	1.4

Difference in Performance Score	.382	.061	.027	14.3
Constant	-1.989		.077	25.9
Log Likelihood	-55629			
Number of Observations	142038			

**Table 4**  
**Variations in Wages and Productivity at Safelite**

Pay Status	Variable	Mean	Standard Deviation	Number of Observations
All	Log (Units-per-work er-per-day)	.895	.762	31059
	Log (Pay-per-worker- per-day)	4.62	.291	31059
	Fixed effect - units	-.082	.773	2610
	Fixed effect - pay	-.009	.228	2610
	Hourly Wages	Log (Units...)	.792	.838
	Log (Pay...)	4.59	.312	15478
	Fixed effect - units	-.062	.721	2111
	Fixed effect - pay	-.020	.236	2111
Piece Rates	Log (Units...)	.998	.663	15581
	Log (Pay...)	4.65	.265	15581
	Fixed effect - units	-.169	.991	499
	Fixed effect - pay	.037	.184	499

**Table 5**  
**The Effect of a Switch to Piece Rates by Group**

Group	Increase in output associated with switch to the piece rate system	Number of Observations
All Workers	.44	29837
Low Output Workers (Piece Rates Never Paid)	.32	16995
All other workers	.55	12842

**Table 6**  
**Transitions in a Financial Services Firm**

quint90	quint94					Total
	15775.76	20884.08	27033.33	39549.12	415000	
10839.38	899	457	232	143	64	1795
	10.02	5.09	2.59	1.59	0.71	20.00
15393.04	558	802	297	109	28	1794 19.99
	6.22	8.94	3.31	1.21	0.31	
20029.28	191	466	861	231	47	1796
	2.13	5.19	9.59	2.57	0.52	20.01
29725.08	101	57	364	1073	199	1794
	1.13	0.64	4.06	11.96	2.22	19.99
275001	46	27	26	239	1457	1795
	0.51	0.30	0.29	2.66	16.24	20.00
Total	1795	1809	1780	1795	1795	8974
	20.00	20.16	19.84	20.00	20.00	100.00

Rows =  
Earnings in  
1990

Columns =  
Earnings in  
1994

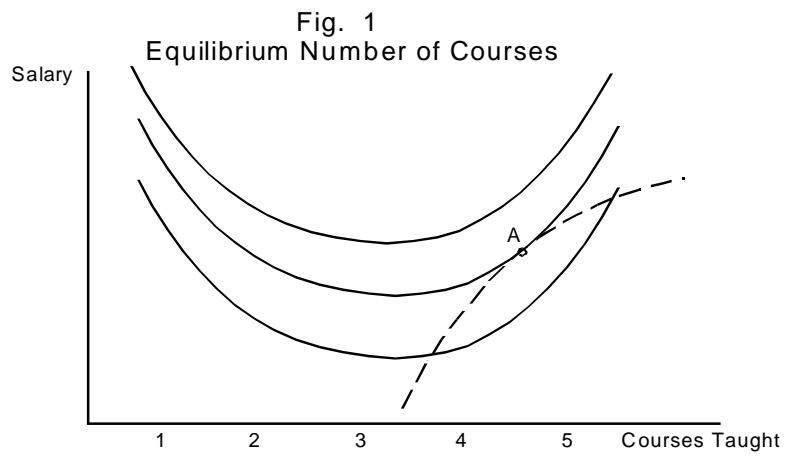
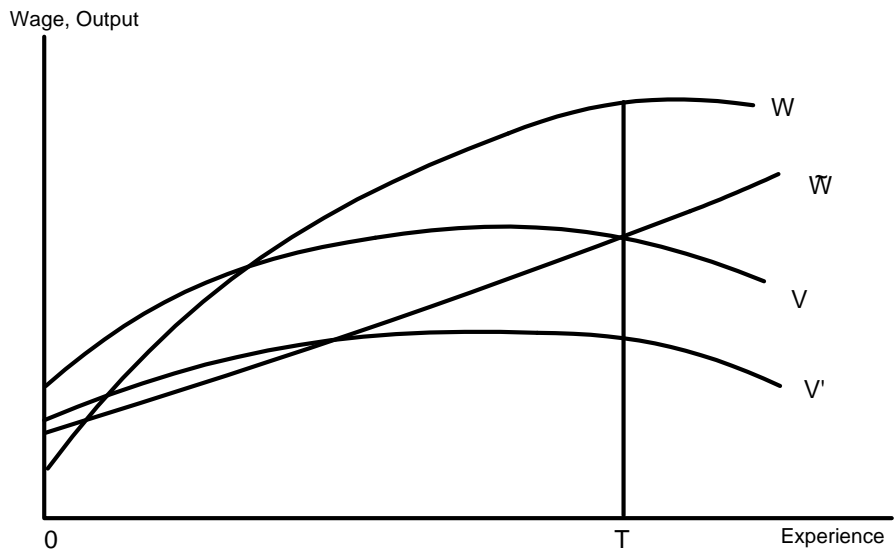


Fig. 2



**Fig. 3**

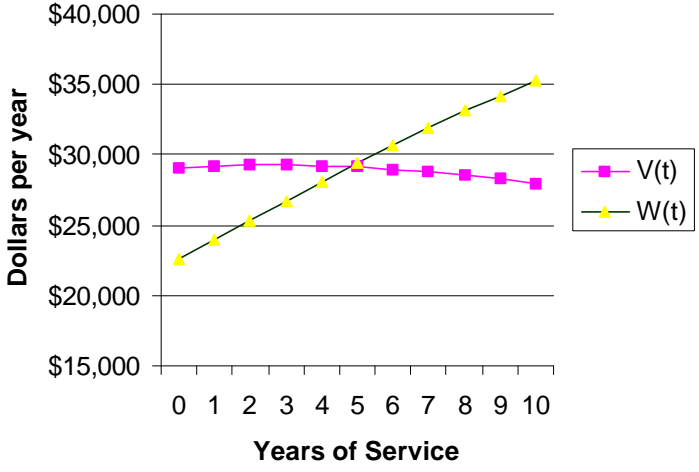
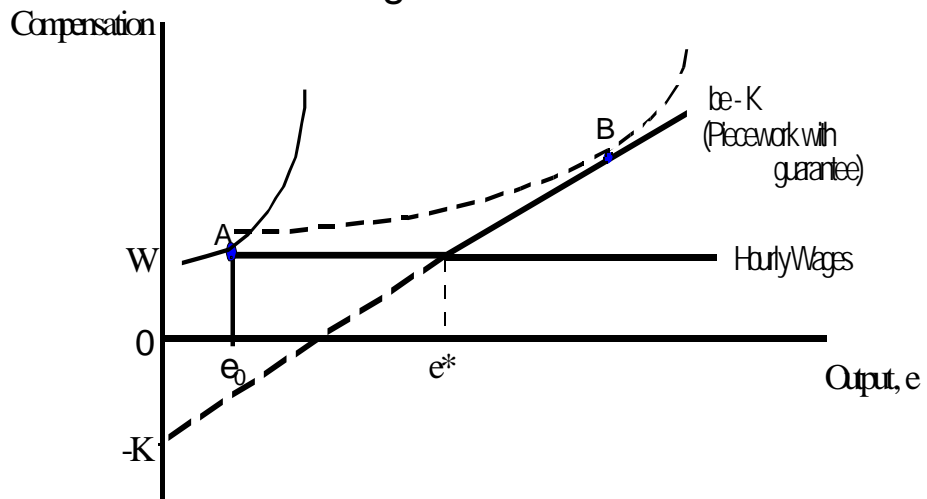


Fig 4





**Fig. 5**

Fig. 6

