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PERSONNEL ECONOMICS:
PAST LESSONS AND FUTURE DIRECTIONS

Edward P. Lazear

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Personnel Economics: Past Lessons and Future Directions
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ABSTRACT

In 1987, the *Journal of Labor Economics* published an issue on the economics of personnel. Since then, personnel economics, defined as the application of labor economics principles to business issues, has become a major part of labor economics, now accounting for a substantial proportion of papers in this and other journals. Much of the work in personnel economics has been theoretical, in large part because the data needed to test these theories has not been available.

In recent years, a number of firm-based data sets have surfaced that allow personnel economics to be tested. Using two such data sets, the implications of theories that relate to life-cycle incentives, tournaments, piecework incentives, pay compression, and peer pressure are given support. The conclusion is that personnel economics is real. It is far more than a set of clever theories. It has relevance to the real world.

Additionally, firm-based data make asking and answering new kinds of questions feasible. The value of research in this area is high because so little is known as compared with other fields in labor economics. Questions about the importance of a worker's relative position in a firm, about intrafirm mobility, about the effect of the firm's business environment on worker welfare, about the significance of first impressions can be answered using the new data.

Finally, it is argued that the importance of personnel economics in undergraduate as well as business school curricula will continue to grow.

Edward P. Lazear
Graduate School of Business
Stanford University
Stanford, CA 94305-5015
and NBER
lazear_edward@gsb.stanford.edu

Personnel economics, defined as the use of economics to understand the internal workings of the firm, has grown in importance over the last decade. Questions that relate to internal labor markets, incentives, compensation, promotion, evaluation, recruitment, turnover, and other resource practices have been investigated at some length in the labor literature. Indeed, in the first three meetings of the Society of Labor Economists, submissions of papers on personnel economics have played a prominent role, accounting for about 25% the total.

My own interest in personnel economics was an outgrowth of my move from the University of Chicago's economics department to its business school. When confronted with students whose focus was primarily business, it became clear that traditional labor economics was less central to their interests than were the topics covered in the organizational behavior curriculum. But economics provides a rigorous and in many cases better way to think about these human resources questions than do the more sociological and psychological approaches. Certain questions, especially those dealing with compensation, turnover, and incentives, are inherently economic. Others, like those associated with non-monetary aspects of the job, norms, teamwork and peer relationships, while seemingly non-economic, are capable of being informed by economic reasoning.

Most of the early work in personnel economics was theoretical. Primarily because of data shortcomings, research focused on dreaming up theories that might explain the empirical regularities of human resources practices. Few papers made serious attempts to test the theories, although other

researchers have provided some evidence on the ideas advanced in the earlier papers.¹

It is now time to take stock. Have the ideas in personnel economics been useful and are they an accurate description of the real world? What kind of evidence can be used to support or refute the claims? Where is the field going? In this essay, three themes are examined:

First, is personnel economics real or merely a series of clever models proposed by abstract thinkers who have little contact with reality? To answer this question, two firm-based data sets are used which can provide direct evidence on a large number of theoretical predictions. The evidence will show that personnel economics has much going for it. Not only does it make sense at an intuitive level, but it finds support in the data. Economics works well in explaining the world and not the least so in the area of human resources. Although it is always prudent to be critical of one's own work, we have much reason to be proud of the success of economic analysis in helping us understand labor markets, both external and internal.

Second, because new firm-level databases are becoming available, labor economists can answer different kinds of questions than the did in the past. Many of these questions are not only interesting, but as a result of their novelty, the answers remain largely unknown. Thus, this is a field that is wide open to discovery. It is much easier to make a mark here than it is in the historically more active traditional important fields like labor supply, labor demand, and human capital. In the second part of the paper, an attempt will be made to make the argument by posing some questions and providing some preliminary answers.

Third, because most students who take labor courses, both at the undergraduate and masters

¹See, for example, Hutchens(1987, 1989), Bull, Schotter, and Weigelt (1987), Ehrenberg and Bognano (1990), Drago and Garvey(1998), Knoeber (1989), Knoeber and Thurman (1994), and Eriksson (1999).

levels are more likely to end up in business than in academic economics or policy analysis, personnel economics is a natural part of their labor economics training. Those less-than-objective economists who work in the field of personnel economics might argue that personnel economics is at least as relevant to the typical economics program as traditional economics curriculum. Thus, the essay concludes by suggesting that personnel economics should become an important part of our teaching programs because of the field's relevance and because of its demonstrated validity.

Personnel Economics is Real

There are a number of theories that have been proposed over the past two decades that purport to explain a variety of human resources phenomena observed in firms.² Since an author cannot expect anyone else to take his theories seriously if he does not, the first part of this essay is devoted to providing evidence that theoretical ideas presented in a number of my previous papers are supported by empirical evidence. The evidence presented comes from two firm-based datasets. One is from an autoglass installation chain named Safelite. The other is from a large financial services company. The approach used is to outline the predictions of the theory, to discuss how the theory could be refuted, to compare the predictions to those of other competing theories, and then to present the results.

Deferred Compensation as a Motivator

My initial foray into personnel economics took the form of a paper entitled, "Why Is There

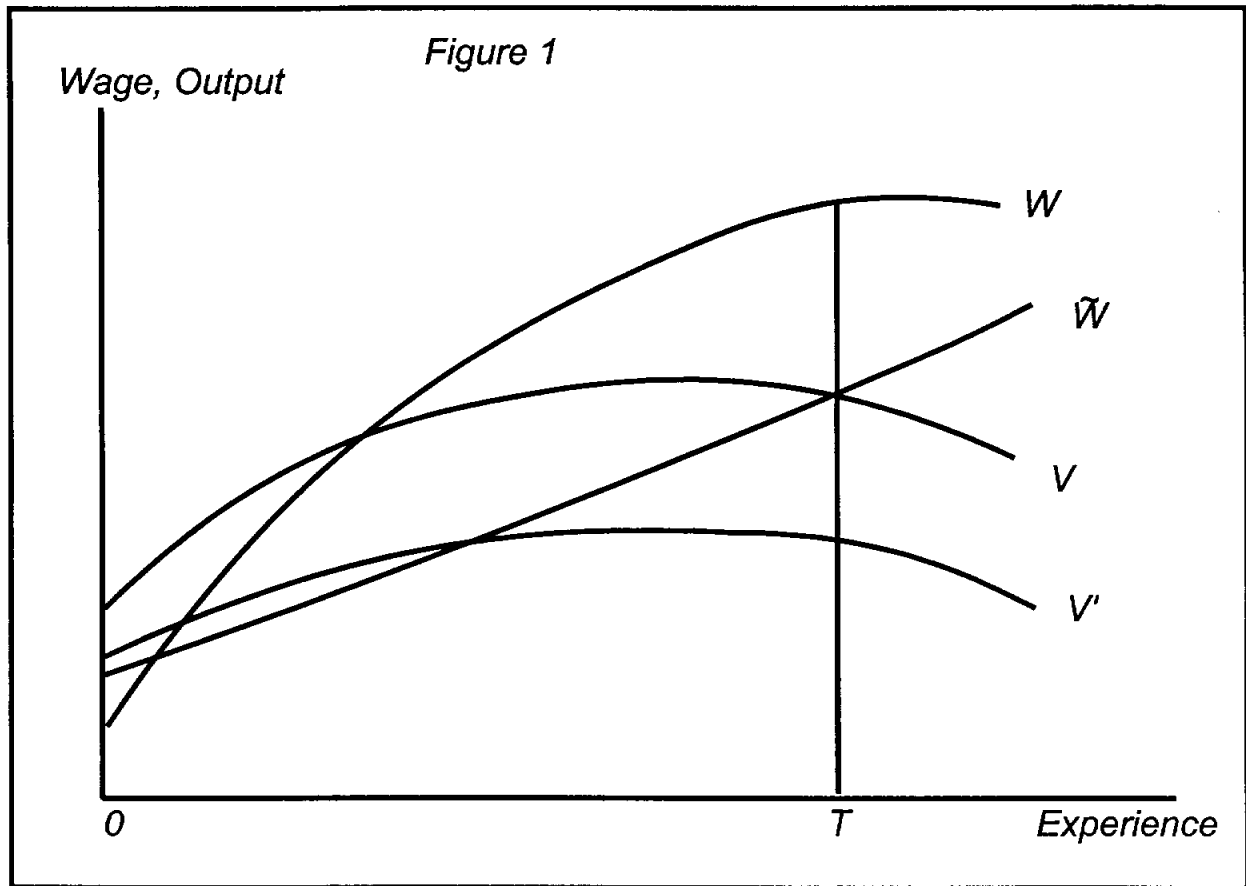
²Actually, the work in personnel economics goes back much further. The earliest mention in relatively modern literature is found in Slichter (1928). Reder (1955) is an excellent example of pioneering work in this area. More recent is the well-known book by Doeringer and Piore (1971).

Mandatory Retirement?" (Lazear, 1979) written in the late 70s when mandatory retirement was still legal in the United States as it currently is elsewhere. Although the purpose of the paper was to explain this particular somewhat puzzling institution, the main contribution was probably proposing a theory of deferred compensation as a motivator. It was argued that senior workers receive high wages not so much because they are worth what they are paid during their senior years, but because high wages served to motivate them during the early stages of their careers. Since the young want to grow old in the firm and reap the benefits of high wage, perhaps cushy jobs, they put forth higher levels of effort than they would for flat wages.³ A brief description of the theory 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 V profile in Figure 1. If he shirks, his output is V' . The \tilde{W} curve in 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 receive 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

³ This theory (see Lazear (1981) for more detail) predated the literature on efficiency wages, but had an efficiency-wage mechanism imbedded in it. High wages are paid to motivate workers and over-supply of labor would result were it not for mandatory retirement or some other hours constraint. The subsequent efficiency-wage literature deviated from the approach used in Lazear (1979, 1981) by obtaining an equilibrium with unemployment. In my work, unemployment does not result. The market clears because workers buy their jobs by taking wages that fall short of the marginal products during the early years on the job. As long as the profile is set up appropriately, and in competition this would be the expected result, the labor market operates efficiently. It is not the incentive component that causes unemployment in efficiency wage models. The incentive component is present in Lazear (1979, 1981) where the labor market clears. Unemployment results in the subsequent efficiency wage models (see Shapiro and Stiglitz (1984)) because sufficiently rich compensation structures are ruled out. It is the wage-rigidity part that creates unemployment, just as it does in the traditional Keynesian story.



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 possibly happen is that he gets fired. If he gets 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 at time T . Thus, 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 \tilde{W} 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, the 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.⁴

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 than performance. Their work has been criticized 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.

The Safelite data set 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

⁴Actually, 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.

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. The results 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. The first is the standard log of earnings (pay-per-day) on tenure and tenure-squared. The second has the same right-hand variables, but uses actual daily output as the dependent variable.⁵ Both regressions allow full interaction with the pay regime by including a dummy equal to 1 if pay during the person-month is piece rate and zero if pay is hourly wage, and also $ptenur$ and $ptenur2$, which are tenure and tenure-squared multiplied by $pppflag$, the piece rate dummy.

The key result is that tenure has a greater effect in the wage regression than it does in the output regression.⁶ The model reported table 1 includes individual-specific effects and a quadratic tenure specification. Using the coefficients from the hourly wage regime, figure 2 shows the slopes of the two estimated profiles. The estimated diagram (figure 2) resembles the predicted diagram (figure 1) 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 omitted, time

⁵The period is a month so that the figures are the average daily figures in a given month.

⁶Although this is true for the raw numbers, it is necessary to normalized these coefficients because output is in windshield units and pay is in dollars. To normalize, it was assumed that the 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.

dummies are included, and a different definition of tenure is used.⁷ The results are unchanged:
 tenure has a greater effect on pay than on output.

Table 1

Pay Regression

Number of obs = 29586
 R-squared = 0.7451
 Root MSE = .15432

ln(pay per day)	Coef.	Std. Err.
Piece Rate Dummy	.1060902	.0052568
tenure	.1723315	.0051049
P.R. Dummy x tenure	-.0080443	.0013366
tenure squared	-.0027871	.0004152
P.R. Dum. x ten. sq.	.0002437	.000063
Constant	3.998284	.0129329

Output Regression

Number of obs = 29412
 R-squared = 0.7562
 Root MSE = .39814

ln(output per day)	Coef.	Std. Err.
Piece Rate Dummy	.2337737	.0135927
tenure	.0809399	.013193
P.R. Dummy x tenure	-.0395036	.0034563
tenure squared	-.0046519	.0010741
P.R. Dum. x ten. sq.	.0014897	.0001629
Constant	.6658699	.0334352

How do these results compare against those that might be expected from traditional human

⁷Within-period tenure rather than total tenure was used. The results were qualitatively the same.

capital theory?⁸ It is necessary to distinguish on-the-job training (OJT) that takes the form of general human capital from OJT that is firm-specific. When investment in OJT is general, the worker bears the full cost of the training. As a result, he is paid exactly his productivity at each point in time. Thus, if OJT were general, then the slope of the experience-productivity profile should be the same as that of the experience-earnings profile. The fact that the slope of the earnings profile is steeper than that of the productivity profile is inconsistent with investment in general OJT being the complete explanation of the experience-earnings relation.

The situation is even more compelling when the alternative considered is that of investing in firm-specific OJT. Because workers and the firm share the costs and benefits of investment, experience-earnings are flatter than experience-productivity profiles. But the Safelite results clearly indicate that experience-earnings rise more steeply than experience-productivity. Thus, firm-specific OJT cannot be the full story either.

The idea that earnings rise more rapidly than productivity is not a rejection that investment in human capital is important. The large tenure coefficients in the experience-productivity relation suggest that learning on the job is very important at Safelite. The question is about the link between productivity growth and earnings growth, not about productivity growth per se. The conclusion from this section is that innovations in personnel economics, which take the form of worklife incentive theory, are necessary to reconcile earnings growth with productivity growth, at least at this one company.

⁸The empirical implications were first spelled out by Becker (1962) and Mincer (1962).

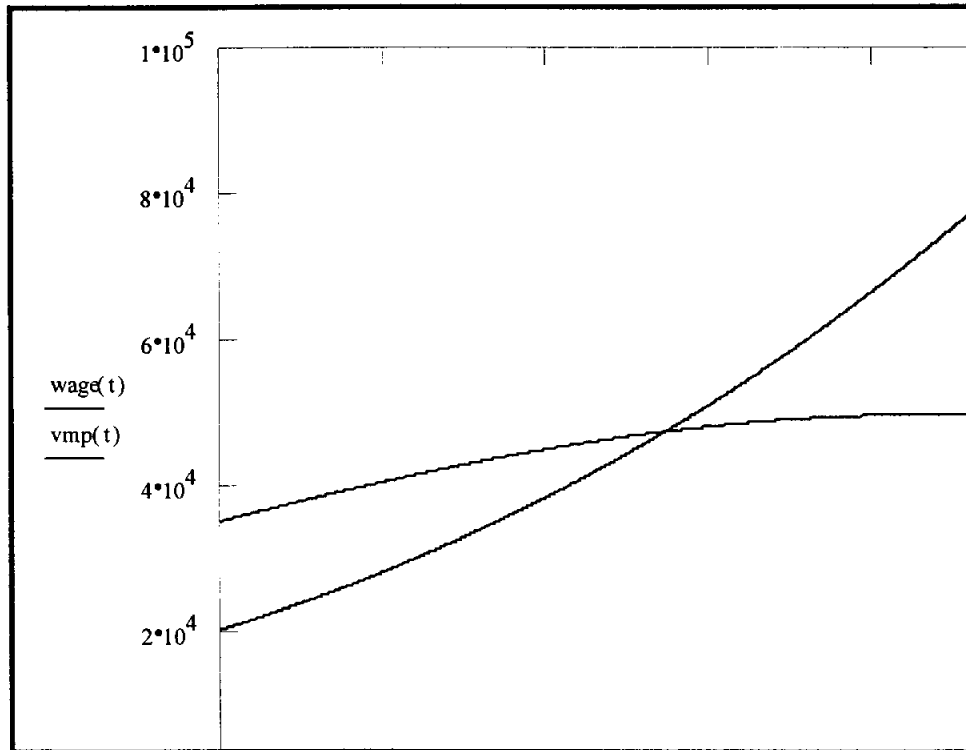


Figure 2

Tournament Theory:

Somewhat related to worklife incentive schemes is tournament theory,⁹ which maintains that firms use promotions to motivate workers. There are two major differences between tournament theory and worklife incentive theory. First, tournament theory emphasizes relative comparisons

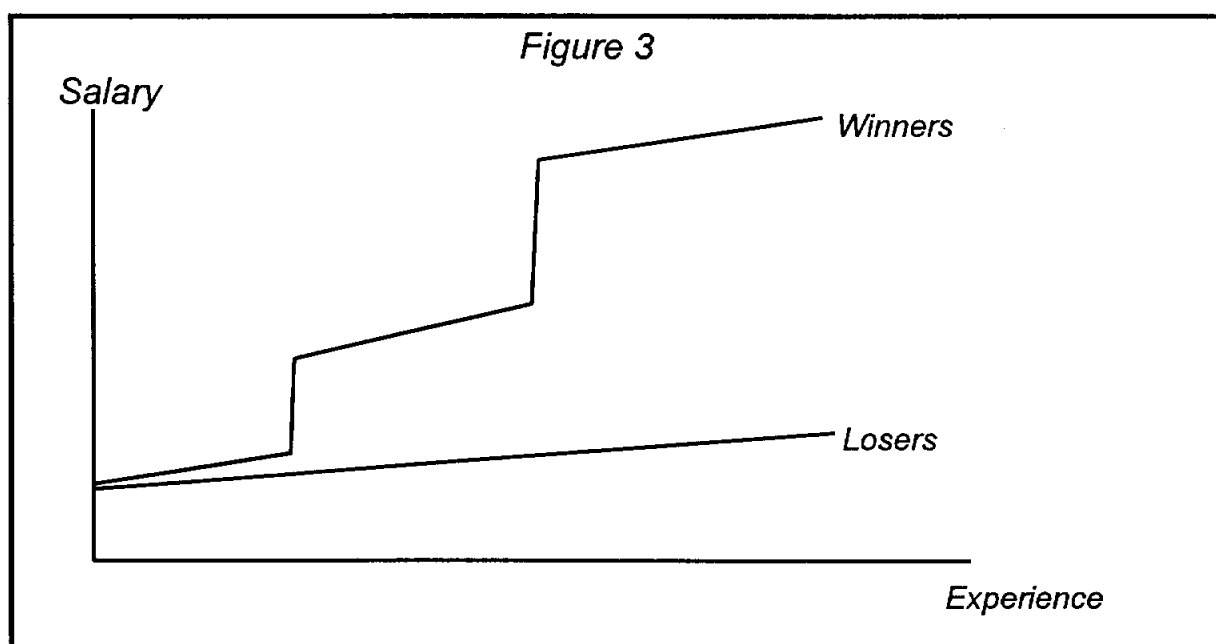
⁹See Lazear and Rosen (1981).

between individuals; worklife incentive theory does not rely on interpersonal comparisons of any kind.¹⁰ Second, tournament theory focuses on pay changes that are associated with promotions, which correspond in the real world to job title changes. The emphasis in the worklife incentive scheme is on wage growth that occurs within a job rather than the growth between them. Both schemes can be at work within the same firm. The salary hierarchy that corresponds to a particular job structure can be modeled by tournament theory. The within job wage growth that is associated with work experience is modeled by worklife incentive theory, particularly for those who are past the stages where a great deal of human capital investment is occurring. At the normative level, promotions are used to motivate young managers. Middle-level managers who know that future promotions are highly unlikely can be motivated through worklife incentive schemes.¹¹

¹⁰Actually, direct relative comparisons are unnecessary. Each worker is assumed to be competing against the equilibrium level of effort, which could also be represented by an effort or output standard.

¹¹This distinction is somewhat overstated because promotions need never cease. There is no reason why changes in job titles must be associated with changes in tasks. "Promotions" could merely signify wage increases.

The important component of tournament theory is that job changes carry with them significant wage increases and that the paths of winners and losers diverge. This is shown in figure 3. Not only do winners have steeper experience-earnings profiles than losers, but winners' profiles are characterized by discontinuous jumps at promotion points. Neither worklife incentive theory nor human capital theory imply any discrete salary changes. Unless learning were extremely discontinuous, human capital theory, taken literally would imply smooth wage growth. Similarly, there is no reason for discontinuity (except at the retirement date) in the worklife incentive story.



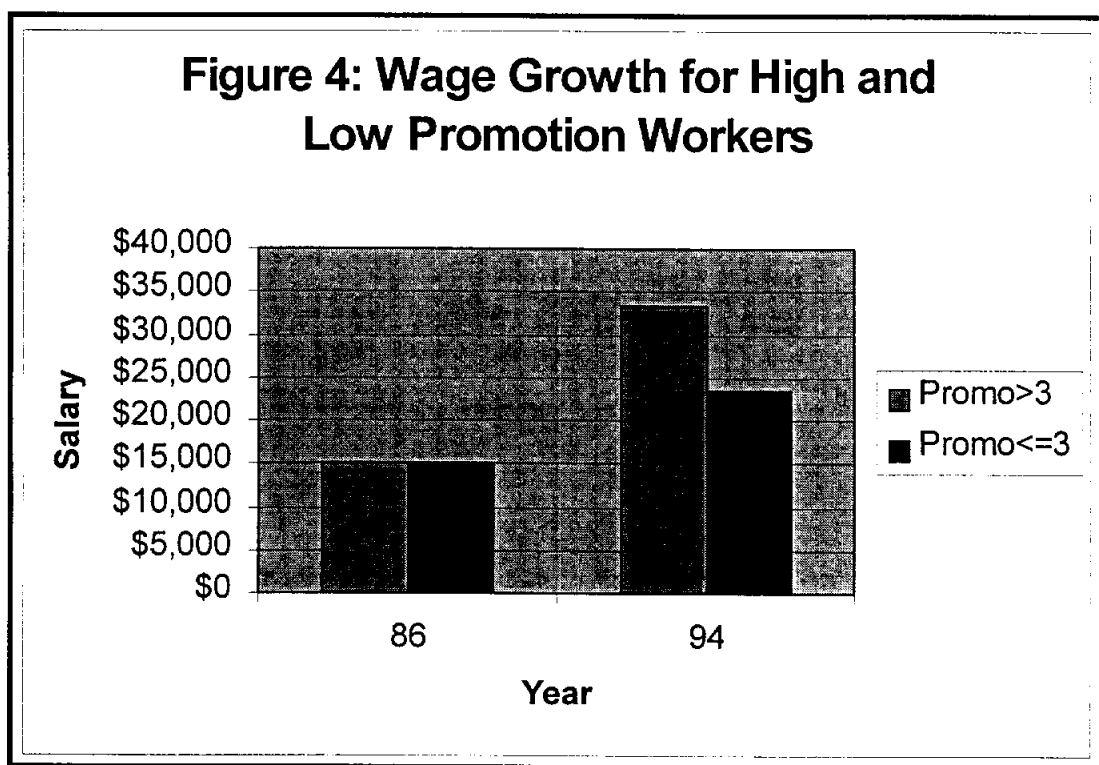
In order to generate discrete jumps, it is necessary to resort to tournament theory or some other explanation.¹²

It is possible to get some sense of whether promotions are associated with discrete wage

¹²Rosen (1986) shows how skew in within firm earnings results in a multi-stage tournament context.

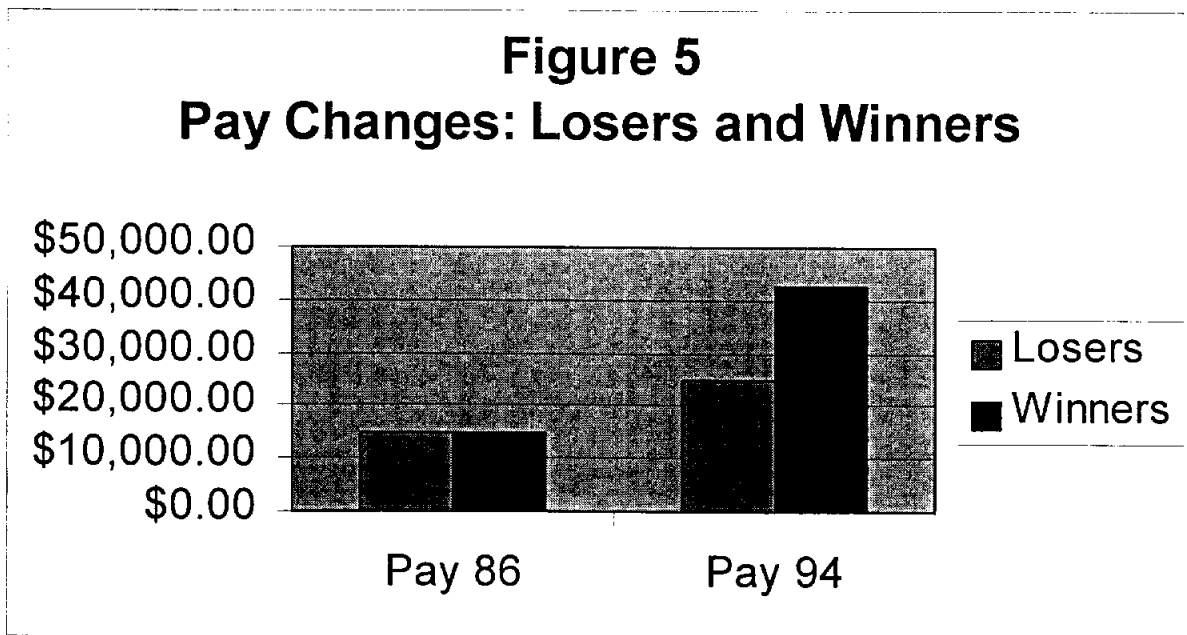
growth above that implied by changes in the levels of experience. McCue (1996) examined this using the Panel Study of Income Dynamics and found that promotions were important in explaining job growth. McCue's study is enlightening, but draws inferences from examining workers at many different firms. To complement her approach, it is useful to examine the entire salary structure of a given firm. To do this, firm based data are needed. The data used here come from a large financial services firm with approximately 42,000 employees at the end of the sample period in 1994. Data were obtained on all employees of this firm (including the CEO) for the period 1986 through 1994. Some workers who were present in 1986 were not present in 1994. Many working in 1994 were not present in 1986. The dataset consists of a series of snapshots of the payroll file on the same date each year. Thus, the exact career path of each employee can be described and compared to others in the same firm.

To see that promotion matters for wage growth, examine figure 4. The sample is the group of individuals who were with the firm continuously from 1986 through 1994. Those with more than three promotions over the period experienced an increase in log of pay of .80. Those with three or fewer promotions experienced a wage increase in log of pay



of .45. Two individuals who both started with the mean wage for young workers¹³ of just under \$15,000 would diverge significantly by 1994. Those with more than three promotions would have on average a salary in 1994 of about \$33,400 whereas those with three or few promotions would have a salary in 1994 of about \$25,500.

Figure 5 presents similar information, but for a slightly different cut. Here, workers who stay during the entire period and are young at the beginning of the period are split into two groups. “Winners” are defined as those with 5 or more promotions over the period. “Losers” are defined as those with no promotions over the eight year period. The losers are not really losers, however, because they have managed to remain with the firm for at least eight years. Still, the difference in wages at the end of the period between the two groups is large, as is shown in figure 5.



¹³Young is defined as having been with the firm for 3 or fewer years in 1986.

Table 2 reports regression result that examine the effect of promotions on wage growth. This is done in two ways.¹⁴ First, each person-year is treated as a separate observation and the effect of promotion on annual wage growth is estimated. Second, wage growth is estimated over the entire 8 year period for the sample of individuals who were with the firm continuously from 1986 through 1994. These are reported in table 2.

The first regression reports a coefficient on “totpromo” of .13. This variable measures the total number of promotions between 1986 and 1994. Thus, an individual with one promotion during the 8 year period would have wage growth that is about 13% higher than one who did not have any promotions during the period. The second regression examines one year wage growth and reports a coefficient of .14 on “promo,” which is a dummy equal to one if a promotion occurred in a given year.

There are two points. First, promotions do create kinks in the earnings function. From the second regression, it is clear that earnings grow about 14% faster in a year during which a promotion occurred than in a year without a promotion.

The importance of promotions is demonstrated in figure 6, which shows two profiles. The profile labeled “Stars” corresponds to an individual who started with wages of just under \$15,000 (the mean for young workers in 1986), but enjoyed 5 promotions during the eight year interval. These were assumed to occur in 1987,88,89,91, and 93. The stars’ profile has kinks that correspond to promotion years. There are no jumps like the ones shown in figure 3 because we cannot determine the exact point at which the promotion and raise associated with it was given. Thus, the picture

¹⁴Summary statistics on the variables in table 2 are reported in appendix table A.

assumes that growth occurred smoothly throughout the year.¹⁵ Second, stars end up with earnings that are 4.4 times their initial earnings, whereas losers end up with wages that are 2.3 times their initial earnings. This corresponds to annual earnings growth rates of 23.5% and 16.2%, respectively. So promotion clearly matters at this firm in a way consistent with tournament theory. Because promotion implies a kink in the profile, neither human capital theory nor worklife incentive theory provides an explanation of the pattern of wage growth that is both observed and a reflection of within-firm tournaments.

The effect of a promotion on wage growth may be misstated by the contemporaneous coefficient on PROMO. The coefficient may overstate the effect of promotion on wage growth if the firm takes in a subsequent year what it gives up this year in promotion. It may understate the effect on wage growth if promotion opens up opportunity for future wage growth. It is possible to examine this directly. One can look at the effect of past promotion on this year's wage growth. This is done in regression 3 of table 2.

This regression contains variables that reflect promotion lagged one year (promolag) and two years (promolag2). These reduce the coefficient on contemporaneous promotion somewhat, but the total effect of a given promotion is now estimated to be .20 on change in log wages, or about .06 greater than that of contemporaneous promotion alone. Evidently, promotion implies additional within-job wage growth. Some of this may reflect ability differences that were observed at the time of hire. Such differences could show up in the promotion decision. Some of the wage growth associated with promotion may reflect reward or ability learned after the time of hire. It is possible

¹⁵The same is true for all raises. These come in discontinuous fashion, but they are assumed to raise wages continuously throughout the year.

to examine the two effects separately. Ability known at the time of hire is as likely to be reflected in future promotions as it is in past promotions, but the effect of the rewards or new knowledge of ability is reflected only in lagged coefficients. Regression 5 in table 2 reports these results. Leads on promotion are shown as “promole.” Note that the effect of the promole variable on this period’s wage growth is very small compared with that of last period’s promotion. Learning about ability after hire or reward as reflected in promotion seem to be an important source of wage growth. Information on ability that shows up generically in promotion does not appear to determine wage growth.¹⁶

¹⁶ Note that the coefficients in this regression on promotion are smaller than in the previous regressions. The sample size is different because individuals had to have been in the sample for the next year as well to be in these regressions. The basic regression on this sample is reported in regression 4. The same pattern is observed when two-period lags and leads are included.

Figure 6
Pay Progression: Stars and Losers

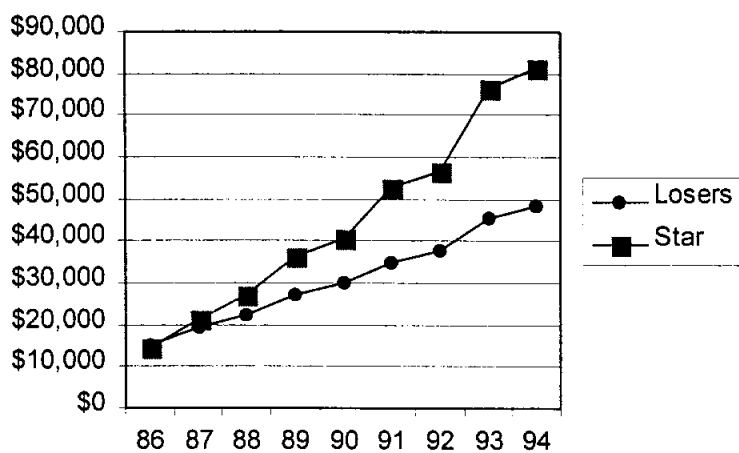


Table 2
The Effect of Promotions on Wage Growth

1:

Dependent Variable = Change in log wages between 1986 and 1994

Number of obs= 4891

R-squared = .17

dpay	Coef.	Std. Err.
tenure	-.0216384	.0011618
totpromo	.1345333	.0072543
_cons	.6218923	.0236682

2:

Dependent Variable = Annual Change in Log Wages (Unit of analysis = person-year)

Number of obs = 123233

R-squared = .04

dlnpay	Coef.	Std. Err.
tenure	-.0176034	.0002819
promo	.1400868	.0050373
_cons	.2186578	.0030998

3:

Dependent Variable = Annual Change in Log Wages (Unit of analysis = person-year)

Number of obs = 57005

R-squared = 0.0115

dlnpay	Coef.	Std. Err.
tenure	.0009663	.0002725
promo	.1078641	.0052318
promolag	.0778803	.0049764
promolag2	.0165095	.0047457
_cons	-.0704595	.0039956

4:

Dependent Variable = Annual Change in Log Wages (Unit of analysis = person-year)

Number of obs = 57390

R-squared = 0.0160

dlnpay	Coef.	Std. Err.
tenure	-.0031468	.0001521
promo	.0540001	.0028358
_cons	.0849271	.0018738

5:

Dependent Variable = Annual Change in Log Wages (Unit of analysis = person-year)

Number of obs = 57390

R-squared = 0.0244

dlnpay	Coef.	Std. Err.
tenure	-.0025411	.000155
promo	.0565873	.0028276
promolag	.0596881	.0026912
promole	.005603	.0029692
_cons	.0653392	.0021526

Salaries and Piece Rates:

The most direct application of personnel economics is to the provision of incentives and one of the cleanest incentive schemes is piecework. When individuals are paid on the basis of their output, their incentives are aligned with those of the firm. Of course, output may be difficult to measure and these practical difficulties may induce firms to offer salaries, defined as payment on input, rather than piece rates, defined as payment on output.

The groundwork for the analysis of compensation methods was laid in a number of papers,¹⁷ but the specific application to worker compensation is found in Lazear (1986). Two issues arise in the discussion. First, how do firms select a compensation scheme? More specifically, what are the factors that affect the choice between payment on input and payment on output? Second, do workers respond to incentives in the predicted fashion?

Knowing the answer to the second question is a prerequisite to answering the first. The analysis of a firm's choice of compensation scheme proceeds in two steps. The worker's behavioral response to various schemes is modeled. Then, the firm chooses the parameters that maximize profits, given the labor supply response behavior derived in the first stage. It is therefore important to establish that workers do indeed respond to incentives as predicted by basic theory.

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, since in most circumstances only one scheme is likely to be optimal, only one scheme is observed for each worker if optimality obtains. Second, in the context of salaries and piece rates, the major reason for

¹⁷These include D.G. Johnson(1950), S. Cheung (1969), Stiglitz(1975), Ross (1973), and Holmstrom (1979).

choosing input-based pay is that some or all components of output are not perfectly observable.¹⁸ 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 have arisen.¹⁹ 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.²⁰ A simple diagram, taken from Lazear (1996), 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

¹⁸See Baker (1992).

¹⁹See Fernie and Metcalf (1997), Paarsch and Shearer (1996), Prendergast (1999).

²⁰The sorting approach was suggested earlier in another context by Salop and Salop (1976).

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 wage guarantee is a required minimum standard of effort, or when it can be observed, output. 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 figure 7.

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 schedule with guarantee 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.²¹

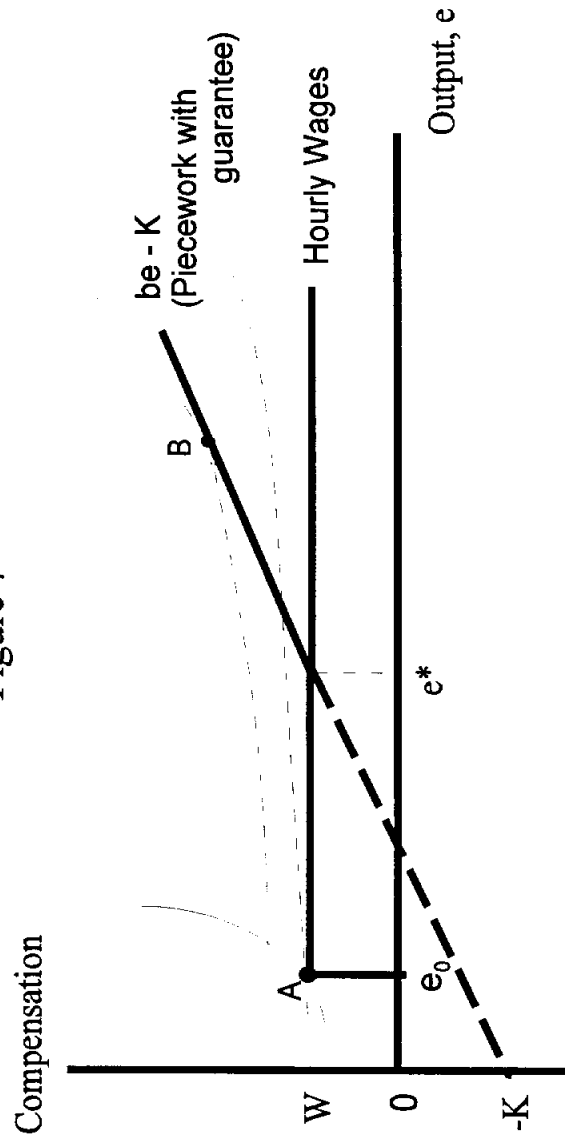
First, average effort does not decrease and generally increases when the firm switches from hourly wages to piece rates. As long as some workers put forth enough effort to be in the piece rate range, then average output rises. This is the incentive effect associated with moving from hourly wages to piece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

²¹The formal derivation of this material is contained in Lazear (1996).

Figure 7



The evidence on these points is presented in table 3, which comes from Lazear (1996). It can be summarized as follows:

Table 3
Regression Results
Dependent Variable: ln (units installed per-worker per-day)
Number of Observations: 29,837

Reg. #	PPPFLAG	r-sqr.	Description
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)

Standard errors are reported in parentheses below the coefficients.

1. Overall productivity increased about 44% (an increase in the log equal to .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 .197, or a 22% increase in productivity for the average worker, as shown by the coefficient in the second row of table 3.

3. The sorting effect can be seen as the difference between the incentive effect and the total effect.²² Sorting can also be examined more directly. Since high ability workers are made most

²²There are some other possibilities for this component, however, which result from the way in which the plan was implemented. See Lazear (1996) for the details.

happy by the new plan, their turnover rates should fall. Table 4 presents some evidence.

Table 4
Separation Rates by Regime and Worker Type

	Hourly Wage Observations	Piecework Observations
Normal Output (Lower 90%)	.046	.053
High Output (Upper 10%)	.035	.029
Total	.045	.050

Separation rates went down for high output individuals after the switch to piecework from 3.5% to 2.9% per month, but went up from 4.6% to 5.3% per month for normal output individuals after the switch. As a result of these very high turnover rates and new hiring, the company had a very different workforce composition in July, 1995 after the firm was completely switched to the new plan than it did in January, 1994 before any switch had occurred.

4. Finally, variance in output rose. Under hourly wages, the variance in average output was 2.02. Under piecework, the variance rose to 2.53.

All predictions of the model are borne out. The effects are large and statistically precise. The Safelite data support the predictions from personnel economics.

Pay Compression:

The argument in Lazear (1989) is that it is rational for firms hiring in a competitive labor market to compress the wage structure. 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.

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

$$\text{Pay} = b e - K$$

where e measures output, setting $b=0$ and K equal to some negative number would result in completely compressed pay. As b goes to 1, the correlation between pay and productivity increases.

Table 5 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 daily output

in units varies, it is necessarily the case that productivity variation will exceed wage variation at least on a daily 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 (1996), 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.²³ 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. Figure 8 shows a histogram of the fixed effects for output (fixedu) and for pay (fixedp).

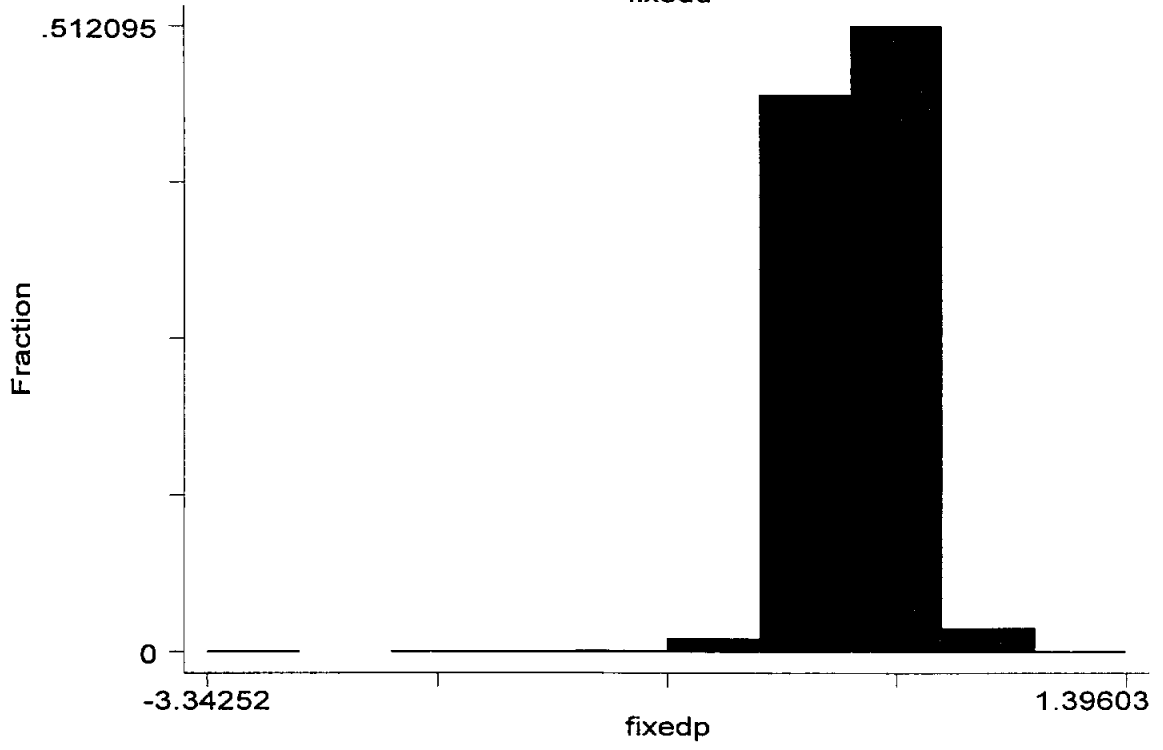
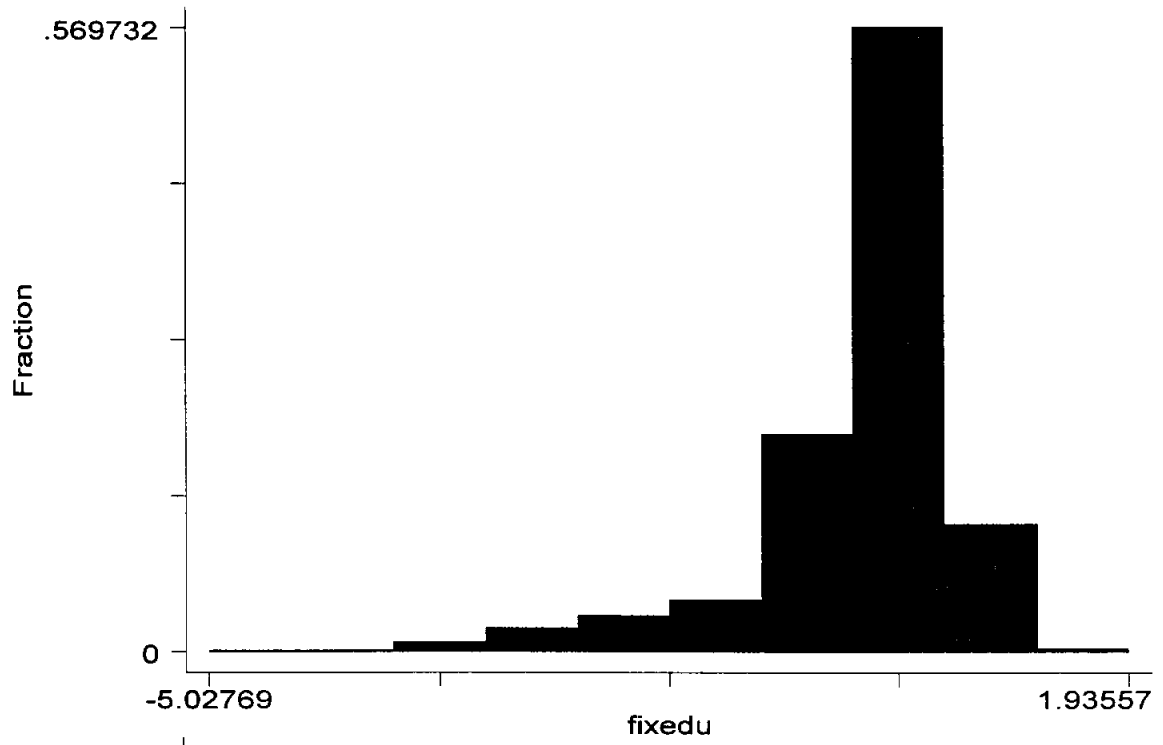
The results of table 5 are clear evidence of pay compression relative to productivity. They may or may not support the view that firms compress wages so as to bring about more harmony at the workplace. There is a fundamental difficulty in testing the latter proposition. In order provide evidence on this 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 with, but not conclusive proof that firms compress wages to foster cooperation.

²³The 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 5 computes the mean of each individual's fixed effect and does not weight by the number of observations used in computing each fixed effect.

Table 5
Variations in Wages and Productivity at Safelite

Pay Status	Variable	Mean	Standard Deviation	Number of Observations
All	Log (Units-per-worker-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	15478
	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

Figure 8



Norms:

Kandel and Lazear (1991) analyze the effects of peer pressure on output. To the extent that norms are important at the workplace, they are most likely to be in force at the small stores that Safelite operates throughout its company.²⁴ 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.

The effects of peer pressure could have operated in a number of ways at Safelite. First, the announcement that the firm was going to move from hourly wages to piece rates could have a direct effect on worker behavior. This effect is picked up in the time dummies, though, and cannot be disentangled from other variations in output that are caused by seasonality and idiosyncratic weather events.

Second, when a given store moves to the piece rate system, there may be effects on all workers. As low output workers see other workers putting forth higher levels of effort, they may become less secure in their positions. This might be true even if the low output workers are never even close to being in the piece rate range.

Recall that hourly wages are always coupled with some (implicit or explicit) minimum standard on input or, if observable, output. This was labeled e^* on figure 7. A worker may not know e^* , but may try to infer it by looking at the output of his peers. As average output rises, a worker who feels that he is close to the minimum cutoff level may be induced to increase his output. This can be tested using the Safelite data.

Let us define two groups of workers. A dummy variable, L , for low output, is set equal to

²⁴Encinosa, Gaynor and Rebitzer (1997) examines peer pressure and profit sharing in medical practices.

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 figure 7, they are the workers who should have chosen to be at point A.

The fixed-effects regression reported in table 3 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 6.

Table 6
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

Workers who are or have potential to be in the piece rate range experienced an average increase in output of .55 units. Those who never reached (or close to reaching) the piece rate range experienced an increase in output of .32 units. The model as illustrated by figure 7, 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.²⁵

Workers who are out of the piece rate range probably increased their effort level because they sensed that e^* , 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^* .

The Evidence Supports the View that Personnel Economics is Real:

The evidence presented in this section supports the view that personnel economics is real and that the theories have the power to explain patterns that are observed in the real world. Of course, the data used to demonstrate this proposition comes from only two firms. As such, this is little more than a case study.²⁶ But more data of this type are becoming available so additional evidence is likely to be presented in the near future.

In order to demonstrate that personnel economics is real, I believed it most appropriate to examine the validity of my own theories first. A number of the propositions that I have put forth

²⁵Note that the coefficients in table 6 are the effect only of the switch to piece rates. Thus, output of low output workers increased by .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 .32 is not the effect of improvement in general conditions at Safelite in general.

²⁶The results that pertain to worker reaction to Safelite's change should not be interpreted as coming from one case study. It is best interpreted as a shock that hits about 3000 workers. It is the behavior of the 3000 workers, not the one firm, that is reported.

over the past twenty years were checked. The evidence supports the following views:

1. Age-earnings profiles are steeper than age-productivity profiles, consistent with the view that the earnings profile serves an incentive and perhaps a retention role, in addition to compensating workers for the enhanced skills that they acquire on the job.

2. Consistent with tournament theory, promotion is an important source of wage growth for “winners.” Further, the difference between the earnings of those who are promoted and those who are not are substantial. The prize associated with winning the race up the corporate ladder is large enough to matter to most workers. Finally, some of the gains from being promoted are received as additional wage growth within the position after the promotion is granted.

3. The theory of incentives, specifically as applied to the difference between hourly or time-based compensation and piece rate compensation, finds strong support in the data. Worker behavior, both in terms of sorting and response to incentives, matches the predictions of incentive theory very well.

4. Pay compression seems to be an important force in the firm studied. Personnel economics predicts that compression will be used to facilitate cooperation among workers. The evidence is consistent with this view, but the firm examined is not one in which cooperation effects are likely to be strongest. As such, additional corroboration is needed.

5. Peer pressure, perhaps through demonstration effects, seems to be a force in motivating workers. Even workers who were not able to take advantage of the piece rate schedule directly increased their output when the compensation scheme was switched. This probably reflected the message that standards had risen, which was made credible by the fact that overall output rose.

New Directions for Research in Personnel Economics

As a result of firm-based data becoming available, there is a whole range of new questions that can be answered. Most of these are quite new, at least to economics. As such, the potential for significant breakthroughs is great. Indeed, I believe that the rate of return to research on these new questions in personnel economics is likely to be much greater than that on research in more traditional labor economics areas. It is not that the older questions are less important than they were in the past. Rather, it is much more difficult to make substantial advancements on our knowledge in areas that have been investigated for thirty or forty years than it is in a new area. As such, the issues discussed below may yield greater payoffs, at least in the near future.

I first proposed that we turn our attention to empirical issues that used job-based or firm-based data in Lazear (1992) and used a panel data set constructed from one firm's complete personnel records over about a ten year period. This work was followed by Baker, Gibbs, and Holmstrom (1994) who made similar uses of company based data. The basic pitch in Lazear (1992) was that taking the job as the relevant unit of analysis leads us to consider different questions and to use different kinds of data sets. In what follows, the questions outlined there are expanded and new ones are discussed.

To investigate the issues, the financial services company data will be used. Recall that this is a nine year panel on everyone who worked at the firm between 1986 and 1994. In addition to information on pay and position, scores on annual evaluations done by supervisors are reported. Although admittedly subjective, the evaluation data allow for some interesting areas of investigation that are less standard in the economics literature. Some questions and preliminary answers, which are based on the financial services data, follow.

Relative v. Absolute Performance:

The essence of tournament theory is that relative performance matters. The most direct test of this basic premise of tournament theory involves an examination of whether promotions are based on relative performance. The theory predicts that workers should be judged and rewarded on the basis of their performance relative to others in their comparison group. It is only possible to assess a worker's relative position by having data on the group against which he is compared, in this case, the other workers at his firm in his same job. One of the firm based data sets discussed above makes this comparison possible.

In the financial services data set, individuals are rated by their supervisors annually. Those scores, numerical values between 0 and 5, can be used to rank individuals relative to one another. This is done on a job-year basis. That is, for each year and job, the average score on the performance evaluation is computed. Then a variable that measures the difference between an individual's performance level and the mean for his or her job can be computed.

Before analyzing relative performance, it is important to define the group of which the individuals is part for the purposes of comparison. 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 7, where the probability of promotion is posited to depend on absolute and relative performance scores.

Table 7

Logit Estimates Number of obs = 142038
 Log Likelihood = -55629.363

Dependent Variable = Promotion Dummy

	Coef.	Std. Err.	z
Performance Score	.0312077	.0219066	1.4
Difference in Performance	.3825541	.0267416	14.3
Constant	-1.989317	.0767519	-25.9

As is clear from table 7, “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 .61 whereas that of the difference is .50. The means are 3.48 and zero, respectively.) 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 are 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 more likely to be promoted than A. These findings are supportive of the tournament view of promotion and could only be obtained by using firm-based data, which allow the relative comparisons to be made.²⁷

²⁷The 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.

The Dynamics of Intrafirm Status:

Are relative positions in the firm stable over time? Is the person who is situated at the firm's 95 percentile of income in 1986 also likely to be at the same position in 1994 or do relative positions shift around? Is there a "once a star, always a star - once a loser, always a loser" effect or is there a great deal of intrafirm mobility? Simple human capital theory suggests us that there must be some upward mobility in relative positions as individuals start at the bottom, acquire skills, and move up in the income distribution. What is the typical pattern?

The transition matrix shown in table 8 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.

Table 8

Rows=Earnings in 1990; Columns = Earnings in 1994

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
	6.22	8.94	3.31	1.21	0.31	19.99
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

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.

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. This is examined in another way below.²⁸

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.

Turnover - Who stays and who goes?

Although there is a large literature on worker mobility, it is based on individual-based data sets that do not permit an examination of the worker's situation in his current firm. Do firms keep their best workers or do they lose them to the competition? Firm-based data allow us to determine how workers do in relation to their peers and broaden the set of theoretical propositions that can be tested.

Again, using the financial services data, it is possible to look at turnover probabilities and their determinants. This is done in two ways. First, each person-year is treated as a distinct observation and a logit is run that has as its dependent variable a dummy (SEPAR) that is equal to

²⁸See the section labeled, "What have you done for me lately?"

one in the year during which the individual left the firm. Second, a proportionate hazard model for censored data is estimated. The results are contained in table 9:

Table 9
Separation Results

Logit Estimates Dependent Variable is SEPAR

Number of obs = 134632

Log Likelihood = -31588

separ	Coef.	Std. Err.	z
year	-.1601774	.0044923	-35.656
date hired	-.0137769	.0020442	-6.740
total comp.	-.00018	1.67e-06	-107.887
comp. sal.	.0001243	1.71e-06	72.485
age	-.0021733	.0011614	-1.871
promoted	-.6322732	.0350984	-18.014
performance	-.4020703	.0190723	-21.081
_cons	15.14701	.3854178	39.300

Hazard Ratio Estimation for Job Length

Estimated correcting for censored data since only some individuals have completed their employment.

Number of obs = 26072

Log Likelihood = -13964.678

	Coef.	Std. Err.	z
date hired	-1.99e-06	4.94e-07	-4.036
age	-.0272142	.0035962	-7.567
ave. comp.	-.0000142	2.99e-06	-4.758
comp. sal.	.00002	3.79e-06	5.274
ave. perform.	.0941915	.0552432	1.705

Observe that the higher is total compensation, the lower is the likelihood of a separation. This could reflect one of two factors. One possibility is that within grade, those who are better performers are likely to be better rewarded, which results in fewer quits. Alternatively, it could be

that those who are better compensated are at higher levels in the firms hierarchy and that higher level jobs exhibit more stable employment. The second explanation is contradicted by the positive coefficient on “comp. sal.” This variable is the salary on jobs comparable to the one held and is an indicator of level in the hierarchy, but is a measure different from the individual’s own salary. At this firm, it is the higher level workers, not the lower level ones who separate most often. Within grade, however, the more highly paid and presumably better suited workers, are the ones who remain on the job.

There seems to be a “play-me-or-trade-me” mentality in this firm. Workers who have experienced a recent promotion are less likely to separate than those who have not been promoted. This may seem to be an obvious finding, but it is not. Promotion also signals to the outside that a worker is valuable (see Waldman (1984)) as well. If all human capital were general, one would expect no relation between promotion and separation because the worker’s value inside and outside would be identical. The current firm should be willing to match outside offers. However, as long as some human capital is firm-specific, then a promotion may signal that the worker is better suited to the current firm than to other firms. Under these circumstances, promotion would be negatively associated with turnover.²⁹

The coefficient on performance is similar. It, too, suggests that better performers are less likely to separate. Better performance may reflect general skills, which would have no implications for turnover, or specific skills, which would reduce turnover. The fact that separation is negatively associated with performance suggest that at least some of what is measured by the internal

²⁹This is the mechanism that is discussed in Jovanovic (1979) and more directly applicable to the context here, in Lazear (1986).

performance evaluation is firm-specific.

There is an additional complication in interpretation. The logit holds wages constant. For these explanations to hold, it is necessary that performance and promotion measure rents to at least one side. Thus, at a given wage, those with higher levels of performance must have lower alternatives and/or must be worth more to the firm. Either would result in lower turnover, holding wage constant.

The second panel of table 9 estimates a proportional hazard model. The variables mimic those in the first panel except that they reflect the averages over the period during which the individual is employed by the firm.³⁰ All coefficients, except the one on age have the same sign as those in the annual separation logit. The coefficient on age is positive, but not significantly different from zero, in the hazard model.

One somewhat surprising result is that the date of hire is negatively related to separation probability. Those who are hired most recently are less likely to leave in this firm. Of course, this is after age, wage, and other performance factors are held constant so the interpretation is different from that in the usual separation models. Additionally, this firm experienced major growth throughout the period and those workers hired in the past may not have been well suited to the new environment.

Promotions and Performance:

Are those who are promoted likely to perform less well in their new job than they did in their

³⁰Promotion is deleted because including number of promotions over the period is a proxy for job length since there can be no more than one promotion per year.

previous job? There are two reasons to expect this to be true. First, there may be learning that takes place on the job. Individuals who were recently promoted are necessarily new to the job and are likely to be acquiring new skills. Those who were not recently promoted do not have as steep a learning curve. Second, a recently promoted individual has moved into a higher ability pool and the comparison with his peers is likely to be less favorable than that with his prior job-mates. An extreme version of this is the Peter Principle³¹, which states that workers are promoted to their level of incompetence. That is, workers stop being promoted only after they are found to be lacking in their new job.

Table 10 provides some evidence on these issues. Here, the observation is a person year. All person-year observations are divided into two categories: those in which promotions occurred and those in which they did not. For each person-year, a performance evaluation score is reported. Those workers who remained with the firm for the next two years also have performance evaluation scores in each of those two years. Thus, PDIFF is the difference in the performance score that was received by a given individual two years after the date of the observation and the performance score for that same individual during the year of the observation.

Table 10

	Not promoted during the year	Promoted during the year
PDIFF (Change in the performance score)	.052 (.003)	.003 (.006)

The main finding is that performance evaluation scores tend to rise for workers who are not

³¹See Peter (1968).

promoted. They get better in their current jobs or, at least are perceived to improve over time. This is consistent with acquiring job-specific human capital. Those who are promoted do not experience the same performance evaluation growth over the two year period. Relative to the average employee, their performance falls with time. To the extent that performance evaluations measure objective productivity, those who are promoted are less likely to be as productive in their new jobs. This finding is consistent with the view that the firm sorts workers by ability and promotes those with higher levels of ability to higher level jobs. Because job evaluations have a relative component, the tougher the competition, the less improvement in an individual's performance score as he acquires additional experience.

What Have You Done For Me Lately?

It is possible to ask whether there are halo effects within the firm. Are employees who are identified as good performers during prior years more likely to be treated well, given their performance this year?. Table 11 reports the results of a regression where the change in the log of annual pay is the dependent variable. The right hand variables include age, tenure, and performance measures for this year, last year, and two years ago.

Table 11
Halo Effects

Simple correlations: Performance with lagged performance = .63 (N=100,310)
 Change in log wage with lagged change = .70 (N=84,369)
 Number of obs = 69296
 R-squared = 0.0109
 Dependent variable = Change in log of total annual pay over one year period

dlnpay	Coef.	Std. Err.	t
tenure	.0007322	.0002941	2.4
age	-.0015321	.0002077	-7.3
performance	.0708476	.0037186	19.0
Last year's performance	.0074964	.0042266	1.7
Performance 2 years ago	-.001714	.0037154	-0.4
Constant	-.2455407	.0146196	-16.7

The results suggest that there are no halo effects. Neither last year's nor the previous year's performance, as measured by the evaluation, affects wage growth this year. But there is a very strong effect of this year's performance on wage growth. Apparently, this firm continually asks, "What have you done for me lately?"³²

The Effect of the Business Environment on Worker Welfare:

What is the effect of macroeconomic variables on worker welfare, as reflected by wage growth and or promotion? Specifically, how does firm growth affect wages and promotions? The firm in question experienced two different growth paths during the sample period. These are shown in figure 9. The period from 1986 through 1989 was one of slow growth, whereas the period from 1990 through 1994 was one of rapid growth. It is possible to examine how employees did in the two

³²It is also possible that the current evaluation score is "rigged" to justify the wage increase that a supervisor wants to give his subordinate.

different time periods.

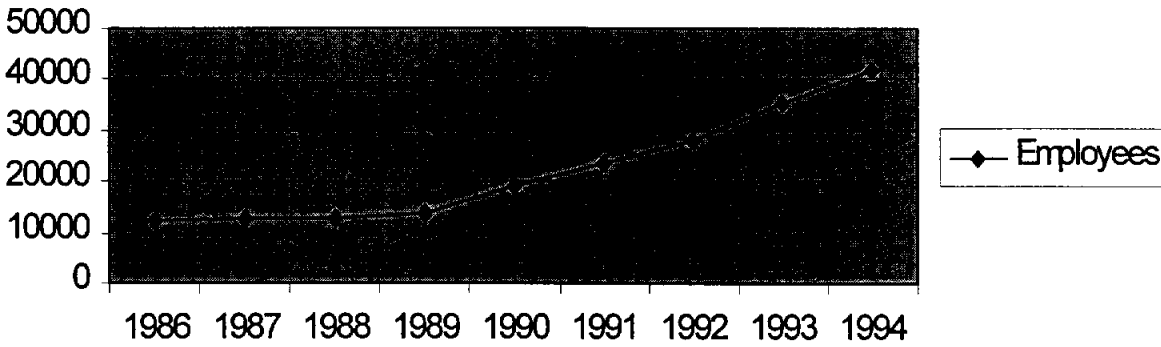
Table 12
Wage Growth and Promotion in Low and High Growth Environments

Period	Average growth rate in number of Workers	Average growth rate in wages	Promotion Rate
Low Growth 1986-1989	.039	.083 (.0007)	.114 (.0014)
High Growth 1990-1994	.223	.123 (.0007)	.135 (.0009)

(Standard errors are in parentheses.)³³

³³Partial year observations were dropped from the wage growth calculations.

Figure 9
Number of Employees over Time



The evidence in table 12 makes it quite clear that firm growth, wage growth, and promotion all move together in this firm. Wages grew about 50% faster during the high growth period (after 1989) than during the low growth period (1986-89). Additionally, promotions were almost 20% more likely during the high growth period than during the low growth period. New hiring and/or acquisition of other firms is clearly good for the workers at this particular firm.

The relation of worker welfare to firm growth is not well understood. Again, it belongs in the realm of personnel economics to a large extent because of the required unit of analysis. Firm based data are almost essential. This is not the kind of question that can be answered using standard national panel data (like the NLS or PSID) because those data sets do not contain the relevant information about the firm in which the individual works.

Within-firm Cohort Effects:

Market conditions seem to affect the wage at which an individual is hired into a job. It is commonly alleged that brand new assistant professors earn more than the second year group, who arrived a year earlier. Are cohort effects a reflection of different firms doing the hiring in different years or does a given firm pay attention to a worker's entering cohort?

Why should one even care about the firm-specific cohort effect? If wages are market driven, then the national datasets that use the individual as the unit of analysis incorporate all market effects. Although firms may not be able to affect the wage function, they can choose where on the pay-quality spectrum to locate. This, by itself, may be interesting to researchers.

The financial services data allow us to examine within-firm cohort effects, at least at this one firm. In table 13, a regression that removes the average job effect is reported. The year effects are

large and significant and amount to more than the average rate of inflation. A worker who is hired one year later earns about 8% more than a worker hired into the same job during the previous year. This is another manifestation of the effects of firm growth on worker wages since the latter period was also one during which the firm was growing.

Table 13
Regression of Log of Total Pay on Year, Job Effects Removed

Number of obs = 63430
R-squared = 0.4765
Root MSE = .95392

lnpay	Coef.	Std. Err.	t
year	-.0811626	.0029928	-27.119
Constant	16.26978	.2712165	59.988

absorbs (job) F(8248,55180) = 5.744 (8249 categories)

Many Questions, Some Answers:

A number of somewhat unconventional questions were addressed in this section. These questions can be answered only with the use of firm-based data. It is the increased availability of this kind of data that makes answering these question feasible today. In this analysis, only one firm's data were used, so the results are hardly conclusive. Still, they suggest that further research along these lines may be useful. Specifically,

1. Relative performance as measured by annual evaluations matter. It is the within-job rather than within firm comparisons that determine promotions, consistent with tournament theory.
2. Internal mobility is substantial. Theories that require internal reward and punishment of

workers are bolstered by these findings.

3. Turnover is less likely among the high wage, high performing workers. Also, those who have been recently promoted are more likely to stay with the firm.

4. Individuals who are recently promoted do not experience as much growth in their performance scores as those who are not promoted. This is consistent with job-specific learning and with ability differences that sort by levels in the firm's hierarchy.

5. Rapid growth in the size of the firm produced both more rapid wage growth and higher promotion rates.

6. Cohort effects are important and large, even within a given firm.

The Role of Personnel Economics in the University Curriculum

Although personnel economics is becoming a standard part of the business school curriculum, particularly at the graduate level, the material has not become a major part of the education programs of economics departments. This is beginning to change and will accelerate over the next few years.

There are a few reasons. First, most economics students at the undergraduate level do not go to graduate school in economics. The majority enter business. Personnel economics, with its direct focus on business issues, is at least as relevant to these students as the standard material taught in an undergraduate labor economics course.

Second, there is precedent set by other business school fields, most notably finance. Fifty years ago, finance was a field with little solid theoretical or empirical literature. As a result of breakthroughs in the theory of finance, an enormous empirical literature was generated.

Subsequently, finance started being taught in business schools and used by practitioners and consultants in business. Now, finance has become a part of the subject matter taught by economics departments, especially among the best departments in the country.

We may expect similar developments for personnel economics. Thirty years ago, personnel economics did not exist. The literature in personnel was descriptive, loose, and ad hoc. But personnel economics is now an intellectually respectable field. It is rigorous, analytic, and rich in empirical predictions that are starting to be tested. It was the lack of substance, not the lack of interest that kept the subject out of the economics curriculum in the past. That reason no longer exists.

Third, many more people are working in this area than was the case even ten years ago. These researchers are well-equipped to bring personnel economics into the classroom and have an interest in doing so. At the time of this writing, I am the only economist to have written a book or textbook in the field³⁴, but despite my willingness to monopolize the market, others are sure to follow.

Fourth, personnel economics is not just a fad. The field has been around now for at least 20 years. The growing availability of firm-based data and other data that are appropriate for testing the theories will only strengthen the interest and activity in personnel economics. It is a field that is here to stay.

³⁴Lazear (1995) is a short book that describes the field at a mildly technical level. Lazear (1998) is a genuine textbook intended to bring the material to the MBA and undergraduate classroom.

Conclusion

I began by arguing that personnel economics is real. There are a large number of theories that relate to the use of labor economics in business that now form the crux of personnel economics. The theories are not just ideas; when evidence can be brought to bear on them, the evidence supports the theories.

Furthermore, the theories and new data sets lead to additional issues and researchable questions. Some of those have been discussed here and some preliminary evidence has been presented. The evidence illustrates that it is possible with data now available to answer questions that could not be addressed in the past.

Finally, because of the relevance and newly-found rigor of personnel analysis, personnel economics should and will become a more important part of the educational curriculum. The field is growing and is one that has a large potential audience, of both students and practitioners.

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Appendix Table A

Variable	Obs	Mean	Std. Dev.	Min	Max
dlnpay	123233	.124132	.7226912	-7.592198	7.047651
dpay	33659	.3180266	1.246648	-7.683821	8.80177
promo	131110	.2006102	.4004584	0	1
promolag	86590	.2157524	.4113457	0	1
promole	131110	.2006102	.4004584	0	1
totpromo	4966	1.288361	1.037569	0	6