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Working paper 98-06A

Current version: May 27, 1998

Keywords: layoffs, seniority, deferred compensation
JEL classification: J33

We are grateful to Jim Rebitzer for helpful comments and insights. Lowell Taylor wishes to thank the Research Department of the Federal Reserve Bank of St. Louis for research support. Views stated here are those of the authors and not necessarily those of the Federal Reserve Bank of St. Louis.

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Abstract

This paper provides a simple economic rationale for two elements that often appear—implicitly or explicitly—in firms' personnel policies. When firms reduce their labor input they often (i) lay off a few individuals rather than adjust work hours, and (ii) make retention decisions on the basis of seniority. We show that in a stochastic environment, a seniority-based layoff policy can have the effect of making the job valuable to a worker over most of her career. This provides work-life incentives using a mechanism similar to Lazear's well known model of upward-sloping wage profiles. Firms reduce their workforce by adjusting employment rather than work hours because layoffs are an intregal part the incentive scheme.

In two well known papers, Lazear (1979, 1981) argues that firms' resolution to pervasive agency problems may sometimes entail paying a lifetime wage profile in which the wage is below the value of workers' marginal product early in their careers, but above the value of marginal product later in their careers. In essence, junior workers post performance bonds which are repaid as they near retirement. This makes jobs valuable, which in turn makes dismissal-based policies an effective means of regulating worker behavior.

We pursue Lazear's logic in the context of a model in which the firm faces an uncertain future. In our setting, the firm's manager and employees alike understand that changes in future product demand or shocks to productivity can affect the firm's demand for labor, and result in layoffs. These layoffs are typically costly to workers as they suffer short-term loss of income, even if the layoff is temporary, and incur search and relocation costs if the layoff is permanent. Because job loss is costly, workers will place a higher value on jobs that are secure.

We show that a layoff policy that provides senior workers a high degree of job security (relative to junior counterparts) in principle has the same incentive effects on workers' behavior as upward-sloping wage profiles. In contrast to firms' use of upward-sloping wage profiles, however, use of seniority-based layoffs need not be accompanied by the potential for moral hazard. A myopic manager in a firm that posts upward-sloping wage profiles will always be tempted *ex post* to violate the implicit contract with workers by discharging expensive senior workers (though this temptation might be mitigated by reputation effects). There is no analogous scope for moral hazard for a firm that adopts a flat wage profile but uses seniority-based layoffs to make jobs valuable. In short, a seniority-based layoff policy is incentive compatible.

Our theory, though quite simple, makes two contributions. First, it provides a compelling rationale for a management practice—the use of seniority as a basis

for worker retention decisions—which appears to be extremely common. Rousseau and Anton (1991), for example, find widespread agreement among managers about the "fairness" of policies that provide senior workers with an increased degree of job stability even when senior workers are not more productive than younger workers. From a 1981 survey Abraham and Medoff (1984) conclude that "in over 80 percent of private sector nonagricultural, nonconstruction employment, senior workers enjoy substantial protection against losing their jobs" (p. 96). Idson and Valletta (1996) provide persuasive empirical evidence of a positive effect of seniority on employee retention, and refer to other relevant empirical work.

Second, our model gives a simple answer to an important question in labor economics: Why do firms often make labor-force reductions by laying off workers rather than reducing work hours for all employees? Our answer is that layoffs can be an integral part of an incentive-compatible scheme to resolve the agency problem.

Our explanation for the use of seniority-based layoffs is distinct from most of the literature addressing this topic. Our argument does not rely on the assumption that senior workers are more productive or reliable than their younger counterparts (as in, say, Grossman, 1978), nor do we assume that younger workers suffer a smaller uninsurable loss from being laid off than do older workers (as in Nosal, 1990).[1] Instead our explanation is an unusually simple application of an important idea in personnel economics, that firms will often find it advantageous to adopt policies that give jobs value.

1. The Basic Model

We consider the compensation policy of a firm that occasionally faces periods in which its optimal labor utilization declines, due, for example, to a negative product

[1] See Carmichael (1983) for a skeptical note on explanations of seniority-based layoff based on an assumption of rising productivity.

demand shock. The timing is as follows: At the beginning of each period the firm announces its personnel policy (wages and layoff strategy) and hires the desired number of workers. After the workforce is in place, the firm learns the state of demand. When demand sufficiently is high, the firm keeps its entire labor force; when demand is low, the firm lays off workers according to the realized state. Retained workers are paid the agreed upon wage and production proceeds.[2]

The workforce in our model consists of risk-neutral workers whose careers span T periods. We assume that workers who are laid off suffer a decline in that period's utility from w, the wage they would have earned, to $b < w$. If a worker age $T-1$ or younger is laid off, she can be recalled in the next period. We focus on temporary layoffs (as opposed to a mix of temporary and permanent discharge) becuase it allows for an especially transparent presentation of our main point. As an empirical matter, a large part of employers' responses to economic fluctuations does in fact take the form of temporay layoff and recall (Feldstein, 1975; Lilien, 1980; and Lilien and Hall, 1986).

We suppose that the firm faces an agency problem that can in principle be resolved by personnel policies that provide value to the job. (The example we use below entails regulating work effort.) As Lazear has noted, there is considerable indeterminacy over how the firm might insure that jobs are valuable. One simple mechanism is for the firm to have workers post a performance bond, but a variety of upward-sloping wage paths generate a similar incentive effect. We will see shortly that in an environment in which the firm faces variable labor demand, a seniority-based layoff policy is yet another mechanism for providing value to the job.

The advantage of the seniority-based layoff policy is that it may be less vulnerable to opportunistic behavior on the part of the firm. Once a worker posts a bond, the

[2] In the spirit of the "employment at will" doctrine that pertains in the United States, we assume the firm is contractually obligated to pay retained workers the agreed upon wage, but is not obligated to retain workers.

firm has the incentive to dismiss the worker and keep the bond. Some firms may be able to credibly sustain a reputation for resisting this temptation. For instance, successive cohorts of job market entrants may learn the past behavior of the firm. Then the firm and workers can be regarded as playing a repeated game in which workers respond to a firm's bond theft by playing a "trigger strategy," forever refusing to be again taken in by the firm's gammon. In one perfect equilibrium to this game the firm always honors its commitment to workers. This equilibrium is possible, however, only if the value to the firm of maintaining an honest reputation is high relative to the short-term gain of cheating its current workforce, and even then it is not guaranteed. The equilibrium also relies on an assumption that all participants in the game are confident about the willingness of future cohorts of workers to follow through on the trigger strategy (Bull, 1987).

With this in mind, for clarity we adopt the most restrictive assumption—that the firm does not use upward-sloping wage profiles at all. Even in this constrained environment, the firm can make jobs valuable by adopting a seniority-based layoff rule. Suppose that at the beginning of each period the firm has N workers, with N/T in each of T cohorts. We are assuming that workers are hired at the beginning of their careers (at age 1) and are retained by the firm until they retire (after age T); any layoffs are temporary. Once the labor force is in place, one of $i = 1, \ldots I$ states is revealed; the probability of a state is p_i. The fraction of workers retained in state i is λ_i.

In a strict seniority-based layoff scheme, the fraction of cohort t workers retained in state i is

$$\lambda_i^t = \begin{cases} 1, & \text{if } \lambda_i \geq (T-t+1)/T \ ; \\ t-(1-\lambda_i)T, & \text{if } (T-t+1)/T > \lambda_i > (T-t)/T; \\ 0, & \text{if } \lambda_i \leq (T-t)/T \ . \end{cases}$$

Thus workers in the oldest cohort, T, are laid off only if λ_i is lower than $1/T$. Workers in the youngest cohort face the prospect of layoff whenever the fraction of workers

retained is less than one. More generally,

$$\lambda_i^T \geq \lambda_i^{T-1} \geq \ldots \geq \lambda_i^1$$

for all states. Our formulation assumes that when some, but not all, workers in a cohort are laid off the firm makes layoff choices randomly. (We also ignore integer constraints.)

Given our set up it is clear that the expected current-period value of the job is increasing in the seniority of the cohort. In particular, if the firm posts a wage w for all workers, the expected current-period payoff to a worker in cohort t is

$$v_t = \sum_{i=1}^{I} p_i[\lambda_i^t w + (1 - \lambda_i^t)b].$$

Note that

$$v_T \geq v_{T-1} \geq \ldots \geq v_1,$$

since the probability of retaining jobs in any period is higher for more senior cohorts.

In general we would expect w to solve a lifetime participation constraint. Let β be a common discount factor, and define θ_t to be the unconditional probability of job retention for workers in cohort t ($\theta_t = \sum_{i=1}^{I} p_i \lambda_i^t$). Then if we normalize b to zero, the firm's wage w must be set so that the present value of a job to an entering cohort of workers,

$$\sum_{t=1}^{T} \beta^{t-1} v_t = w \sum_{t=1}^{T} \beta^{t-1} \theta_t,$$

equals the present value of a lifetime stream of spot market wages (say w_0),

$$w_0 \sum_{t=1}^{T} \beta^{t-1}.$$

Given that $\theta_t \leq 1$ (with strict inequality holding for at least some worker cohorts), the wage w posted by the firm must exceed w_0. Further, because the expected return

on the job ($v_t = \theta_t w$) is rising with t, v_t must obviously be less than w_0 for young cohorts, but more than w_0 for older cohorts.

Figure 1 gives a simple example.[3] The dashed line indicates the spot wage w_0, and the solid line the expected per-period return on the job, v_t, for workers in each cohort. As discussed, the per-period value of the job is initially less than the market wage, but rises above w_0 for senior workers.

The solid line in Figure 2 plots the net present value of a job at our firm for workers in each cohort. For the youngest workers, this is zero since the lifetime participation constraint binds. As a worker's seniority increases, though, the value of the job initially increases; the worker has an increasingly secure income stream at a wage that exceeds the outside opportunity. The value of the job declines for the very oldest cohorts because there are fewer years remaining in which the worker holds a valuable job. By using seniority-based layoff rules the firm has managed to give the job value at all but the very youngest age.

It is easy to show how such a policy can provide appropriate work–life incentives. As an example, suppose now that workers can provide effort at a high or low level. Let e be the monetized disutility of effort, so that utility in each period is $w - e$ with $e \in \{0, e^h\}$. We assume that all firms find it efficient to induce the high effort level. At any point during her working life, a worker who chooses to work at low effort gets a utility gain e, but gambles that she will be caught—this happens with probability d—and lose her job. Given this, a worker aged s will work at the lower effort level if

$$e > d \sum_{t=s+1}^{T} \beta^{t-s}(v_t - w_0).$$

That is, the "no-shirking condition" specifies that the expected present value of the job equal or exceed e/d.

[3] The underlying stochastic structure is as follows. In each period the state i is drawn from a discrete uniform distribution with support [1,100]. For states 1–60 the entire work force is retained. For states 61-100, retention rates are $\lambda_i = (100 - i)/40$. We used $T = 40$, $\beta = .97$, and $w_0 = 10$.

Use of seniority-based layoffs can insure that the no-shirking constraint is met over most periods of a worker's career. Refer to Figure 2, which shows the age-specific value of the job, and also plots the constant e/d.[4] In the example, the agency problem is resolved from ages s^* to s^{**}. The remaining concerns are at the youngest and oldest ages. As discussed above, the value of the job is created by the accumulation of expected future compensation (in excess of the market wage) starting at zero. Initially, therefore, the value of the job must be less than e/d; some mechanism other than work–life incentives must be used to motivate workers during this interval.[5] Similarly, effort regulation at the end of the career requires special attention (perhaps use of a retirement benefit that can be withheld if the worker shirks).

2. Discussion

Clearly our model functions in much the same way as the upward-sloping wage profile in Lazear's work-life incentive model. Indeed, risk-neutral workers will view a job that pays a secure money-wage profile $w_t = v_t$ (as illustrated in Figure 1) as identical to a job that pays a fixed wage w but uses layoffs to make the effective per-period value of the job v_t. It is not surprising that adoption of a seniority-based layoff policy has the same potential benefits to a firm as posting an upward-sloping wage profile.

It is worth noting, though, that the seeming equivalence of a compensation path that rises due to increased job security and a path that rises due to increasing wages, does not necessarily mean that equilibrium responses will be the same for workers promised these paths by a particular firm. As we discuss above, the incentive effects of an announced compensation policy depend critically on workers' beliefs about the

[4] In the figure, we set $e = 4$ and $d = 0.5$.

[5] This same point was made by Akerlof and Katz (1989) in the context of models in which firms use upward-sloping wage profiles.

firm's inclination to carry out the policy *ex post*. The advantage of the seniority-based layoff strategy we outline is incentive compatibility of *firm* behavior. Even a myopic manager will typically be willing to follow through on the announced layoff policy, since all workers are being paid the same. In contrast, the manager of a firm that uses an upward-sloping wage profile will generally be tempted to dismiss the firm's best-paid workers, i.e., senior workers. If workers anticipate such behavior, the incentive scheme unravels.

This being said, it should be clear that variation in labor demand determines the slope of v_t in Figure 1; the effective wage profile cannot be made arbitrarily steep. We would therefore expect that many firms implement work-life incentives by a combination of seniority-based layoffs and upward-sloping wage payments (or other mechanisms such as tournaments).

Another feature of our theory is that it provides one answer to an important question in labor economics: Why do labor force reductions often entail layoffs, rather than reducing the hours of a large number of workers?[6] In our model, the firm is obviously not indifferent between these options. Laying off "in people" using the seniority-based rule creates an upward-sloping career profile of worker utility. A reduction "in hours" of the firm's entire workforce has no such effect. Though this prediction about layoffs being "in people" would be tempered in a formulation that admits risk averse workers and imperfect credit markets (e.g., Akerlof and Miyazaki, 1980), our model clearly pushes strongly against equilibrium outcomes in which employment is smoothed via hours adjustments.

We have focused on temporary layoffs. The essential logic applies, though, if some layoffs are permanent. To the extent that workers anticipate layoffs will fall most heavily on younger workers, the value of jobs rise with tenure even when the firm offers a flat wage profile.

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[6] See, e.g., Ham (1986) for econometric evidence on this point.

The issue of permanent layoffs is somewhat more complicated if workers accumulate firm-specific human capital. As suggested in Haltiwanger (1984) and Freeman and Lazear (1995), firms may, in this case, find it efficient to lay off the very young (because they have built up little firm specific human capital) as well as the oldest workers (who have only a little time left with the firm).[7]

In sum, this paper outlines a simple explanation for the use of seniority-based layoffs based on a central premise of personnel economics—that firms often find it advantageous to make jobs valuable. The model highlights why such policies might be an effective incentive device even for firms that cannot post an explicitly upward-sloping wage profile (that is, when workers expect firms to behave opportunistically). It also provides an answer to the question of why firms' workforce adjustments often entail laying off individuals, rather than reducing hours for all workers. Our answer is that the strategic use of layoffs can be an integral part of an incentive-compatible policy that resolves agency problems.

[7] These models, like ours, provides an explanation for young workers being targets for discharge, and in addition rationalize the use of "early retirement" severance pay in the process of labor force reduction.

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Figure 1

Expected Return on Job

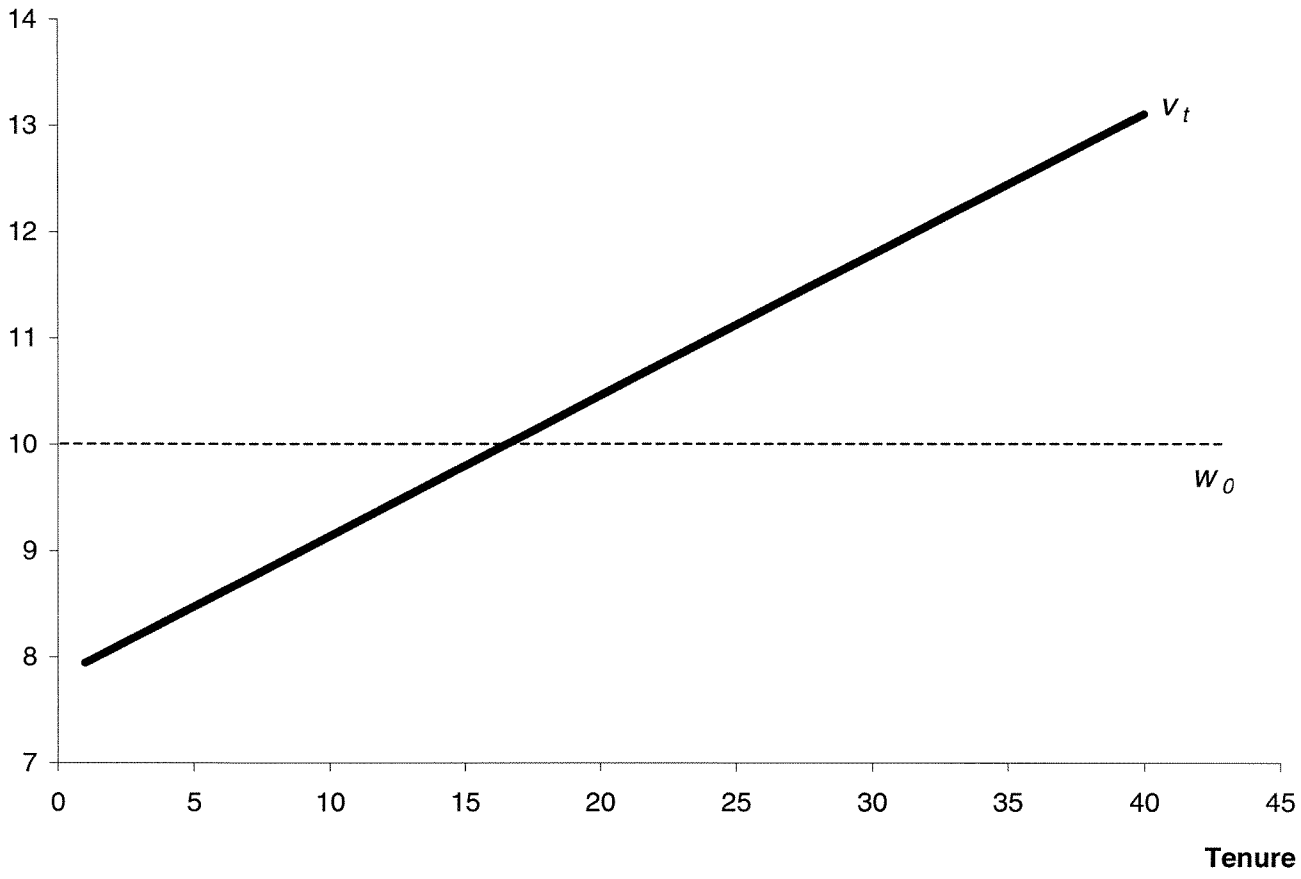

Figure 2

Value of Job