Role Models and Up-or-Out Policies

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Abstract

Workers may be more productive when they imitate the behavior of another worker known to have performed well in the past. This can lead firms to adopt "up-or-out" rules, and to pay senior workers more than junior workers though observed differences in productivity will be small.

A worker who wants to maximize output may nevertheless not know what to do. He may therefore look at the choices made by some other worker he believes is successful, and imitate his choice. Accordingly, management may encourage imitation of good workers, and discourage imitation of bad workers; hiring good "role models" may be one way of doing so. Similarly, a firm may name an "employee of the month," or hold a large celebration for the top salesman, not only to reward that person and to give incentives for hard work, but also to identify a good worker so that other workers could imitate his successful behavior.

This paper explores some implications of imitative behavior within a firm. I shall focus on two applications. First, since a bad worker not only produces little himself, but can also be a bad model for others, firms may adopt up-or-out rules. Second, an able worker may produce little more than less able workers because the less able ones imitate him. Nevertheless, the presence of the able worker can much enhance the firm's productivity. One result is that the wage will rise with seniority, though observed marginal product increases little.

1 Literature

At first sight, up-or-out rules are inefficient: the firm should be able to profit by retaining workers whom it would pay a low wage: up-or-out rules force the firm to fire otherwise productive workers.[1] The literature offers several explanations for up-or-out contracts. All rely on a commitment by the firm to offer such a contract, and thus the solutions are not subgame-perfect: rather than firing a worker with low productivity, a firm would prefer to keep him and pay him a lower wage.

Kahn and Huberman (1988) propose that up-or-out rules are used as a solution to a moral hazard problem. They suppose that the employer wants a worker to invest in human capital, thereby increasing his productivity. But after he made the investment, the firm may claim that he did not, that his productivity was low, and therefore that it will only pay him a low wage. A commitment to either pay a worker the higher wage or else to fire him can overcome the moral hazard problem—if the worker is indeed productive, the

[1]Spurr (1987) offers evidence for the use of up-or-out rules. He finds that law firms promote lawyers found to have high quality, while making the rest leave.

firm would prefer to retain him at the higher wage rather than to fire him. Realizing this, the worker would be willing to make the investment.

Waldman (1990) extends this idea to consider general human capital rather than only firm-specific capital, and to consider the signaling aspects of firing and retention: a firm which retains a worker signals to other firms that the worker likely has high productivity, thereby inducing other firms to offer this worker a higher wage, and inducing the worker to invest in human capital.

1.1 Peer-group effect

A different line of explanation focuses on the information a firm gains about the worker over time. O'Flaherty and Siow (1992) consider a younger and an older worker, where the productivity of the older worker increases with the quality of the younger worker. Though a young worker's productivity may exceed the market wage, the firm may prefer to fire him because of the option value of finding a younger worker who is even more productive. More generally, Berglas (1976), Brueckner (1991), and McGuire (1991) consider how the peer-group effect affects the characteristics of a competitive equilibrium when firms hire workers with different skills. They do not, however, consider firing decisions.

1.2 Job matching

A worker who is unproductive on one job may nevertheless be productive at another job. The quality of a worker relates to job matching, as in Jovanovic (1979) and Harris and Weiss (1984). Suppose all workers are *ante* identical, but *ex post* some workers find that they can do a particular job better than others. Then at the end of the first period, people who find they cannot do the work well will leave to try a different job. Only the workers best suited for a particular job are left in the second period, and, by virtue of their higher productivity, they earn higher wages than those who leave the employer. I make similar assumptions, but also allow for imitative behavior; this amplifies differences in productivity (even allowing productivity to be negative), while making observed differences in productivity appear to be small.

Evidence consistent with job-matching appears from studies of plant closings: the displaced workers experience large wage losses (Jacobson, LaLonde, and Sullivan (1993)).

1.3 Herd behavior and informational cascades

Imitation has been studied by authors who look at how an actor revises his beliefs about the state of nature by looking at the behavior of others; see Banerjee (1992), Bikhchandani, Hirshleifer, and Welch (1992), and Bikhchandani, Hirshleifer and Welch (1998) for a survey. Managers concerned about their reputations may also want to take the same action that others do (Scharfstein and Stein (1990)). Vega-Redondo (1997), and Schlag (1998 and 1999) consider individuals facing repeated choice problems who imitate others who obtained high payoffs in previous rounds. These authors do not consider how a firm manages imitation.

2 Assumptions

2.1 Production

The firm produces two goods, with each worker producing each of them. When producing good 1, the worker cannot observe the behavior of anyone else. When producing good 2, he can observe the behavior of one older worker, whom he can imitate. (To recall the notation, think of task 1 as having 1 person working on each task, whereas on task 2 each worker takes advantage of the expertise of 2 people.)

In each period and on each task there is a correct way and a wrong way of doing the job. A person who works correctly on a good produces q_H of that good. A person who works incorrectly produces q_L of that good, with $q_H > q_L$.

A worker is either good or bad. In the absence of any imitation, a good worker acts correctly with probability γ; in the absence of any imitation, a bad worker acts correctly with probability β, with $\gamma > \beta > 1/2$. The prior probability that a worker is good is π. The firm can observe a worker's output, but not his type or his action.

2.2 Workers

Workers live for 2 periods, and in each period labor supply is perfectly inelastic and fixed at 1 unit for each worker. A worker in the first period of employment is called young; in his second period of employment he is called old. For simplicity, suppose that there are two workers, where one of them can be old and the other is young. Workers (and firms) are risk neutral and have a zero rate of discount.

Ability is firm specific. That is, a person who is a good worker at one firm need not be at another firm. This means that a worker's reservation wage is the wage of a young worker at any firm.

3 Rehiring worker who performed well

My interest lies in determining whether the following type of equilibrium can exist: a firm retains a worker it believes is better than average, fires a worker it believes is worse than average, and a worker imitates an older worker (if there is one) on task 2.

3.1 Output

Consider first behavior when the firm had rehired a worker whose output was high in period 1, and hires a young worker in period 2. I am interested in total output in period 2. Suppose also that a worker does not know his own type at this firm, so that a young worker maximizes expected output on task 2 by imitating the rehired worker: since the firm is assumed to retain only a worker who it thinks has probability higher than π of being good, a young worker rationally expects the older worker to have a higher probability than he himself of acting correctly.

In period 2 the young worker will imitate the older worker on task 2. But the quality of the rehired worker is not known with certainty; rather we must use Baye's theorem to determine the posterior probability that he is a good worker given that his output was high on task 1 in period 1.

On task 1, the young worker cannot imitate, and so he takes the action that he thinks correct. On that job, his output is either high or low. If the output is high, then the posterior probability that he is a good type is

$$\mathrm{pr}(G|q_H) = \frac{\mathrm{pr}(q_H|G)\mathrm{pr}(G)}{\mathrm{pr}(q_H|G)\mathrm{pr}(G) + \mathrm{pr}(q_H|B)\mathrm{pr}(B)} = \frac{\gamma\pi}{\gamma\pi + \beta(1-\pi)}. \tag{1}$$

If his output is low, then the posterior probability that he is a good type is

$$\mathrm{pr}(G|q_L) = \frac{\mathrm{pr}(q_L|G)\mathrm{pr}(G)}{\mathrm{pr}(q_L|G)\mathrm{pr}(G) + \mathrm{pr}(q_L|B)\mathrm{pr}(B)} = \frac{(1-\gamma)\pi}{(1-\gamma)\pi + (1-\beta)(1-\pi)}. \tag{2}$$

If the firm rehires a worker who had produced high output, the probability that such a worker acts correctly is

$$\gamma\left(\frac{\gamma\pi}{\gamma\pi + \beta(1-\pi)}\right) + \beta\left(1 - \frac{\gamma\pi}{\gamma\pi + \beta(1-\pi)}\right) = \frac{\gamma^2\pi + \beta^2 - \beta^2\pi}{\gamma\pi + \beta - \beta\pi}. \tag{3}$$

We can now calculate expected output in period 2. There are two workers, a retained one and a new one. On the non-imitative task the expected output of the new worker is

$$q_L + (q_H - q_L)\left(\pi\gamma + (1-\pi)\beta\right). \tag{4}$$

On the imitative task, the expected output of the new worker is

$$q_L + (q_H - q_L)\frac{\gamma^2\pi + \beta^2 - \beta^2\pi}{\gamma\pi + \beta - \beta\pi}. \tag{5}$$

The preceding is of course also the expected output of the retained worker on the imitative task, and on the non-imitative task.

Thus expected total output by the two workers in period 2 is

$$\begin{aligned} &q_L + (q_H - q_L)\left(\pi\gamma + (1-\pi)\beta\right) + \\ &3\left(q_L + (q_H - q_L)\frac{\gamma^2\pi + \beta^2 - \beta^2\pi}{\gamma\pi + \beta - \beta\pi}\right). \end{aligned} \tag{6}$$

One might ask why not retain a worker whose output was low, but tell a worker in the next period not to imitate him, but rather to follow his own judgment. One difficulty with such a solution is the greater informational burden: the worker has to know who is the older worker, and remember whether he should imitate him or not. Since the firm does not gain from retaining a worker who had low output, but retaining him creates noise about what a young worker should do, the firm would strictly prefer to fire a worker whose output was low.[2]

Also, a firm which retained all workers would have to offer different contracts to an older worker, depending on his output in the previous period. The different contracts are necessary because a payment for low and high output which generates reservation utility for a good worker will generate less than that reservation utility for a bad worker. So retaining bad workers involves either paying excess wages, or else offering more complicated contracts. And it opens the possibility that a good worker will prefer to behave as a bad one in period 1, so that he will be offered the more attractive contract in period 2.

That said, there could be multiple equilibria. One has all workers retained, and no young worker imitating an older worker. Another equilibrium, the one emphasized here, has the firm retain only a worker with high output, and has young workers imitate him.[3]

Contrast this solution to outcomes were no worker retained for period 2, making imitation infeasible. Expected output in period 2 is

$$4\left(q_L + (q_H - q_L)\left(\pi\gamma + (1-\pi)\beta\right)\right). \tag{7}$$

We can now calculate the marginal product of retaining a good worker, that is the difference between (6) and (7), namely

$$\begin{gathered} q_L + (q_H - q_L)\left(\pi\gamma + (1-\pi)\beta\right) + \\ 3\left(q_L + (q_H - q_L)\frac{\gamma^2\pi + \beta^2 - \beta^2\pi}{\gamma\pi + \beta - \beta\pi}\right) - \\ 4\left(q_L + (q_H - q_L)\left(\pi\gamma + (1-\pi)\beta\right)\right). \end{gathered}$$

For a simpler case, suppose that $q_L = 0$, $q_H = 1$, and $\pi = 1/2$. Then the added output from rehiring a good worker when a young worker imitates an

[2]This analysis overestimates the benefits of retaining a worker who had done well—since he will be imitated by young workers, there will be less information about their abilities, and so the rehiring decisions in the future will be worse.

[3]A puzzle is why large Japanese firms, which were so successful until the 1990s, offered lifetime employment. One explanation may arise from the existence of yet a third equilibrium. If workers know each other very well, then they know who to imitate. But if there is much turnover among workers, then each has no private knowledge about which co-worker is best, and instead must rely on the firm's retention and firing policies to determine whom to imitate.

older worker is

$$\frac{3}{2}\frac{(\gamma-\beta)^2}{\gamma+\beta}. \tag{8}$$

In the absence of imitation, the added output from rehiring a worker who had produced well compared to replacing him is

$$2\left(q_L+(q_H-q_L)\left(\frac{\gamma^2\pi+\beta^2-\beta^2\pi}{\gamma\pi+\beta-\beta\pi}\right)\right)-2\left(q_L+(q_H-q_L)\left(\pi\gamma+(1-\pi)\beta\right)\right). \tag{9}$$

Making the subsitutions $q_L = 0$, $q_H = 1$, and $\pi = 1/2$ gives

$$\frac{(\gamma-\beta)^2}{\gamma+\beta}. \tag{10}$$

Thus, the added benefit of rehiring a good worker because imitation is possible is

$$\frac{3}{2}\frac{(\gamma-\beta)^2}{\gamma+\beta}-\frac{(\gamma-\beta)^2}{\gamma+\beta}=\frac{1}{2}\frac{(\gamma-\beta)^2}{\gamma+\beta}$$

3.2 Rehiring worker who performed poorly

To examine the benefits of an up-or-out rule, consider output in period 2 if a worker who had performed poorly in period 1 is rehired. We are looking at an equilibrium in which young workers expect a rehired worker to be good, and so imitate him. Therefore, they will also imitate a worker who had done badly.

The probability that a worker who had low output in period 1 is a good type is

$$\mathrm{pr}(G|q_L)=\frac{\mathrm{pr}(q_L|G)\mathrm{pr}(G)}{\mathrm{pr}(q_L|G)\mathrm{pr}(G)+\mathrm{pr}(q_L|B)\mathrm{pr}(B)}=\frac{(1-\gamma)\pi}{(1-\gamma)\pi+(1-\beta)(1-\pi)}. \tag{11}$$

The probability that the rehired worker will act correctly on a job is thus

$$\gamma\frac{(1-\gamma)\pi}{(1-\gamma)\pi+(1-\beta)(1-\pi)}+\beta\left(1-\frac{(1-\gamma)\pi}{(1-\gamma)\pi+(1-\beta)(1-\pi)}\right)$$

or

$$\frac{-\pi\gamma+\pi\gamma^2-\beta+\beta\pi+\beta^2-\beta^2\pi}{\pi\gamma-1+\beta-\beta\pi}.$$

Thus, the expected output by the rehired worker on either job is

$$q_L + (q_H - q_L)\frac{-\pi\gamma + \pi\gamma^2 - \beta + \beta\pi + \beta^2 - \beta^2\pi}{\pi\gamma - 1 + \beta - \beta\pi}.$$

Expected total output by the two workers in period 2 is

$$\begin{aligned} &q_L + (q_H - q_L)(\pi\gamma + (1-\pi)\beta) + \\ &3\left(q_L + (q_H - q_L)\frac{-\pi\gamma + \pi\gamma^2 - \beta + \beta\pi + \beta^2 - \beta^2\pi}{\pi\gamma - 1 + \beta - \beta\pi}\right). \end{aligned} \tag{12}$$

Letting $q_L = 0$, $q_H = 1$, and $\pi = 1/2$, gives

$$\frac{1}{2}\frac{7\gamma^2 - 8\gamma + 2\gamma\beta - 8\beta + 7\beta^2}{\gamma - 2 + \beta}$$

Output when a poorly performing worker is rehired compared to when he is not is

$$\frac{3}{2}\frac{(\gamma - \beta)}{\gamma + \beta - 2}$$

Since $\gamma < 1$ and $\beta < 1$, this is negative: the firm would prefer to fire a worker who had done poorly in period 1. And note that this does not simply occur because a random worker is likely to do better than one who had done poorly. The imitation of a rehired worker exacerbates the problem.

4 Implications

The analysis in this paper supposed that the firm's only choice variable was whether to fire or rehire a worker. But when imitation is possible, a firm may want to adopt policies that increase the benefits of imitation. For example, there is a positive probability that in the initial period all the workers the firm hired were bad, and so in later periods none is worth imitating. To reduce this probability, the firm may hire a greater number of workers in period 1 than would be called for by maximizing profits in period 1, thereby increasing the chance that some will turn out to be good.

A central finding in economics is that in competitive markets a worker will be paid his marginal product. But when one worker learns from another, the two are essentially engaged in team production, and determining a worker's marginal product can be tricky. For a good senior worker raises the marginal product of a junior worker. If both were paid their marginal products, the firm would lose money. Only if the firm has some market power in the labor market can it use senior workers to train younger workers.

In that case, a senior worker's value to the firm exceeds his own marginal revenue product, which can explain why some senior workers are paid so much.[4]Moreover, the firm may want to publicize the high salaries it gives some workers, because it thereby allows junior workers to identify who are the successful fellow workers, and thereby encourages imitation of profitable behavior.

If there are many imitative tasks, and few non-imitative tasks, then a worker who is retained will perform barely better than new workers: the young ones imitate him. That is consistent with the older worker having a high marginal product, but not performing much better. So it can explain the anomaly that wage increases with tenure, though measured output does not (see Hutchens (1989)).

A further implication is that a new firm, with no senior workers, will increase productivity more quickly than will an established firm. The reason is that an established firm has a senior worker, whom younger workers imitate. So it cannot be as certain of who is a good worker. But a young firm has no senior workers, and so is better informed about the young workers whom it can promote. Moreover, since the new firm did not have imitation, its young workers did not do as well, on average, as in the old firm. Indeed, in period 2 the young firm will overshoot the older firm in productivity, and then it will revert to the average productivity of older firms.

[4] I spoke of different workers assigned identical tasks. But that is unnecessary. A salesman assigned a small territory can learn from the techniques used by a senior manager responsible for sales to major customers. A mid-level manager may learn how to motivate subordinate by observing how his boss does it.

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5 Notation

N_i Number of workers of age i

p_i Price of good i

q_H Output by worker who acts correctly

q_L Output by worker who acts incorrectly

β Probability a bad worker takes correct action

γ Probability a good worker acts correctly

π Prior probability that worker is good