Volume 39, Issue 4

A bonus given: noise, effort and efficiency in a flat hierarchy

John G Sessions
Newcastle University

John D Skatun
University of Aberdeen

Abstract

We show that bonuses are efficient in terms of effort exertion and greater in noisier environments. This could explain the prevalence of bonuses in the financial sector, which is characterised by flat hierarchies and inherently noisy environments. Policies to restrict bonuses should be implemented cautiously since they may imply undesirable efficiency effects.

Abstract

We show that bonuses are efficient in terms of effort exertion and greater in noisier environments. This could explain the prevalence of bonuses in the financial sector, which is characterised by flat hierarchies and inherently noisy environments. Policies to restrict bonuses should be implemented cautiously since they may imply undesirable efficiency effects.

1.   Introduction

In this paper we ask a straightforward question: Why are worker bonuses so prevalent? To this question we offer a simple yet novel solution: Firms can use bonuses to attain first-best effort levels. Thus, we demonstrate that bonuses can be added to the growing list of optimal payment structures that have emerged in the literature on asymmetric information, where firms cannot directly observe effort. Our model is rooted in the share cropping-tenant debates of the 1950s. These found that charging workers a flat fee and then allowing them to retain the residual rent out-performs sharecropping as a contractual arrangement [Johnson (1950), Cheung (1969) and Reid (1973)].

A seminal paper especially relevant to our model is Lazear and Rosen's (1981) tournament model, which demonstrated that relative performance rewards in the workplace can be used by hierarchical firms to elicit efficient effort levels. Noise plays a particularly important role in the Lazear and Rosen paper and the large tournament literature that followed. An increase in noise reduces the marginal effect of worker effort on the probability of winning the tournament and attaining promotion. This reduction in potency induces workers to moderate effort and to instead ride their luck in the more random environment created by the increased noise. But firms do not sit idly by on the demand side. Instead they increase the wage spread between winners and losers to counterbalance the adverse effect of noise.

It has been long thought that such an intuition is restricted to firms that offer promotions. Yet, in what follows we show that such a presumption is incorrect and demonstrate, for the first time, that the intuition can be extended beyond promotions in hierarchical firms. Indeed, we show that bonuses in firms with flat hierarchies play a similar incentivising role as wage spreads in tournaments. We establish that a simple bonus structure can attain first-best efficiency and that whilst increases in noise reduce the level of effort ceteris paribus, firms can perfectly counteract this by offering larger bonuses.

It is important to note that promotions are unlike bonuses in that they usually entail a change in tasks. Pergamit and Veum (1999) find that 85% of workers who are promoted experience an increase in their job responsibilities, and similarly in Kosteas (2011) where 65% of promotions lead to an increase in supervisory tasks. Whilst added responsibility may enhance job satisfaction, it might also come with strings attached, potentially increasing workloads and reducing workplace well-being – see Diriwaechter and Shvartsman (2018). Any increase in remuneration that follows a promotion is not, therefore, a perfect measure of the associated effort incentives. Such ambiguities do not typically arise with bonuses, which are normally awarded ex post subject to a standard being attained with no other conditions attached.

Whilst it is possible that the firm could reframe a bonus as a promotion, with no change in associated job responsibilities, there may be good reasons for it not to do so. In a world of asymmetric information, a firm may hesitate to publically promote its workers to then face competition from its competitors who might come in to tempt the workers away. This is the central tenet of the market-based tournament theory literature based on the seminal paper by Waldmann (1984) and followed by, among others, Gibbs (1995), Zabojnik and Bernhardt (2001) and Ghosh and Waldman (2010). A better incentive scheme that avoids worker

poaching may be to pay externally unobservable bonuses. Thus we argue the firm, with a flat hierarchy in terms of tasks, may opt for unobservable bonuses to observable (reframed) promotions when it faces an external threat of worker poaching.

One would expect that any mechanism which attains efficiency to be widespread in the economy. For efficient outcomes facilitate the full exploitation of all gains to trade. Bonuses are indeed common, especially in industries with flat hierarchies and noisy environments, such as the financial sector, and where the downsides of tournamounts are insurmountable [Bell and Van Reenen (2014)].[1] The dearth of academic studies investigating the effort efficiency of bonuses is therefore surprising.

Whilst some studies have looked at how bonuses can enhance efficiency, none propose, as do we, that the use of bonuses can attain full efficiency. Thus, none provide the same strong argument for their widespread use. Instead they rely on efficiency enhancements. An example of this literature is Kim (1997) who shows that bonus payments combined with piece rates can generate effort enhancing outcomes under limited liability. In contrast, our model considers a cleaner bonus system comprising a fixed wage (independent of output) and an output threshold triggered bonus.[2]

Other strands of literature compare bonuses and efficiency wages – see, for example, MacLeod and Malcomson (1998), Yang (2008) and Maestri (2012). Some investigate altruism and show that this shifts incentives from sticks/dismissals to carrots/bonuses [Dur and Tichem (2015)]. Herweg et al. (2010) demonstrate the second-best optimality of bonuses when workers are averse to loss. Bakó and Kálecz-Simon (2013) study bonus quotas within a Bertrand duopoly. Imhof and Kräkel (2014) investigate when pooling bonuses benefit firms. Ekinci et al. (2019) study bonus within market-based tournament models and demonstrate that bonuses enhance efficiency.

There are, of course, other arguments that can explain the use of bonuses. One of these is similar to the often-repeated claim that a key advantage of tournaments over other performance related pay (PRP) schemes is the lower monitoring costs they entail. The same argument can be applied to bonus systems.[3] Bonuses are common in non-hierarchical firms where tournaments are not an option and may be preferable to PRP for cost of monitoring reasons. Another reason lays in the binary nature of bonuses. PRP rewards performance monotonically whereas bonuses are only triggered after a certain threshold has been achieved. Thus, bonuses are arguably more likely than other forms of PRP when threshold standards are of critical importance to firms.

The binary modelling approach that we adopt, which is of such critical importance to our results, is usually overlooked in the literature. Indeed, it is usually the case that bonuses are modelled as a continuous form of PRP – see, for instance, Bénabou and Tirole. (2016). More recently, Enknci et al. (2019) set out a two-period model where the bonus rate is set dependent on, and continuous in, output. This entails the bonus rate being set such that the worker receives the full additional productivity that arises from increases in effort. Our model contrasts to this approach and is important in making the previously un-stated link between bonuses and

---

[1] Flat organisatioal hierarchies offer a number of benefits. They elevates employees' sense of responsibility and remove excessive management layers thererby improving the coordination and speed of communication between employees. The potential downsides of tournaments include excessive pay inequality, discouragement of lesser able workers and selfish, colluding or sabotaging behaviour. It has also been found that female workers may be disinclined to fully participate in tournaments even when they are more skilled and capable than their male counterparts - see Sheremeta (2016)].

[2] Our model has more in common with Oyer (2000) who, like Kim (1997) but in contrast to us, considers the special case of limited liability.

[3] Our argument that bonuses enable firms to reduce monitoring costs is also a central theme of the efficiency wage literature, such as Shapiro and Stiglitz (1984) and Bulow and Summers (1986). The focus in this literature, however, differs from the present paper by concentrating on equilibrium unemployment.

tournaments. Like binary tournaments where the worker is either promoted or not, bonuses are also binary in our set up and either paid or not.

Our model can help to answer a well-known puzzle stated by among others Prendercast (1999) and Salanié (2003) that concerns the relatively complex contractual predictions of incentive in theory is not reflected in the relatively simple contractual forms that exists. Whereas Holmstrom (1979) and Grossman and Hart (1983) argued that pay should be monotonically increasing in performance, evidence from the labour market suggest that this is far from the universal contractual form in the labour market. Indeed, the binary nature of bonuses stand in sharp contrast. Some have tried to explain binary payment schemes, see de Meza and Webb (2007) and Herweg et al. (2010), by appealing to loss aversion, where bonuses are paid for good performance, but no penalties are incurred for bad performance. We rely on the much simpler modelling scheme outlined below where it is demonstrated that bonuses can generate efficient effort levels. This, we argue is a powerful argument for their widespread use.

We venture that our model, whilst simple, is not simplistic and has important policy implications. With increasing pressures on government to restrict financial sector bonuses, it suggests some caution.[4] For whilst capping bonuses may be beneficial for income distribution reasons, it may come at the expense of efficiency.

2. The Model

We assume that output, q, depends on worker effort, μ, and a state contingent variable, φ, vis. $q = \varphi f(\mu)$ where $f'(\mu) < 0$ and $f''(\mu) < 0$. We interpret φ as 'luck' – specifically, a draw from a uniform distribution with a lower and upper bound φ^L and φ^H respectively such that $\varphi \in \left[\varphi^L, \varphi^H \right]$, where the spread $\Delta\varphi = \varphi^H - \varphi^L$ is a measure reflecting 'noise'. The larger this spread, the noisier the work environment. The firm, which observes neither effort nor luck, pays its (single) worker a fixed wage, w, and a bonus, b, contingent on a given output standard, $\tilde{q}$, being met.[5] The worker can achieve this threshold by a combination of luck and exertion. It follows that the critical level of luck, $\tilde{\varphi}$, which the worker needs to trigger the bonus, is a function of effort vis. $\tilde{\varphi} = \tilde{\varphi}(\mu) = \tilde{q}/f(\mu)$. This critical level is declining in effort since $\tilde{\varphi}'(\mu) = -f'(\mu)\tilde{q}/\left[f(\mu) \right]^2 < 0$. Thus, the probability of securing the bonus is characterised by $\bar{\varphi} = \left[\varphi^H - \tilde{\varphi}(\mu) \right]/\Delta\varphi$, where $\bar{\varphi}'(\mu) = -\tilde{\varphi}'(\mu)/\Delta\varphi > 0$. With risk neutral workers and a cost of effort function $c(\mu)$, where $c'(\mu) > 0$ and $c''(\mu) > 0$, expected worker utility is $E\{u(w,b,\mu)\} \equiv w + \bar{\varphi}(\mu)b - c(\mu)$. Worker optimisation requires:

$$\frac{\partial E\{u(w,b,\mu)\}}{\partial \mu} = \bar{\varphi}'(\mu)b - c'(\mu) = 0 \tag{1}$$

We now derive the first of our key results:

Proposition 1.   *Worker effort is decreasing in noise.*

Proof.   *Total differentiation of the first-order condition (1) implies* $d\mu/d\Delta\varphi = -\tilde{\varphi}'(\mu)\big/\Delta\varphi^{-2}\big/\big[d^2E\{u(w,b,\mu)\}\big/d\mu^2\big] < 0$.[6]

     QED.

Thus, workers in a flat hierarchy respond to an increase in noise by reducing their effort. As such, Proposition 1 provides a clear parallel to tournament theory that produces a similar effect. In both that literature and here, workers are more inclined to gamble and ride their luck when noise levels are5 high. In noisier work environments, workers find the return to their effort is low and so shade exertion. However, it is also the case that:

Proposition 2.   *Worker effort is increasing in the bonus.*

Proof.   *Total differentiation of the first-order condition (1) implies* $d\mu/db = \tilde{\varphi}'(\mu)\big/\Delta\varphi^{-1}\big/\big[d^2E\{u(w,b,\mu)\}\big/d\mu^2\big] > 0$.

     QED.

Thus, irrespective of noise, the worker will always work harder the larger the bonus, ceteris paribus. Intuitively, the bonus acts as an incentive mechanism that the firm can exploit when it maximises expected profit $E\{\pi\} = E\{\varphi\}f(\mu) - \big[w + \varphi(\mu)b\big]$. With the worker having an outside option of V, we define a Lagrangian, L^g, such that the constrained optimisation problem facing the firm is given by:

$$\max_{w,b,\lambda} L^g = E\{\varphi\}f(\mu) - \big[w + \bar{\varphi}(\mu)b\big] + \lambda\big\{V - \big[w + \bar{\varphi}(\mu)b - c(\mu)\big]\big\} \tag{2}$$

Satisfaction of (2) leads us to:

Proposition 3.   *The firm's use of bonuses yields the efficient level of effort,* μ^* .

Proof.   *Disregarding corner solutions, we have:*

$$\frac{\partial L^g}{\partial w} = -(1 + \lambda) = 0 \tag{3a}$$

---

6 The second-order condition associated with (1), $d^2E\{u(w,b,\mu)\}/d\mu^2 = \bar{\varphi}''(\mu)b - c''(\mu) < 0$, follows from $\bar{\varphi}''(\mu) = -\tilde{\varphi}''(\mu)/\Delta\varphi < 0$ since $\tilde{\varphi}''(\mu) = \{-f''(\mu)f(\mu) + 2[f'(\mu)]^2\}[f'(\mu)]^{-3} > 0$.

$$\frac{\partial L^g}{\partial b} = \left[\mathrm{E}\{\varphi\} f'(\mu) + \lambda c'(\mu) \right] \frac{\partial \mu}{\partial b} - (1+\lambda) \left[\overline{\varphi}'(\mu) \frac{\partial \mu}{\partial b} b + \overline{\varphi}(\mu) \right] = 0 \ (3b)$$

Substituting $\lambda = -1$ *from (3a) into (3b) implies* $\mathrm{E}\{\varphi_j\} f'(\mu^*) = c'(\mu^*)$
to obtain the required efficiency outcome.

QED.

This new result, which adds bonuses to PRP schemes in attaining first-best efficiency, where the expected return to effort equals the cost of effort, is accompanied by some straightforward intuition that follows from Proposition 1 and Proposition 2. These illustrate, respectively, that worker effort decreases with the level of noise and increases with the level of the bonus. Thus, as Proposition 3 shows, the firm can use the latter effect to perfectly counterbalance the former and thus achieve a first-best efficient outcome. This ability to deliver first-best efficiency in flat hierarchies when there is asymmetric information regarding luck/noise may explain why bonuses are so common in the labour market.

3.   Concluding Comment

This paper has shown that bonuses are efficient in terms of effort exertion and that bonuses are greater in noisy environments. Whilst this is of considerable interest in itself, it could also help explain stylised facts of the prevalence of bonuses in the financial sector, which is characterised by flat hierarchies whose environment is inherently noisy. It further has an important public policy implication on how that industry is regulated. Policy makers should exercise caution in respect to regulation that restricts bonuses as this may have undesirable efficiency effects.

References

Bakó, B. and A. Kálecz-Simon (2013) "Quota Bonuses with Heterogeneous Agents" *Economics Letters* 119, 316–320.

Bell, B. and J. Van Reenen (2014) "Bankers and Their Bonuses" *The Economic Journal* 124, F1–F21.

Bénabou, R. and J. Tirole (2016) "Bonus Culture: Competitive Pay, Screening, and Multitasking" *Journal of Political Economy* 124, 305-370.

Bulow, J. I. and L. H. Summers (1986) "A Theory of Dual Labor Markets with Application to Industrial Policy, Discrimination, and Keynesian Unemployment" *Journal of Labor Economics* 4, 376-414.

Cheung, S. N. S. (1969) *The Theory of Share Tenancy* Chicago: Univ. Chicago Press.

de Meza, D. and D. C. Webb (2007) "Incentive Design Under Loss Aversion Being Exacted for Poor Performance" *Journal of the European Economic Association* 5, 66–92.

Diriwaechter, P. and E. Shvartsman (2018) "The Anticipation and Adaptation Effects of Intra- and Interpersonal Wage Changes on Job Satisfaction" *Journal of Economic Behavior & Organization* 146, 116–140

Dur, R. and J. Tichem (2015) "Altruism and Relational Incentives in the Workplace" *Journal of Economics & Management Strategy* 24, 485–500.

Ekinci, E., Kauhanen A. and M. Waldman (2019) "Bonuses and Promotion Tournaments: Theory and Evidence" *Economic Journal* 122, 2342-2389.

Ghosh, S. and M. Waldman (2010) "Standard Promotion Practices Versus Up-or-Out Contracts" *The Rand Journal of Economics* 41, 301–325.

Gibbs, M. (1995) "Incentive Compensation in a Corporate Hierarchy" *Journal of Accounting and Economics* 19, 247–277

Grossman, S. J. and O. D. Hart (1983) "An Analysis of the Principal-Agent Problem" *Econometrica* 51, 7-45.

Holmstrom, B. (1979) "Moral Hazard and Observability" *The Bell Journal of Economics* 10, 74-91.

Imhof, L. and M. Kräkel (2014) "Bonus Pools and the Informativeness Principle" *European Economic Review* 66, 180-191.

Johnson, D. G. (1950) "Resource Allocation under Share Contracts" *Journal of Political Economy* 58(2), 111-23.

Kim, S. K. (1997) Limited Liability and Bonus Contracts" *Journal of Economics & Management Strategy* 6, 899-913.

Kosteas, V. D. (2011) "Job Satisfaction and Promotions" *Industrial Relations: A Journal of Economy and Society* 50, 174-194.

Lazear, E. P. and S. Rosen (1981) "Rank-Order Tournaments as Optimum Labor Contracts" *Journal of Political Economy* 89, 841-864.

Maestri, L. (2012) "Bonus Payments versus Efficiency Wages in the Repeated Principal-Agent Model with Subjective Evaluations" *American Economic Journal: Microeconomics* 4, 34-56.

MacLeod, B. and J. Malcomson (1998) "Motivation and Markets." *American Economic Review* 88, 388-411.

Murphy, K. J. and C. M. Jensen (2011) "CEO Bonus Plans and How to Fix Them" *Harvard Business School NOM Unit Working Paper 12–022*; Marshall School of Business Working Paper No. FBE 02–11.

Oyer, P. (1998) "Fiscal Year Ends and Nonlinear Incentive Contracts: The Effect on Business Seasonality" T*he Quarterly Journal of Economics* 113, 149–185.

Pergamit, M. R. and J. R. Veum (1999) "What is a Promotion?" *Industrial and Labor Relations Review* 52, 581-601.

Prendergast, C. (1999) "The Provision of Incentives in Firms" *Journal of Economic Literature* 37 (1), 7-63.

Reid, J. D. (1973) "Sharecropping as an Understandable Market Response: The Post-Bellum South" *Journal of Economic History* 33, 106-30.

Salanié, B. (2003) "Testing Contract Theory." *CESifo Economic Studies* 49, 461-477,

Shapiro, C. and J. E. Stiglitz (1984) "Equilibrium Unemployment as a Worker Discipline Device" *American Economic Review* 74(3), 433-444.

Sheremeta, R. M. (2016) "The Pros and Cons of Workplace Tournaments" *IZA World of Labor: 302*.

Waldman, M. (1984) "Job Assignments, Signalling, and Efficiency" *The Rand Journal of Economics* 15, 255–267.

Yang, H. (2008) "Efficiency Wages and Subjective Performance Pay" *Economic Inquiry* 46, 179–196.

Zabojnik, J. and Bernhardt, D. (2001) "Corporate Tournaments, Human Capital Acquisition and the Firm Size-Wage Relation" *Review of Economic Studies* 68, 693–716.