# Paying for Staying: Compensation Contracts and the Retention Motive*

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**Abstract**

Talented employees may leave the firm in order to work elsewhere. Focusing on the portability of employees' resources, we develop a model in which compensation contracts are designed to prevent inefficient departure. The model rationalizes the widespread use of flat salaries in combination with non-indexed stock options and is consistent with observed differences in compensation contracts across individuals, firms, industries, and countries.

## 1 Introduction

Managerial compensation usually comprises two main components: a fixed salary and a stock-option package (Murphy (1999) and Frydman and Saks (2010)). Similar compensation contracts are being offered to other groups of employees as well, especially in some human capital intensive industries (Oyer and Schaefer (2005)).

For economists, these contracts pose a puzzle. The leading academic theory of compensation contracts emphasizes that variable pay encourages the employee to work harder, at the cost of providing less insurance (Holmström (1979)). But this effort inducement theory has several implications for which there is only limited empirical support. First, variable compensation

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ought to be carefully indexed so as to filter out the effect of exogenous shocks on measured performance. But in reality many compensation contracts, especially those that involve significant use of stock options, contain little or no explicit indexing (see Lazear and Oyer (2012) and references therein). Second, pay ought to depend on performance at all performance levels. In reality, most employees' pay is bounded below by a substantial salary. Third, there ought to be a negative relationship between the riskiness of the environment and the power of the incentives. In reality the relationship is as likely to be positive (Prendergast (2002)). Fourth, variable pay should only be linked to performance measures that the employee can substantially influence. In reality, options and stocks are frequently being used to reward broad layers of managers and other worker categories (Oyer and Schaefer (2005)).

Alternative theories of compensation focus on recruitment and retention rather than motivation.[1] While the alternative theories have generated a smaller academic literature, they are popular among practitioners. For example, according to the survey data reported by Ittner et al. (2003), employee retention is the most important motive for equity grant programs in "new economy" firms.

Here, we explore theoretically the hypothesis that variable compensation primarily serves the purpose of retaining employees when their outside options are attractive. Building on previous insights of Hashimoto (1979), Harris and Holmström (1982), Holmström and Ricart i Costa (1986), Blakemore et al. (1987), and Oyer (2004), we construct a simple model of retention-based compensation. We find that the optimal contract is composed of a salary and a non-indexed stock option package. Besides explaining contracts' shape, the model is consistent with observed variation in compensation practices across firms, industries, and countries.

The model's key assumption is that there is uncertainty concerning the future value of the employee's services, and that the inside and outside value are closely correlated. Intuitively, these conditions create a tension between optimal risk sharing, which calls for a fixed level of compensation, and employee retention, which calls for compensation that is responsive to market conditions. When the outside value becomes high enough, an employee who is only paid a fixed salary would leave the firm. Stock options have the desirable feature that they

[1] Performance related pay could also come about for other reasons. It might be a device to screen out low ability employees; see, for example, Lazear (2005) and the references therein. It might also be a device to maximize powerful managers' pay subject to "outrage constraints", as owners are more willing to tolerate high pay when stock prices are high; see for example Bertrand and Mullainathan (2001) and Bebchuk and Fried (2004). While we think that these arguments are relevant, they have not as yet been formalized to the extent that they can be systematically confronted with all the regularities that we seek to address here.

are "in the money" precisely when times are good and the employee's value increases. Thus, if the employee holds sufficiently valuable options that are forfeited upon departure, she will stay with the firm even in good times. This model applies to all employees whose value to the firm co-moves with industry conditions, and therefore explains why pay is sometimes linked to the firm's stock price even for categories of workers whose individual efforts do not substantially affect the stock price.[2]

Specifically, the model produces the following predictions. (i) The relative importance of stock options in compensation contracts depends on the portability of the employee's human capital.[3] If portability is high, the salary will be low and the option package large. (ii) The relative value of the option package is greater when the firm's value is more uncertain. (iii) The legal environment matters. When the employee's best outside option is to set up a new firm, start-up funding is easier to acquire when the legal system functions well, and we predict that there is more variable pay in good legal environments. (iv) Turnover is higher when the industry is performing poorly. (v) Severance pay compensates the employee for the difference between current compensation and the outside option, and need not be specified in the contract.

Our basic theoretical argument is perhaps most closely related to Holmström and Ricart i Costa (1986). In their model too, optimal compensation takes the form of an option contract, with the fixed salary being due to the employee's risk aversion and the variable pay being due to the employee's inability to commit to staying with the current employer when outside opportunities become attractive. However, where Holmström and Ricart i Costa emphasize uncertainty about employee characteristics, we emphasize uncertainty about future market conditions. As a result, we are able to address many empirical regularities regarding which their model is silent. For example, we can explain why plain stock options are used to reward employees whose talents are well known and whose effort does not greatly affect the value of the firm; in their model, the option is instead tied to what is revealed about the specific skills of individual employees, for which the stock price is typically a less precise indicator.[4] Another

[2]For workers whose market value is constant, the model says that pay should be in the form of a fixed salary.

[3]While we lack formal measures of portability, many observations suggest that it is empirically relevant. Garvin (1983) finds that younger firms have more value in human than physical assets, and argues that this fact could explain why there are more spin-offs among younger firms. Likewise, Bhide (2000) finds that 71 percent of the firms included in the Inc 500, a list of young, fast-growing companies, were founded by people who replicated or modified an idea encountered in their previous employment. Detailed evidence on portability in the laser industry and from investment banks is offered by Klepper and Sleeper (2005) and Groysberg et al. (2008) respectively.

[4]In Holmström and Ricart i Costa (1986) the option value will be linear in the stock price only when there is a strong impact of worker's ability on the firm's value, which is only true for exceptionally important employees.

difference is that Holmström and Ricart i Costa abstract from mobility barriers. Without any benefit from retention, the magnitude of their fixed wage component is bounded by the principal's ability to extract surplus from the employee through low pay in an initial period. In our model, the magnitude of the fixed wage is instead largely driven by the size of the mobility barrier.

Apart from Holmström and Ricart i Costa (1986), we are not aware of any previous model that explains why employees are paid a combination of fixed salary and non-indexed stock options.[5] Among theoretical contributions considering the retention motive, Hashimoto (1979) and Blakemore et al. (1987) merely assume that contracts are piece-wise linear. Oyer (2004) and Giannetti (2011) assume linear contracts, and thus by construction fails to account for the lower bound to compensation that the combination of salary and options implies. Dutta (2003) derives a linear contract from first principles, but similarly fails to account for the lower bound to payments.[6] Models emphasizing effort inducement usually impose a linear relationship between pay and performance, which in turn can be justified with reference to Holmström and Milgrom (1987). Hence, by construction, these models also fail to account for options.[7] Failing to account for the exact contractual shape is not necessarily a major drawback of a model, but here it is quite problematic because the empirically observed contracts appear to be so far from optimal, given standard assumptions about preferences (Hall and Murphy (2002); Dittmann and Maug (2009)).[8]

An apparent objection to our argument is that the employer could offer a fixed salary and rely on renegotiation to retain the employee if outside options become too attractive. However, we show that the two schemes are only equivalent if employees cannot affect their outside options. If the employee can take unobservable actions to improve the outside option, for example through costly search, the state-contingent ex ante contract is strictly preferable to ex post renegotiation.

The paper is organized as follows. Section 2 sets up the basic model. Section 3 derives the optimal compensation contract. Comparative static results are presented and discussed in

[5] Models that attempt to explain how option packages vary with firm and market conditions, such as Johnson and Tian (2000) and Kuang and Suijs (2006), merely impose a combination of salary and options.

[6] Pakes and Nitzan (1983) examine how contracts can be designed to retain research personnel. Their focus is similar to ours, but the contract derived is generally not linear in performance and it depends on the potential rivalry between old and a new firm given that the researcher leaves.

[7] Innes (1990) derives an option-like contract, but exogenously imposes monotonicity.

[8] However, Dittmann et al. (2010) show that observed contracts can be approximately justified if managers are sufficiently loss averse.

Section 4. We then develop several extensions. Section 5 considers the possibility of efficient inter-industry turnover and provides an explanation for severance pay. Section 6 allows the employee to undertake unobservable investments in order to improve the outside option. Section 7 concludes.

# 2 The basic model

An employer (the principal) recruits an employee (the agent) to run a two-period project. In order to retain the agent until the project completes, the principal proposes a contract which specifies pay as a function of the industry's state.

For conventional reasons, we assume that the principal is risk neutral and that the agent is risk averse. The agent's utility function is defined on final consumption, $c$, which in turn depends linearly on pay, $w$. Denote the agent's von Neumann-Morgenstern utility function $u(c)$. We assume that the utility function is twice differentiable, with $u'(\cdot) > 0$ and $u''(\cdot) < 0$ everywhere.

The principal is financially unconstrained. An agent's wealth is assumed to be non-negative and the same for all potential agents. For most of the results, the agent's wealth is irrelevant. We assume that it is zero except when otherwise noted. In this convenient special case, we may write utility as $u(w)$. Both the principal and the potential agents are completely informed about the environment.

## 2.1 The project

If the agent stays through the second period, the project generates revenue, or gross profit, $p$. (For example, we may interpret $p$ as the output price, with the production volume being normalized to one unit.) The revenue $p$ is assumed to be uncertain when the project starts and to be realized at the end of the first period. The uncertainty is captured by the probability density function $f(p)$, with support $P \subseteq \mathbb{R}$. Let $\overline{p}$ denote the expected revenue.

If the agent departs after one period, the project generates revenue $\alpha p$ where $\alpha \in [0, 1]$. Thus, $(1 - \alpha)$ is the fraction of the project's gross profit that is lost if the agent departs prematurely at date 1.

## 2.2 The outside opportunity

An agent who departs at the end of first period, can potentially generate an outside revenue $\theta p$, where $\theta \in [0, 1]$. The "portability parameter" $\theta$ is central to the model. It represents the resources that a departing agent can legally utilize elsewhere. In reality, portability may depend on, among other things, the nature of the agent's expertise, the availability of intermediate goods, intellectual property rights protection, and the ability to include credible no compete clauses in the employment contract.

We assume that

$$\alpha p \leq (1 - \theta)p. \tag{1}$$

In other words, the departure of an agent in the midst of a project is inefficient. If the agent departs, the principal loses more than the agent gains.

For most of the paper, we assume that the agent can leave the principal, but never leaves the principal's industry. We relax this assumption in Section 5, where we assume that another outside option is to take a job in a different industry.

## 2.3 The agent's participation condition

Let $\underline{u}$ be the expected value, in the first period, of the best alternative offer to the agent. We assume that the agent's best outside offer satisfies the inequality

$$\underline{u} \geq \int_0^\infty \max\{u(\theta p), 0\} f(p) dp. \tag{2}$$

That is, the best outside offer in the first period exceeds the agent's expected utility associated with second-period departure. Hence, $\underline{u}$ is the agent's reservation utility. As will become clear, the assumed lower bound on $\underline{u}$ ensures that the optimal compensation contract has a fixed salary component. For convenience, we also assume that the principal cannot go bankrupt. More precisely, we assume that the project is always sufficiently profitable to pay the agent's reservation wage, that is

$$P \subseteq \left[u^{-1}(\underline{u}), \infty\right). \tag{3}$$

## 2.4 Contracting and timing

At stage $t = 0$, the principal proposes a compensation contract $w(p)$, which the agent accepts or rejects. The compensation contract is costlessly enforced. Since both the agent and the principal are indifferent concerning the time profile of payouts, there is no reason to pay out anything before the end of the second period. If anything, delaying payment mitigates the agent's temptation to leave. As leaving is inefficient, we may restrict attention to contracts that only pay the agent upon having completed the project.

We impose no exogenous restriction on the shape of the contract, except that it is deterministic (and even this feature is without loss of generality) and non-negative. More precisely, compensation can be any mapping $w : P \to \mathbb{R}_+$.

At stage 1, $p$ realizes and the agent decides whether to stay or leave.

Finally, at stage 2, the project is completed, revenues realize, and the agent is paid. Figure 1 summarizes.

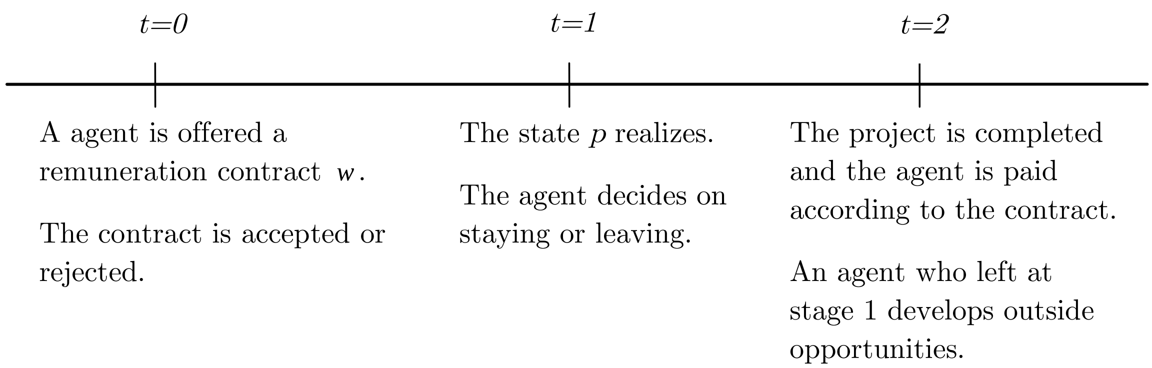


Figure 1: Timing.

# 3 Analyzing the basic model

A crucial assumption is that the agent is unable to commit to stay with the principal. As a benchmark, let us consider first the opposite case. That is, suppose the agent may contractually commit to stay, irrespective of the state of the world.

**Proposition 1** *If the agent could commit not to depart, the optimal contract, $w^{**}(p)$, would be given by the fixed wage $w^{f**}$ solving $u(w^{f**}) = \underline{u}$.*

The result follows directly from the assumption that the agent is risk averse: For any contract $w_1(p)$ that is non-constant (on a subset of $P$ with positive measure), there is an $\varepsilon > 0$ such that the agent would prefer the constant wage $w_2(p) = E_p[w_1(p)] - \varepsilon$. Hence, the uniquely optimal contract from the principal's point of view is the lowest fixed wage that the agent is prepared to accept.

Let us now analyze the optimal contract given the realistic assumption that the contract must respect laws against involuntary servitude. In this case, the agent only stays in the second period if the remuneration matches the best outside offer. As long as $\theta < 1$, any optimal contract induces retention in all states. (Suppose to the contrary that $w(p)$ has the property that there is some set of states in which the agent departs. Then the principal prefers to replace this contract with one that differs only by paying exactly the outside option in this set of states.)

Of course, one way to solve this problem would be to agree on a base wage and negotiate possible pay increases after the state $p$ realizes and the agent's outside option becomes known. However, such a sequential pay setting procedure invites the agent to invest strategically in improving the outside option, as we will demonstrate more formally in Section 6. It is thus strictly preferable to commit to a compensation contract up front.

The principal's problem is to find the compensation contract $w(p)$ that maximizes expected payoff,

$$U = E_p[p - w(p)], \tag{4}$$

subject to the agent's participation constraint at date 0,

$$E_p[u(w(p))] \geq \underline{u}, \tag{5}$$

the agent's retention constraint at date 1,

$$u(w(p)) \geq u(\theta p), \tag{6}$$

or simpler

$$w(p, \theta) \geq \theta p. \tag{7}$$

Step 2: Observe that the principal can minimize expected wage costs and satisfy (5) and (7) by offering a fixed wage $w^f$ in combination with an additional state-contingent wage $w^v(p)$ equal to the difference between the outside opportunity and the fixed wage (whenever this difference is positive). In the range where $w^v(p)$ is positive, the total payment is the smallest that ensures retention. Hence, in all states in which more than $w^f$ is paid out, the pay cannot be reduced without violating any constraint. Thus, it is impossible to rearrange the remuneration without reducing the pay below $w^f$ in some states and thereby imposing more risk on the agent. Let us now formally compute the optimal contract.

Because inequality (7) is linear in $p$, variable pay $w^v(p)$ is linear as well. Let

$$p^h = \frac{w^f}{\theta} \tag{8}$$

denote the lowest value of $p$ that makes the retention constraint bind. To ensure that the inside wage exactly matches the outside opportunity, the variable wage must thus satisfy

$$w^v(p) = \max\left\{0, \theta p - w^f\right\} \tag{9}$$

Finally, to ensure the participation of the agent at date 0, the fixed wage must satisfy

$$\underline{u} = E_p\, u\left(w^v(p) + w^f\right), \tag{10}$$

Since the right-hand side of equation (10) is monotonically increasing in $w^f$, the optimal fixed wage is uniquely defined by equation (10). Finally, note that Assumption (2), implies $w^f > 0$. This completes the proof that the the optimal contract satisfies equation (11) and equation (9). To summarize, the optimal contract can be described as follows.

**Proposition 2** *The optimal contract is*

$$w^*(p) = w^f + \max\left\{0, \theta p - w^f\right\},$$

*where $w^f$ is the unique solution to*

$$\underline{u} = E_p\, u\left(w^*(p)\right). \tag{11}$$

The optimal contract is illustrated in Figure 2.

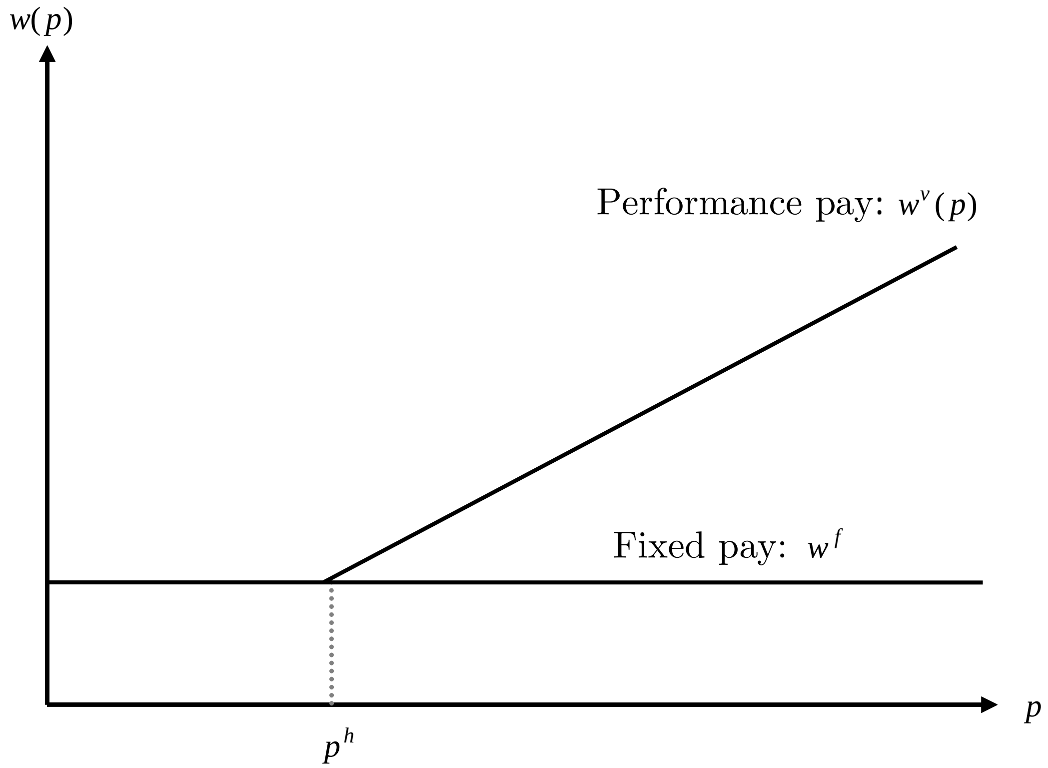


Figure 2: The figure describes the agent's compensation, composed of fixed pay and variable pay, as a function of the state $p$.

The general shape of the optimal contract fits well with stylized facts. Managerial compensation is more strongly related to performance when performance is high than when it is low; see e.g., Hermalin and Weisbach (1998), Bertrand and Mullainathan (2001), and Garvey and Milbourn (2006). Indeed, the compensation contract matches exactly a rather common form of pay: the flat salary in combination with a package of conventional stock options (conventional in the sense that the hurdle price is equal to the exercise price; we consider assumptions that give rise to more exotic stock options in Section 7). That is, the agent holds a fraction $\theta$ of the firm's stock, where the exercise price accords with the stock price in state $p^h$.

To demonstrate the point, and prepare for subsequent comparative static analysis, let us derive the options explicitly. If the agent stays, the share price (normalizing the number of shares to 1), including the agent's equity claim but not the fixed wage, is $V = p - w^f$. According to the contract, the agent gets variable pay once the output price reaches the threshold $w^f/\theta$. Correspondingly, when the share price reaches the hurdle

$$h = \frac{w^f}{\theta} - w^f = \frac{(1-\theta)w^f}{\theta},$$

the agent can exercise the call options at exactly the hurdle price $h$. Clearly, this option package implements the desired compensation.

To what extent are our results affected if we assume that the agent has positive wealth? The only way in which wealth may matter here is as a bonding device. The principal can ask the agent to invest $\omega$ in the firm and only return the money in case the agent stays. Such bonding will have the beneficial effect of making the agent more reluctant to leave, which in turn allows a reduction in variable pay and a corresponding increase in fixed pay, thereby reducing the risk that the agent has to bear. At first sight, such bonding schemes may seem unrealistic. However, many firms ask managers to pay for their option packages and have vesting clauses that require the manager to stay with the firm for several years after the purchase. As far as we know, our risk reduction explanation for selling options to the manager, rather than merely giving the options for free, is new in the literature. However, again we emphasize that the argument's basic logic is present already in Holmström and Ricart i Costa (1986).

# 4 Pay across firms and industries

Let us now investigate how compensation depends on the parameters of the model and relate these comparative static results to empirical regularities.

## 4.1 Asset exposure and corporate governance

The portability of assets vary across firms and industries. First, portability is related to technological properties of the assets. Assets that are highly portable include knowledge of possible business projects, customer relationships and knowledge of key technologies to the firm. Other assets, such as buildings and equipment, are not legally portable at all. Second, portability is related to organizational properties of the firm and its environment. For example, presence of a knowledgeable owner or of family ties between owners and managers, as well as absence of alternative social connections, are all likely to reduce portability.

**Proposition 3** *Higher asset portability $\theta$ entails (i) an increase in the quantity of granted options, and (ii) a decrease in the hurdle price $h$.*

Proof: See the Appendix.

In other words, more portable assets implies that the agent's performance threshold is lowered and that the agent owns a larger fraction of the firm if the threshold is exceeded.

Available evidence indeed suggests a positive relationship between the importance of intangible assets and variable pay. The link is most direct in the sizeable literature documenting that "knowledge" firms utilize stocks and especially stock options to a larger degree than do "brick and mortar" firms (Anderson et al. (2000); Ittner et al. (2003); Murphy (2003); Oyer and Schaefer (2005)), and the firms themselves report that such performance-based pay is primarily used for retention purposes (Ittner et al. (2003)). The model is likewise compatible with the prominence of option-based compensation in "growth firms", both for executives (e.g., Smith and Watts (1992); Gaver and Gaver (1993); Mehran (1995); Himmelberg et al. (1999); Palia (2001)) and non-executives (e.g., Core and Guay (2001)).

According to Cremers and Grinstein (2010), industries with a higher fraction of outside executives have both a larger fraction of performance related pay and a smaller degree of indexing, i.e., more pay for luck; see also Murphy and Zabojnik (2006) and Murphy and Zabojnik (2004). To the extent that the prevalence of recruitment of outside managers is a proxy for human resource portability, this is what the model predicts.

The role of the legal environment is perhaps clearest in regulated industries, where the manager is typically prevented from starting up a new business. It is well established that managers have weaker performance incentives in regulated sectors (Murphy (1999); Frydman and Saks (2010)). A similar mechanism might explain why there is less performance-based pay in family firms (e.g., Kole (1997); Andersson and Reeb (2000); Bandiera et al. (2010)), especially when the manager is a family member (Gomez-Mejia et al. (2003)).

More generally, we would expect stricter corporate governance to manifest itself as a reduction of portability, and thus entail less "pay for luck." Therefore, the model is consistent with the finding that pay for luck is smaller in companies with large owners, especially when these large owners sit on the company's board of directors (Bertrand and Mullainathan (2001); see also Fahlenbrach (2009)). Likewise, it is consistent with the more specific finding that the performance hurdles for option contracts are increasing in the quality of corporate governance (Bettis et al. (2010)).

Strictly speaking the model cannot explain variation in indexation, since it predicts that options should always be non-indexed. However, if we were to introduce a force favoring indexation, the model trivially implies that portability should reduce indexation. This is in line with the empirical finding of Rajgopal et al. (2006), who find that there is less indexation in industries where there is stronger competition for managers.

In addition to this cross-section evidence, Murphy and Zabojnik (2006) and Murphy and Zabojnik (2004) argue that the relative importance of transferable talent has increased over time, as evidenced by the executives' education as well as the increasing frequency of externally hired executives. If this view is accepted, our model can account for the increase in variable pay over the last few decades (see Frydman and Saks (2010)).

## 4.2 The role of risk

Some firms have more volatile performance ($p$) than others. According to the model, what is the relationship between the riskiness of the environment and the shape of executive compensation?

Let more risk be depicted as a mean-preserving spread in the probability density function.

**Proposition 4** *Let $f_H(p)$ be a mean-preserving spread of $f(p)$. Then, ceteris paribus, the expected value of the agent's options is weakly higher under $f_H(p)$ than under $f(p)$. The relationships are strict if*

$$\int_0^{p^h} F_H(p)dp > \int_0^{p^h} F(p)dp.$$

**Proof:** See the Appendix.

The intuition is simple. Greater uncertainty means that it is relatively more likely that extreme states are realized. A higher frequency of extremely bad states does not affect the value of the option (it is worthless in those states), but a higher frequency of extremely good states does.

The result is the opposite of the prediction of classical linear incentive model, which predicts that higher risk entails less variable wage, although the difference narrows if we consider marginal pay. In our model, the marginal pay is constant once the realization of the state exceeds the critical level $p^h$. Overall, our result is well in line with the empirical absence of a negative relationship between risk and incentives (Prendergast (2002)).

## 4.3 The role of productivity

To examine the role of changes in productivity, we introduce the new parameter $\lambda$ and let profit be $\lambda p$ instead of $p$ as assumed above. The productivity parameter $\lambda$ may reflect technology, organization, or market conditions.

**Proposition 5** *Suppose productivity increases, that is, $\lambda$ goes up. Then, (i) the fixed wage and the hurdle price decrease, and (ii) the agent's options become more sensitive to market demand, that is, $dw^v(p)/dp$ increases.*

**Proof:** See the Appendix.

The value of the agent's stock options becomes more sensitive to market demand because the agent's outside option improves when the productivity increases. Proposition 5 offers an explanation for why, empirically, the pay-performance sensitivity is greater for managers with better reputation (Milbourn (2003)).[9]

# 5 Severance pay

Hitherto, we have assumed that the agent will only leave the job for another job in the same industry. Realistically, agents sometimes change industry, especially when the own industry is declining (Jenter and Kanaan (forthcoming)). Such transitions are often efficient, as talented agents should be matched with profitable projects. How should the contract be designed to accommodate efficient transitions?

Let $\beta \underline{w}$ be a (fixed) wage offer from a principal in an unrelated industry to the agent at date 1, with $0 < \beta < 1$. The agent should depart to another industry if the remuneration in the other industry exceeds the current principal's loss from the agent's departure;

$$\beta \underline{w} \geqslant (1 - \alpha)p$$

or, equivalently, if

$$p \leqslant p^s = \frac{\beta \underline{w}}{(1 - \alpha)}.$$

To make the problem non-trivial, assume that $p^s \leq p^h$. In order to induce the agent to leave in the states $p \leqslant p^s$, the contract can give the principal the right to replace the agent, who in

[9] Could the proposition also be used to address the relationship between the pay-performance sensitivity and market-to-book value, which has been found to be positive by some authors (Core and Guay (1999); Smith and Watts (1992); Core and Larcker (2002); Frydman and Saks (2010)) and negative by others (Bettis et al. (2010); Yermack (1995))? As noted in Ellingsen and Kristiansen (2011) (p. 341), a theoretical problem here is that the relationship between productivity and the market-to-book value (Tobin's Q) is ambiguous in general, provided that the firm has invested optimally.

exchange is entitled to a severance pay $s = w^f - \beta \underline{w}$. Under this contract, separation is efficient and the agent's utility is independent of whether there is separation or not.

**Proposition 6** *Suppose an unrelated industry is offering wage $\beta \underline{w}$ at date 1 ($0 < \beta < 1$). (i) Then the optimal contract is the same as in Proposition 1, except that in states $p \in [0, p^s]$ the agent departs and receives a severance pay $s = w^f - \beta \underline{w}$. (ii) The likelihood of turnover is higher when the principal's industry is performing badly relative to other industries (p is low) and when the inter-industry portability of human capital, $\beta$, is high.*

If the principal has all the bargaining power, the optimal contract's outcome can alternatively be implemented by renegotiating the original contract in states $p < p^s$. In this sense, the model is consistent with the evidence that severance pay is usually awarded on a discretionary basis by the board of directors and not according to terms of an employment agreement (Yermack (2006)).[10] Since it may be difficult to contract explicitly on $\beta$, as the agent's best alternative is not always known in advance, discretion may even be strictly preferred.

The feature that severance pay makes up for the loss in expected compensation, $w^f - \beta \underline{w}$, rhymes well with Yermack's (2006) interpretation of severance pay data: "boards use severance pay to assure CEOs of a minimum lifetime wage level."

The predicted role of industry performance $p$ on turnover is consistent with the central regularity emphasized by Jenter and Kanaan (forthcoming): They find that CEOs are mostly fired after bad firm performance caused by factors beyond the manager's control, especially when the firm's industry is performing poorly. As Jenter and Kanaan note, this behavior by corporate boards is inexplicable, or suggestive of irrationality, in the incentive provision framework. Once we consider the retention motive, however, it makes perfect sense to keep talented agents when the industry is profitable and growing and release them to other more productive jobs elsewhere when the industry declines.

Likewise, the predicted role of inter-industry portability of the agent's human capital, $\beta$, is consistent with the view that increased managerial turnover is related to the increased importance of general, as opposed to firm-specific or industry-specific, managerial skills (Murphy and Zabojnik (2004), Murphy and Zabojnik (2006), Frydman (2005)).

[10] Discretionary severance pay is difficult to reconcile with models that emphasize ex ante incentive issues, such as those of Almazan and Suarez (2003), Inderst and Mueller (2010), and Manso (2011). In these models, it is necessary to commit to severance pay in advance.

# 6 Endogenous outside option

So far, we have assumed that the agent makes no strategic choice after agreeing to the employment contract, except staying or leaving. In this section we consider how the optimal compensation contract is affected if the agent has the opportunity to affect the outside option. For example, the agent can search for outside opportunities, engage in self-promotion, or focus on building externally valuable human capital. Under plausible conditions, it is then better to commit to a state-contingent compensation contract than to adjust the wage upwards in a discretionary fashion as the need arises.

Specifically, let the outside option be a function $\theta(e)$, where $e \in \mathbb{R}_+$ is the agent's effort. The effort decision is taken at Stage 0, that is, before the state $p$ realizes. Suppose moreover that it is impossible to contract on either $e$ or $\theta$. (For example, they may be unverifiable.) Suppose effort has a cost $C(e)$, which is non-negative, increasing, and convex. Finally, suppose that the principal has all the bargaining power in any contract renegotiation.

If the initial contract specifies a fixed salary $w^f$, in the renegotiation the agent will receive a wage increase of min $\left\{0, \theta(e)p - w^f\right\}$. Thus, the agent chooses the effort $e$ to maximize

$$w^f + \int_{w^f/\theta(e)}^{\infty} (\theta(e)p - w^f)f(p)dp - C(e).$$

Let $e^*(w^f)$ be the (smallest) solution to the agent's problem. Note that $e^*(w^f) > 0$ under conventional assumptions about the functions $\theta(e)$ and $C(e)$.[11] The principal's problem now amounts to select $w^f$ in order to minimize the total expected pay,

$$w^f + \int_{w^f/\theta(e^*(w^f))}^{\infty} (\theta(e^*(w^f))p - w^f)f(p)dp$$

subject to the agent's participation constraint.

Let $\widehat{w}^f$ denote the solution to the principal's problem, and define $\theta^* = \theta(e^*(\widehat{w}^f))$. To see that the principal can do better by committing to a state-contingent contract, suppose now that the principal promises to pay $\widehat{w}^f + \max\left\{0, \theta^* p - \widehat{w}^f\right\}$. Observe that this contract yields an outcome that is identical to the equilibrium pay in the renegotiation case. Since the agent

[11] For example, let $\theta(e)$ be non-negative, increasing and concave, with $\lim_{e\to 0}\theta'(e) = \infty$, $\lim_{e\to\infty}\theta'(e) = 0$, and $\lim_{e\to\infty}\theta(e) < 1$, and let $C(e)$ be non-negative, increasing, and convex, with $\lim_{e\to 0}C'(e) = 0$, and $\lim_{e\to\infty}C'(e) = \infty$.

is now already getting the pay that corresponds to $e^*(\widehat{w}^f)$, it follows that any effort level $e > e^*$ cannot yield a higher utility for the agent; the marginal effort cost exceeds the marginal expected gain from being able to depart to take up the improved outside option. An effort level $e < e^*$, on the other hand, strictly improves the agent's payoff compared to $e = e^*$. Indeed, under the proposed state-contingent contract the agent's optimal effort is $e = 0$, as that saves the effort cost $C(e^*)$ without any offsetting loss. (For any effort level $e < e^*$, the agent is always better off staying than leaving.) The implication is that the proposed state-contingent contract yields an expected utility above the agent's reservation utility. Hence, the principal can reduce the fixed pay to a level below $\widehat{w}^f$ while still retaining the agent. We summarize as follows.

**Proposition 7** *Suppose (i) the principal commits only to a fixed wage $\widehat{w}^f$ and relies on renegotiation to retain the agent in good states; (ii) the agent may take an unobservable effort $e$ to affect the outside option $\theta(e)$. Then, whenever the equilibrium effort $e^*(\widehat{w}^f)$ is positive, this compensation scheme is strictly inferior to the best state-contingent contract.*

The intuition is straightforward. Without commitment, the agent is induced to waste effort on improving the outside option solely in order to increase pay. With commitment, the principal can eliminate this waste and capture all the gains from doing so by reducing the fixed pay.

This is not to say that there are never circumstances under which the principal may prefer renegotiation to ex ante commitment. Suppose in particular that the effort $e$ increases productivity $\lambda$, but that productivity is unverifiable. Any contract that conditions pay only on the state $p$ will have no effect on the effort; on its own, the state-contingent wage induces $e = 0$. However, under renegotiation, since the outside option is now $\lambda(e)\theta p$, the agent knows that sufficiently high effort may induce a better outside offer. In general, there is now a trade-off between the provision of risk sharing, which calls for a high fixed wage in combination with the smallest possible variable payment $\max\{0, \lambda(0)\theta p\}$, and the provision of effort incentives, which calls for a lower wage in combination with renegotiation - at least if productivity is sufficiently sensitive to effort. Ironically, any explicit state-contingent pay in this case only serves to mute the agent's effort to improve productivity.[12]

[12] Of course, if it is possible to contract on $\lambda$, matters are quite different. In that case, we are back to a more classical effort inducement problem. We refrain from analyzing this combination of the effort inducement problem and the retention problem.

# 7 Entrepreneurship as the outside option

Returning to the case with an exogenous outside option, let us now consider the effect of a fixed departure cost, $I > 0$. For example, the outside option consists of setting up a new firm and become an entrepreneur. In order to become an entrepreneur, a departing agent must then be able to fund the investment $I$. Let there be a competitive financial market, where investors' required rate of return is normalized to 0.

Without financial frictions, the only change to the model is to make the outside option less attractive, allowing a reduction of the variable pay and a corresponding increase in the fixed wage. With financial frictions, on the other hand, the agent may be unable to fund the investment cost $I$ even if the return is positive. That is, there are states in which the agent stays due to the financial friction. However, as the state $p$ gets sufficiently favorable, the investment can be funded despite the friction. At this point, the compensation needs to jump up in order to match the discontinuous increase in the agent's outside option. The argument may be formalized as follows.

To capture frictions in the financial market, assume that financial contracts are imperfectly enforced, as in Ellingsen and Kristiansen (2011): An entrepreneur who diverts resources is apprehended with probability $\varphi < 1$. With probability $1 - \varphi$ the diversion attempt succeeds and the entrepreneur can enjoy the (illegally) diverted revenues. In case of a failed diversion attempt, the entrepreneur has to give up all financial resources. Additionally, the apprehended entrepreneur suffers a nonmonetary utility loss $\gamma$, such as the inconvenience of being jailed or the shame associated with status loss. These assumptions guarantee that optimal financial contracts are easy to characterize and deliver a simple expression for the agent's outside option. Because the parameters $\varphi$ and $\gamma$ can be seen as proxies for the quality of the legal environment, the model is suitable for cross-country comparisons.

It is easy to show that necessary and sufficient conditions for external funding are that the project is profitable,

$$\theta p - I \geq 0, \tag{12}$$

and that the entrepreneur does not divert the returns,[13]

$$u(\theta p - I) \geq (1-\varphi)u(\theta p) + \varphi(u(0) - \gamma). \tag{13}$$

Let $p^r$ denote the (smallest) state in which the no-diversion constraint (13) holds with equality. Observe that the constraint gets stricter as $I$ increases and as $\varphi$ and $\gamma$ decrease.

Since competition among potential investors drives their returns to zero, whenever the project is funded external investors are always repaid exactly $I$. Of course, the agent will only consider the outside project if it yields more than the fixed wage. Hence, if condition (13) is slack, the variable compensation is $\theta p - w^f - I$ in all states $p$ satisfying $\theta p - w^f - I > 0$. However, if condition (13) is violated for $p^q = (w^f - I)/\theta$, there is a set of states $[p^q, p^r]$ in which the agent would ideally like to depart in order to become an entrepreneur, but where investors are unwilling to fund the project. In this parameter range, the principal does not need to offer any variable compensation. Figure 3 illustrates the optimal contract in this case.

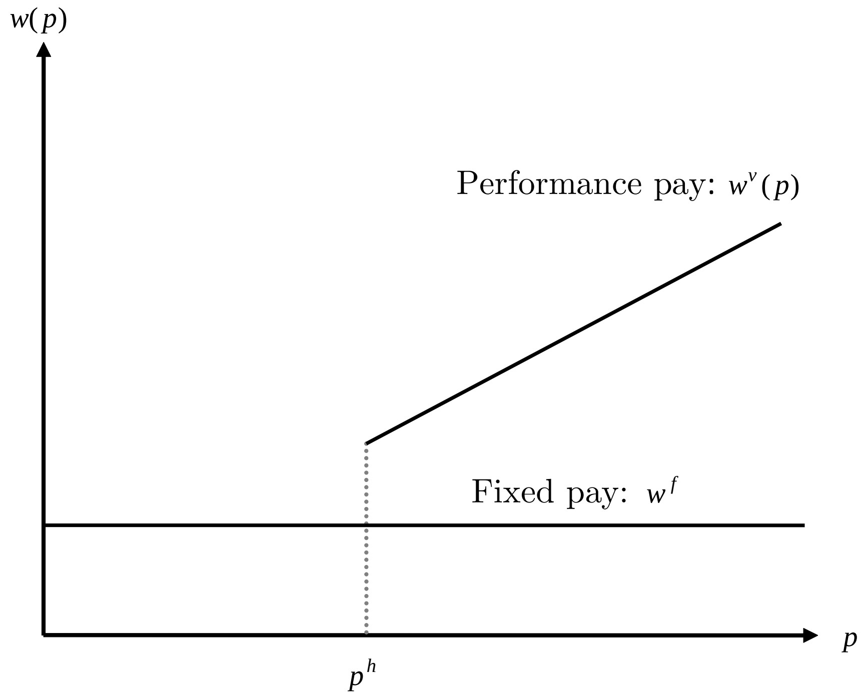


Figure 3: The figure describes the agent's compensation when the outside option requires external funding.

[13]By Lemma 1 in Ellingsen and Kristiansen (2011) it is never optimal to offer a contract to outside investors that implies that the entrepreneur makes a diversion attempt.

As before, the contract can be implemented through a stock option, but this time the option is more exotic. The hurdle price, which corresponds to the state $p^r$, is strictly higher than the exercise price, which corresponds to state $p^q$.[14] That is, the option is "performance-vesting".[15] Ours seems to be the first model in which stock options with performance-based vesting is shown to be an optimal form of compensation. Bettis et al. (2010) examine the use of performance-vesting provisions in contracts offered by a sample of US firms and conclude that existing optimal-contracting models cannot establish a specific role for performance vesting. Given that entrepreneurship is an attractive outside option, our model yields testable predictions for the design of performance-based vesting.

## 7.1 Managerial pay across countries

The "law and finance" literature has found that access to financing vary across countries due to differences in legal protection of investors. An agent considering to become an entrepreneur will take into account the financing opportunities of new ventures. Knowing the agent's outside options, the firm's owners in turn adjust the compensation package. Where it is easy for managers to set up their own business, variable pay should be more prominent.

**Proposition 8** *If the agent's entrepreneurial opportunities are affected by financial frictions, then improved investor protection (higher $\varphi$ or $\gamma$) entails less fixed pay $w^f$, a lower hurdle price, and more variable pay in the form of stock options.*

**Proof:** See the Appendix.

More generally, outside financing is one of several complementary assets which enhance the portability of managers' talents and human capital. In this sense, Proposition 8 echoes Proposition 3's message that increased portability entails more performance pay.[16] The result adds yet another possible explanation why, compared to managers in other countries, top

[14] More precisely, the exercise price is given by the stock price at $p^q$, which is $p^q - w^f$, and the hurdle price is given by $p^r - w^f$.

[15] As an example, consider the compensation contract offered to the CEO of Conoco, Archie Dunham, in 1998. The contract included a performance-vesting provision where Dunham received stock options with an exercise price of \$ 21.73 which only will be paid out if the stock price increased by 20% (exceeding the exercise price). See Bettis et al. (2010) for more examples of different types of performance-based vesting provisions.

[16] Glaeser and Kerr (2009) showed that level of entrepreneurship in the US manufacturing sector to a large extent can be predicted by the level complementary assets such as workers with relevant skills and the distribution of relevant suppliers.

managers in the United States receive a larger fraction of their pay as performance pay (Abowd and Kaplan (1999); Conyon et al. (2011); Fernandes et al. (2012)).

# 8 Final remarks

We have argued that many features of compensation contracts can be understood in light of the retention motive: When the agent's outside option does not bind, a fixed salary is optimal, but when the state is sufficiently favorable, pay must adapt to match the agent's most attractive outside employment opportunity. Giving the agent an option on the firm's own stock is an optimal retention mechanism.

Besides rationalizing the cross-sectional evidence described above, we think that the model offers a plausible explanation for the vast increase in executive stock options over the last few decades (Frydman and Saks (2010)). This movement has gone hand in hand with greater turnover, more external recruitment, managers with more general education, and better access to outside financing. In short, stock options has become more important precisely when employees' outside options are more likely to be binding.

There are several natural directions for future theoretical research on the implications of the employee retention motive. A narrow extension of the model is to relax the assumption that the employee's outside option is perfectly correlated with the inside value. Surely, there are cases in which the best outside option is imperfectly correlated with the inside value. But recall that we are not primarily seeking optimal risk sharing here; we are seeking the best defense against attractive outside offers. Tying pay to some broader measure of industry performance would run the risk of overpaying employees when the firm's industry segment is doing relatively poorly while failing to retain workers when the firm's segment is doing particularly well.

A more ambitious extension would be to consider a richer set of employee actions, providing a unified treatment of effort and retention incentives. Another ambitious extension is to study the strategic interaction between firms as they dynamically compete for workers.

# 9 Appendix: Proofs

**Proof of Proposition 3:** Part (i) follows directly from the fact that the option grant is proportional to $\theta$. To prove part (ii), differentiate the hurdle price equation

$$h = \frac{(1-\theta)w^f}{\theta},$$

and get

$$\frac{dh}{d\theta} = \frac{1}{\theta^2}\left[(1-\theta)\frac{dw^f}{d\theta} - w^f\right].$$

We only lack the sign of $dw^f/d\theta$. To find it, differentiate eq. (9) and eq. (11) to get

$$\frac{dw^v(p)}{d\theta} = p - \frac{dw^f}{d\theta} \tag{14}$$

and

$$0 = \int_h^\infty u'(w(p))\frac{dw^v(p)}{d\theta} f(p)dp + u'(w(p))\frac{dw^f}{d\theta} \tag{15}$$

where the second computation uses the fact that $w^v(h) = 0$. By substituting in eq. (14) into eq. (15) we get

$$0 = \int_h^\infty u'(w(p))pf(p)dp + \int_0^h u'(w(p))\frac{dw^f}{d\theta}f(p)dp.$$

By the fact that the first term is positive it follows that $dw^f/d\theta < 0$, and hence that $dh/d\theta < 0$.

**Proof of Proposition 4:** First consider the effect on expected performance pay. To show that expected performance pay is increasing in an MPS we need to show that

$$\int_{p^h}^\infty \left(\theta p - w^f\right) f_H(p)dp > \int_{p^h}^\infty \left(\theta p - w^f\right) f(p)dp. \tag{16}$$

Observe that

$$\begin{aligned}
\int_{p^h}^\infty \left(\theta p - w^f\right) f(p)dp &= \int_0^\infty \left(\theta p - w^f\right) f(p)dp \\
&\quad - \int_0^{p^h} \left(\theta p - w^f\right) f(p)dp \\
&= \theta\overline{p} - w^f \\
&\quad - \int_0^{p^h} \left(\theta p - w^f\right) f(p)dp \\
&= \theta\overline{p} - w^f + \theta\int_0^{p^h} F(p)dp.
\end{aligned} \tag{17}$$

The last equality follows from integration by parts. By deriving the analogous expression for $f_H$, it follows that inequality (16) holds if $\int_0^{p^h} F(p)dp \leq \int_0^{p^h} F_H(p)dp$, which is a consequence of the definition of $F_H$. The inequality (16) is strict if $\int_0^{p^h} F(p)dp < \int_0^{p^h} F_H(p)dp$.

**Proof of Proposition 5:** (Closely parallels the proof of Proposition 3, but stated for completeness.) To capture productivity improvements substitute in $\lambda p$ for $p$ in eq (11) and eq. (9). the option grant is proportional to $\lambda$. To prove part (i), differentiate the hurdle price equation

$$h = \frac{(1-\theta)w^f}{\theta},$$

and get

$$\frac{dh}{d\lambda} = \frac{(1-\theta)}{\theta}\frac{dw^f}{d\lambda}.$$

To find the sign of $dw^f/d\lambda$ differentiate eq. (9) and eq. (11) to get

$$\frac{dw^v(p)}{d\lambda} = \theta p - \frac{dw^f}{d\lambda} \tag{18}$$

and

$$0 = \int_h^\infty u'(w(p))\frac{dw^v(p)}{d\lambda}f(p)dp + u'(w(p))\frac{dw^f}{d\lambda} \tag{19}$$

where the second computation uses the fact that $w^v(h) = 0$. By substituting in eq. (18) into eq. (19) we get

$$0 = \int_h^\infty u'(w(p))\theta p f(p)dp + \int_0^h u'(w(p))\frac{dw^f}{d\lambda}f(p)dp.$$

By the fact that the first term is positive it follows that $dw^f/d\lambda < 0$, and hence that $dh/d\theta < 0$.

Part (ii) follows directly from the fact that $d^2w^v(p)/dpd\lambda = \theta > 0$ (follows from eq. (9)).

**Proof of Proposition 8.** The hurdle price is $\widehat{h} = p^r - w^f$. By equation (13), $p^r$ is decreasing in $\varphi$ and $\gamma$. For a given $w^f$, variable pay increases in all states above the new hurdle. Since the agent's participation constraint is binding, $w^f$ must decrease.

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