NBER WORKING PAPER SERIES

OUTPUT-BASED PAY: INCENTIVES OR SORTING?

Edward P. Lazear

Working Paper 7419
http://www.nber.org/papers/w7419

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
November 1999

Output-based Pay: Incentives or Sorting?
Edward P. Lazear
NBER Working Paper No. 7419
November 1999
JEL No. J3

ABSTRACT

Variable pay, defined as pay that is tied to some measure of a firm's output, has become more important for executives of the typical American firm. Variable pay is usually touted as a way to provide incentives to managers whose interests may not be perfectly aligned with those of owners. The incentive justification for variable pay has well-known theoretical problems and also appears to be inconsistent with much of the data. Alternative explanations are considered. One that has not received much attention, but that is consistent with may of the facts, is selection. Managers and industry specialists may have information about a firm's prospects that is unavailable to outside investors. In order to induce managers to be truthful about prospects, owners may require managers to "put their money where their mouths are," forcing them to extract some of their compensation in the form of variable pay. The selection or sorting explanation is consistent with the low elasticities of pay to output that are commonly observed, with the fact that the elasticity is higher in small and new firms, and with the fact that variable pay is more prevalent in industries with very technical production technologies. It does not explain why some firms give stock options even to very low-level workers.

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

The typical rationale given for tying compensation to the profitability of the firm is that output-based variable pay aligns to managerial incentives with those of owners. While appealing, this explanation is not easily reconciled with theory or facts. Free-rider effects in a multi-agent firm suggest that incentives are very much diluted, perhaps to the point of being trivial. At the empirical level, even CEOs, whose compensation is most likely to depend on company performance, own a very small part of the firm. Other facts that will be documented below also seem to be at variance with, or at least not directly supportive of the incentive argument. For example, information technology firms are more likely to offer stock options than other kinds of firms. The probability of offering variable pay through options to managers varies with firm size as does the pay-performance elasticity. High level executives are more likely to receive variable pay than lower level employees But in some firms, notably start-ups, the evidence suggests that even lower level employees receive stock options. The simple incentive explanation that is cast in the framework of a single-agent firm does not go far toward explaining these observations.

Additionally, stock options have become an increasingly important part of compensation over the past few years.[1] Some[2] view the growth as totally unwarranted, reflecting among other things, pressure that CEOs can place on their boards to award them high salaries It is alleged that stock options are not as apparent to shareholders as other forms of compensation and this explains their use

---

[1]See Murphy (1999).

[2]See, for example, O'Reilly, Crystal and Main (1988) .

1

over other, more direct forms of compensation.[3]

Other authors have argued that a larger part of compensation should take the form of stock options. Their view is that the relation of pay to output is not strong enough. Incentives are important, given what executives can do to affect firm profits, and CEOs, it is claimed, are not sufficiently affected by firm profitability. Jensen and Murphy (1990) find very low sensitivity of CEO pay to firm value. They worry that this induces CEOs to spend shareholder money on unwarranted CEO perks, like a corporate jet.[4] The claims on this side of the debate are bolstered by recent evidence that variable pay can have dramatic effects on productivity.[5] Although true, there is little hope that making the elasticity higher can have the appropriate effect on incentives. For example, if a $10 billion corporate jet only costs the CEO $60,000 and this is too low a cost to make the CEO behave prudently, then it would be necessary to make a risk-neutral CEO the owner of the firm to provide efficient incentives.[6]

The two views are not necessarily contradictory. Even those who believe that CEOs are overpaid do not claim that pay should not be tied to output. Rather, they argue that because options camouflage compensation, executives are paid too much. Those who complain about options are complaining primarily about the level of compensation, rather than its form. Critics of executive

---

[3]See *Fortune*, 1997-8.

[4]Hall (1998) re-examines the issue more critically, but still finds coefficients in the output-wage equation that are well below 1.

[5]See, for example, Lazear (1996), Freeman and Kleiner (Big Foot), Paarsch and Shearer (1996).

[6]Baker and Hall (1998) divide production activities undertaken by CEOs into two polar cases. This is discussed below.

compensation are not supporting the claim that a larger part of compensation should be fixed pay. Perhaps economists should be asking why has it taken so long for variable pay to become important, rather than why has there been pronounced growth in the use of options.

The question is more general: What is the appropriate relation between output and worker pay? The answer depends on what one believes is accomplished by linking pay to performance. The strongest version of concern over the low sensitivity of pay to performance comes from analyzing incentives in a risk-neutral environment. The observation is that the coefficient of output, properly measured, on CEO pay is much less than one. To align incentives, it is argued, CEOs should be full residual claimants. This argument is a straw man. Those who worry that the coefficient relating wages to output is too low cannot be taken too seriously because the idea that the coefficient should be one, or close to it makes no sense for a variety of reasons. A number of authors have defended the fact that the coefficient on output, properly defined, in a CEO compensation equation is not one. Most have been on the basis of risk aversion.[7] Another, in some ways more obvious constraint, is that of personal bankruptcy on the part of the CEO or the agent who is made residual claimant. Given the size of the swings in profit, it would be impossible for most CEOs to be full residual claimants. If profits fell by $1 billion, as they might in a large corporation, the CEO would be unable to pay that amount to the firm. This floor on losses actually makes an otherwise risk-neutral CEO a risk preferer because the downside is limited.

The situation is made more complicated when it is recognized that there are many workers that a firm wants to be motivated. It is difficult, if not impossible, to make all workers residual

---

[7]See, for example, Haubrich (1994).

claimants.[8] The most important point for the purposes here, however, is that it is simply infeasible for the typical worker or even executive to be full residual claimant.

In what follows, another approach is taken. Rather than focusing on the incentive role of variable pay, the importance of sorting (or selection) and information will be stressed. The idea is that insiders have more information about the profitability of an enterprise than outsiders. Outsiders, who might be inclined to invest in an enterprise, would like some assurance that the firm is likely to make a positive profit. By taking compensation in a contingent form, insiders put their money where their mouths are. A worker who will take a lower wage, coupled with pay that varies with the profitability of the firm is betting that the firm's profits will be sufficiently high to make up for any deviation in the fixed pay from the market wage. This information is reassuring to outside investors.

The implications of sorting and information are quite different from incentives. The sorting story seems to mesh better with a number of facts than at least the most extreme version of the incentive story. Most important, it implies a coefficient on output that is much closer to zero than it is to one. It also suggests that to the extent that variable pay is used, it is more likely to be used in new firms and those where information is most likely to be private than in older, better understood firms. Finally, this explanation is consistent with having a number of workers receive variable compensation, because the coefficient on the output-pay variation for any one worker is expected to

---

[8]A Groves (1973) scheme could make each a residual claimant by offering to pay every worker $1 for every $1 of profit. The worker pays a fixed amount for the privilege so that, on net, he receives his reservation wage. The problem is that capital owners prefer lower profits under such schemes and bankrolling the uncertain payoff is more than just a practical difficulty. Carmichael (1983) has argued that tournament compensation, where all workers but one receive fixed prized depending on rank, create optimal incentives for the entire firm.

4

be very small.

In addition to incentives and sorting, another explanation of providing variable pay, particularly non-vested stock options, is the desire to retain workers. The various theories have very different empirical implications that can be tested. There already exists considerable evidence on some of these points. That evidence will be examined to ascertain the importance of the different explanations.

The main conclusion is that many facts are more consistent with sorting than with incentives, although neither does well in explaining the growing trend toward giving more stock or options to low-level employees. Additionally:

1. Sorting does not require that the manager "own" the firm. An elasticity very close to zero sorts projects perfectly.

2. Selling the manager the firm is the wrong solution to the sorting problem because the price at which the sale takes place induces inefficiency.

3. Worker retention is not a justification for awarding non-vested stock options.

Some Views of Variable Pay

Risk Aversion:

It can be argued that there should be no variable pay at all. Variable pay transfers risk from capital to labor, defined to include management. This is bad for two reasons. First, workers have their human capital tied up in the firm, whereas non-labor owners of capital do not. From the point of view of diversification, a transfer of more idiosyncratic risk to labor is a step in the wrong

5

direction. Second, except for executives, a firm's own workers do not offer funds at the lowest cost. Consider, for example, a cash-constrained start-up that asks its clerical workers to take below-market ages in return for stock options. A cheaper source of capital would appear to be available. Low wage workers should charge a higher price for funds than should, say, venture capitalists or debt-based investors. If a worker would accept say, 5000 options, in lieu of 20% of the market wage, then a venture capitalist who is in a better position to bear risk should provide that same amount for less than the 5000 options. The firm should simply borrow from the venture capitalist and pay the worker the market wage. Yet it is common at start-ups to see even the lowest level workers receiving below market wages, which are offset by stock options.[9] This is inconsistent with what risk allocation theories would predict.[10]

Incentives:

The standard incentive model is well-known. When there is one risk-neutral agent whose effort is variable, the agent should be made full residual claimant. A compensation scheme that takes the form

---

[9]According to John Morgridge, former CEO and current Chairman of Cisco Systems, the San Jose, California based firm that produces internet servers, is well-known for distributing stock options to every employee.

[10]Davis and Willen (1998) argue that workers may want to hold shares in their own industries because when wages in their industries fall, profits in their industries rise so that buying the industry might provide insurance. Even if true at the industry level, there is evidence that suggests that firm profitability and worker wages are positively correlated. (E.g., see Lazear (1999)).

6

(1) $\qquad$ Compensation $= a + b\,\pi$

where π is profit, wil' induce first-best behavior if $b=1$.[11] This induces the agent to set the marginal cost of effort equal to the marginal return. The constant term, a, is then adjusted to distribute the rents. With perfectly elastic labor supply, a is set such that

$$a + b\,\pi^* = W,$$

where W is the workers reservation wage and π^* is the level of profits when effort is set to the optimal level.

The main problem with this result is that if flies in the face of the facts. Except for franchisees and a few 100% commission agents, very few individuals have this sort of relationship with a firm or other provider of capital. The reasons have already been mentioned. First, when there are multiple agents whose effort cannot be monitored and compensated directly, there are practical difficulties in making all agents residual claimants. Risk aversion and the ability to declare bankruptcy also pushes away from this kind of system. No doubt that incentives play some role in determining the compensation. But the fact that the coefficient in the pay-earnings equation is far less than one suggests that other issues are present.

Retention:

---

[11]This is shown in many places. See, for example, Lazear (1995) pp. 14-15.

Another explanation that is sometimes offered by business persons is that granting non-vested options assists in employee retention. A number of firms offer options to employees, but the worker must stay with the firm for some ti: ie before the options vest. Any departure before that date results in a loss of the options.

Although the non-vested aspect of options does cause retention, there are two problems with this argument. First, nothing requires that non-vested pay take the form of equity. Second, retention is not always efficient.

To the extent that the typical worker is more risk averse than the outside suppliers of capital, non-vested pay should take the form of bonds rather than equity. At the time that the promise is made, the firm could simply put a bond (like a t-bill) in an escrow account. If the worker were to stay for the required period, he would receive the bond. If he left early, it would revert to the firm. Such an arrangement would have all the binding power of non-vested options, but would not transfer risk to employees who are not the efficient risk bearers.

Furthermore, binding a worker to the firm is not usually efficient[12]. If a worker's outside opportunities exceed his value at the current firm, then distorting pay to enhance retention is inefficient. Both worker and firm could be made better off by negotiating a separation.

The conclusion is that the retention argument fails to explain the granting of options, non-vested or otherwise.

---

[12]One exception is when there is firm-specificity to the relationship, either because of human capital or informational considerations. Additionally, it may be privately (although not socially) optimal to bind workers to the firm in order to prevent a monopoly from becoming an oligopoly.

Sorting:

A story that has received much less attention than the incentive story, but seems more consistent with the facts, is that of sorting or selection. Sorting can occur across workers or it can be across projects. Both are relevant, but the initial discussion will be in terms of project sorting. The clearest way to frame the discussion is through an example of a capitalist who is considering extending her enterprise into a new direction. Consider, for example, a clothing manufacturer who sells pajamas, but is thinking about moving into the lingerie line.[13] The manufacture has no expertise in lingerie, nor does the company know the prospects in the lingerie market. There are, however, a number of individuals with managerial expertise in lingerie who are potential developers or partners in this line. One such manager, named Jim, contacts the owner of the pajama firm, whose name is Gladys. Jim claims that Gladys, Inc. can enter lingerie profitably, with his assistance. Jim may be correct, but his statement may be wrong for two reasons: Jim's assessment of the lingerie market may be wrong or Jim may know the truth, but may gain personally by drawing Gladys into the venture, even if it is unprofitable. We focus on the second reason first and return to the first reason below.

To begin, consider the fact that π, now thought of as the profit on the lingerie line, is a random variable, the realization of which is important information to Gladys, the capitalist. Specifically, a capitalist with complete knowledge would would only choose to invest in positive profit projects. If capitalists were able to screen out all negative profit projects, then expected profits would be

---

[13]This example is real. It is based on the experience of a student in the Stanford-NUS executive program.

$$(2) \quad E(\pi | \pi \geq 0) \equiv \int_0^\infty \pi f(\pi) d\pi$$

$$\equiv \int_0^\infty \pi \, dF$$

where π has density $f(\pi)$ with distribution function $F(\pi)$. This is obvious, but is easily derived from the condition

$$\max_{\pi^*} \int_{\pi^*}^\infty \pi \, dF$$

which has first-order condition

$-\pi^* f(\pi^*) = 0$.

The solution is $\pi^* = 0$. To maximize profits, the firm should reject only and all negative profit projects. The expected profits in (2) are the maximum attainable profits under perfect information.

Now, a manager who knows π and has alternative opportunities W accepts whenever

$$(3) \quad a + b\pi \geq W \quad .$$

One can implement the optimal solution by using the compensation scheme of setting a=W, and setting b positive, but arbitrarily close to zero. Using (3) and substituting a=W, the manager only chooses to accept the job when

$b\pi \geq 0$,

10

or, since $b>0$, he accepts only when and only when $\pi \geq 0$. A value of $b=0$ would not work, however, because then the manager would accept the job even when profits were negative.[14]

There are a few points to note. First, and most important, managers receive their reservation wage and the capitalists capture all rent above W. Of course, any $b>0$ would result in efficiency as well, but larger values of b would distribute a larger share to the manager than necessary. Still, the implied relation between profit and wages of the manager is much closer to zero than it is to one. The purest incentive story suggests a coefficient on b of one, whereas the sorting explanation implies a coefficient on b that approaches zero.

In some sense, this mechanism is too easy. As long as a manager knows that he cannot receive anything above the reservation wage, he should be willing simply to tell the owner whether the project is worthwhile. The information is valuable to the owner, but the manager extracts no rents because of the competitive nature of the managerial market. Thus, b arbitrarily close to zero solves the problem. Indeed, it could be argued that $a=W$ and $b=0$ works as well because the manager has no incentive to lie under these circumstances. Unobserved heterogeneity among managers breaks the indifference and nails down more precisely the exact level of b, which must be positive. This is shown below, but intuitively, with $b=0$ some managers whose alternative wage is less than W (even as a result of search cost) might lie to the capitalist stating that the project is profitable when it is not.

Second, efficiency prevails. Capitalists obtain perfect information; the manager accepts the job for every positive profit project and rejects the job for every negative profit project. Note further

---

[14]Note that economic profit nets out the opportunity cost of managerial time, which equals W.

that setting $a<W$ and $b>0$ does not attain efficiency. For any $\gamma>0$ such that $a = W - \gamma$, there is a range of positive profit projects that are rejected by the manager. Specifically, in those situations where

$$a + b\pi < W,$$

the manager rejects the job. This implies the manager rejects when

$$W - \gamma + b\pi < W$$

or when

$$\pi < \gamma / b.$$

The larger is gamma, the more positive profit projects are rejected. Conversely, were a greater than W, the manager would accept the job in some cases where profits were negative.

Third, and related, the solution is not to "sell the manager the firm." Selling the manager the firm would imply a negative value of a, and would necessarily imply $b=1$. The manager would be made full residual claimant. This could be accomplished by using debt financing rather than equity financing.[15] But this solution is neither efficient nor profit maximizing for the capitalist. For the capitalist to make money on the sale, a must be negative, i.e., the manager must pay the capitalist a fee to acquire the firm. To see that this is inefficient, note that this is merely a special case of $\gamma>0$ with $b=1$, because when $a<0$, the manager rejects projects for which $\pi<-a$. As shown above, this

---

[15]Capital owners would issue a bond that had a fixed payoff. All amounts of profit that exceeded the owed amount would revert to the equity holder, namely the manager. Of course, this debt would be quite risky because if profits turned out sufficiently negative, the manager could not repay the loan. Worse, managers would have incentives to borrow even if profits were negative as long as they could consume some of the loan before having to repay. Collateral of some sort or more direct monitoring is usually required under these circumstances.

results in positive profit projects being rejected by the manager. Even though a project yields positive profit, it may not yield enough to make the manager willing to take on the activity, given that he must pay something to obtain the firm in the first place. If the manager already owned the firm, then he would take on all positive profit projects. But the manager is making the decision to buy the firm after he has already obtained information on the realization of profits. Put differently, if the owner knew the value of π, a deal could be struck for every $\pi>0$. But when the owner charges a price in advance for the firm, some positive profit projects will be rejected.

Furthermore, selling the manager the firm does not maximize capitalist profit. If the sorting view holds, then the problem for the capitalist is an ex ante one because the capitalist does not know the true value of the firm. The manger's decision, on the other hand, is made ex post of the realization. To see what this implies formally, consider the capitalist who wants to sell the firm. The choice is merely over a, because once the firm is sold, $b=1$. Now, the manager buys the firm whenever

$$a + \pi > 0$$

or whenever[16]

$$\pi > -a .$$

The more negative is a, the less often the firm is bought by the manager. But the more negative the a, the more the owner receives for the firm. This is the classic stochastic monopoly problem where

---

[16]Note that the W term has vanished. When the manager owns the firm, he also pays himself W, which is already netted out of profit.

the capitalist receives $-a$ and the manager "receives" a, which will be negative. To see this, note that the capitalist wants to choose a so as to maximize

$$(-a) \quad \text{prob} \, (\, a + \pi > 0)$$

or

$$(-a) \, [\, 1 - F(-a) \,]$$

The first order condition is

$$- [\, 1 - F(-a)] - a \, f(-a) = 0$$

or

$$(4) \qquad a \; = \; - [\, 1 \, - F(-a) \,] \, / \, f(-a) \; .$$

This is the standard condition that says set the price equal to the inverse hazard ratio.[17] It yields a value of a that is negative. The manager must pay a positive amount to the capitalist.

Selling the firm to the manager at the optimal a in (4) always results in lower profits to the capitalist than setting $a{=}W$ and b close to zero. The solution of $a{=}W$, b close to zero yields full efficiency and distributes (almost) all the rent to the capitalist. It is impossible to do better. When $a{<}0$, the condition that the firm is managed whenever $\pi{>}0$ is violated. Profits must exceed $-a$ in order

---

[17]This is the same result as that obtained in Hall and Lazear (1984) in the context of calling out a wage that induce a worker to accept a job when his reservation wage is unknown.

to induce the manager to buy the firm. Since positive profit opportunities are foregone (i.e., those when $0<\pi<-a$), expected profit is strictly lower when the firm is sold to the manager than when it is retained by the capitalist who pays $a=W$ and b close to zero. Selling the firm to the manager solves the moral hazard problem, but it does not solve the adverse selection problem. Since the sorting issue discussed here is one of adverse selection, it is less surprising that the solution does not come down to selling the firm to the manager.

The result is another example of a price discriminator extracting all the rents and a monopolist extracting only a part of them. By setting $a=W$ and b close to zero, the capitalist price discriminates. Gladys implicitly charges a lower price for the firm when π is low than when it is high. The firm is worth more and Gladys receives more when $a=W$ and b is close to zero. With $a<0$ and $b=1$, no price discrimination occurs. The price that the Gladys receives for the firm from Jim is always $-a$, and this occurs only when $\pi>-a$. Thus, the capitalist does better by using the $a=W$, b close to zero compensation scheme than she does by selling the firm to the manager, even if such a sale were feasible.[18]

With competitive bidders, an auction could be held that would extract all rents. Instead of charging $-a$, the firm would simply allow the informed managers to bid against one another to buy

---

[18]The solution that assigns all the rent to the capitalist need generalizes to any solution of the rent split. Simply think of W as the equilibrium amount that the manager captures, given his bargaining strength. This is an ex ante amount because the capitalist, who is ignorant of π, does not base his negotiation strategy on π. Then all results hold. In the lingerie example, the capitalist captures all rents because there are substitute managers who also know the lingerie business.

If the market for such knowledge were sufficiently large, then a "certifying" business might be viable. Rather than having the manager actually take the job with the manufacturer, the potential manager could simply provide a diagnostic service and charge a fee for giving unbiased assessments of profit opportunities.

the firm. Competition among managers would drive the price paid up to π and the capitalist could extract all rent this way. This would be fully efficient because no positive bids would be received when profits were negative. This solution gives identical rents and allocations as the solution of $a=W$ and b arbitrarily close to zero. The difficulty here, of course, is the same as mentioned earlier. In order to extract full rent, the manager must be in a position to buy the entire firm outright at the present value of its future profit stream. In most situations, this is infeasible and is part of the reason why managers are managers and not owners. Managers neither have the capital nor can they borrow enough to buy the firm outright. Borrowing introduces severe moral hazard problems. A lender would only be willing to finance the firm if the collateral, in this case, the firm itself, were sufficient to protect the loan. But to make this determination, the capitalist who lends the money must have the same information as the informed manager. Were this the case, an informed manager would be unnecessary, which negates the entire premise on which this explanation is based. Instead, the solution of setting $a=W$ and b slightly positive accomplished everything that selling the firm outright does, but it does not require a loan nor does it put managers in a position where they benefit from lying about the value of the firm to obtain loan funds that they can consume and before a default.

Put more intuitively, the sorting story boils down to this. Before an capitalist is willing to put resources into an enterprise, he wants to be confident that the investment will yield a significant payout. Worker behavior, and especially the behavior of those most knowledgeable, provides the capitalist with clues. In order to get informed managers to put their money where their mouths are, the capitalist makes pay contingent on profit. If those with the most knowledge are unwilling to take a job under a contingent pay arrangement, then the capitalist is less inclined to invest. It is sensible

16

for an capitalist to be more willing to commit to an organization where all the knowledgeable people accept contingent pay than to an organization where those people demand a guaranteed wage.

All Managers are Not Created Equal:

There are two dimensions of managerial differences that are relevant for sorting. First, the manager may not know true profits with certainty. Second, managers are a heterogeneous lot and the firm may want to induce only the most able managers to apply.

How does uncertainty about managers change the solution? First of all, even risk neutral capitalists prefer to be dealing with agents who have more precise information. The reason is that a perfectly informed manager accepts the job only when profits are positive and rejects it always when profits are negative. An imperfectly informed manager makes mistakes, sometimes taking the job when profits are negative and sometimes rejecting the job when profits are positive. These false positive and false negative mistakes reduce the overall level of expected profits for the capitalist. To see this more formally, consider two managers. One knows π with certainty (as assumed up to this point). The other only estimates π with $\hat{\pi}$

$$\hat{\pi} = \pi + v,$$

where v is random measurement error.

Given compensation scheme $a + b\pi$, the risk neutral imperfectly informed managers accepts the job whenever

$$a + b\hat{\pi} > W$$

17

or when

$$\hat{\pi} > (W - a) / b .$$

Thus, .he imperfectly informed manager would accept the job when

(5) $v > -\pi + (W - a) / b$.

The rule in (5) implies that even with negative profits, an imperfectly informed manager would accept a job that a perfectly informed manager would reject.

Conversely, if v is sufficiently low, then an imperfectly informed manager rejects positive profit projects. Again, if $a = W$ and b is small but positive, the perfectly informed manager always does the right thing, which results in maximum profits for the capitalist. The imperfectly informed manager does not. Since the capitalist receives $(1-b)\pi$ of every investment made, the existence of either false negative or false positive errors results in lower profits than those in (2), which are obtained when a perfectly informed manager is paid W, plus a very small positive fraction of profit. Since (2) yields the maximum profit, any acceptance of projects other than those where $\pi>0$ results in lower profits than those in (2). Because (5) implies that false positive and/or false negative errors are made, the project acceptance rule deviates from that in (2) and results in lower overall profit Thus, the capitalist's expected profits are lower with an imperfectly informed manager than with a perfectly informed one.[19]

The second point, that managers are heterogeneous, requires some discussion. There are two

---

[19]For risk averse managers, using a higher value of b and lower value of a is more of a burden to an imperfectly informed manager than to an otherwise identical perfectly informed manager. Because v is a random variable, the larger the b, the larger the amount of random variation in income.

dimensions along which managers differ. Managers have different ability to affect profit and also have different alternative uses of time. One might suspect that the two would be correlated. This has implications fo. the size of b. Once worker heterogeneity is taken into account, it is no longer the case that the firm can simply ask knowledgeable managers to reveal voluntarily whether a project is profitable. Sorting of managers requires a value of b that exceeds zero by a specific amount.

This is precisely the problem that Gladys was worried about in setting up her lingerie division. Gladys wanted Jim to run the division because he could turn a profit for the company, not because his alternatives were poor. Gladys had no expertise in the lingerie business. She had to rely on Jim or someone like him. But she wanted to ensure that he was right for the job and that the project would be profitable under his guidance.

Were Gladys able to auction off the lingerie division, then all would be solved. But this simply begs the question. Why does Gladys own the clothing firm in the first place? Presumably, she has some comparative advantage in managing a firm of this type. The fact that Jim knows lingerie does not imply that he is the efficient owner of the firm along all dimensions. Jim's inability to raise sufficient capital provides just one reason why he might not be the owner.

Short of selling the firm to the manager, what can the owner do? She can set up a compensation scheme that attempts to induce sorting along two dimensions. She wants to weed out the bad managers and also induce managers to take the job only when it is profitable to do so. Because managers have different alternative uses of time, the solution no longer simple. For example, suppose there were two types, Quicks and Slows. The quick managers produce profit level π_Q for the firm, whereas the slow managers produce profit level π_S for the firm, with $\pi_Q > \pi_S$. Furthermore,

19

the quick managers are also likely to have better alternatives than are the slow managers, even if only in self employment. Let the Quicks have alternative wages W_Q and the Slows have alternative wages W_S.

There exists no linear compensation scheme that accomplishes sorting, efficiency and pays the manager only his reservation wage.[20] To see this, note that it is necessary that

$$a + b\pi_Q \geq W_Q .$$

To keep the less able manager from taking the job, it is necessary that

$$a + b\pi_S < W_S$$

Finally, to ensure that efficiency prevails, it is necessary that the able manager accept the job if and only if π_Q is non-negative. Thus, when $\pi_Q = 0$, the able manager should be just indifferent between accepting and declining the job and he should strictly prefer it when profits are positive. Suppose we choose $a = W_Q$ and b close to zero, as before. This scheme induces efficiency for the able individual, but since $W_Q > W_S$, the less able manager also takes the job, even when profits are considerably negative. For this individual, there is no longer a "tie." The Slow is not indifferent between telling the truth about the profitability of the firm and working elsewhere. Even were profits negative, as long as $\pi_S > (W_S - W_Q)/b$, which is a negative number, the Slow would be better off accepting the job and lying about the profitability of the venture.[21] Again, this was Gladys's concern. She worried that Jim would say that the venture was profitable, even if it was not, just to take advantage of the

_____

[20]It may be possible to improve on performance by offering a menu of compensation schemes. See Roger Myerson, 1983.

[21]The Slow accepts when $a + b\pi_S > W_S$. Setting $a = W_Q$ means that the Slow accepts when $b\pi_S > W_S - W_Q$.

20

high fixed salary.

Unfortunately, other compensation schemes that keep Slows out also result in inefficiency for Quicks. To obtain efficiency for Slows, the firm would set $a = W_S$ and b close to zero. But then Quicks would not accept the job for a range of positive profit opportunities. In order for the Quicks to accept, it would be necessary that $W_S + b\pi_Q > W_Q$ or that $\pi_Q > (W_Q - W_S) / b$. This leaves out a range of profitable projects because $W_Q - W_S$ is positive.

One solution is to obtain information on the worker's alternatives. If Gladys knew that Jim's alternatives were higher than a, she would feel much more comfortable launching the effort. Jim's willingness to give up some fixed salary to take the job with her would signal that he estimated that the firm would earn positive profit. Knowledge that Jim was giving up something to take the position at Gladys's firm could completely alter her view of the project.

If the firm were unable to obtain information on the value of the manager's alternatives, then it must choose a and b, knowing only distributions and not realizations. This problem is somewhat more complicated than the previous specification, but it can be solved.

Formally, let managers have talents, k_i, distributed with density $g(k_i)$ such that profit at the firm equals

(5) $\pi_i = \pi + k_i$

where π continues to be known to the manger. As before, the owner only knows the ex ante density $f(\pi)$. Finally, allow managers to have alternative uses of time given by W_i. To make things simple,

let

$$W_i = W + \lambda k_i$$

where λ is a parameter that is less than one. The most able managers also have better alternatives, but they have a comparative advantage at the new firm.

Now, manger i will only accept the job when

$$a + b(\pi + k_i) > W + \lambda k_i$$

or when

(6) $$\pi > \frac{W + \lambda k_i - a}{b} - k_i$$

Thus, the firm's expected profits are

(8) $$profit = \int_{-\infty}^{\infty} \int_{\frac{W+\lambda k - a}{b} - k}^{\infty} ((-a + (1-b)(\pi + k))) f(\pi) g(k) d\pi$$

The solution can be found by differentiating (8) with respect to a and b and setting the resulting expressions equal to zero. The f.o.c. is messy,[22] but it is clear from the f.o.c. that either a<0

---

[22]They are

$$\frac{\partial}{\partial a} = \int_{-\infty}^{\infty} \int_{\frac{w+\lambda k - a}{b} - k}^{\infty} -f(\pi) g(k) d\pi \, dk + \frac{1}{b} \int_{-\infty}^{\infty} [-a + (1-b)(\frac{w + \lambda k - a}{b}) f(\frac{w + \lambda k - a}{b} - k)] g(k) dk$$

22

or b<1, or both. If this were not so, the firm would never make a positive profit. The exact nature of the solution depends on the underlying distributions of k and π. Also clear is that since there is no longer a unique alternative wage, there is no way, ex ante, to set a equal to the alternative wage for every potential manager.

Although no general characterization is provided, an example makes clear why the optimal b exceeds zero. If f() is uniform between -20 and 20, with g() uniform between 0 and 10, then, when W=1 and λ=.05, the solution is to set a=1.12 and b=.06 .With these values, the managers alternatives vary between 1 and 1.5, so setting a=1.12 pays managers a fixed component that is less than the average wage that managers earn outside. However, the positive coefficient on b makes the job attractive for some, especially those who have high values of k. There is not complete efficiency. For example, a worker with a value of k=0 and therefore an alternative wage of 1 would accept the manager's job even when profits were slightly negative. As long as bπ is not less than .12, the worker is still better off being manager at this enterprise than taking the alternative position. Conversely, some efficient opportunities are foregone. Consider, for example, an individual with k=10 so that his alternative wage would equal 1.5. Since base pay is 1.12, it is necessary that the difference, in this case, .38 is made up by the variable component. Were b(π+10)<.38, then the manager would pass up the opportunity, even when profit under his management, π+10, is greater

___

and

$$\frac{\partial}{\partial b} = \int_{-\infty}^{\infty} \int_{\frac{w+\lambda k-a}{b}-k}^{\infty} -(\pi-k)f(\pi)g(k)d\pi\,dk + \int_{-\infty}^{\infty} \frac{w+\lambda k-a}{b^2}[-a+(1-b)(\frac{w+\lambda k-a}{b})f(\frac{w+\lambda k-a}{b}-k)]g(k)dk$$

than zero.

Summarizing this section, a higher value of b coupled with a lower value of a is relatively more advantageous to the more able managers. The firm can encourage more able managers to take the job and discourage less able ones from doing so by using a value of b that exceeds zero. This also implies a fixed wage component, a, that is less than the alternative wage of the most able type of worker. The cost of using a low value of a and a high value of b is that some profitable projects are passed up by more able workers.

Implications

Elasticity of pay with respect to output:

The implications for b, the coefficient of pay with respect to profit, depends on the primary mechanism that generates managerial compensation. The pure incentive story in its simplest form implies a coefficient of one. This is a straw man, however, for a variety of reasons. Already mentioned are that risk aversion, bankruptcy limitations and multi-agent firms keep principles from implicitly or explicitly selling the firm to the manager. Still, the incentive story in its purest form seems inconsistent with the facts.

A demand for insurance by workers implies a b equal to zero. If the firm is risk neutral and workers are risk averse, then in the absence of incentive considerations, pay should not vary with the outcome in the firm.

The desire to retain workers has been put forth as a reason for making pay both variable and non-vested through the use of deferred stock options. But this argument in its simple form is simply

24

incorrect. There is no necessity to make pay variable to retain workers. Furthermore, it is not clear that it is efficient to retain workers in the first place. Paying workers exactly their marginal products at each point in time induces appropriate turnover behavior without resorting to variable pay or incomplete vesting. Only when there is specificity to the relationship between workers and firms is there any reason to attempt to keep workers on. Thus, non-vested compensation should be more prevalent in situations where specificity exists.[23]

To the extent that the value of the relationship is proxied by the stock price of the firm, awarding non-vested options might be thought of as variable compensation that induces more turnover in bad states and less turnover in good states. Although possible, it is hardly clear that the rigid relation of stock price to option value is the one that is optimal for turnover considerations It would seem more likely that a variable wage, which reflected not only firm level considerations, but also factors that affected the individual per se, would be a better instrument. Whether the variable pay takes the form of stock options or wage variation, there does seem to be a retention argument that justifies variable pay.

Finally, the sorting argument suggests a small coefficient of b. In the purest case, b can be set arbitrarily close to zero. When capitalist are attempting to sort managerial types as well as projects, a significantly positive b may be warranted. However, even under these circumstances, the optimal level of b may be very close to zero.

---

[23]The nature of the firm-specific relationship is unimportant. It could reflect firm-specific human capital or, alternatively, information that firms possessed about their own employees that was not known to outsiders.

Evidence

The Size of b:

There is substantial evidence on the relation of compensation to output, particularly for CEOs. Most of the evidence finds that that b, the coefficient of some measure of output on compensation is very small, even for CEOs. For example, Murphy (1999) finds that b is between .001 and .007 during the 1990s at the sample of firms that he examines. The coefficients vary with year and industry.[24] This means that a $1000 change in shareholder value implies about a $1 to $7 change in the compensation of the CEO. These numbers depend on how compensation is calculated. Hall and Liebman (1998) find larger effects than the earlier studies by taking into account changes in compensation that results from changes in the market value of the firm. Still, the results support a low value of b. It is quite clear that CEOs are not close to being full residual claimants.

The sorting view is not inconsistent with the fact that b is small. It also seems to fit well with some other facts. For example, Yermack (1995), finds that the form of stock options are inconsistent with the view that they are provided for incentive reasons, despite the fact that most firms call them incentive plans. For example, the vast majority of options are issued with the exercise price set at the current market price. This does not provide the kind of leverage that would be useful to increase incentives necessary to offset the free-rider effects of having diluted ownership[25]. There may be other reasons for setting the strike price equal to the current price, but it is difficult to argue that providing optimal incentives is one of them.

---

[24]See his figure 8.

[25]See Lazear (1998, pages 317-25, 340-42).

Sorting is not inconsistent with setting a strike price equal to the market price. Again, since the b implied by sorting may be very small, no leverage is required to provide the right sorting mechanism. Furthermore, tying value to stock price is exactly what sorting implies. Since investors are concerned about the value of the firm, the sorting story is relevant even if the recipient of variable pay is not the one that generates high value in the firm. It is only necessary that he knows about value generation and is willing to bet on it. Sorting does not do well as an explanation for all observed patterns. Although much more unusual than grants of stock or stock options to executives, some firms give stock even to lower level employees. The fact that grants of stock and options to lower level employees are less common than those to managers does fit the sorting explanation, but it is not clear from a sorting viewpoint why lower level workers should get any stock or options at all.

Other examples of variable pay:

Stock and stock options reflect one form of variable pay, but more direct pay variation is also observed. In Lazear (1986), I argued that American workers might have pay that is actually more variable than that of Japanese workers because raises implicitly depend on company profits in the US. This elasticity might be higher than the elasticity of pay to profit in the more explicit wage contracts observed in Japan. In a recent paper,[26] I found that firm growth and worker wage growth were positively related. This suggests that there may be some implicit variation even in the pay of workers who have fixed wages that are explicitly independent of variations in profit. Also relevant is the volatility of stock price. Where information is more important, stock prices are more volatile because

---

[26]See Lazear (1999).

there are larger deviations between ex ante and ex post valuations. The sorting explanation suggests that stock options and variable pay should be more common when stock price is more volatile. No clear prediction on volatility comes from an effort motive for stock grants.

Do incentives work?

There are a number of studies that show that variable pay can indeed have large effects on productivity and possibly on profit as well. In addition to the micro-studies mentioned earlier (Lazear (1996), Paarsch and Sheerer (1996) and Fernie and Metcalf (1996)), there are survey based analyses that find positive effects. Prendergast (1997) surveys the work on incentives in firms and concludes, based in part on studies already discussed, that incentives matter, but that the selection or sorting explanation has received too little attention given its apparent empirical importance. Additionally, Prendergast suggests that most incentives are produced through promotion in a tournament context, rather than through variable pay. Estrin, Perotin, Robinson and Wilson (1997) find that higher productivity is associated with the existence of profit sharing across a large number of firms in OECD countries. Finally, Blinder (1990) summarizes the findings of a conference on pay and performance by stating that profit sharing appears to raise productivity, but that ESOPs do not. The most direct evidence on ESOPs is presented in the Blinder volume by Conte and Svenjar (1990), who conclude that ESOPs do not reduce productivity, as some who worry about dilution effects predict, but that there is little evidence of increased productivity. Weitzman and Kruze (1990) cite the industrial relations literature and summarize it as implying that productivity rises when some form of gainsharing or profit sharing is instituted.

28

The fact that these papers find incentive effects suggests that variable pay can generate incentives. This is consistent with the incentive view of variable pay. To the extent that the studies on profit sharing are taken to imply causation, the findings are noteworthy because standard models suggest that profit sharing should not have much of an effect on worker behavior, again because of free-rider problems.[27] However, the results, while supportive of incentive stories, do not provide evidence which discriminates between incentives and sorting. Although the results may indicate incentive effects, it is also possible that the data reflect a separating equilibrium. One possibility is that successful profit sharing firms attract knowledgeable workers, unsuccessful profit sharing firms attract no informed workers and fail (as they should), and fixed-wage firms attract less knowledgeable workers. If knowledge requires costly investment by workers, then profit sharing firms would have to offer higher wages and employ smaller, more productive workforces than fixed-wage firms. Thus, the findings may also be consistent with sorting.[28]

Incentives are obviously important in some cases where sorting and information is irrelevant. Two examples leap to mind. First, taxicab drivers generally lease their cabs from cab companies and are complete residual claimants. For them $b=1$. With cabs, incentive problems are key. Were drivers paid a fixed hourly wage, they would prefer to park the cab rather than to seek out customers. Making drivers full residual claimants solves this problem. (It also eliminates the desire of the driver to offer a ride with the meter off at a fixed fee. Both passenger and driver could be made better off

---

[27]See Kandel and Lazear (1992).

[28]Lazear(1996) uses panel data, which allow total productivity effects to be partitioned into those that result from pure incentives and those due to other factors, including sorting. In that study, half of the total effect of switching to variable pay reflected incentives.

by this deal, but it would result in reduction of revenue for the company.) Also clear is that those who invest in the cabs do not have poorer knowledge of the taxi business than individual drivers. Set ng $b=1$ serves no informational role here, but it does provide the right incentives for the drivers.[29]

The same logic applies to franchise salespersons. Mary Kay Cosmetics, Amway, and peanut sellers at ballparks fit here. They all have $b=1$. The salesperson buys the product and resells it, keeping the difference as payment for services. The information argument makes little sense in this context, but the incentive justification seems sound. Of course, these cases, along with the taxicab example, involve situations where implicit purchase or rental of all of the capital is feasible.

The conclusion, then, is that the typical case has b far less than 1. Few managers are full residual claimants. Although there are many reasons why this is so, it implies that incentive stories, at least in their purest form, do not explain all of the data. Sorting may be a better explanation in some cases. Furthermore, in those situations where information is unimportant and incentives clearly matter, $b=1$ is observed.

Hierarchical Considerations:

As mentioned earlier, high level managers are more likely to have information about prospects (both their own and the firm's) than are lower level production workers. This would imply that straight fixed wage contracts should be more prevalent among low level workers than among higher level ones if information arguments imply a b that is positive, but small. Indeed, the evidence is clear

---

[29]It does tend to sort out the better drivers. Those who are least able to use the cab effectively will not find it profitable to lease the cab at the equilibrium price.

on this point. The American Compensation Association Salary Survey from 1998-9 reports that about 94% of firms offered their offices and executives stock options, whereas only 19% of firms offered options to their non-exempt, hourly, non-union workers.

Is this finding also consistent with the provision of incentives? Aggarwal and Samwich (1998) suggest that it is. If workers are risk averse, and if market value is a better signal of CEO output than it is of output of lower level executives and production workers, then CEO compensation would be more closely tied to market value than that of other workers.

Firm Size and Firm Age:

Gathering information would seem to be more important in new industries than in older ones. Although there is little hard evidence on this point, the general impression is that the typical manger in a start-up firm in Silicon Valley receives a large part of his compensation in the form of variable pay (often stock options). These new firms fit the story modeled above. It is less clear why it would be more important from an incentive point of view to provide variable pay for incentives in new firms than in old.[30]

Although no evidence is provided on the relation of variable pay to age, there is evidence on the relation of variable pay to firm size. The absolute number of dollars at risk to managers is lower for top executives in small firms than is in large ones, but the elasticity of compensation is higher in

_____

[30]Aggarwal and Samwick's explanation may fit here also. To the extent that new firms are small, firm value is likely to be a better signal of managerial output in small firms than in larger ones.

large firms than in small ones.[31] Size and age are surely correlated because almost all new firms are small. Is elasticity or absolute dollars at risk relevant for incentive consideration? Baker and Hall (1998) argue that to motivate activities, the effects of which are independent of firm size, absolute dollars should be the target variable. To induce managers to take actions that have more value in larger firms, the elasticity is relevant. By using data on the actual distribution of b across firms, they infer that the mix of desired activities is somewhere in the middle of the two extremes. Their results, while interesting, do not provide independent evidence on incentives because they assume an optimal incentive structure to estimate the underlying parameters.

One implication of the information-sorting story is that variable pay should be used when information is more important or more difficult for investors to obtain. New industries are one example, but another is provided by high-tech industries, where those with comparative advantage operating in a capital market are not likely to have a comparative advantage in the technical activity itself. There is some evidence on this point. Anderson, Banker and Ravindran (1998) find that there is greater use of stock options in information technology firms. Not only is this a new industry, but it is one where the level of technical expertise is high and skills are specialized. Using stock options to induce specialists to bet on their beliefs is logical in this industry.

Periods of Uncertainty:

If the information-sorting argument is correct, then variable pay might be more prevalent during periods of uncertainty. When an industry is undergoing major change or when a firm is in a

---

[31]See Murphy (1999), figure 9, and Baker and Hall (1998).

32

transition period, stock options and other variable pay might be observed. Mergers, divestitures, bankruptcies and other events that signal a period of rapid change for a firm may be associated with variable pay. Although I am not aware of any evidence on this point, there are anecdotes that support the point. In the early 80s, when Chrysler was on the verge of bankruptcy, Lee Iacocca, a knowledgeable auto industry insider, was brought in as CEO for $1 a year plus variable pay that depended on Chrysler's performance. Iacocca's willingness to take this bet was touted in the press as reflecting his confidence in Chrysler and its ability, under his leadership, to turn around. Indeed, one rationale in publicizing the nature of his contract was to advertise Iacocca's confidence in Chrysler to investors and consumers.

Conclusion

Variable pay has become an important part of compensation. Most economists have tried to explain the use of variable pay in the context of incentive models. Although incentives may be a justification for a number of the variable pay contracts that are observed, incentives do not fit well with a number of other facts. An alternative story that relies on information and sorting seems to be consistent with some facts that are at odds with the incentive justification. Sorting cannot explain all the facts. Although the proportion of compensation that takes the form of variable pay is positively correlated with hierarchical level, it is unclear that low level workers should receive any variable pay at all on the basis of information and sorting. That point notwithstanding, the focus on incentives almost to the exclusion of sorting and selection has misled researchers and created apparent empirical anomalies where none may exist. Perhaps more attention should be paid to selection and sorting and

less to incentives when attempting to explain the data on variable pay.

References

Aggarwal, Rajesh K. and Andrew A. Samwick. "Performance Incentives Within Firms: The Effect of Managerial Responsibility," Dartmouth College, 1998.

American Compensation Association "Report on the 1998-1999 Total Salary Increase Budget Survey, " Scottsdale, Arizona: American Compensation Association, 1998.

Anderson, Marck C., Rajiv D. Banker and Sury Ravindran. "Executive Compensation in the Information Technology Industry," The University of Texas at Dallas, 1998.

Baker, George and Brian Hall. "CEO Incentives and Firm Size," draft, Harvard University, November 1998.

Blinder, Alan. "Introduction," in Alan Blinder, editor, *Paying for Productivity*. Washington: The Brookings Institution, 1990, pp. 1-14.

Carmichael, H. Lorne. "The Agent-Agents Problem: Payment by Relative Output," *Journal of Labor Economics* 1 (January 1983): 50-65.

Conte, Michael A. and Jan Svenjar. "The Performance Effects of Employee Ownership Plans," in Alan Blinder, editor, *Paying for Productivity*. Washington: The Brookings Institution, 1990, pp.143-72.

Davis, Steven J. and Paul Willen. "Using Financial Assets to Hedge Labor Income Risks" Estimating the Benefits," University of Chicago, 1998.

Estrin, Saul, Virginie Perotin, Andrew Robinson and Nick Wilson. "Profit-Sharing in OECD Countries: a Review and Some Evidence," *Business Strategy Review*, 8,4, (1997), pp 27-32.

Fernie, Sue and David Metcalf "It's Not What You Pay It's the Way That You Pay It and That's What Gets Results" Jockeys' Pay and Performance, Centre for Econ. Performance Disc. Paper #295, LSE, 1996.

Freeman, Richard and Morris Kleiner "The Last American Shoe Manufacturers: Changing the Method of Pay to Survive Foreign Competition," NBER Working Paper #6750, Oct. 1998.

Groves, Theodore. "Incentives in Teams," *Econometrica* 41 (May 1973): 617-31.

Hall, Brian J. and Jeffrey B. Leibman "Are CEOs Really Paid Like Bureaucrats?" *Quarterly Journal of Economics*, August 1998.

Hall, Robert E., and Lazear, Edward. ``The Excess Sensitivity of Layoffs and Quits to Demand,'' *Journal of Labor Economics* **2** (April 1984): 233-57.

Haubrich, J. "Risk Aversion, Performance Pay, and the Principal-Agent Problem," *J. Pol. Econ.* 102,2, (1994), 258-76.

Jensen, Michael C., and Murphy, Kevin J. ``Performance Pay and Top Management Incentives,'' *Journal of Political Economy* 98 (April 1990): 225-64.

Kandel, Eugene and Edward P. Lazear, "Peer Pressure and Partnerships." *Journal of Political Economy* 100(4) (August 1992): 801-17.

Lazear, Edward P. ``Salaries and Piece Rates,'' *Journal of Business* **59** (July 1986): 405-31.

Lazear, Edward P. *Personnel Economics*, Cambridge: MIT Press, 1995.

Lazear, Edward P. "Performance Pay and Productivity," NBER Working Paper #5672 (August 1996). *American Economic Review*, 1999.

Lazear, Edward P. *Personnel Economics for Managers*. New York: John Wiley & Sons, Inc. 1998.

Lazear, Edward P. "Personnel Economics: Past Lessons and Future Directions," *Journal of Labor Economics*, 16,2 (April, 1999).

Murphy, Kevin J. "Executive Compensation," in Orley Ashenfelter and David Card, *Handbook of Labor Economics*, forthcoming, 1999.

Myerson, Roger. "Mechanism Design by an Informed Principal" *Econometrica* (Nov. 1983) Vol. 51, 1767-97.

O'Reilly, Charles; Main, Brian; and Crystal, Graef. ``CEO Compensation as Tournament and Social Comparison: A Tale of Two Theories," *Administrative Science Quarterly* **33** (June 1988): 257-74.

Paarsch, Harry J. and Bruce S. Shearer."Fixed Wages, Piece Rates, and Intertemporal Productivity. A Study of Tree Planters in British Columbia," unpub. manuscript, 1996.

Prendergast, Canice. "The Provision of Incentives in Firms," forthcoming, *Journal of Economic Literarture*, expected 1999.

Weitzman, Martin L. and Douglas L. Kruse "Profit Sharing and Productivity," in Alan Blinder, editor, *Paying for Productivity*. Washington: The Brookings Institution, 1990, pp.96-139.

Yermack, David. "Do Corporations Award CEO Stock Options Effectively?" *Journal of Financial Economics*, 52,2, (1995) 449-76.

</ref_section>