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AGENCY, DELAYED COMPENSATION AND THE STRUCTURE OF EXECUTIVE REMUNERATION

Jonathan Eaton

Harvey S. Rosen

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ABSTRACT

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by

Jonathan Eaton

and

Harvey S. Rosen

In this paper we examine the factors affecting the structure of executives' compensation packages. We focus particularly on the role of various types of delayed compensation as means of "bonding" executives to their firms.

The basic problem is to design a compensation package that rewards actions that are in the long-run interest of the stockholders. Firms must take into account (1) their ability to discern unfortunate circumstances from mismanagement; (2) the extent to which a compensation package forces the executive to face risks beyond his control; and (3) the willingness of a given executive to bear this risk.

We use our theory to interpret some executive compensation data from the early 1970's. The results are generally in line with the theoretical predictions.

Professor Jonathan Eaton
Department of Economics
Yale University
New Haven, Conn. 06520

Professor Harvey Rosen
Department of Economics
Princeton University
Princeton, New Jersey 08544

"A mental midget can tell whether top management deserves a bonus based on current profits. It is much harder to figure out whether top management has positioned the company well for the long run." (Thurow [1981].)

1. Introduction

Recently, executive incentive structures have become a matter of public concern. The comments in a New York Times article entitled "Overhauling America's Business Management" are typical: "American managers are too worried about short term profits ... A lot of American companies know they have old machines ... But the manager figures he'll keep the old machines as long as they still run, make a big profit one year, and take that record as an advertisement to get a job elsewhere." (Lohr [1981, p. 42].) Such inappropriate incentives are often linked to the "productivity crisis."

Clearly, it is in the interest of firms that their managers be concerned with long run profits. Frequently, however, the long run implications of an executive's job performance cannot be assessed until after the executive has terminated his relationship with the company. To relate an executive's reward more closely to his performance, firms can delay a large component of compensation until better information is available, so that the amount of remuneration becomes dependent upon indicators of performance.

Of course, other factors may also affect the extent to which delayed compensation is used. Tax considerations, for example, may play an important role. If the tax rate on unearned income is lower for the firm than for the individual executive, there may be an advantage to postponing

compensation.[1] The firm may also have better access to capital markets.

In this paper we examine the various factors affecting the structure of executives' compensation packages. We focus on the role of various types of delayed compensation as means of "bonding" executives to their firms. The theoretical framework is established in Part 2. We show how the preferences of firm owners and executives interact to determine the form of the equilibrium compensation package. An important aspect of the theory is a generalization of the "theory of agency"[2] to allow for the possibility of delayed compensation. The model leads us to expect certain empirical regularities in the way that compensation packages are related to characteristics of firms and executives. In Part 3, these are explored using data on a sample of top ranking American executives from the early 1970's. A concluding section contains a summary and suggestions for future research.

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1 The extent to which tax considerations, rather than monitoring problems, determine the firm's decision to delay compensation has been a subject of debate. Miller and Scholes [1980] argue that tax considerations dominate, while Lazear [1981] takes the contrary view.

2 See Ross [1974], Jensen and Meckling [1976], and Goldberg [1980] for useful discussions of agency theory.

2. A Theoretical Framework

We use a simple two-period model to explain the essential features of the process that determines the composition of the executive's compensation package. In the first period the executive expends effort in managing the firm and receives a salary as compensation. In the second period he is retired, and consumes his savings and delayed compensation. The stockholders are assumed to be unable to observe his effort contemporaneously, and hence cannot make salary contingent on performance. In the second period firm owners do receive information on performance, although that information may be imperfect. The stockholders may then provide additional compensation in an amount that depends on their perception of his performance.

2.1 The Executive's Problem

We first examine the problem from the executive's point of view. Assume that an executive of type i has a utility function $u^i(c_1,c_2,e)$ where c_1 represents period 1 consumption, c_2 period 2 consumption and e his effort in managing the firm. We assume that $u^i_j \equiv \frac{\partial u^i}{\partial c_j} > 0$, $j = 1, 2$, $u^i_e \equiv \frac{\partial u^i}{\partial e} < 0$ and u^i is concave in c_1 and c_2, given e.

Consider an executive i who works for firm j. In period 1 he receives before tax wage w_1^{ij} and in period 2 before tax wage $w_2^{ij}(x^{ij})$ where x^{ij} is a measure of the executive's performance. We assume that $x^{ij} = x^{ij}(e,\theta)$ where θ is a random variable and $x^{ij}_e \equiv \frac{\partial x^{ij}}{\partial e} > 0$.

Let W_1^i and W_2^i denote executive i's income from other sources in periods 1 and 2 respectively. The function $\tau(\ )$ denotes after tax income as a function of before tax income. Finally, let $\phi(s,w_2^{ij})$ denote the after-tax resources available in period 2 from saving an amount s in period 1 and earning w_2^{ij} in period 2.

The function ϕ depends both on the interest rate and on tax parameters, and by definition,

$$s = \tau(w_1^{ij} + W_1^i) - c_1 \quad . \tag{2.1}$$

The executive, facing a given w_1^{ij} and given functions $w_2^{ij}(\ )$, $x^{ij}(\ )$, $\phi(\ )$ and $\tau(\ )$, chooses c_1 and e in period 1 to maximize $E[u(c_1,c_2,e)]$ where

$$c_2 = \phi\{\tau(w_1^{ij}+W_1^i) - c_1, w_2^{ij}[x^{ij}(e,\theta)]\} \quad . \tag{2.2}$$

We denote by $c_1^*(\ )$ and $e^*(\ )$ values of c_1 and e that maximize expected utility subject to (2.2), where these optimal values depend upon w_1^{ij} and functions $w_2^{ij}(\ )$, $x^{ij}(\ )$, $\phi(\ )$ and $\tau(\ )$. The realization of c_2 given c_1^* and e^* and θ is denoted $c_2^*(\theta)$. The maximum value of expected utility that executive i can attain working for firm j is thus given by $v^{ij} \equiv E[u(c_1^*,c_2^*(\theta),e^*)]$.

2.2 The Firm's Problem

Like the executive, the firm takes the schedules $\tau(\ )$, $\phi(\ )$ and $x^{ij}(\ )$ as given. It determines, however, w_1^{ij} and the schedule $w_2^{ij}(x^{ij})$, taking into account their effects on e^* through the executive's optimizing behavior discussed above.

Assume for a moment that firm j has decided to attract an executive of type i. Let $f^{ij}(e,\theta)$ represent firm j's revenues, gross of executive compensation, when executive i is employed. In general, it depends on the effort he expends and on a random variable beyond his control. If the firm is risk neutral it will choose w_1^{ij} and $w_2^{ij}(x^{ij})$ to maximize

$$E\{f^{ij}[e^*(\ ),\theta] - w_1^{ij} - w_2^{ij}(x^{ij})/(1+r)\} \qquad (2.3)$$

subject to $$v^{ij} \geq \bar{u}^i \ ,$$

where r denotes the interest rate facing the firm.[3] We denote by $w_1^*(\ )$ and $w_2^*(\ )$ the payments that maximize (2.3), where both depend upon $e^*(\ )$, $x^{ij}(\ )$, $\phi(\ )$ and $\tau(\ )$, and where w_2^* depends upon the realized θ through $x^{ij}(\ )$ as well. The maximal value of (2.3) is denoted ψ^{ij}.

2.3 Equilibrium Compensation Schemes

Given that firm j employs executive i, an equilibrium is associated with the fixed point $w_1^*(\ )$, $w_2^*(\ )$, $e^*(\ )$ where $w_1^*(\ )$ and $w_2^*(\ )$ attain ψ^{ij}, given $e^*(\ )$, while $e^*(\ )$ attains v^{ij} given $w_1^*(\ )$ and $w_2^*(\ )$. For the match between i and j to be an equilibrium one $\psi^{ij} \geq \psi^{i'j}$ for any other executive i'. In general, the equilibrium compensation structures will depend upon the executive's preferences $u^i(\ )$, the firm's technology $f^{ij}(\ )$, the functions $\tau(\ )$, $\phi(\ )$, $x^{ij}(\ )$, and the parameter r.

The equilibrium payment scheme can be interpreted in terms of Rosen's [1974] model of hedonic product characteristics and prices: working for firm j provides executive i with a level of expected utility that depends upon the level, timing and riskiness of compensation while the

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3 We treat this interest rate as a constant, a reasonable approximation for the range of variation considered here. Note that r is an after tax rate of return.

type of compensation firm j offers executive i depends upon its technology and ability to monitor. With many heterogeneous firms and executives, a whole set of equilibrium compensation packages will appear, determining a "market locus" of the type discussed by Rosen [1974].

Because the optimal package depends upon a complex interaction of firm and executive characteristics, explicit solutions for the compensation scheme are difficult to obtain for very general cases. We provide, instead, a qualitative discussion of how various firm and executive characteristics are likely to affect aspects of compensation.[4] Then, in Section 2.4, we derive an explicit solution for a particular example.

Other things equal, a firm will prefer to delay a larger share of compensation when future indicators of executive performance are more reliable than those presently available. We thus anticipate that delayed compensation will be used more when monitoring costs are high in the present relative to the future.

To minimize expected compensation costs the firm will, ceteris paribus, tie compensation to indicators that are relatively risk free. This is because tying compensation to a "noisy" indicator exposes the executive to greater income variability. Given our assumption on the concavity of the utility function, the expected level of compensation must then be higher to attract a given executive. This line of reasoning suggests that future firm value is less likely to be used as a performance indicator the more it is influenced by factors beyond the executive's control. Future firm value will, of course, be used more as a performance indicator when direct measures

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4 Although we consider these to be likely effects, it may be the case that for certain functional forms and/or parameter values, they do not obtain.

are unavailable.

A compensation package that exposes an executive to risk beyond his control will be especially undesirable to an executive who is risk averse. Since younger executives have a longer period over which to pool risk, they should be more willing to receive compensation in risky forms. We thus anticipate that younger executives' compensation will come in forms that depend relatively heavily upon such noisy indicators as the value of the firm at a future date.

We would also anticipate that executives who are in a high income tax bracket currently relative to the one they expect to be in upon retirement will find delayed compensation of any form more attractive. By postponing compensation the firm reduces such executives' lifetime tax obligations, and hence can attract them for a smaller number of pre-tax dollars.

In the next section we present an example that illustrates some of these relationships mathematically.

2.4 A Simple Illustration

We consider a firm whose profit, gross of executive compensation, is given by $Z^{ij} = \theta^{ij} e$, where θ^{ij} is a random variable equaling y^{ij} with probability $1-\pi$ and 0 with probability π. An executive may choose either to put forth effort, in which case $e=1$, or else to "shirk,"[5]

5 The term "shirking" should be interpreted broadly. In our context it means taking actions that are not in the long-run interest in the firm. For example, these may take the form of maximizing sales or personnel, possibly as a means of achieving fame and a job elsewhere, or simply for the pleasure of exercising power.

in which case $e=0$. z^{ij} , then, is 0 if $e=0$, while, if $e=1$, it is 0 with probability π and y^{ij} otherwise. The stockholders cannot observe e or θ^{ij} but only z^{ij} , which becomes known after w_1^{ij} is paid. Given a decision to hire executive i , and given that executive i expends effort, expected firm profits, gross of compensation, are $(1-\pi)y^{ij}$. Note that, in this example, the variable π measures simultaneously the riskiness of the firm (in the sense of a probability of a bad outcome), and the difficulty of monitoring executive performance.

We assume that all executives have an indirect utility function of the form

$$u(w_1,w_2,e) = \log w_1 + \alpha \log w_2 + (1-e) \quad . \tag{2.4}$$

(This function embodies not only underlying preferences but tax parameters and investment opportunities as well.) An executive of type i can attain an expected utility level $\bar{u}^i$ elsewhere.

Since z^{ij} can assume only two values, a non-random compensation package[6] can involve only two possible levels of compensation in period 2, which we denote w_2^G , corresponding to the outcome $z^{ij} = y^{ij}$, and w_2^B corresponding to the state $z^{ij} = 0$.

Given that the executive expends effort $(e=1)$, a competitive compensation package must satisfy:

$$\log w_1 + \alpha\pi \log w_2^B + \alpha(1-\pi) \log w_2^G \geq \bar{u}^i \tag{2.5}$$

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6 Concavity of u guarantees that a random compensation package is strictly inferior to a non-random one. Hence we only consider the second type.

that is, an executive who joins the firm and exerts effort must find the expected reward to exceed his compensation elsewhere.

If the executive chooses not to exert effort, $z^{ij} = 0$ with certainty. To provide an incentive to exert effort the compensation package must also satisfy

$$\log w_1 + \alpha \log w_2^B + 1 < \log w_1 + \alpha\pi \log w_2^B + \alpha(1-\pi)\log w_2^G , \quad (2.6)$$

which can only obtain if $w_2^B < w_2^G$.

To attract an executive and to provide him an incentive to work the firm must provide a compensation package (w_1, w_2^B, w_2^G) satisfying (2.5) and (2.6). A risk-neutral firm will choose to do so in a way that minimizes the expected compensation cost,

$$w_1 + \frac{\pi w_2^B + (1-\pi)w_2^G}{1+r} \quad (2.7)$$

Clearly the constraint (2.5) will be binding. Otherwise, w_1 could be reduced to provide a savings of wage costs without affecting (2.6). Furthermore, concavity of the executive's utility function guarantees that (2.6) will in the limit be binding as well. Intuitively, the distance between w_2^G and w_2^B must be as small as possible to keep down the size of the risk premium required by the executive, without inducing shirking.

Incorporating (2.5) and (2.6) into (2.7) and minimizing gives, as solutions:

$$w_1 = \chi^{\alpha/1+\alpha} \exp\left(\frac{\bar{u}}{1+\alpha}\right) \quad (2.8)$$

$$w_2^B = \chi^{-1/1+\alpha} \exp\left(\frac{\bar{u}}{1+\alpha} - \frac{1}{\alpha}\right) \quad (2.9)$$

$$w_2^G = \chi^{-1/1+\alpha} \exp\left(\frac{\bar{u}}{1+\alpha} + \frac{\pi}{\alpha(1-\pi)}\right) \quad (2.10)$$

where

$$\chi \equiv [\pi \exp(-1/\alpha) + (1-\pi)\exp(\pi/\alpha(1-\pi))]^{\alpha(1+r)} \qquad (2.11)$$

The total expected cost of the compensation package is

$$(1+\alpha)\chi^{\alpha/1+\alpha}\exp\left(\frac{\bar{u}}{1+\alpha}\right) \quad .$$

The percentage difference between w_2^G and w_2^B is approximately

$$\log w_2^G - \log w_2^B = \frac{1}{\alpha(1-\pi)} \qquad (2.12)$$

As this difference becomes larger, delayed compensation becomes riskier, and more dependent upon firm performance. Note that this expression falls as α rises and rises with π. Executives who value consumption in the future more heavily, e.g., older executives who discount retirement income less, will, ceteris paribus, receive delayed compensation that is less tied to the indicator of firm performance. On the other hand, executives working for firms where the exogenous probability of a bad outcome is important (in the form of higher value of π), will be penalized relatively more if firm performance is poor, or rewarded relatively more if it is good. Note that (2.12) is independent of y^{ij}. We may thus change π and y^{ij} in a way that keeps expected profits constant, while only the change in π affects the form of compensation. A change in r, the interest rate facing the firm, also leaves the spread unchanged.

The percentage differences between w_2^G and w_1 and between w_2^B and w_1 are approximately

$$\log w_2^G - \log w_1 = \log \chi + \frac{\pi}{\alpha(1-\pi)} \tag{2.13}$$

$$\log w_2^B - \log w_1 = -\log \chi + \frac{1}{\alpha} \tag{2.14}$$

respectively. Not surprisingly, both increase in r : the firm postpones more compensation into the future when its interest costs are high.

The effect of changes in α and π are, in general, ambiguous. However, if the chance of a bad outcome is low (i.e., around the point $\pi=0$), w_2^G and w_2^B both rise relative to w_1 with α (delayed compensation is used more when it is valued more) and both rise relative to w_1 with π . (delayed compensation is used more by riskier firms). As the probability of failure rises, however, these results are reversed. When π is near 1 an increase in α and an increase in π reduce delayed compensation. Intuitively, when the risk of failure is high, increasing valuation placed on future income reduces the extent to which risky, delayed compensation is used relative to current compensation. Similarly, when the level of risk is already very high, an increase in risk makes current compensation relatively attractive. Again, y^{ij} does not enter (2.13) or (2.14), so that these relationships are independent of the expected profitability of the firm.

This example is simple, and abstracts from a number of the considerations we discussed in Section 2.3. In particular, it does not allow us to distinguish monitoring costs from firm risk. Nevertheless, the example demonstrates the complexity of the relationships between the firm's characteristics, executive's preferences, and the optimal compensation package.

3. Empirical Analysis

In this Section we use our theory to analyze compensation data for a group of high ranking American executives during 1970-73. To do so, we must first recognize that actual compensation practices are considerably more complicated and varied than suggested in the theoretical discussion. As Lewellen [1968] notes, probably the minimum number of meaningful compensation types is four: salary and bonus, pensions, deferred compensation, and stock options. A method must be devised to measure the values of each of these components in comparable units. The other major problem in exploring the theory's empirical implications is the selection of a relevant set of company characteristics. These characteristics are supposed to measure the extent to which: (a) the executive's activities can be monitored, and (b) the firm's performance is subject to risk beyond the executive's control. In Section 3.1 the variables used are described. In Section 3.2 we specify an econometric model. The results are presented in Section 3.3.

3.1 Data

We first discuss the components of executive pay, and then turn to the characteristics of their companies.

3.1.1 Executive Characteristics and Compensation[7]

We use Lewellen's [1975] data on the compensation of the five highest executives in 22 large manufacturing companies during the period 1970 to 1973,

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7 These data were kindly provided to us by Professor Wilbur G. Lewellen of Purdue University. For further detail on their construction, see Lewellen [1968], [1972], and [1975].

inclusive.[8] The firms are listed by their 1973 corporate names in Appendix A. Attention is focused on the top five positions because it is only for these that useable annual data on compensation are publicly available from corporate proxy statements. Clearly, this sample of firms is not random. Thus, although we think that our results are of considerable interest, they cannot be regarded as a definitive "test" of the theory.

Lewellen provides data on the executive's age, rank in the company, and total compensation. In order to compare the pension, deferred compensation, and stock option components of the pay packages, he converts them into current income equivalents -- "...the amounts of immediate cash income that would be as valuable, after taxes, to the executive recipients under consideration" [1973, p. 160]. We discuss briefly below each form of compensation.

Salary and Bonuses

Salary and bonuses are aggregate direct current remuneration and comprise on average 64% of the value of total compensation in our sample. All such payments are taxable to the individual at ordinary personal income tax rates when received, and are prominently reported on corporate proxy statements. To compute their after tax value is not straightforward, because information is needed on deductions, and income from sources other than the corporate employer. Using Internal Revenue Service data, Lewellen determines the average ratio of exemptions and deductions to gross income for individuals in each tax bracket and assumes that each executive takes exemptions and deductions as the average person in his income bracket. "Outside income" is essentially impossible to establish with any certainty. Lewellen assumes that such income equals 15% of direct current remuneration.

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8 Data on two of the executives were incomplete, so our sample was reduced from 110 to 108 observations.

The estimates of the executives' marginal tax rates are probably not very sensitive to these assumptions. The average salary plus bonuses in our sample exceeds $100,000. By virtue of corporate remuneration alone, most of the executives were probably subject to the maximum tax on earned income, regardless of assumptions on income from other sources.

Pensions

A pension gives an executive the right to receive a series of periodic payments of a given (nominal) size beginning at the future retirement date and continuing throughout his lifetime. An important institutional fact is that pension benefits for executives are made on the same basis as for other employees (Lewellen [1972, p. 121]). Indeed, consistency in the benefit formulas is one of the key conditions for tax qualification of a plan. Other types of deferred compensation which are discussed below offer considerably more flexibility. In our sample, on average pensions account for about 15% of the value of the compensation package.[9]

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9 Lewellen computes the after tax current equivalent of a pension as the size of the annual premium the executive would have to pay were he to purchase from an insurance company a retirement annuity equal in value and similar in form to his pension promise. Each increase or decrease in benefits is regarded as a separate pension award whose current equivalent begins at the time the award is made, and continues thereafter up to the executive's anticipated retirement age. It is assumed that the executive does not anticipate resigning from the company. On this possibly controversial assumption, Lewellen notes, "Although almost everyone can point to an example of a corporate officer who was either lured away from or priced out of his job, the conclusion suggested by an examination of proxy statements is that such occurences are quite infrequent when viewed in relation to the entire senior managerial group." [1968, p. 25].

Because the pension component of compensation is typically determined by a formula that applies to all employees covered by the corporation's pension plan, unless the plan is a defined contribution plan and the contributions are largely invested in stock of the firm itself, the executive's claim on future pension benefits will not depend importantly upon his own performance. A possible exception occurs when pension benefits are highly influenced by earnings during the last few years of service, so that firms can influence the size of the pension on the basis of past performance. But the amount of latitude is limited compared to the other forms of executive compensation, so it seems unlikely that in this case pensions play a major role in tying compensation to performance. Furthermore, unlike stock options and deferred compensation, the executive has no legal guarantee that higher compensation will follow an indication of good performance; any such understanding is based on trust.

Deferred Compensation

Deferred compensation includes the value of all arrangements -- other than pensions -- that promise benefits at or after retirement. They comprise about 13% of the total compensation package, on average. One type of arrangement that is often used guarantees the executive a defined benefit sum, the difference between that figure and any payments received prior to his death being payable to his estate. In return for such promises, certain restrictions are usually imposed on the executive's activities. The Internal Revenue Service has ruled that as long as such restrictions are part of the contract, so that forfeiture is possible in principle, the post-retirement payments are not taxable until received. Thus, to the extent that marginal tax rates differ during the working life and at retirement, there is an element of tax arbitrage in deferred compensation schemes.

Deferred compensation takes a variety of forms, including profit-sharing and thrift plans, as well as individual contractual schemes. Hence, deferred compensation schemes are likely to be more closely tailored to the circumstances of particular executives than are pension plans. With respect to the extent to which they are stock based, deferred compensation packages are quite heterogeneous. For example, the investment vehicles for thrift plans can vary from a mixed portfolio of fixed income securities to one consisting solely of the firm's stock. Unfortunately, in our data we are not able to distinguish between those components of deferred compensation whose value are stock determined, and those that are not.[10]

When deferred compensation is defined in terms of benefits and is vested, from the executive's viewpoint it is a close substitute to a pension and will be desired for similar reasons. Occasionally, payment is made contingent upon certain well-defined actions on the part of the executive, such as staying with the firm a certain period or not working for a competitor. A firm is likely to find deferred compensation packages of this type attractive when there are a few easily monitored potential future actions by the executive that it wishes to discourage. It provides a means of providing a disincentive without subjecting the executive to variation in his income beyond his control. However, other types of deferred compensation are tied to the value of the firm's stock. These are similar, for our purposes, to stock options, which we discuss next.

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10 For purposes of computing the after-tax current equivalent of deferred compensation schemes, Lewellen assumes that the most appropriate practical alternative to a deferred pay contract is simply an addition to the executive's salary that is equally attractive in terms of its after-tax present value. In contrast, for pensions the equivalence criterion was the premium on an annuity. This distinction is a consequence of the fact that deferred compensation arrangements tend to be less centered on mortality considerations than are pensions.

Stock Options

A stock option granted by a corporation to an executive is an agreement that he may purchase from the firm, at any time within a stated period, a given number of shares of its stock at a price specified on the date of granting. In the early 1970's, the tax rules stipulated that under certain conditions,[11] the difference between the purchase price and later resale could be taxed at capital gains rates.[12] The specific elements of option agreements tend to vary across firms and executives. For example, there may be implicit or explicit restrictions placed on the resale of the stock acquired under the option. Stock options account for about 8% of the value of total compensation in our sample.[13]

Stock options relate the executive's income most directly to what the stockholders care about, the value of the firm, but have the disadvantage of exposing the executive to risk beyond his control. They are likely to be favored by firms whose executives have wide latitude in the performance of their duties and are difficult to monitor closely. Options will be most attractive to executives who are relatively unaverse to risk, and the stock value of whose firms is relatively unaffected by random variables beyond the executive's control.

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11 For example, the option must be non-transferable, must be exercised within a certain number of years after it is granted, etc.

12 During our sample period, the maximum capital gains tax rate was 35%.

13 Lewellen values the option as a function of the difference between the option price to which the executive is entitled and the market price when the option is exercised. In order to account for the possibility that the executive may die before the option is granted, standard mortality tables are used to compute actuarial equivalents of the payments.

3.1.2 Company Characteristics

Information on company characteristics such as size and complexity is required in order to explain patterns of executive compensation. Specifically, we need data that indicate the uncertainty and complexity of the environment in which the executive is operating, because these will determine the importance of bonding considerations in the construction of the pay package. The following variables (all of which were constructed from data obtained from Standard and Poor's Compustat tape), were selected:

(i) A = the cost of advertising media and promotional expenses (millions of dollars);

(ii) L = number (thousands) of company employees as reported to shareholders;

(iii) W = net assets (millions of dollars);

(iv) R = research and development expenditures (millions of dollars);

(v) V = variance of the rate of return of the firm's common stock.

The variance of the stock's rate of return over a T year period is

$$V_t = \sum_{t=1}^{T} \frac{(r_t - \bar{r})^2}{T-1} ,$$

where r_t is the rate of return in year t, defined as

$$r_t = \frac{\phi d_t + \phi P_t - P_{t-1}}{P_{t-1}} ,$$

where P_t = closing common stock price in year t, d_t = dividends per share, ϕ is a correction for changes in the consumer price index, and $\bar{r}$ is the

sample mean. V_t was calculated for several different values of T to insure that the substantive results were not sensitive to the particular value chosen.[14]

Obviously, these are imperfect indicators of the complexity of the environment in which the executive operates. For example, it would be possible to compute more sophisticated measures of riskiness, taking advantage of the theory of efficient markets. However, given that the reliability and robustness of such measures are open to question (see, e.g., Cragg and Malkiel [1979]), this tack did not seem worthwhile.

3.2 Estimation Issues

We seek to explain the shares of total compensation of each of four categories: (1) salary plus bonus, (2) pensions, (3) deferred compensation, and (4) stock options. The following simple econometric specification is used:

$$s_{i\ell} = \gamma_{o\ell} + \gamma_{1\ell} AGE_i + \gamma_{2\ell} AGE_i^2 + \gamma_{3\ell} A_i + \gamma_{4\ell} L_i + \gamma_{5\ell} W_i + \gamma_{6\ell} R_i + \gamma_{7\ell} V_i + \sum_{k=8}^{11} \gamma_{k\ell} RK_{k-7} + \varepsilon_{i\ell} \quad , \tag{3.1}$$

where $s_{i\ell}$ is the share of the i^{th} executive's total compensation in the ℓ^{th} form of compensation; AGE_i is his age; A_i, L_i, W_i, R_i, and V_i are his firm's advertising expenditures, labor force, net assets, research and development expenditures, and variance of return, respectively; the RK_k's

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14 The results presented below use $T=4$, the years being 1970 through 1973.

are dummy variables for rank;[15] the γ_ℓ's are parameters, and $\varepsilon_{i\ell}$ is a random error.

What predictions does theory give concerning the signs of the γ's ? For the coefficients on the AGE variables, the story is fairly straightforward. Because older executives are likely to have a lower discount rate, they should value post-retirment income more than their younger counterparts. Furthermore, older executives are expected to be more averse to income variation -- they have less time for the "law of averages" to assert itself. Hence, the share of pensions, which come in the future and are relatively safe, is expected to increase with age. On the other hand, we expect the share of stock options, the more risky type of compensation, to decline with age. In the absence of information on the specific nature of deferred compensation contracts, we can make no predictions with respect to how their share will vary with age.

Predicting the signs on the firm characteristics is more problematic. The difficulty is that we do not know a priori which characteristics are indicative primarily of situations in which monitoring problems are important, and those which reflect environments in which firms are subject to a lot of exogenous risk. For example, if it were known that firms with high research and development expenses tended to have volatile profits for exogenous reasons, our theory would predict a negative sign for R_i in the stock options equation.[16] However, because we do not have any basis for classifying

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15 RK_i is the i^{th}-ranking executive in terms of total compensation; the omitted category is the fifth rank.

16 As noted in Section 2.3, firms with high exogenous risk should not tie compensation too closely to firm performance.

the firm characteristics into "monitoring" or "exogenous risk" categories, no such predictions can be made. Hence, the signs on the firm characteristics cannot be used to "test" our theory. Instead, the theory is employed to interpret the coefficients and investigate whether any interesting patterns emerge.

Each of the four share equations is estimated by ordinary least squares. Because the shares must add up to unity, certain cross equation restrictions on the coefficients are implied. However, when the same regressors (including a constant term) are used in each equation, ordinary least squares estimation guarantees that the constraints are satisfied.

Before presenting the results, several points need to be made regarding the basic estimating equation:

1. Although there are four years of data for each executive, observations are not entered on an annual basis. Rather, we average the values of the variables over time, and enter the means. The theory is not intended to explain year-to-year fluctuations in compensation shares. Rather, it is supposed to explain "permanent" traits of the compensation package as a function of characteristics of the executive and of the firm. For the sake of comparison, we estimated (3.1) with each of the yearly observations entered separately. There are no important substantive differences. (These results are available upon request.)

2. It may be the case that compensation practices differ systematically across industries. To explore this possibility, the firms were grouped

into six industrial categories,[17] and a set of regressions estimated with a dummy variable for each category. The main qualitative results are not changed very much by their inclusion. It is interesting to note, however, some systematic differences that arise in compensation packages in different industries.

3. The executive's marginal income tax rate is not included as an explanatory variable. As suggested earlier, the incomes of the individuals in the sample are so high that most of them were paying the maximum tax rate, and hence there was insufficient variation to obtain meaningful results.[18]

3.3 Results

The basic results are reported in Table I. We first consider the signs on A, W, L, and V, the measures of firm size and complexity. A number of interesting patterns are present. The shares of salary-bonus and pensions are smaller for those companies in which advertising, total assets, labor

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17 The categories are described in Appendix A.

18 In a set of equations not reported here, we included total compensation as a regressor, on the assumption that it might indicate the executive's ability to benefit from tax arbitrage over time. Given this interpretation, income has the expected sign: positive for deferred compensation and stock options, and negative for the other types. However, such results must be interpreted with caution, because total compensation is determined jointly with its composition, and is therefore endogenous. See Masson [1971] for an empirical study of the determinants of the total level of executive compensation.

force, and the variance of return are high; but larger for those firms in which research and development expenditures are high. Just the opposite is the case in the share equations for deferred compensation and stock options. In the context of our theory, these results suggest that high research and development expenditures are associated with environments in which firm managers face considerable amounts of exogenous uncertainty. On the other hand, when total assets, labor force, and advertising expenditures are large, it appears that monitoring considerations are more important than exogenous risk. Similarly, a high variance of return appears to be associated with firms where monitoring executives is difficult.

With respect to impact of age on the compensation structure, we expected that stock options should become less attractive as the executive ages and pensions more attractive. According to the results in column (4), starting in their mid 50's, executives receive a declining proportion of their incomes in the form of stock options. According to column (2), the proportion of income in pensions increases throughout the executive's working life. (The negative sign on the quadratic term does not dominate until age 70.)

The coefficients on the rank dummies reveal a tendency for the higher ranking executives to receive a greater proportion of their compensation in stock options. We conjecture that this is because the higher the individual's rank, the more important his job, and the greater the necessity to bond him to the firm. In some experiments not reported here, we allowed for a set of full interactions between rank and the other variables, but no interesting patterns emerged.

TABLE I

Shares of the Total Compensation Package*

	(1) Salary + Bonus	(2) Pensions	(3) Deferred Compensation	(4) Stock Options
AGE	.0761 (1.31)	.0350 (.95)	-.214 (3.46)	.103 (2.11)
AGE^2	-.000887 (1.71)	-.000248 (.76)	.00207 (3.75)	-.000936 (2.15)
A	-.000894 (2.21)	-.000691 (2.69)	.00151 (3.49)	7.406×10^{-5} (0.22)
W	-4.839×10^{-5} (2.81)	-4.895×10^{-5} (4.48)	5.500×10^{-5} (2.99)	4.234×10^{-5} (2.93)
L	-.000109 (1.47)	-1.646×10^{-5} (0.35)	2.704×10^{-5} (6.34)	9.806×10^{05} (1.58)
R	.00128 (3.07)	.000960 (3.62)	-.00124 (2.77)	-.00101 (2.88)
V	-.947 (3.76)	-.412 (2.58)	.596 (2.22)	.763 (3.60)
RK_1	-.022 (0.59)	-.017 (0.73)	-.031 (.077)	.070 (2.23)
RK_2	-.058 (1.69)	-.013 (0.61)	-.0053 (0.14)	.077 (2.65)
RK_3	-.047 (1.38)	-.00049 (0.02)	-.010 (0.27)	.058 (2.01)
RK_4	-.035 (1.05)	-.014 (0.65)	-.0060 (0.17)	.055 (1.95)
CONSTANT	-0.612 (0.38)	-0.925 (0.90)	5.406 (3.12)	-2.869 (2.10)
R^2	.58	.34	.50	.24
No. Observations	108	108	108	108

* Variables are defined in the text. Numbers in parentheses are absolute values of t-statistics.

We turn now to the effects of controlling for industrial category. These results are reported in Table II, in which INDi is a dummy for the i^{th} industrial group listed in Appendix A. As suggested by comparing the R^2's of Table II with those of Table I, inclusion of the industry dummies contributes significantly to the explanatory power of the equations. Generally, however, the main qualitative features of Table I remain intact. The coefficients on W, R and V keep the same signs, but in a few cases those on A and L change. The "outliers" with respect to compensation practices appear to be the electronics industry (IND4), with a very high reliance on stock options, and the motor vehicles and parts industry (IND5) with a commensurately large use of current forms of compensation.

4. Conclusion

Designing an executive compensation package that rewards actions that are in the long-run interest of the stockholders is a complex problem. Firms must take into consideration (1) their ability to discern unfortunate circumstances from mismanagement; (2) the extent to which a compensation package forces the executive to face risks beyond his control; and (3) the willingness of a particular executive to bear this risk. Our theoretical analysis suggested several criteria that are likely to affect the composition of an executive compensation scheme: the age of the executive, firm characteristics affecting the ability of the firm to monitor executive behavior and the extent to which the firm faces a high degree of exogenous uncertainty. We found that relatively safe forms of delayed compensation (pensions) were more intensively used for older executives, who value a high <u>level</u> of delayed compensation more but are less tolerant of uncertainty about this income. Younger executives, on the other hand,

TABLE II

Shares of the Total Compensation Package: Industry Dummies Included*

	(1) Salary + Bonus	(2) Pensions	(3) Deferred Compensation	(4) Stock Options
AGE	.167	.0341	-.235	.0336
	(2.82)	(0.96)	(4.37)	(0.85)
AGE^2	-.00166	-.000236	.00221	-.000312
	(4.46)	(0.74)	(4.62)	(0.89)
A	4.564×10^{-5}	-.000105	.00195	-.000860
	(0.11)	(3.02)	(3.74)	(2.24)
W	-3.875×10^{-5}	-6.878×10^{-5}	9.223×10^{-5}	1.531×10^{-5}
	(2.53)	(5.27)	(4.68)	(1.06)
L	.000111	-7.419×10^{-5}	-1.025×10^{-5}	-2.674×10^{-5}
	(1.78)	(1.40)	(0.13)	(0.45)
R	.000914	.00151	-.00210	-.000320
	(2.46)	(4.78)	(4.42)	(0.91)
V	-1.247	-.408	.728	.928
	(5.74)	(2.21)	(2.61)	(4.52)
RK_1	-0.037	-0.029	-.0051	.062
	(1.38)	(0.92)	(0.15)	(2.49)
RK_2	-.065	-0.016	.0085	.072
	(2.71)	(0.76)	(0.28)	(3.18)
RK_3	-.046	-.0025	-.0017	.050
	(1.91)	(0.12)	(0.06)	(2.20)
RK_4	-0.39	0.014	.0008	.052
	(1.64)	(0.72)	(.03)	(2.35)
IND1	0.0748	.0214	-.132	.0358
	(2.42)	(.81)	(3.32)	(1.22)
IND2	-0.0118	-.0803	.106	-.0143
	(0.45)	(3.56)	(3.13)	(0.57)
IND3	0.0566	.00744	-.0168	-.0472
	(2.24)	(0.35)	(0.52)	(1.98)
IND4	-0.151	.0209	-.0553	.186
	(4.37)	(.71)	(1.25)	(5.68)
IND5	0.165	-.0290	-.0757	-.0606
	(5.85)	(1.21)	(2.09)	(2.27)
CONSTANT	-3.31	-.873	6.103	-.917
	(2.82)	(0.87)	(4.04)	(0.82)
R2	.81	.45	.67	.56
No. of Observations	108	108	108	108

* See note to Table I.

were more likely to receive compensation in the form of stock options.

Salary and bonus and pensions were used more in firms with fewer workers, low assets, less advertising expenditure and a low variance of rate of return. If our theory is correct, these characteristics are indicative of situations in which monitoring costs are relatively low. A high level of expenditure on research and development also led to a heavier reliance on these forms of compensation. Our explanation is that firms in which research and development is significant tend to be subject to large exogenous uncertainties. In such firms, linking executive compensation too much to firm performance exposes the executive to substantial risk. The risk premium required to offset this risk limits the extent to which it makes sense for the firm to bond the executive's interests to its own.

A maintained hypothesis in our analysis has been that firms establish compensation schemes optimally given their own characteristics and those of their executives. It would be useful to examine the effects of alternative compensation schemes on firm performance. For example, to what extent does increased use of stock options improve firm performance? Other firm characteristics must be held constant, of course.

We conclude by noting that we have examined the issue of executive compensation in a particular cultural context, and have considered a limited array of mechanisms to reward executives. An interesting topic for research would be a cross-country examination of executive compensation and performance that takes into account different tenure structures and attitudes toward executive-firm relations. Perhaps these have allowed a greater bonding of interests between executive and firm without a concommitant increase in the executive's exposure to risk.

Appendix A

The empirical work is based upon data from the following firms. (They are grouped by the industrial category specified in the Compustat tape. Category 6 is "miscellaneous.")

1. Borden Company
   General Foods Corporation
   Kraftco, Inc.

2. American Cyanamid Corporation
   Dow Chemical Corporation
   DuPont

3. Firestone Tire and Rubber Company
   General Tire and Rubber Company
   Goodrich (B.F.) Company
   Goodyear Tire and Rubber Company
   Uniroyal, Inc.

4. General Electric Corporation
   Westinghouse Electric Corporation

5. Bendix Corporation
   General Motors Corporation
   International Harvester Company
   TRW, Ind.

6. American Brands, Inc.
   Cities Service Corporation
   Eastman Kodak Corporation
   International Telephone and Telegraph Company
   Procter and Gamble Company

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