The Paradox of Insider Information and Moral Hazard*

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Abstract

This article investigates the paradox of insider information and moral hazard as it pertains to managerial compensation. Managers are paid to organize human resources under their command in creative ways to extract more value to the firm. This paper shows that there are indeed good empirical grounds for taking this source of hidden interest(Insider Information) quite seriously as a motivation for changes in managerial portfolios with respect to their own firms.We provide a theoretical framework that explains how these conflicting goals might be resolve within equilibrium.

1 Introduction

Managers are paid to organize human resources in creative ways that add value to their firm. Since their activities are hard to monitor directly, managers are rarely paid for their inputs. Rather, compensation is tied to various indicators of managerial effort, such as their firm's performance. Linking managerial compensation to the firm's performance requires the manager to hold a substantial amount of personal wealth in assets that are sensitive to the firm's performance, such as stocks and options. Thus managerial compensation schemes try to correct for moral hazard by preventing managers from diversifying their wealth as much as they would otherwise.

Implementing such a scheme becomes complicated when shareholders do not know how much wealth the manager should vest in his own firm to simultaneously minimize the cost to shareholders, meet the manager's conditions for

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remaining with the firm, and align his incentives with those of the shareholders. Shareholders not only rely on information from management about the firm's prospects. They also rely on managers for guidance about organizational and incentive structures that will unleash the firm's potential. The duties of executives in large corporations necessarily make them privy to information about their firm's performance that is not available to the stockholders at the time.

As opportunities to make the firm more profitable are explored, the manager gains foresight into which ventures are likely to be successful and those which will probably fail, putting him in a favorable position to trade on his insider knowledge. To the extent that managers can choose the level of firm specific assets to hold without incurring penalties directed at those who engage in insider trading, he would prefer holding more stock and options in his own firms when his private prognosis is more favorable than the market's, and less firm specific assets when his insider knowledge projects a worse outcome than what stockholders and other investors think. Although there are laws against insider trading, eliminating insider trading altogether does not seem like a practical goal of a regulatory body.

The two requirements, that a goodly portion of the manager's wealth should be vested in the firm to align the incentives between the firm's managers and its shareholders, and that the manager knows better than the shareholders the distribution of the firm's returns and how it varies with her own managerial activities, is at the heart of the paradox of insider information and moral hazard. If shareholders's are so well informed that they can precisely shape a managerial compensation contract without guidance from the manager, why employ a manager to run the firm rather than have shareholders manage it through direct governance?

To put this paradox another way, consider the probability distribution characterizing the returns on the stock. Conditioning on all the information available to the manager concentrates the shareholders' subjective distribution about outcomes of the firm's returns. Letting all shareholders know the information the manager has at his disposal mitigates the problem of moral hazard, and also reduces the ability of the manager to trade at the expense of the other shareholders. This effectively reduces the role of a manager, and his scope for seizing upon profitable opportunities as soon as they appear. By inducing the manager to reveal all payoff relevant information, truthfully assess its ramifications for the firm, and thus prevent the manager from taking advantage of foreknowledge, shareholders must involve themselves in the business of management. And supplanting management by collective decision making is a radical alternative form of corporate governance, rarely resorted to by value maximizing entities except in bankruptcy when the major creditors and stakeholders displace the managers.

1.1 Two assumptions

The paradox of moral hazard and insider information is predicated on two assumptions, that moral hazard is an important issue in directing the incentives of executives in large corporations, and that insider trading is profitable despite internal auditing and regulatory oversight. To appreciate the significance of the first assumption, note that one way of resolving the insider trading problem is for the board of directors to prevent the manager from ever holding any of the firm's assets. Existing regulations in the United States require the manager to frequently report all trading in the firm's assets, so this would be a relatively straightforward requirement to enforce. In the absence of moral hazard and/or the opportunity to benefit from inside trading, one is hard pressed to imagine why a manager would prefer to hold financial assets in his own firm compared to the alternative of holding a well diversified portfolio. Therefore managers should have no more qualms about agreeing to such a requirement, than agreeing to rules governing company perks, or theft of company property. Thus insider trading could be greatly curbed if motivating managers to work in the interests of shareholders was not so costly. Because the compensation of executives seems tied to the fortunes of the firms they manage, as recently documented in Hall and Liebman (1998) and Margiotta and Miller (2000) who overturn earlier results to the contrary by Jensen and Murphy (1990), we infer that the first assumption is indeed quite plausible.

To assess the validity of the second assumption, it is useful to briefly review how the Securities and Exchange Commission characterizes insider trading, and how they enforce rules against it. In a pamphlet available on line, the SEC provides information about bounties to those who help expose insider trading:

> "Section 21A(e) of the Securities Exchange Act of 1934 ("Exchange Act") [15 U.S.C. 78u-l(e)] authorizes the Securities and Exchange Commission ("") to award a bounty to a person who provides information leading to the recovery of a civil penalty from an insider trader, from a person who "tipped" information to an insider trader, or from a person who directly or indirectly controlled an insider trader. . . . "Insider trading" refers generally to buying or selling a security, in breach of a fiduciary duty or other relationship of trust and confidence, while in possession of material, non-public information about the security. Insider trading violations may also include "tipping" such information, securities trading by the person "tipped" and securities trading by those who misappropriate such information. Examples of insider trading cases that have been brought by the Commission are cases against: corporate officers, directors, and employees who traded the corporation's securities after learning of significant, confidential corporate developments; friends, business

> associates, family members, and other "tippees" of such officers, directors, and employees, who traded the securities after receiving such information; employees of law, banking, brokerage and printing firms who were given such information in order to provide services to the corporation whose securities they traded; government employees who learned of such information because of their employment by the government; and other persons who misappropriated, and took advantage of, confidential information from their employers . . . Because insider trading undermines investor confidence in the fairness and integrity of the securities markets, the Commission has treated the detection and prosecution of insider trading violations as one of its enforcement priorities."

Harris (2003) describes how the SEC prepares to prosecute cases of alleged insider trading. Large volume transactions accompanied by big price shifts are a signal that information about the firm's prospects may have been exploited by insiders. When alerted to a possible infringement (perhaps by a trader who believes he was exploited by an insider), the SEC compiles a list of investors who traded during the period under consideration, the insiders privy to information that led to the price change, and tries to match parties from both lists. This method of enforcement is most effective in combatting insider profits from arbitrage. However it seems inadequate to deter an insider trading opportunity that is exploited over longer period of weeks or months (as opposed to days), in short trading that involves some risk to the insider, which is balanced against a high expected return. Company executives seem to engage in this more broadly defined insider activity, because they purchase financial assets at opportune times. For example Yermack(1999) found that stock options grants of CEO 'coincides with the announcement of good about the companies earnings, but he concluded their activities do not violate the SEC regulations.

1.2 Plan of this paper

This paper analyzes the quantitative importance of the paradox between insider information and moral hazard. The next section describes the data we utilize. Our analysis is based on two longitudinal data sets taken from non-overlapping periods, which allows us to investigate secular trends in the determinants of compensation, and to compare our findings with previously published results. The first comprises data on compensation packages for the top three executives of 34 firms for the period 1948 through 1977, originally collected by Masson (1971) and extended by Antle and Smith (1985,1986), which has been coupled with time-series data on stock markets returns, interest and inflation rates over that period. The second is a more current data set complied from three main sources Standard & Poor's ExecuComp and Compustat databases and Executive Compensation

Reports data on firm compensation plan responses to Section 162(m) of the tax code. This database tracks 2508 firms over an 11 year panel beginning in 1992 in the S&P 500, Midcap, and Smallcap indices and contains information on the six highest-paid executives for a total of 22,568 Executives.

We begin our empirical investigations of moral hazard and insider trading in Section 3 by documenting certain irregularities that point to insider trading activity. Regressing the manager's portfolio choices on next period's abnormal returns to the firm, we find the latter are positive and significant. We interpret this finding as evidence that future returns are a noisy indicator of inside information available to the manager. To quantify the magnitudes of the insider advantage, we construct a simple dynamic portfolio strategy based on changes in asset holdings by managers, and find that this strategy significantly outperforms the market. We have already argued in the introduction that on a priori grounds profiting from insider information is unlikely to be very costly unless some other form of informational asymmetry between shareholders and managers underlies it. This section address this issue empirically, where we investigate whether managerial compensation also varies with idiosyncratic components to the return of her firm. After controlling for other factors that affect abnormal returns in a linear model, we find that the coefficients on the manager's asset holdings in her firm and unexplained variation in abnormal returns are both positive and significant. To summarize we conclude these empirical findings warrant further, formal investigations, undertaken in the latter parts of the paper.

Thus Section 4 presents a theoretical framework for exploring moral hazard and insider trading. In this model shareholders do not observe the manager's activities and can only prevent her from engaging in insider trade that involves arbitrage. Contracts between shareholders and the executives must satisfy three conditions, a participation constraint, that assures the manager she will have higher expected utility from employment with her firm rather than another one, an incentive compatibility constraint, that induces her to maximize the value of the firm rather than using the resources of the firm to pursue some other objective, and an insider trading condition that reflects shareholders' beliefs that the manager will pursue admissible insider trading when the opportunity arises. We establish the existence of an equilibrium and qualitatively characterize its properties in section 5.

Section 6 turns to identification and estimation of the theoretical model. At this point we have estimated some specializations of the model, and these will be presented in the seminar.

2 Data

Our description of the data are in relation to the applicability to our model. First, we provide a cross-sectional summary of the data set as they pertain to compensation, and then we present some cross-sectional summary statistic of the firms in our data sets. Finally we compare the summary statistics for the two different data set to discern any noticeable trend over time between these two distinct period.

2.1 Old data

There are 306 executives in the survey of which exactly one-third are CEO's. Column 3 of Table 2 provides some summary statistics of compensation within the three sectors that comprises this data set (Aerospace, Chemicals and Electronics). Table shows that CEOs are paid more than non-CEOs but that their compensation exhibits more variability, thus possibly suggesting that CEOs have stronger incentives to engage in non-value-maximizing activities. Relative to its mean the variation in salary and bonus is less than that of the other components to total compensation. This feature suggests that measures of compensation that exclude managerial income from holding and granting financial securities whose value is affect by the firm's abnormal returns[1] are unlikely to capture performance-enhancing characteristics of the compensation package.

Turning to the statistics that describe the firms these executives manage, Table 3 shows that overall, the average of abnormal returns is less than one-tenth of its standard deviation. The hypothesis that the expected value of the abnormal return is equal to zero cannot be rejected by these data at standard significance levels. This provides some empirical justification for ignoring risk premia. On the other hand, the test itself is masked by survivorship bias induced by the sample selection procedure, so we are wary of making too much of the empirical regularity, however, the firms seem representative of the market portfolio.

2.2 New data

Column 4 of Table 2 provides some summary statistics of compensation and stocks and Stock options holdings within ten sectors that comprises the new data set (i.e. Energy, Materials, Industrials, Consumer Discretionary, Consumer Staples, Health Care, Financial, Information Technology, Information Services,and Utilities). Here again CEO's are paid more than non-CEOs and there compensation exhibits more variability, thus possibly suggesting that CEOs have stronger incentives to engage in non-value-maximizing activities. Again relative to it mean the variation in salary and bonus is less than that of the other components to total compensation.

Turning to the statistics that describe the firms these executives manage, column 3 of Table 3 shows that the overall, the average of abnormal returns

[1] Abnormal return is gross excess return, this concept is formally defined in the following sections.

is less one twenty of its standard deviation. The hypothesis that the expected value of the abnormal return is equal to zero cannot be rejected by this data set either at standard significance levels. However with the larger set of firms this seems even more representative of the market portfolio.

2.3 Comparison

First it should be noted that the newer data set have a broader range of companies that the Antle and Smith 's data set. The old data set consist of companies drawn from three narrowly defined sectors, namely, Aerospace, Chemicals and Electronics. The new data used the economic sector groupings according to the Global Industry Classification Standards (GICS) Codes. This classification system has four different levels, namely, economic sector, Industry Group, Industry and finally Sub-industry. Aerospace and Defense would be at the Industry level of the Industrials economic sector. Similarly, chemicals would be at the industry level of the Materials economic sector while Electronics would be a Sub-industry of the Information Technology economic sector. See Table 1 for a partial listing of the GICS sector classification.

Although the within data set features of the compensation packages of the top executives are similar for the two data sets, there seem to be a significantly increase in compensation over the two period. The average after tax compensation more than double over the twenty year period for all executives. Taking a closer look, one notice that this increase is even greater for CEO's with their after tax compensation more than tripling. At the same time there is an even more significant increase in the after-tax value of options granted. This increase is more significant for CEOs versus non-CEOs, the increase is of the order 20 times for CEOs and of the order of 10 times for non-CEOs. The next significant trend over the period is that executives are holding significant more of the shares of their own firm. The order of increase is about 1000% for all executives. This has to be qualified by the fact that if we look at the total assets of the firm in both data set the firms in the new data set have significantly more assets. This along with the fact that the value of equity in both period are significantly different. This can partially be explain by the fact that in the 1990's the period which the second data set spans experienced significant growth in the value of equity. However, the abnormal return of both period are on the same order of magnitude.

Although the above comparison may well be valid it should be taken cautiously since the old data set is made up of only three narrowly defined sectors while the new data set is made up of much boarder defined economic sectors. We did these comparisons by breaking out the sectors that best mirrors the sectors defined in the old data set however these trends did not charge, in fact they became more pronounced.

3 Managerial Ownership, Firm Returns and Compensation

The empirical focus of our study of moral hazard and insider trading is upon the relationship between three variables, namely the firm's performance, the manager's compensation, and the value of her holdings in her firm's financial securities. We denote by W_{nt} the amount of the manager's wealth tied up in firm securities, be they stock or options (which are valued using the Black-Scholes formula). In large economy where each firm contributes a negligible amount to aggregate dividend income, the main reasons for holding financial securities in her firms are attributable to professional ties. This is because outsider risk averse investors shield their wealth from volatility in a firm's returns that is independent of other factors in the economy by holding a diversified portfolio. On the other hand, explicit or implicit contracts that induce ownership in the firm link managerial compensation and firm performance, and are also a useful instrument for exploiting insider information. It is of course not the only instrument; stock holding by friends and relatives are another. In our study this measure also proxies for financial liabilities incurred by the manager by virtue of her position, such personal liability incurred in the event of a law suit connected with her job.

Let π_t denote the market return, π_{nt} the firm specific return, which is defined as,

$$\pi_{nt} \equiv \frac{p_{nt} + d_{nt}}{P_{nt-1}}$$

where p_{nt} is the price of the n^{th} executive firm's stock at time t and d_{nt} is the dividends per share and the market return as

$$\pi_t \equiv \sum_{n=1}^{N} s_n \pi_{nt}$$

where s_n is weights assigned to every company's stocks. The law of motion for insider wealth is defined as,

$$W_{nt+1} = \pi_{nt} W_{nt} + G_{nt}$$

where G_{nt} is grants during the period. We measure firm performance by

$$u_{nt} = \pi_{nt} - \pi_t$$

the deviation of π_{nt}, the n^{th} firm's stock market return in time t, from a diversified portfolio or the market return π_t

$$\pi_t = \lim_{N \to \infty} \left[\frac{1}{N} \sum\nolimits_{n=1}^{N} s_{nt} \pi_{nt} \right]$$

where s_{nt} is the value of the firm as a fraction of the total market value. This measure of firm performance was picked because we are primarily concerned with how the manager affect the performance of her firm relative to other firms. Netting out the market return is reasonable approximation to purging the firm's return of aggregate factors in the economy over which the manager has no control.

Our measure of compensation to the manager ω_{nt} includes not just cash and bonus plus stock and option grants, but also gains and losses from abnormal returns on stocks and other financial securities in the manager's portfolio. The reason for such an encompassing definition stems from the fact that to evaluate the benefits of working for the firm versus pursuing some other activity, the manager accounts for how her personal financial portfolio is affected by accepting the position. Since we assume that abnormal returns are fully diversified and that the manager would hold negligible quantities of the firm's assets if she had no professional interests in the firm, fluctuations in her wealth due to abnormal returns are properly treated as part of her compensation.

In this section we directly analyze the empirical evidence for and against insider trading and moral hazard using regression techniques. We first focus on changes in stockholdings that occur before the period begins to investigate whether they help predict future returns. Using a model with a simple linear decision rule for insider trading, we develop a test for whether managers condition on more than the market in forming their expectations about future returns, and conduct an auxiliary regression to test the robustness of the linearity assumption. Then we undertake some simulations that quantify the magnitudes of the gains to managers from their insider trading opportunities. This section ends by seeking to determine whether, conditional on the information held by the manager, compensation to managers fluctuates with firm returns. If so, this would provide evidence of asymmetric information that goes beyond insider trading opportunities.

3.1 Future returns as a noisy indicator of insider information

We now denote the conditional expectation of the abnormal return in period $t+1$ based on all the information available to the manager in period t as $u_{n,t+\Delta} \equiv E_{t+\Delta}\left[u_{n,t+1}\right]$, and let $q_{n,t+\Delta}$ denote stock purchases by the manager in period t.Assuming temporarily that the manager's decision rule for trading is linear in this expectation, we obtain the the relation

$$\begin{aligned} q_{n,t+\Delta} &= \alpha_1 u_{n,t+\Delta} \\ &= \alpha_0 + \alpha_1 u_{n,t+1} + \alpha_1 \varepsilon_{n,t+\Delta} \end{aligned}$$

where $E_{t+1}\left[\varepsilon_{n,t+\Delta} \left| u_{n,t+\Delta}\right.\right] = 0$ by the definition of $u_{n,t+\Delta}$. If we impose the additional restriction that $\alpha_0 = 0$ then this decision rule may be interpreted as a linear approximation to the optimal rule for a risk averse expected utility maximizer confronted with a favorable gamble. When $\alpha_0 = 0$ the rule implies that $q_{n,t+\Delta} \equiv 0$ if and only if $u_{n,t+\Delta} \equiv 0$. From the definition of $u_{n,t+\Delta}$, this is true if and only if $E_{t+\Delta}[u_{n,t+1}]$ and the unconditional expectation $E[u_{n,t+1}] = 0$, are the same. In that case insider trading is conducted if and only if the manager has insider information about next period's abnormal return. Regressing $q_{n,t+\Delta}$ on $u_{n,t+1}$ we obtain a consistent estimator of

$$\frac{E[q_{n,t+\Delta}u_{n,t+1}]}{E[u_{n,t+1}u_{n,t+1}]} = \alpha_1\left(1 + E\left[\varepsilon^2_{n,t+\Delta}\right]\right)$$

The expression is positive if and only if $\alpha_1 > 0$.

The results from running this regression are reported in Table 4. The coefficient on lead abnormal return, α_1, is positive and significant in the new sample as predicted by this simple model of insider information. Also consistent with the simple linear model, α_0, the constant term is insignificant. In the same regression we also included the ratio of (contemporaneous) salary and bonus to total compensation to investigate whether the manager takes a lower salary and bonus in return for more claims that are contingent on the firms' return. Although the sign of α_2 is negative, it is not statistically significant. The lack of significance should not, however be interpreted as evidence against the model, since the manager is free to draw from her own wealth to invest in her firms' stock when promising prospects arise.

Could the positive association between $q_{n,t+\Delta}$ and $u_{n,t+1}$ be explained by shareholders responding to moral hazard in the contract they make with the manager? Perhaps increasing the ties between the firm and top management by increasing $q_{n,t+\Delta}$ induces improvements in managerial productivity that raises $\pi_{n,t+1}$, the returns to the firm, and hence $u_{n,t+1}$. This argument is flawed. Upon recognizing the positive association, shareholders should raise $q_{n,t+\Delta}$ to the point where further gains in $u_{n,t+1}$ are negligible, and then demand the manager maintain a constant level of her personal wealth in firm assets, henceforth setting $q_{n,\tau+\Delta} = 0$ for all $\tau > t$.

Managers are required to report all their trading activity to the SEC within a month, and their reports are available for public scrutiny. Consequently our finding that managers appear to exploit inside information when investing in their own firm raises the possibility that others might be able to benefit from their serendipitous choices. Table 5 presents our findings from regressing abnormal returns on the manager's lagged trading activity, providing some evidence of how well their trading activity is a useful predictor of abnormal returns. The estimated coefficients in question are positive and significant in both regressions, consistent with the hypothesis that managers exploit insider information. The estimates also show there is a negative relationship between abnormal returns of the firm and the ratio of salary and bonus to total compensation, but again the relationship is statistically insignificant, reinforcing our earlier suggestion that resources used for insider trading need not come at the expense of other components in the compensation package, but could simply reflect an adjustment in the manager's asset portfolio.

Much of the evidence from Tables 4 and 5 supports the notion that managers exploit their superior knowledge about their own firm's performance on the stock market, but not all. Suppose the manager follows the linear decision rule for insider trading, and has access to the other regressors listed in Table 5. In this case the inverse of the coefficient on lagged changes in the manager's stock holdings is α_1 , and the coefficients values on all the other variables are zero. Therefore our finding that several coefficients are significant constitutes evidence against the narrowly construed model of a linear decision rule. Using the relationship between the coefficients on the proxy for information in Table 5 and lagged return in Table 4 we found that the variance of the noise to signal is negative, this is also evidence against the narrowly construed model of a linear decision rule.

3.2 Benefits from insider trading

To gauge the magnitude of the gains from insider trading, we conducted a simulation exercise to evaluate, retrospectively, how lucrative it would have been to base a portfolio investment strategy on data from these reports over the 9 year period covered by the new data set. The simulations generated the outcomes of three strategies. The first strategy is only feasible if the inside investor perfectly anticipates the one period ahead abnormal return of the companies; an investor privy to perfect inside information pertaining to the n^{th} firm invests all her wealth in its shares in period t if $\pi_{n,t+1} > \pi_{t+1}$ and all of it in the market portfolio if $\pi_{n,t+1} \leq \pi_{t+1}$, reaping a certain return for the period of

$$\pi^{(0)}_{n,t+1} \equiv \max\left\{\pi_{n,t+1}, \pi_{t+1}\right\}$$

This strategy sets an upper bound on the gains to insiders with perfect foresight from a self financing strategy after the initial outlay. The third strategy allocates a fraction of the manager's discretionary wealth denoted by λ_{nt} to the market portfolio in period t, and the remaining proportion $(1 - \lambda_{nt})$ to stock in the n^{th} firm for a return of

$$\pi^{(\lambda)}_{n,t+1} = \lambda_{nt}\pi_{t+1} + (1 - \lambda_{nt})\pi_{n,t+1}$$

where λ_{nt} depends on the portfolio choices of the n^{th} manager. We compare the outcomes of these investment strategies, to see whether following the reports managers submit would have been profitable, and how much of the potential gains from clairvoyance managers are able to extract.

To implement the third strategy knowledge of the manager's discretionary wealth is used, but this information is not part of our data. Because we only observe that portion of her wealth that is allocated to financial assets in the firm she manages, the λ_{nt} sequences cannot be constructed from our data. We on the basis of the following maintained hypotheses, that in the presence of moral hazard, managers are required to hold a minimum number of shares in their firms to help align their objectives with shareholders', and that the the total amount of discretionary wealth is related to the maximum amount of wealth placed in the firm's shares over the sample period. Using these guiding principles we construct two related measures.

First suppose discretionary wealth is the difference between the maximum observed wealth in the firm

$$\overline{W}_n = \max_{t \in \{1,...,T\}} \{W_{nt}\}$$

and the minimum

$$\underline{W}_n = \min_{t \in \{1,...,T\}} \{W_{nt}\}$$

Then λ_{nt} may be approximated by

$$\lambda_{nt}^{(1)} \equiv \frac{W_{nt} - \underline{W}_n}{\overline{W}_n - \underline{W}_n} \tag{1}$$

In this case

$$\pi_{n,t+1}^{(1)} = \lambda_{nt}^{(1)} \pi_{t+1} + (1 - \lambda_{nt}^{(1)}) \pi_{n,t+1}$$

A limitation of this approximation is that it fails to account for socio-demographic and economic factors that might affect discretionary wealth. It is easy to imagine that of the total amount of assets lodged in her firm's securities, the fraction that is invested at the manager's discretion also depends on her position, her employer, current aggregate economic conditions, and so forth. This objection by accounting for heterogeneity that is seemingly unrelated to investment decisions motivated by insider information, we formed a vector of such characteristics denoted z_{nt}, and then linear conditional expectation function $E[W_{nt} | z_{nt}]$ as

$$E[W_{nt} | z_{nt}] \equiv \gamma' z_{nt}$$

Adjusted discretionary wealth available to the n^{th} manager in period t is then

$$V_{nt} = W_{nt} - E[W_{nt} | z_{nt}] \tag{2}$$

and the second measure of the fraction of discretionary wealth invested in the firm's assets is

$$\lambda_{nt}^{(2)} \equiv \frac{V_{nt} - \underline{V}_n}{\overline{V}_n - \underline{V}_n} \tag{3}$$

To obtain an estimate of we regressed W_{nt} on z_{nt}, to obtain estimated coefficient vector $\widehat{\gamma}$, that were substituted for the true value of the vector γ to obtain estimates of adjusted discretionary wealth, denoted $\widehat{V}_{nt}$, estimates of $\lambda_{nt}^{(2)}$, which we denote by $\widehat{\lambda}_{nt}^{(2)}$. The one period return from using these weights is:

$$\pi_{n,t+1}^{(2)} = \widehat{\lambda}_{nt}^{(2)} \pi_{t+1} + (1 - \widehat{\lambda}_{nt}^{(2)}) \pi_{n,t+1}$$

Having simulated these investment strategies, we then conducted tests of the following hypotheses:

$$H_0 : \lim_{N\to\infty} \frac{1}{N} \sum\nolimits_{n=1}^{N} \left[\prod\nolimits_{t=1}^{T} \left(\pi_{nt}^{(i)} \right) - \prod\nolimits_{t=1}^{T} \left(\pi_{nt}^{(j)} \right) \right] = 0$$

for various $(i, j) \in \{0, 1, 2, 3\}$ where $\pi_{nt}^{(3)} \equiv \pi_t$ is just the market return.

The results are presented in Tables 6 and 7. They show that building an investment strategy based on the manager's stock holding is more profitable than specializing in the market portfolio

3.3 Evidence for moral hazard

The balance of evidence presented above weighs in favor of the view that managers undertake insider trading, exploiting privy information to trade in their firm's stock at the expense of shareholders. We argued in the introduction that these activities are tacitly or explicitly approved by their respective boards of directors because insider trading by managers could be greatly curbed or even eliminated. Boards could require managers to refrain from owning financial assets of the firms they manage. After all certain positions in the public sector, such as elected offices, require the occupant to divest himself of assets in firms that might create a conflict of interest between his professional duties and the incentives of the firms' shareholders. Moral hazard gives one reason why boards are reluctant to discourage insider trading: compensation from insider trading might help align incentives between shareholders and the manager. If so, executive compensation packages might also depend on those components of abnormal returns that are not anticipated by inside knowledge. We now investigate this possibility.

As before, let $u_{n,t+1}$ denote abnormal profits in the upcoming period $t + 1$, where we assume $E_t [u_{n,t+1}] = 0$, let $u_{n,t+\Delta} \equiv E_{t+\Delta} [u_{n,t+1}]$ denote the conditional expectation of the manager of the n^{th} firm in period t about $u_{n,t+1}$, and let $\omega_{n,t+1}$ denote his compensation paid at the beginning of the next period. If insider trading does not resolve conflict of interest issues, then we would expect that managerial compensation should depend on those components in abnormal returns that are stochastically affected by the manager's diligence, but are nevertheless unanticipated by the manager in period t. Defining

$$v_{n,t+1} \equiv u_{n,t+1} - u_{n,t+\Delta}$$

we might hypothesize that $\omega_{n,t+1}$ is an increasing function of $v_{n,t+1}$. It is therefore reasonable to ask whether the regression slope of ω_{nt} on an estimate of u_{nt} is positive and significant or not.

Table 8 presents our results from testing this hypothesis by forming

$$\widehat{v}_{n,t+1} \equiv u_{n,t+1} - \widehat{u}_{n,t+\Delta}$$

from the estimated expectation function presented in Table 5 , and then regressing $\omega_{n,t+1}$ on $\widehat{v}_{n,t+1}$ and the variables used in estimating $\widehat{u}_{n,t+\Delta}$. Our estimates show that managers are rewarded when the abnormal return is higher than they expected, while simultaneously confirming our earlier results that established the existence of other factors in abnormal returns that managers can exploit through insider trading because of foreknowledge. Overall these results provide empirical evidence that although shareholders use compensation packages to diminish the significance of moral hazard, insider trading by managers is also a component in their financial remuneration.

4 The Model

Our model focuses on the executive compensation when the manager is subject to moral hazard and also has private information about the firms prospective returns, from which she is able to benefit through insider trading on the stock market. At the beginning of each period the manager proposes a compensation plan to the directors on the board, chooses a work routine that is not observed by the directors, and also picks real consumption expenditure for the period. During the period the manager has the opportunity to trade shares in her own firm on the basis of new information she receives about the return to shareholders. The return on the firm's assets are realized at the end of the period. It depends on the how well the firm was managed during the period, the private information available to the manager as well as other factors that were not anticipated by anybody.

The objective of the manager is to sequentially maximize her expected lifetime utility, but she competes with other managers for her position. We assume competition from her rivals drives down the expected to utility from working for the firm to that which she could gain elsewhere. Accordingly competition from rival managers and firms is modeled as a participation constraint. To convince the board that she will pursue the goal of the firm, which we assume is value maximization, the manager chooses a contract that aligns her interests with those of the firm. This alignment is embedded in the incentive compatibility constraints. Finally it is public knowledge that the manager will trade as an insider whenever the opportunity arises, so the expected gains she makes from such trading are incorporated into the compensation plan.

4.1 Choices

Each period t the manager chooses for her work activities, her consumption and her financial portfolio with a view to maximizing her expected remaining lifetime utility. With regards work effort, the manager has three choices in each period t, to work diligently for the firm, to be employed by the firm but shirk, or to be engaged outside the firm, either with another firm or in retirement. Let $l_t \equiv (l_{t0}, l_{t1}, l_{t2})$ where $l_{tj} \in \{0,1\}$ for $j \in \{0,1,2\}$ and

$$\sum_{j=0}^{3} l_{tj} = 1$$

where $l_{t0} = 1$ signifies choosing another job or retirement, l_{t1} means choosing to be employed by the firm but to pursue different objectives than maximizing the firm's value, and l_{t2} means that the manager pursues the shareholders objectives of value maximization. Consumption in period t is a positive real number denoted by c_t. During the period the manager receives insider information about the end of period return that she may exploit by buying or selling shares $q_{t+\Delta}$, a real number (taking negative values if she sells shares).

4.2 Preferences

Preferences over consumption and work are parameterized by a utility function exhibiting absolute risk aversion that is additively separable over periods and multiplicatively separable with respect to consumption and work activity within periods. In the model we estimate, lifetime utility can be expressed as:

$$-\sum_{t=0}^{T} \sum_{j=0}^{3} \alpha_j \beta^t l_{tj} \exp(-\rho c_t)$$

where β is the constant subjective discount factor and ρ is the constant absolute level of risk aversion. We assume $\alpha_2 > \alpha_1 > \alpha_0$ to reflect the fact that compared to the activity called shirking, diligence is more aligned to the firm's interest than the managers interests.

4.3 Information

News about the firm is treated as events that arrive over time. At the beginning of each period t everyone receives information about the performance of the firm when it profits are announced for the preceding period. At that time the manager is paid compensation denoted w_t, and her managerial contracts is up for renewal. She then makes her consumption and labor choices, (c_t, l_t). During the period the manager of the firm receives inside information about how the firm is likely to perform in the current period. After reviewing this information she has the opportunity to trade the firm's shares on the stock market, and we denote her net demand by $q_{t+\Delta}$. To simplify the analysis we assume that managerial effort affects output in the current period only, and that inside information has no value beyond the current period. We model possible paths that event histories might take as an increasing sequence of $\sigma-$*algebras,* denoted by $\ldots F_t \subseteq F_{t+\Delta} \subseteq \mathcal{F}_{t+1} \ldots$, where $\mathcal{F}_t$ characterizes all publicly disclosed knowledge that has accumulated by period t, and $\mathcal{F}_{t+\Delta}$ characterizes the manager's information set after the contract has been set but before she trades the firm's shares on the stock market. Thus the decision rule determining (c_t, l_t), her consumption and labor choices in the t^{th} period, is an F_t-*measurable* mapping, while $q_{t+\Delta}$, the manager's portfolio choice in that period, is an $F_{t+\Delta}-$*measurable* mapping.

4.4 Budget constraint

We assume there are a complete set of markets for all publicly disclosed events, with price measure Λ_t defined on F_t and derivative λ_t. This implies that consumption by the manager is limited by a lifetime budget constraint which reflects both the opportunities she faces as an insider trader, and the expectations she has about her compensation. The lifetime wealth constraint is endogenously determined by the manager's work activities and her insider trading activity. By assuming markets exist for consumption contingent on any public event, we effectively attribute all deviations from the law of one price to the particular market imperfections under consideration. Let e_0 denote the endowment at date 0, and let p_t denote the current price of shares, denumerable in terms of forgone consumption units in period t. We also measure w_t, the manager's compensation in period t, in units of current consumption. To indicate the dependence of the consumption possibility set on the set of contingent plans determining labor supply and effort, we define $E_0[\bullet \,|l]$ as the expectations operator conditional on work and effort level choices throughout the manager's working life. The budget constraint can then be expressed as:

$$E_0\left[\sum\nolimits_{t=0}^{T} \lambda_t \left(c_t + p_t q_{t+\Delta} - w_t\right) |l\right] \leq e_0$$

The fact that prices are F_t measurable but that quantities traded by the manager are $F_{t+\Delta}$ measurable embodies her inside information. In the special case where $F_t = F_{t+\Delta}$, the manager does not receive any inside information, and the framework reduces to a standard model of moral hazard. This paper concentrates on situations where $F_t \subset F_{t+\Delta}$, and we shall only refer to the specialization that $F_t = F_{t+\Delta}$ as a benchmark for comparison purposes linking the literature on moral hazard to our richer model.

4.5 Restrictions on arbitrage

In the absence of regulation, one advantage inside trading might confer upon informed managers is profit from arbitrage. Arbitrage would certainly occur if $F_{t+\Delta} = F_{t+1}$, that is when the manager receives advance notice of next period's state. Consequently we assume $F_{t+\Delta} \subset F_{t+1}$. However this assumption does not rule out all arbitrage possibilities. For suppose inside information leads the manager to rule out certain event histories with unit probability. Denoting the set of these histories with a $*$ superscript, we express this statement by the two inequalities $E_t\left[1\left\{0=\lambda^*_{t+2}\right\}\right]=0$ and $E_{t+\Delta}\left[1\left\{0=\lambda^*_{t+2}\right\}\right]=1$. The first equality states that at time t the market places some value on obtaining a share at time $t+2$ in the event of a $*$ history; the second equality states that an insider with information $F_{t+\Delta}$ (and also the general public with information $\mathcal{F}_{t+1}$ next period) places no value on this event. In this event

$$E_0\left[1\left\{\lambda_{t+2}\neq\lambda^*_{t+2}\right\}\lambda_{t+2}p_{t+2}\right]<E_0\left[\lambda_{t+2}p_{t+2}\right]$$

so arbitrage profits can be made is possible by short selling the stock for the contingencies defined by the $*$ histories. Arbitrage is more easily prosecuted than other types of insider information, and managers are typically prohibited form short selling stock in their own firm. Moreover arbitrage is incompatible with another assumption in our model, competitive equilibrium. Accordingly, we assume that for any arbitrary set of $*$ histories, if $E_t\left[\lambda^*_{t+2}\right]>0$ then $E_{t+\Delta}\left[\lambda^*_{t+2}\right]>0$. This assumption guarantees that the only type of portfolio investment opportunities that managers face as insiders require them to trade off a higher return on shares against volatility induced by some uncertainty.

4.6 Contracts

Short term contracts apply to workers who are considering whether to work elsewhere, or to work for one period with the firm and then quit. In this model the optimal long term contract can be implemented by a sequence of short term contracts, a result proved in the Appendix. For this reason the text is focused on short term contracts. In our model a short term contract for managing the firm in period t is a $F_{t+1}-$*measurable* function, interpreted as a payment schedule and denoted by w_{t+1} that satisfies three constraints defined below.

The three constraints relate to participation, incentive compatibility and insider trading. The participation constraint states that the manager is indifferent between working one period and then leaving, versus not working for the firm at all. We show this is a necessary and sufficient condition for the worker to prefer managing the firm for a period, regardless of the choices she makes in the future. The incentive compatibility constraint restricts short term contracts to those payment schedules in which the manager prefers to work diligently rather than shirk. Finally the insider trading condition requires payment schedules to be structured so that upon observing her private information it is not optimal for the manager to buy any additional shares in the firm. In this sense, when agreeing upon the compensation schedule, both managers and shareholders understand and account for the opportunities that managers with private information routinely exploit.

5 Equilibrium

The model is solved in stages. First we derive the indirect utility function for the worker upon leaving the firm, and then solve for optimal consumption when the manager plans to work at most one period before retiring. Using the valuation function that solves this problem, we then derive the participation and incentive compatibility constraints that circumscribe the short term contracts. This leads to a formulation of the two contracting problems that account for the insider trading opportunities. Both problems satisfy the Kuhn Tucker conditions, permitting us to use Lagrangian methods to characterize of the optimal short term contracts.

5.1 Optimal consumption and savings

Although there are complete markets in this model, the manager requires only two securities to attain her optimal consumption stream. Accordingly let b_t denote the price of a bond that pays of a unit of consumption from period t through to period T, relative to the price of a unit of consumption in period t.

$$b_t = E_t \left(\sum\nolimits_{s=0}^{T} \frac{\lambda_s}{\lambda_t} \right)$$

Also let a_t denote the price of a security which pays off the random quantity $(\log \lambda_s - s \log \beta)$ in periods t through T.

$$a_t = E_t \left[\sum\nolimits_{t=s}^{T} \frac{\lambda_s}{\lambda_t} (\log \lambda_s - s \log \beta) \right]$$

It is straightforward to show that maximizing the utility function upon retirement

$$-\sum\nolimits_{t=0}^{T} \alpha_0 \beta^t \exp(-\rho c_t)$$

subject to the budget constraint

$$E_0 \left[\sum\nolimits_{t=0}^{T} \lambda_t c_t \right] \leq e_0$$

yields the indirect utility function

$$-\alpha_0 b_t \exp\left(-\frac{a_t + \rho \lambda_t e_t}{b_t} \right)$$

Applying Bellman's principle, it now follows that conditional on choosing activity α_j the two period utility staring at t and then continuing with the indirect utility from retiring the following period is

$$-\alpha_j \beta^t \exp(-\rho c_t) - \alpha_0 E_t \left[b_{t+1} \exp\left(-\frac{a_{t+1} + \rho \lambda_{t+1} e_{t+1} + \rho \lambda_{t+1} w_{t+1}}{b_{t+1}} \right) | l_{tj} = 1 \right]$$

Following Margiotta and Miller (2000) we now solve for the optimal consumption subject to the no short sale constraint plus the two period budget constraint

$$\lambda_t c_t + E_0 \left[\lambda_{t+1} e_{t+1} \right] \leq \lambda_t e_t$$

to obtain the indirect utility function

$$-b_t \alpha_j^{\frac{\lambda_t}{b_t}} \alpha_0^{1-\frac{\lambda_t}{b_t}} \exp\left(-\frac{a_t + \rho\lambda_t e_t}{b_t}\right) E_t \left[\exp\left(-\frac{\rho\lambda_{t+1} w_{t+1}}{b_{t+1}}\right) | l_{tj} = 1 \right]$$

5.2 Insider trading

In this model shareholders permit the manager to buy additional stock after the contract is written upon acquiring inside information. If she purchased additional stock denoted by $q_{t+\Delta}$ at price p_t, her budget constraint would decrease her wealth by $p_t q_{t+\Delta}$, and her compensation form the additional stock would rise by $x_{t+1} p_t q_{t+\Delta}$. Hence her indirect utility would adjust to

$$\begin{aligned} & -b_t \alpha_j^{\frac{\lambda_t}{b_t}} \alpha_0^{1-\frac{\lambda_t}{b_t}} \exp\left(-\frac{a_t + \rho\lambda_t e_t - \rho\lambda_t p_t q_{t+\Delta}}{b_t}\right) \\ & \times E_{t+\Delta} \left[\exp\left(-\frac{\rho\lambda_{t+1} w_{t+1} + \rho\lambda_{t+1} x_{t+1} p_t q_{t+\Delta}}{b_{t+1}}\right) | l_{tj} = 1 \right] \end{aligned}$$

The first order necessary condition for an interior optimal choice of $\widetilde{q}_{t+\Delta}$ is

$$E_{t+\Delta,j} \left[\left(\frac{\lambda_{t+1} p_t x_{t+1}}{b_{t+1}} - \frac{\lambda_t p_t}{b_t} \right) \exp\left(-\frac{\rho\lambda_{t+1} w_{t+1} + \rho\lambda_{t+1} x_{t+1} p_t \widetilde{q}_{t+\Delta}}{b_{t+1}} \right) \right] \leq 0$$

with an equality holding whenever $\widetilde{q}_{t+\Delta}$ is strictly positive. Rather than carry the extra notation, we incorporate the gains from insider trading within the compensation schedule itself by requiring the w_{t+1} itself to satisfy the asset pricing conditions

$$E_{t+\Delta,j} \left[\left(\frac{\lambda_{t+1} p_t x_{t+1}}{b_{t+1}} - \frac{\lambda_t p_t}{b_t} \right) \exp\left(-\frac{\rho\lambda_{t+1} w_{t+1}}{b_{t+1}} \right) \right] \leq 0$$

The interpretation of the compensation schedule is, then, the sum of compensation plus gains from insider trading.

5.3 Participation and incentive compatibility constraints

The participation constraint requires that the expected lifetime utility from working one more period exceeds the expected utility from retiring immediately, or

$$b_t \alpha_j^{\frac{\lambda_t}{b_t}} \alpha_0^{1-\frac{\lambda_t}{b_t}} \exp\left(-\frac{a_t + \rho\lambda_t e_t}{b_t}\right) E_{tj} \left[\exp\left(-\frac{\rho\lambda_{t+1} w_{t+1}}{b_{t+1}}\right) \right] \leq \alpha_0 b_t \exp\left(-\frac{a_t + \rho\lambda_t e_t}{b_t}\right)$$

where the second subscript on the expectations operator refers to the choice of work activity.

The incentive compatibility constraint requires the manager to prefer working diligently to shirking, or

$$
\begin{aligned}
& b_t \alpha_1^{\frac{\lambda_t}{b_t}} \alpha_0^{1-\frac{\lambda_t}{b_t}} \exp\left(-\frac{a_t+\rho\lambda_t e_t}{b_t}\right) E_{t1}\left[\exp\left(-\frac{\rho\lambda_{t+1}w_{t+1}}{b_{t+1}}\right)\right] \\
\leq \; & b_t \alpha_2^{\frac{\lambda_t}{b_t}} \alpha_0^{1-\frac{\lambda_t}{b_t}} \exp\left(-\frac{a_t+\rho\lambda_t e_t}{b_t}\right) E_{t2}\left[\exp\left(-\frac{\rho\lambda_{t+1}w_{t+1}}{b_{t+1}}\right)\right]
\end{aligned}
$$

5.4 Cost minimization

In our framework the board minimizes its costs, subject to the participation and incentive compatibility constraints, and cognizant of the perks from insider trading. The criterion function for shareholders is $E_{t2}[w_{t+1}]$. These optimization problem has a compact formulation. We define

$$
y_{t+1} = \left(\frac{\lambda_{t+1}x_{t+1}}{b_{t+1}} - \frac{\lambda_t}{b_t}\right)
$$

as the net return on the asset, and $g(x_t)$ as the ratio of the probability density functions

$$
g(x_t) = \frac{f_1(x_t)}{f_2(x_t)}
$$

Note that from its definition $g(x_t) \geq 0$ and $E_t[g(x_t)|l_{t2}=1] = 1$.Also let

$$
v_{t+1} \equiv \exp\left(-\frac{\rho\lambda_{t+1}w_{t+1}}{b_{t+1}}\right)
$$

as the amount that lifetime utility is scaled up by compensation. Then the no insider trading condition reduces to

$$
E_{t+\Delta,j}[y_{t+1}v_{t+1}] \leq 0
$$

while participation and incentive compatibility conditions are now compactly restated as

$$
\left[\frac{\alpha_0}{\alpha_j}\right]^{1-1/b_t} \geq E_{tj}[v_{t+1}]
$$

and

$$
\left[\frac{\alpha_2}{\alpha_1}\right]^{1-1/p_t} E_{t2}[v_{t+1}] \leq E_{t2}[v_{t+1}g(x_t)]
$$

The object of shareholders becomes $-E_{t2}[\log v_{t+1}]$. This expression is minimized subject to the insider trading condition, the participation constraint, and the incentive compatibility constraint. Reversing the sign of the objective, the Lagrangian for the transformed maximization problem is thus:

$$E_{t2}\left\{\log v_{t+1}+\eta_1\left(\left[\frac{\alpha_0}{\alpha_j}\right]^{1-1/p_t}-v_{t+1}\right)+\eta_2 v_{t+1}\right.$$
$$\left.\times\left(g\left(x_t\right)-\left[\frac{\alpha_1}{\alpha_2}\right]^{1-1/p_t}\right)-\eta_{t+\Delta}E_{t+\Delta,j}\left[y_{t+1}v_{t+1}\right]\right\}$$

The constraints for this maximization problem are linear and the objective function is concave. Therefore we may appeal to the Kuhn-Tucker theorem, and conclude that the first order conditions plus the associated complementary slackness conditions uniquely characterize the solution for v_{t+1}.

5.5 Properties of solution

Since Let F_t^* characterize all knowledge that has accumulated by period t by running time backwards from the future into the past, and denote the increasing sequence of $\sigma-$*algebras* of historical discovery by $\ldots F_{t+1}^* \subseteq F_{t+\Delta}^* \subseteq F_t^* \ldots$. Denoting by $E_{t+1,j}^*\left[\eta_{t+\Delta}\right]$ is the expected value that $\eta_{t+\Delta}$ conditional F_{t+1}^*, and in particular on the realization of $y_{t+1}v_{t+1}$ at the beginning of next period, plus the choice of activity j in the t^{th}, it now follows from the definition of conditional probability that

$$E_{t2}\left\{\eta_{t+\Delta}E_{t+\Delta,j}\left[y_{t+1}v_{t+1}\right]\right\}=E_{t2}\left\{y_{t+1}v_{t+1}E_{t+1,j}^*\left[\eta_{t+\Delta}\right]\right\}$$

Substituting the right side of this equation into the the Lagrangian defined above, the first order condition is:

$$\frac{1}{v_{t+1}}-\eta_1+\eta_2\left(g\left(x_t\right)-\left[\frac{\alpha_1}{\alpha_2}\right]^{1-1/p_t}\right)-y_{t+1}E_{t+1,j}^*\left[\eta_{t+\Delta}\right]=0$$

and the complementary slackness conditions are

$$\begin{aligned}
\eta_1 E\left(\left[\frac{\alpha_0}{\alpha_2}\right]^{1-1/p_t}-v_{t+1}\right) &= 0\\
\eta_2 E\left[v_{t+1}\left(g\left(x_t\right)-\left[\frac{\alpha_1}{\alpha_2}\right]^{1-1/p_t}\right)\right] &= 0\\
\eta_{t+\Delta}E_{t+\Delta,j}\left[y_{t+1}v_{t+1}\right] &= 0
\end{aligned}$$

5.6 Some intuition about the general case

In principle an equilibrium for the model can be found by solving the first order condition, the complementary slackness conditions, plus the asset portfolio choice equation, in the choice variables v_{t+1} and the Kuhn Tucker multipliers η_1, η_2 and $\eta_{t+\Delta}$. First multiply the first order equation by v_{t+1}, then add $\eta_1 \left[\frac{\alpha_0}{\alpha_j}\right]^{1-1/p_t}$ to both sides, take take unconditional expectations, and appeal to the complementary slackness conditions to obtain

$$\begin{aligned}
\eta_1 \left[\frac{\alpha_0}{\alpha_2}\right]^{1-1/p_t} &= E_{t2}\left\{1 - v_{t+1}\eta_1\eta_1 \left[\frac{\alpha_0}{\alpha_j}\right]^{1-1/p_t} + v_{t+1}\eta_2 \right. \\
&\quad \left. \times \left(g(x_t) - \left[\frac{\alpha_1}{\alpha_2}\right]^{1-1/p_t}\right) - v_{t+1}y_{t+1}E^*_{t+1,j}\left[\eta_{t+\Delta}\right]\right\} \\
&= 1 - E_{t2}\left\{\eta_{t+\Delta}E_{t+\Delta,j}\left[y_{t+1}v_{t+1}\right]\right\} \\
&= 1
\end{aligned}$$

This implies

$$\eta_1 = \left[\frac{\alpha_2}{\alpha_0}\right]^{1-1/p_t}$$

Substituting the solution for η_1 into the first order condition back into the equations defining the solution we obtain

$$\begin{aligned}
\exp\left(\frac{\rho\lambda_{t+1}w_{t+1}}{b_{t+1}}\right) &= \left[\frac{\alpha_2}{\alpha_0}\right]^{1-1/p_t} - \eta_2\left(\frac{f_1(x_{t+1})}{f_2(x_{t+1})} - \left[\frac{\alpha_1}{\alpha_2}\right]^{1-1/p_t}\right) \\
&\quad + \left(\frac{\lambda_{t+1}x_{t+1}}{b_{t+1}} - \frac{\lambda_t}{b_t}\right)E^*_{t+1,j}\left[\eta_{t+\Delta}\right]
\end{aligned}$$

plus the two remaining complementary slackness conditions

$$\eta_2 E\left[\exp\left(-\frac{\rho\lambda_{t+1}w_{t+1}}{b_{t+1}}\right)\left(\frac{f_1(x_{t+1})}{f_2(x_{t+1})} - \left[\frac{\alpha_1}{\alpha_2}\right]^{1-1/p_t}\right)\right] = 0$$

and

$$\eta_{t+\Delta}E_{t+\Delta,j}\left[\left(\frac{\lambda_{t+1}x_{t+1}}{b_{t+1}} - \frac{\lambda_t}{b_t}\right)\exp\left(-\frac{\rho\lambda_{t+1}w_{t+1}}{b_{t+1}}\right)\right] = 0$$

It is reasonable to assume that over much of its domain

$$g(x_{t+1}) \equiv f_1(x_{t+1})/f_2(x_{t+1})$$

is an increasing function of x_{t+1}.This assumption corresponds to the notion that the mass of the returns distribution from being diligent lies to the right of the mass of the returns to the firm when the manager shirks. Thus we conjecture the incentive compatibility constraint would have a positive effect on the derivative of w_{t+1} with respect to x_{t+1}. Similarly we conjecture

$$y_{t+1}E^*_{t+1,j}\left[\eta_{t+\Delta}\right] \equiv \left(\frac{\lambda_{t+1}x_{t+1}}{b_{t+1}} - \frac{\lambda_t}{b_t}\right)E^*_{t+1,j}\left[\eta_{t+\Delta}\right]$$

is also an increasing function of x_{t+1}. Clearly y_{t+1} is increasing x_{t+1}. Moreover $\eta_{t+\Delta}$ is more likely to have been zero (meaning the the asset portfolio condition was met with a strict inequality) when ex-post returns are low because the manager was less likely to have hold any more stock above that which would be required by the incentive compatibility constraint. This line of reasoning suggests $E^*_{t+1,j}\left[\eta_{t+\Delta}\right]$ is also increasing in x_{t+1}. Thus the conditions imposed by insider trading opportunities on the optimal contract have a positive effect on the derivative of w_{t+1} with respect to x_{t+1} too.

5.7 Solving a contract with moral hazard and no inside trading

There are two special cases to consider. The first occurs if $\eta_{t+\Delta} = 0$ for all possible values of inside information, implying that the insider information is never valuable enough for the manager to trade on her inside information. In this case the shareholders solve a moral hazard problem only. In this case the first order condition simplifies to

$$\frac{1}{v_{t+1}} - \left[\frac{\alpha_2}{\alpha_0}\right]^{1-1/p_t} + \eta_2\left(g\left(x_t\right) - \left[\frac{\alpha_1}{\alpha_2}\right]^{1-1/p_t}\right) = 0$$

Substituting for v_{t+1} the complementary slackness condition for incentive compatibility the solution for η_2 can be obtained numerically as a function of $g\left(x_t\right)$ and the preference parameters for leisure over work α_2/α_0 and shirking over diligence over shirking α_1/α_2.

$$E\left[\frac{\left(g\left(x_t\right) - \left[\frac{\alpha_1}{\alpha_2}\right]^{1-1/p_t}\right)}{\left[\frac{\alpha_2}{\alpha_0}\right]^{1-1/p_t} + \eta_2\left(g\left(x_t\right) - \left[\frac{\alpha_1}{\alpha_2}\right]^{1-1/p_t}\right)}\right] = 0$$

Having solved this case we check whether the asset portfolio conditions are satisfied or not, and hence whether the specialization applies.

5.8 Solving a contract with inside trading but no moral hazard

Consider the special case in which $\eta_2 = 0$ and the opportunities for insider trading alone suffice to motivate the manager. In this case the first order condition and the complementary slackness conditions reduces to a system of equations that is (almost) separable in v_{t+1} and $\eta_{t+\Delta}$. First we solve the interior solution of the asset portfolio equation $E_{t+\Delta,j}\left[y_{t+1}v_{t+1}\right]=0$ to determine the amount of the firm's asset the manager wishes to buy in each of the states. Then we solve for $\eta_{t+\Delta}$ in the first order condition of the shareholder's maximization problem

$$1-v_{t+1}\left[\frac{\alpha_2}{\alpha_0}\right]^{1-1/p_t}-v_{t+1}y_{t+1}E^*_{t+1,j}\left[\eta_{t+\Delta}\right]=0$$

Given the manager's preference for employment with the firm versus elsewhere α_2/α_0 and the transition probability that relates y_{t+1} to $\eta_{t+\Delta}$ it can solved using matrix algebra if there are only a finite set of outcomes in y_{t+1}. To determine whether this case applies we check whether the incentive compatibility conditions are met.

6 Identification and Estimation of the Moral Hazard Model

The data on compensation to the six top executives, firms' abnormal returns, and security prices will be used to identify and estimate the three version on the model, the moral hazard model, the insider information and the general model with both moral hazard and insider information. The observations are ordered by $n\in\{1,2,...,N\}$, each observation referring to one of the six executive positions in one of the firms in one of the 9 years in our data set.

Three different measures of assessing the importance of moral hazard are used in the specialization in this framework. The first is the loss shareholders incur from not observing the manager's actions directly. A second measure is the value to the manager of the compensation differential from working diligently versus shirking. Third is the income loss a firm would sustain from signing a contract with a manager to shirk.

This estimation technique is just the adaptation of the Margiotta and Miller(2000) methodology. The intuitive basis for identification in this framework stems from the idea that graphing fluctuations in realized compensation against the firm's abnormal returns trace out the compensation schedule and that the distribution of abnormal returns itself can be estimated nonparametrically from realizations over time. Therefore, the curvature of the compensation schedule is informative about expected firm losses if the manager shirks, the extra utility the manager would derive from shirking, and his or her attitude toward risk. Indeed, the compensation contract in the proceeding sections maps the prices of observed securities and firm returns into compensation received by manager. To avoid stochastic singularity we postulated a measurement error that induces a discrepancy between the observed compensation and actual compensation $w_{n,t+1}$. Accordingly, for each n$\in \{1,...,n\}$, define the observed compensation, denoted $\widetilde{w}_{n,t+1}$, as

$$\widetilde{w}_{n,t+1} = w_{n,t+1} + \varepsilon_{n,t+1}$$

where $\varepsilon_{n,t+1}$ is an independent and identically distributed normal random variable with mean 0 and variance $2\lambda_{t+1}^{-1}p_{t+1}\rho^{-1}\xi$, and ξ is a normalizing parameter to be estimated. We incorporate the deferences between the ten sectors that affect the probability distribution for abnormal returns and to distinguish between the preferences of top manager and the other two executives. To this end, let $s \in \{1,...,S\}$ enumerate the industrial sector and $k \in \{1,...,K\}$ label the executive's position within the firm's hierarchy. For each observation $n \in \{1,...,N\}$ the indicator variables d_{1ns} and d_{2nk} are now, respectively, defined as

$$d_{1ns} = \begin{cases} 1 & \text{if the n}th\text{ observation occurs in the sth industrial sector} \\ 0 & \text{otherwise} \end{cases}$$

and

$$d_{2nk} = \begin{cases} 1 & \text{if the n}th\text{ observation occurs in the kth executive position} \\ 0 & \text{otherwise} \end{cases}$$

The parameter estimates were obtained in two steps. First, $f_{1s}(x)$ was estimated for $s \in \{1,...,S\}$using data on abnormal returns to the firm.The estimates of the other parameters were found using data on managerial compensation and firm returns by constructing orthogonality conditions from the participation and incentive compatibility constraints, as well as managerial compensation schedule. These steps are briefly outlined below, the interesting reader is referenced to Margiotta and Miller (2000).

6.0.1 The Distribution of Abnormal Returns

Our empirical application parameterizes $f_{js}(x)$ for $s \in \{1,...,S\}$ and $j \in \{1,2\}$. More specifically, we assume that for each $j \in \{1,2\}$, the firm's abnormal returns are distributed as a truncated normal random variable with support bounded below by ψ_s. Thus in each sector s$\in \{1,...,S\}$

$$f_{js}(x) = \left[\Phi\left(\frac{\mu_{js} - \psi_s}{\sigma_s}\right)\sigma_s\sqrt{2\pi}\right]^{-1} \exp\left[\frac{-(x-\mu_{js})^2}{2\sigma_s^2}\right]$$

where Φ is the standard normal distribution function, and (μ_{js}, σ_s) denotes the mean and variance of the parent normal distribution associated with $l_{tj} = 1$

In the data section we showed that our data cannot reject the simple hypothesis that $E(x_{n,t+1} \mid l_{1n,t+1} = 1) = 0$. We exploit this condition in the estimation along with the formula for the mean of the normal distribution truncated from below at ψ, we obtain

$$\mu_{2s} = -\frac{\sigma_s \phi[(\psi_s - \mu_{2s})/\sigma_s]}{\Phi[(\mu_{2s} - \psi_s)/\sigma_s]} \equiv \mu(\psi_s, \sigma_s)$$

where the mapping $\mu(\psi_s, \sigma_s)$ from $\mathcal{R} \times \mathcal{R}^+$ to $\mathcal{R}$ is implicitly defined by the first line above. Therefore, the distribution of abnormal returns for the ten-sector case is characterized by two vectors $\theta_1 \equiv (\psi_1, ..., \psi_{10})'$ and $\theta_2 \equiv (\sigma_1, ..., \sigma_{10})'$.

We first estimated $\theta_1^{(0)}$, the true value of θ_1. For each sector $s \in \{1, ..., S\}$, consistent estimator for $\theta_1^{(0)}$ is $\theta_1^{(N)} \equiv (\psi_1^{(N)}, ..., \psi_{10}^{(N)})'$, where

$$\psi_1^{(N)} \equiv \min_{n \in \{1,...,N\}} \{d_{1ns} x_{nt}\}$$

This estimator is super-consistent and hence will not have any effect on the subsequent maximum likelihood estimation. The estimation of $f_{2s}(x)$ is completed by maximizing the log likelihood function for N observation in θ_2 conditional on $\theta_1^{(0)}$.

6.0.2 The Remaining Parameters

This leaves the parameters characterizing managerial preferences and the firm's distribution of abnormal returns from shirking to estimate. because utility levels are unobserved, α_0, α_1, and α_2 are only identified up to a factor of proportionality. For this reason, α_0 was normalized to unity. Because in the exponential utility setting the optimal contract is independent of the subjective discount factor, β cannot be identified either. consequently, the only remaining parameters to be estimated are

$$\theta_3 \equiv (\mu_{11}, ..., \mu_{110}, \alpha_{11}, ..., \alpha_{16}, \alpha_{21}, ..., \alpha_{26}, \rho, \xi)'$$

Denote the true value of θ_3 by $\theta_3^{(0)}$. It was estimated using a generalized methods of moments (GMM) procedure by constructing orthogonality conditions derived from the compensation schedule; from the participation constraint ; and from the incentive compatibility condition. Substituting the estimates from the previous stages and estimating the remaining parameters and correcting the standard errors for the pre-estimation.

7 Identification and Estimation of the General Model

The production and information technology in this model is described by the probabilitiy density function for the firm's return conditional on diligent management, $f_2(x_{t+1})$, the ratios of the denisties for diligence versus shirking $g(x_{t+1})$, as well as the mapping from inside information the manager receives to the firm's return. There are five parameters characterizing utililty in our model, the coefficient of absolute risk aversion ρ, the preference parameters for diligent work, α_2, shirking, α_1, and alternative employment or retirement, α_0, and the discount factor β. In addition there are The discount factor is not identified because the optimal long term contract can be implemented by a sequence of short term contracts. Because the level of utility is not identified, we normalize $\alpha_0 = 1$. As we demonstrate below, the $g(x_{t+1})$ and $f_2(x_{t+1})$ mappings, along with the other parameters $(\rho, \alpha_1, \alpha_2)$, are identified by a cross section of data on compensation that includes the value of firm securities held by the manager in the preceding period.

This section proves our model is identified. This is undertaken by construction. First we consistently estimate the marginal rate of substitution function from the asset portfolio equation, and provide conditions for identifying those states where the incentive compatibility constraint is not binding.n our model. This amounts to estimating the corefficient of aboslute risk aversion ρ, and defining threshold expectation levels that determine the how much insider trading would occur in the absence of an incentive compatability contraint. The risk aversion parameter can also identified in a model where there is ojnly moral hazard, but in that case a dirrent procedure would be used. Having identified and estimated the marginal rate of substitution function, we then estimate the differential utility between working diligently and taking alternative employment or retirement, parameterized by α_2 in our model. This is simply accomplished by substituting our implicit estimate of v_{t+1} obtained from the first stage into a sample analogue of the participation constraint. The third stage of estimation uses the first order condition to estimate the parameters in the technology that change when the manager chooses to be diligent rather than shirk. In our framework the mapping $g(x_{t+1})$ characterizes the ratio of the two probability density functions for the firm's abnormal returns conditioanl on effort. To undertake this stage, we remark that the incentive compatibility constraint is binding if there are states of the world in which the manger holds more of the firm's assets than she would choose as an inside trader. Conversely the $g(x_{t+1})$ mapping is not identified otherwise. Noting that $E^*_{t+1,j}[\eta]$ is a linear operator in η, we develop conditions for its inverse to exist. We appeal to those conditions, invert $E^*_{t+1,j}[\eta]$ in the expression for the first order condition to derive a set of identifying equations for $g(x_{t+1})$ when $\eta_{t+\Delta,j} = 0$, equations that form the basis for estimating $g(x_{t+1})$. The only remaining parameters measure the preferences for diligence over shirking, α_1, and can be obtained from the incentive compatitibilty condition (in cases where it binds) by substuting in the estiamtes of the incidental parameters v_{t+1} and our estimate of $g(x_{t+1})$.

7.1 Asset portfolio equation

First we estimate the corefficient of aboslute risk aversion ρ from the asset pricing equation in the states where the incentive compaitibility constraint is not binding

$$1\left\{\eta_{t+\Delta,j}>0\right\}E_{t+\Delta,j}\left[\left(\frac{\lambda_{t+1}p_t x_{t+1}}{b_{t+1}}-\frac{\lambda_t p_t}{b_t}\right)\exp\left(-\frac{\rho\lambda_{t+1}w_{t+1}}{b_{t+1}}\right)\right]=0$$

In general the conditions under which a trader is compelled to carry more of the firms' assets than he would otherwise prefer depend on all the properties of the stochastic process generating $u_{n,t+1}$ from its conditional expectation $u_{n,t+\Delta}$. We simulatneaously identify when the asset portfolio holds and estimate the marginal rate of subsitution function by placing enough structure on the stochasitic process. To do this we establish conditions under which there is a threshold level denoted $\overline{u}_n$ such that for $u_{n,t+\Delta}>\overline{u}_n$ the trader equates the expected marginal rate of substituion function with the relative prices, and below $\overline{u}_n$ the manager carries more of teh firm's asset than she would choose otherwise. In terms of our notation we seek to establish conditions under which there exists a real number $\overline{u}_n$ such that $\eta_{t+\Delta,j}>0$ for all $u_{n,t+\Delta}>\overline{u}_n$ and $\eta_{t+\Delta,j}=0$ for all $u_{n,t+\Delta}<\overline{u}_n$.

7.2 Preferences between alternative employment

The preference parameter for working diligently as a manager versus choosing some other activity outside the firm is given by α_2^{-1}, which can be estimated from the pariticipation contraint

$$\alpha_2^{(1-b_t)/b_t}=E_{t2}\left[v_{t+1}\right]$$

using $\widehat{\rho}$, our estimate of ρ obtained from the first stage. We define $\widehat{v}_{t+1}$, an estimate of v_{t+1}, as

$$\widehat{v}_{t+1}\equiv\exp\left(-\frac{\widehat{\rho}\lambda_{t+1}w_{t+1}}{b_{t+1}}\right)$$

and then form:

$$\widehat{\alpha}_2=\frac{1}{T}\sum\nolimits_{t=1}^{T}\left[\frac{1}{I_t}\sum\nolimits_{i=1}^{I_t}\left(\widehat{v}_{t+1}^{i}\right)\right]^{1-1/b_t}$$

7.3 Dependence of returns on unobserved effort

The estimates of $g\left(x_{t+1}\right)$ are based on the first order condition for cost minimization, namely

$$v_{t+1}^{-1}-\left[\frac{\alpha_2}{\alpha_0}\right]^{1-1/p_t}+\eta_2\left(g\left(x_{t+1}\right)-\left[\frac{\alpha_1}{\alpha_2}\right]^{1-1/p_t}\right)-y_{t+1}E_{t+1,j}^{*}\left[\eta_{t+\Delta}\right]=0$$

which may be expressed as

$$z_{t+1} = E^*_{t+1,j}\left[\eta_{t+\Delta}\right]$$

where z_{t+1} is defined as the expression

$$z_{t+1} \equiv \frac{1}{y_{t+1}}\left[v_{t+1}^{-1} - \alpha_2^{1-1/p_t} + \eta_2\left(g\left(x_{t+1}\right) - \alpha_1^{1-1/p_t}\right)\right]$$

Suppose there are a a discrete number of outcomes that x_{t+1} can take, say J. In that case y_{t+1}, v_{t+1}, $\eta_{t+\Delta}$ and therefore z_{t+1} and can only take on J values too. Similarly assume that $\eta_{t+\Delta}$ takes on at most K values, meaning that there are $K \geq J$ states of inside information. According let by $z' = (z_1, \ldots, z_J)$ denote the J dimensional row vector of possible z_{t+1} outcomes, and let $\eta' = (\eta_1, \ldots, \eta_K)$ denote the K dimensional row vector of the possible $\eta_{t+\Delta}$ multipliers associated with the insider information trading condition. Finally define the $K \times J$ dimenional matrix P as

$$z = P\eta \equiv \left(E^*\left[\eta_1\right], \ldots, E^*\left[\eta_K\right]\right)'$$

Thus

$$P \equiv \begin{bmatrix} P_{11} & \cdots & P_{1K} \\ \vdots & \ddots & \vdots \\ P_{J1} & \cdots & P_{JK} \end{bmatrix}$$

is the probability transition that associates outcomes back to the multipliers, where P_{jk} is the probability that η_k occurred conditional upon the subsequenlty outcome z_j. Note that our no arbitrage condition rules out the possibility that the dimension of η is less than the dimension of z. If the dimension of η was bigger than the dimension of z we would lose identification.

We now further assume that $J = K$ and that P has an inverse, which we denote by P^{-1}. Then

$$P^{-1}z = \eta$$

Note that whenever the incentive compatibility condition is binding there is at least one component in the η vector that is binding. Suppose there are $L < J$ multipliers taking the value of zero. We partiton η and P^{-1} into

$$\eta = \begin{bmatrix} 0 \\ \eta^{(+)} \end{bmatrix}$$

and

$$P^{-1} = \begin{bmatrix} P_0^{-1} \\ P_+^{-1} \end{bmatrix}$$

Then we obtain L equations of the form

$$P_0^{-1}z = 0$$

in the K dimensional vector z. We set

$$\widehat{z}_{t+1} \equiv \frac{1}{y_{t+1}}\left[\widehat{v_{t+1}^{-1}} - \widehat{\alpha}_2^{1-1/p_t} + \eta_2 g\left(x_{t+1}\right) - \eta_2 \alpha_1^{1-1/p_t}\right]$$

and obtain an estimate of P_0^{-1} by first estimating P from the data with $\widehat{P}$ and then inverting $\widehat{P}$. Then we impose the conditions that

$$\widehat{P}_0^{-1}\widehat{z} = 0$$

Note that the more outcomes on which the contraint is binding gives us more degrees of freedom for estimating $g\left(x_{t+1}\right)$. this would seem to pave the way for nonparametric identification of $g\left(x_{t+1}\right)$. This stage identifies $g\left(x_{t+1}\right)$ nonparametrically up to a linear mapping. Denote this by

$$G\left(x_{t+1}\right) \equiv \eta_2 g\left(x_{t+1}\right) - \eta_2 \alpha_1^{1-1/p_t}$$

7.4 Preferences between diligence versus shirking

The last step is to estimate the ratio $\left[\frac{\alpha_1}{\alpha_2}\right]$ from the incentive compatibility constraint and recover $g\left(x_{t+1}\right)$ from $G\left(x_{t+1}\right)$, in the process obtaining a consistent estimate of η_2 as well. We appeal to the incnetive compatibility constraint

$$E_{t2}\left[v_{t+1}\left(g\left(x_{t+1}\right) - \left[\frac{\alpha_1}{\alpha_2}\right]^{1-1/p_t}\right)\right] = 0$$

and the normalization for $g\left(x_{t+1}\right)$ that requires

$$E\left[g\left(x_{t+1}\right)\right] = 1$$

At this stage we should also require or alternatvely test that

$$E\left\{x\left[1 - g\left(x_{t+1}\right)\right]\right\} > 0$$

Noting that

$$g\left(x_{t+1}\right) \equiv \frac{G\left(x_{t+1}\right)}{\eta_2} + \alpha_1^{1-1/p_t}$$

we obtain

$$E_{t2}\left[v_{t+1}G\left(x_{t+1}\right)\right] = \eta_2 \alpha_1^{1-1/p_t}\left(\alpha_2^{1-1/p_t} - 1\right) E_{t2}\left[v_{t+1}\right]$$

and

$$\begin{aligned} E_{t2}\left[G\left(x_{t+1}\right)\right] &= \eta_2 - \eta_2 \alpha_1^{1-1/p_t} \\ \eta_2 &= E_{t2}\left[G\left(x_{t+1}\right)\right] + \frac{E_{t2}\left[v_{t+1}G\left(x_{t+1}\right)\right]}{\left(\alpha_2^{1-1/p_t} - 1\right) E_{t2}\left[v_{t+1}\right]} \end{aligned}$$

Therefore

$$\eta_2 = E_{t2}\left[G\left(x_{t+1}\right)\right] + \frac{E_{t2}\left[v_{t+1}G\left(x_{t+1}\right)\right]}{\left(\alpha_2^{1-1/p_t} - 1\right)E_{t2}\left[v_{t+1}\right]}$$

and

$$\alpha_1^{1-1/p_t} = \eta_2 - E_{t2}\left[G\left(x_{t+1}\right)\right]$$

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TABLE 1

GLOBAL INDUSTRY CLASSIFICATION STANDARDS

Economic Sector	Industry Group	Industry
Energy	Energy	Energy Equipment& Services
		Oil&Gas
Materials	Materials	Chemicals,Construction Materials
		Containers, Packaging, Metals & Mining
		Paper& Forest Products
Industrials	Capital Goods	Aerospace& Defence,
		Building Products,Machinery
		Construction , Engineering &Electrical Equip
	Commercials Svc& Supplies	Commercials Svc& Supplies
	Transportation	Air Freight & Couriers
		Airlines,Marine,Road&Rail
		Transportation Infrastructure
Consumer	Automobiles& components	Automobiles& Components
Discretionary	Consumer Durables & Apparel	Household Durables,Textiles Apparel
		Leisure equipment & Products
	Hotels Restaurants & Leisure	Hotels Restaurants & Leisure
	Media	Media
	Retailing	Distributors,Multiline retail
		Internet , Catalog &Specialty retail
Consumer	Food& Drug Retailing	Food& Drug Retailing
Staples	Food Beverage Tobacco	Beverages,Tobacco&Food Products
	Household & Personal Products	Household & personal Product
Health Care	Health Care Equipment & Svcs	Health Care Equip & Svcs
		Health Care Providers & Svcs
	Pharmaceuticals & Biotech	Biotechnology & Pharmaceuticals
Financials	Banks	Banks
	Diversified Financials	Diversified Financials
	Insurance	Insurance
	Real Estate	Real Estate
Information	Software & Svcs	Internet Software&Software
		IT Consulting & Services
Technology	Technology Hardware & Equip	Communications Equip
		Computers& Peripherals
		Electronic Equip& Instruments
		Office Electronics & Semiconductor
Telecommunication	Telecommunication Services	Diversified Telecomm Svcs
		Wireless Telecomm Svcs
Utilities	Utilities	Electric Utilities&Gas Utilities
		Multi-Utilities&Water Utilities

TABLE 2
CROSS-SECTION INFORMATION ON EXECUTIVE COMPENSATION IN 1992 US$
(STANDARD DEVIATIONS IN PARENTHESIS)

VARIABLES	RANK	OLD	NEW
After-tax	All	280, 185 (463, 892)	541, 103 (854, 210)
Compensation	CEO	364, 720 (579, 963)	917, 358 (1, 514, 749)
	Non-CEO	237, 246 (400, 985)	454, 601 (574, 423)
Pretax	All	348, 782 (67, 757)	773, 530 (1, 244, 720
Salary and bonus	CEO	454, 164 (67, 263)	1, 316, 287 (2, 236, 362)
	Non-CEO	290, 236 (51, 874)	648, 746 (820, 093)
After-tax Value	All	40, 515 (51, 874)	644, 229 (3, 740, 710)
options granted	CEO	50, 766 (60, 354)	1, 392, 526 (6, 885, 465)
	Non-CEO	36, 264 (46, 987)	483, 915 (2, 586, 269
Return on	All	−6, 677 (411, 763)	−4, 021, 536 (651, 366, 100)
stock held	CEO	12, 792 (499, 470)	4, 531, 728 (417, 580, 100)
	Non-CEO	−16, 481 (359, 753)	−8, 447, 919 (744, 039, 000)
Value of	All	3, 051, 351 (2, 287, 593)	47, 535, 930 (858, 395, 300)
stock held	CEO	3, 747, 969 (2, 212, 716)	135, 480, 400 (1145, 285, 000)
	Non-CEO	2, 700, 822.3 (2, 316, 198)	27, 299, 540 (776, 158, 500)
Return on	All	15, 240 (123, 808)	234, 479 (6410, 778)
options held	CEO	22, 257 (165, 162)	665, 482 (10, 245, 480)
	Non-CEO	11, 709 (96, 559)	12, 113 (2, 830, 293)

TABLE 3
CROSS-SECTIONAL INFORMATION ON FIRMS
(SALES, EQUITY, AND ASSETS ARE IN MILLIONS OF 1992 US$;
STANDARD DEVIATIONS IN PARENTHESIS)

VARIABLES	OLD	NEW
Abnormal Returns	0.022 (0.291)	0.024 (0.431)
Return on Assets	0.129 (0.071)	0.0583 (0.09964)
Sales	213.18 (127.68)	4507.33 (10828.23)
Common Equity	270.90 (29.99)	1894.805 (4317.28)
Total Assets	269.81 (52.36)	10509.25 (37764.94)

TABLE 4

COEFFICIENTS FROM REGRESSION OF CHANGES IN MANAGERS STOCK HOLDINGS ON (STANDARD ERRORS IN PARENTHESIS)

VARIABLES	OLD	NEW
Ratio of Salary and bonus to Total Compensation	−0.000251 (0.0024609)	−0.768 (2.13)
Lead Abnormal Return	1.078547 (0.5187983)	2.304 (1.108)
Constant	30.34 (22.51)	80.34 (50.21)

TABLE 5

COEFFICIENTS FROM REGRESSION OF ABNORMAL RETURN ON

(STANDARD ERRORS IN PARENTHESIS)

Variable	OLD	NEW
Lagged Change in Manager's Stock Holdings	0.0026878 (0.0010237)	0.0002911 (.0000796)
Ratio of Salary and bonus to Total Compensation	-0.00365 (0.0234)	-0.008193 (0.523)
Lagged Return on Assets	-	−0.0040613 (0.0004682)
Lagged Dividends per Share	–	−0.0347653 (.0094995)
Lagged Return on Equity	–	−0.000423 (0.0000588)
lagged Earnings per Share	–	$3.75e-06$ (0.000115)
Sector Dummies		
Energy	–	−0.1659349 (0.0290332)
Materials	–	−0.083984 (0.0259997)
Industrials(Aerospace)	0.0602269 (.0333716)	−0.0977236 (0.0253111)
Consumer Discretionary	–	−0.0591831 (0.0314063)
Consumer Staples	–	0.0172671 (0.0286603)
Health Care	–	−0.0591459 (0.0268537)
Financials	–	−.0884987 (0.027084)
Information Technology (Electronics)	0.039684 (0.0437386)	−0.0683958 (0.0506959)
Telecommunication Services	–	−0.0351766 (0.0306364)
Constant	0.0006547 (0.0117921)	0.0831565 (.0228746)

TABLE 6

AVERAGE ACCUMULATED RETURNS OVER TIME

PORTFOLIO	OLD DATA	OLD DATA	NEW DATA	NEW DATA
	$\lambda_{nt}^{(1)}$	$\lambda_{nt}^{(2)}$	$\lambda_{nt}^{(1)}$	$\lambda_{nt}^{(2)}$
Market	1.038	1.038	1.089 (0.097)	1.069 (0.097)
Actual	1.084 (0.179)	1.079 (0.156)	1.192 (0.336)	1.174 (0.352)
Perfect	1.144 (0.151)	1.123 (0.108)	1.196 (0.268)	1.182 (0.266)
T-STATISTIC	FROM DEFERENCE	BETWEEN MEAN	TEST OF $\lambda_{nt}^{(1)}$	AND $\lambda_{nt}^{(2)}$
Actual		6.28 (0.00)		9.28 (0.00)
perfect		2.93 $(1.3e-2)$		2.53 $(9.8e-3)$

TABLE 7

RESULTS FROM DIFFERENCE IN MEAN TESTS : T-STATISTICS

(P-VALUE IN PARENTHESIS)

DIFFERENCES	OLD DATA	OLD DATA	NEW DATA	NEW DATA
	$\lambda_{nt}^{(1)}$	$\lambda_{nt}^{(2)}$	$\lambda_{nt}^{(1)}$	$\lambda_{nt}^{(2)}$
MARKET-ACTUAL	-14.791 $(1.0e-16)$	-10.629 $(2.0e-15)$	-15.8 $(1.0e-17)$	-10.18 $(3.0e-16)$
MARKET-PERFECT	-24.915 $(1.0-16)$	-22.038 $(4.0e-15)$	-28.47 $(2.0e-18)$	-29.95 $(2.0e-15)$
ACTUAL-PERFECT	-18.333 $(1.0e-16)$	-17.358 $(2.0e-16)$	-33.51 $(1.0e-17)$	-42.23 $(2.0e-15)$

TABLE 8

COEFFICIENTS FROM REGRESSION OF TOTAL COMPENSATION ON

(STANDARD ERRORS IN PARENTHESIS)

VARIABLES	PARAMETERS	OLD	NEW
LAGGED RETURN ON ASSETS	α_{21}	-	16.85 (6.66)
LAGGED RETURN ON EQUITY	α_{22}	-	0.56 (0.85)
LAGGED EARNINGS PER SHARE	α_{23}	-	-0.95 (1.65)
LAGGED DIVIDEND PER SHARE	α_{24}	-	60.39 (115.17)
LAGGED CHANGE IN STOCK HOLDINGS	α_{25}	11.91 (1.49)	11.58 (1.15)
$\widehat{u}'_{nt}$	α_1	1126.65 (124.702)	725.95 (88.97)
CONSTANT	α_0	1148.03 (216.16)	2503.77 (98.00)

Table 9
Estimates of Truncation Points

Parameters	Sectors	Estimates
ψ_1	Energy	-0.8198
ψ_2	Materials	-0.9812
ψ_3	Industrials	-2.1423
ψ_4	Consumer Discretionary	-1.4905
ψ_5	Consumer	-1.0323
ψ_6	Health care	-1.0301
ψ_7	Financial	-1.0184
ψ_8	Information technology	-1.1362
ψ_9	Telecommunication Services	-0.8911
ψ_{10}	Utilities	-0.8097

Table 10
Maximum Likelihood Estimation of Diligent Return Distribution.

Parameters	Sectors	Estimates	Standard Errors
σ_1	Energy	0.898	0.032
σ_2	Materials	0.333	0.005
σ_3	Industrials	1.743	0.022
σ_4	Consumer Discretionary	0.626	0.006
σ_5	Consumer Staples	0.420	0.008
σ_6	Health care	42.815	0.775
σ_7	Financial	0.373	0.004
σ_8	Information Technology	1.849	0.069
σ_9	Telecommunication Services	0.579	0.029
σ_{10}	Utilities	0.289	0.004
μ_{21}	Energy	−0.5591	0.0592
μ_{22}	Materials	−0.0017	0.0003
μ_{23}	Industrials	−0.5652	0.02452
μ_{24}	Consumer Discretionary	−0.0158	0.0011
μ_{25}	Consumer Staples	−0.0087	0.0012
μ_{26}	Health Care	−1608.1984	29.0809
μ_{27}	Financial	−0.0037	0.0004
μ_{28}	Information Technology	−2.2483	0.2108
μ_{29}	Telecommunication Services	−0.0989	0.0207
μ_{210}	Utilities	−0.0024	0.0003

TABLE 11
STRUCTURAL ESTIMATION OF SHIRKING RETURN DISTRIBUTION AND UTILITY PARAMETERS.

PARAMETERS	DESCRIPTION	INDUSTRY /EXECUTIVE	ESTIMATES	STANDARD ERRORS
ρ	Risk tolerance parameter		0.208	0.102
ξ	Variance associated with measurement error		2.03	0.505
α_2/α_0	preference for diligence relative to retiring	CEO	1.292	0.0162
		2nd ranked Executive	1.523	0.126
		3rd ranked executive	1.420	0.118
		4th ranked executive	1.48	0.375
		5th ranked executive	1.373	0.504
		6th ranked executive	1.849	0.969
α_2/α_1	preference for diligence relative to shirking	CEO	1.356	0.129
		2nd ranked Executive	1.034	0.034
		3rd ranked executive	1.012	0.045
		4th ranked executive	1.023	0.078
		5th ranked executive	1.01	0.678
		6th ranked executive	0.987	0.567
μ_{11}	Mean return from shirking	Energy	−0.7591	0.0592
μ_{12}		Materials	−0.037	0.0033
μ_{13}		Industrials	−0.6652	0.0352
μ_{14}		Consumer Discretionary	−0.0458	0.0211
μ_{15}		Consumer Staples	−0.027	0.0312
μ_{16}		Health Care	−1901.19	40.02
μ_{17}		Financial	−0.0097	0.0024
μ_{18}		Information Technology	−4.433	0.4108
μ_{19}		Telecommunication s	−0.2989	0.0307
μ_{110}		Utilities	−0.0324	0.0083

Table 12

cost of moral hazard(in 1992 us$)

Measure	industry	executive	cost
Δ_1	Energy	CEO	10,450,320
		2nd ranked executive	1,345,098
	Materials	CEO	11,450,450
		2nd ranked executive	1,745,067
	Industrials	CEO	14,670,350
		2nd ranked executive	1,675,067
	Consumer Discretionary	CEO	8,210,950
		2nd ranked executive	3,245,067
	Consumer Staples	CEO	4,210,950
		2nd ranked executive	545,068
	Health care	CEO	30,410,580
		2nd ranked executive	10,450,000
	Information Technology	CEO	12,410,580
		2nd ranked executive	4,550,134
	Telecommunication	CEO	15,670,892
		2nd ranked executive	4,550,134
	Utilities	CEO	6,590,872
		2nd ranked executive	450,674
Δ_2		CEO	24,690,192
		2nd ranked executive	4,460,774
Δ_3	Energy		1,289,690,782
	Materials		1,467,780,213
	Industrials		1,678,987,321
	Consumer Discretionary		1,234,765,786
	Consumer Staples		987,456,987
	Health Care		2,876,897,345
	Financial		1,567,987,598
	Information Technology		1,456,987,196
	Telecommunication		1,078,409,384
	Utilities		568,825,195