DETERMINING CEO COMPENSATION STRUCTURE

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Abstract

We construct a model based on the analytic hierarchy process (AHP) to determine the mix between CEOs' cash and equity-based compensation that maximizes shareholder wealth. The AHP makes it possible to examine a large number of variables and their interactions within the firm, as well as to use variables for which empirical proxies do not exist. Inputs for pairwise comparisons of the variables in the model are based on survey of the theoretical and empirical literature on corporate control and executive compensation as well as a survey of 31 members of compensation committees who serve on 74 boards. Using the literature, we find the mean wealth-maximizing compensation package includes 62.01% cash, 27.99% equity-based compensation, and 10% in other compensation forms. Results based on boards' opinions are similar. These findings are consistent with the observed compensation structure.

I. Introduction

CEO compensation has long been a popular topic in the press and among academics. Earlier research has focused on the determinants of level of compensation and their relationship to firm performance. Recently, there has been a surge of interest in the structure of CEO pay packages. The mix between cash compensation (i.e., salary and annual bonus) and equity-based compensation plans (i.e., stock options, restricted stock plans, phantom stock plans, and performance shares) has received particular attention. Many
studies examine the proposition established by Smith and Watts (1982) that equity-based plans can resolve the conflicts of interest between CEOs and shareholders. Other studies have focused on the relationship between equity-based compensation and firm performance, since Jensen and Murphy (1990) have argued that performance is more sensitive to the form of compensation than to the level. Studies by Smith and Watts (1982) and Jensen and Murphy (1990) suggest that equity-based compensation improves CEO incentives, but do not establish what level of equity-based compensation maximizes shareholder wealth.

Examination of this issue is important: although equity-based compensation increases organizational efficiency, it also exposes CEOs to a risk that is beyond their control (e.g., Lambert and Larcker, 1985a). Moreover, Paul (1992) shows that when CEOs have better information than the market, maximizing the current stock price does not lead to efficient operation of the firm. Paul further argues that boards use compensation plans based on accounting measures of performance, because these measures provide information about the value added to the firm by the CEO. These studies therefore suggest that reliance on too much equity-based compensation can diminish shareholders' wealth. Recognizing that a compensation package is firm-specific, we need to determine what mix maximizes shareholder wealth.

To answer this question we construct a model based on the analytic hierarchy process (AHP) developed by Saaty (1980). Saaty developed the concept as a ratio-scaled mechanism for evaluating multiple-attribute alternatives. The AHP is a methodology dealing with complex and unstructured problems, and is particularly useful when dealing with subjective criteria and intangible attributes or decision alternatives. The process necessitates describing a complex decision problem as a hierarchy, which involves identifying various levels representing the objective, criteria, subcriteria, and decision alternatives. Preferences at each level can then be synthesized into overall rankings of the decision alternatives. The AHP forces the individual to make explicit pair-wise comparisons of the various advantages and disadvantages of the variables in the hierarchy, which in turn may lead to more thoughtful decision process.
Using the literature on agency and contract theory, we construct a hierarchy to specify the channels of influence of potential determinants of the split between cash and equity-based compensation. We then rank the relative importance of the determinants in the hierarchy. Using this ranking, the AHP algorithm calculates a mix between cash and equity-based compensation.

Although CEO pay packages may include other forms of compensation (e.g., dividend units, savings plans, property, insurance, and performance units), we focus on cash (salary and bonus) and equity-based compensation because together they account for about 90% of total compensation (see Mehran, 1992). We consider annual bonus and salary as one, since both are short-term compensation and are guaranteed. Although CEOs receive equity-based compensation in forms other than stock options (such as restricted stock and phantom stock), options account for the lion's share of this type of pay. For example, Mehran (1992) documents that 17.8% of CEO compensation over 1979 and 1980 is in stock options, and all equity-based compensation is greater by only 4.2%. More recent studies show that the percentage of CEOs' income in stock options is on the rise. For example, Yermak (1995) for a sample of 792 large U.S. corporations shows that the percentage of CEO compensation in stock options increased from 20% in 1984 to 30% in 1991, and the fraction of other forms of equity-based compensation over the same period declined. Thus it is reasonable to argue that determining equity-based compensation is identical to determining stock options.

Inputs for ranking the variables in the hierarchy were initially determined from a survey of the literature on corporate control and CEO compensation and the authors' understanding of the process affecting compensation structure. We then asked 31 members of compensation committees who serve on 74 boards whether they agreed with the compensation hierarchy we had constructed, as well as about what they saw the relative importance of the variables in the hierarchy. Using the literature, we find the mean of the wealth-optimizing compensation package includes 62.01% cash and 27.99% equity-based compensation (and 10% in other compensation forms). The results are similar when we use boards' opinions. These empirical findings are consistent with the observed compensation...
structure (see Murphy, 1993).

The paper is organized as follows. The methodology is described in section 2. Section 3 discusses the model's application to compensation design, reports the results from the survey of compensation committees and compares them with the observed compensation structure. We present our conclusions in section 4.

II. Methodology

The methodology for this study is the AHP (Saaty, 1980). The AHP is an axiomatic theory with a normative orientation in which decision makers provide the relative importance of each criterion and the relative preference for each decision alternative. Moreover, the AHP does not assume any particular probability distribution for the relative preferences. Instead, it satisfies the criterion of cardinal consistency by considering the consequences of changes in the judgments through observations of the changes in the entire set of judgments (Saaty, 1977). The model is discussed next.

The AHP is a method for solving multicriteria decision problems. It proposes separating the underlying unstructured problem into components and then arranging these elements in hierarchical order. On the basis of its relative importance, each element is assigned a numerical value and the priorities are set by synthesizing the judgments. By compelling decision-makers to assign a weight to each element, the AHP forces them to view the problem as a collection of well-ordered subparts.

The model consists of four steps:

1. Set up the decision hierarchy: break down the main problem into primary components (criteria). Group criteria on different levels, forming a chain or hierarchy. Break down each criterion in turn into subcriteria. Continue this process to the lowest level of the hierarchy (alternatives).

2. Collect input data: to measure the relative importance of any two criteria, decision-makers use a pairwise comparison. The process results in a set of comparison
3. Estimate relative weights of criteria: there are several methods to compute the priorities for criteria in each matrix. In general, solution techniques use the pairwise comparisons from step two as input and produce relative weights for criteria at each level as output.

4. Rate the alternatives: aggregate the weights of criteria for various levels, computed in step three, to produce a vector of level priorities. When there are several levels in the hierarchy, overall priorities should be estimated. Level priorities are then transformed to overall priorities by weighting them with the priorities for the elements in the preceding level. Priorities for the last level reflect the decision-maker's relative weights for the alternatives.

The following is a brief mathematical description of the methodology following Saaty (1980). Consider \( n \) objects \( A_1, \ldots, A_n \) with known weights \( w_1, \ldots, w_n \). The matrix \( A \) of pairwise ratios whose rows give the ratios of the weights of each object with respect to the others has the form of:

\[
A = \begin{bmatrix}
A_1 & A_2 & \cdots & A_n \\
A_1^T & w_1/w_1 & w_1/w_2 & \cdots & w_1/w_n \\
A_2^T & w_2/w_1 & w_2/w_2 & \cdots & w_2/w_n \\
\vdots & \vdots & \ddots & \ddots & \vdots \\
A_n^T & w_n/w_1 & w_n/w_2 & \cdots & w_n/w_n
\end{bmatrix}
\]

When \( A \) is multiplied by a vector of weights \( \mathbf{w} \), the result will be
This is a system of homogeneous linear equations that can be rewritten as $\mathbf{A}\mathbf{w} = n\mathbf{w}$ or $(\mathbf{A} - n\mathbf{I})\mathbf{w} = \mathbf{0}$. It has a nontrivial solution if and only if $n$ is an eigenvalue of matrix $\mathbf{A}$. By using the special structure of $\mathbf{A}$, one can show $n$ to be an eigenvalue of $\mathbf{A}$ and also recover the unique $\mathbf{w}$ vector, given $\mathbf{A}$. With $n$ objects, the solution is any column of $\mathbf{A}$ normalized. $\mathbf{A}$ has a reciprocal property, $a_{ij} = 1/a_{ji}$; diagonal entries are unity, $a_{ii} = 1$; and $\mathbf{A}$ is consistent, $a_{ik} = a_{ik}/a_{jj}$. Therefore, the whole matrix can be constructed from a single row or column. When the values are not the ratios of physical weights but the relative importance of criteria, however, the matrix comprises estimates rather than precise values. This implies small perturbations of the eigenvalues. The problem now becomes $\mathbf{A}'\mathbf{w}' = l_{\text{max}}\mathbf{w}'$, where $l_{\text{max}}$ is the largest eigenvalue of $\mathbf{A}'$. The question is how close $l_{\text{max}}$ is to $n$ and $\mathbf{w}$ is to $\mathbf{w}'$. It has been shown that $\mathbf{A}$ is consistent if and only if $l_{\text{max}} = n$.

Since the deviation of $l_{\text{max}}$ from $n$ is a deviation of consistency, $(l_{\text{max}} - n)/(n-1)$ can be called the consistency index. For perfect consistency, the consistency index is zero. When the consistency index is compared with the same index for a randomly generated matrix of the same scale, the resulting ratio is called the consistency ratio. As suggested by Saaty, a consistency ratio of 10% or less is considered acceptable; otherwise, one can attempt to improve consistency.

Comparisons based on objective measurements must be ordinally and cardinally consistent, aside from errors in measurement. When a
subjective measurement such as judgment or opinion is used, consistency in comparison is not so obvious. One of the most important advantages of the AHP over other multicriteria decision methods, especially the multiattribute utility function, is its capability to provide systematic checks on consistency of judgments.\(^7\) We use a scale of 1 to 9 to compare judgments as shown in table 1.\(^8\) In comparing the contribution of two elements to an objective, a value of 1 indicates equal importance and a value of 9 signifies that one is more important than the other. The numbers in this scale are absolute rather than ordinal. Also, if a comparison requires numbers larger than 9 or smaller than 1/9, the hierarchy can be used to compare element clusters before the separate elements are compared. Thus, it is assumed that all variables being compared fall within the range 1/9 to 9.

III. Application of the AHP to Compensation Structure

3.1. Design of the hierarchy

In applying the AHP to CEO compensation, we follow the agency framework (e.g., Jensen and Meckling, 1976), which enables us to identify variables related to compensation structure. We first introduce the hierarchy levels and then provide the intuition for their introduction. Our compensation structure hierarchy is shown in figure 1.

To be consistent with Jensen and Meckling, we suggest that the shareholders' wealth [Level 1] is influenced by the CEO's ownership of the company's stock and by control mechanisms [Level 2]. Jensen and Meckling argue that CEOs with small equity ownership may not maximize shareholder wealth. In addition, they point out that in an efficient capital market, shareholders will anticipate deviation from wealth maximization. A number of mechanisms that reduce the costs generated by conflicts of interest between CEOs and shareholders have been suggested in the literature. Three are introduced in this study: the threat of takeover, board composition, and outside block-holders. They are grouped under control mechanisms [Level 3].\(^9\) Level 4 contains two sets of elements, which are related to the elements in Levels 2 and 3. One is the characteristics of the firm's investment opportunity set (i.e., business risk, growth opportunities, and assets in place), which are assumed to be related to the control
Table 1
Scale for the analytic hierarchical process.

<table>
<thead>
<tr>
<th>Intensity of Importance</th>
<th>Definition</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Equal importance</td>
<td>Two activities contribute equally to the objective</td>
</tr>
<tr>
<td>3</td>
<td>Weak importance of one over another</td>
<td>Experience and judgment slightly favor one activity over another</td>
</tr>
<tr>
<td>5</td>
<td>Essential or strong importance</td>
<td>Experience and judgment strongly favor one activity over another</td>
</tr>
<tr>
<td>7</td>
<td>Very strong or demonstrated importance</td>
<td>An activity is favored very strongly over another; its dominance is demonstrated in practice</td>
</tr>
<tr>
<td>9</td>
<td>Absolute importance</td>
<td>The evidence favoring one activity over another is of the highest possible order of affirmation</td>
</tr>
<tr>
<td>2, 4, 6, 8</td>
<td>Intermediate values between adjacent scale values</td>
<td>When compromise is needed</td>
</tr>
<tr>
<td>Reciprocals of above nonzero</td>
<td>If activity i is assigned one of the nonzero numbers above when compared with activity j, then j has the reciprocal value when compared with i</td>
<td>A reasonable assumption</td>
</tr>
</tbody>
</table>

Figure 1: Executive compensation structure hierarchy

- Wealth maximization
- Ownership
- Diversification
- Equity-based compensation
- Age
- Cash Compensation
- Outside blockholders
- Assets in place
- Growth opportunities
- Business risk
- Takeover
- Control mechanisms
- Board composition

LEVEL
1 2 3 4 5
mechanisms in Level 3. The other set includes CEOs' characteristics, namely, their ages and the diversity of their portfolios. These are assumed to be related to CEO equity ownership in Level 2. The intuition behind the inclusion of the variables in Level 4 is that in the design of compensation, it is important to consider the assets of the firm as well as the agent who manages them. Finally, Level 5 links CEO compensation structure (i.e., the percentage of total compensation in cash and equity-based forms) to the variables in Level 4.

The justification for these levels is as follows. The theoretical rationale for the positive relationship between CEO equity ownership and the value of the firm is established in the literature (e.g., Jensen and Meckling, 1976). Morek, Shleifer, and Vishny (1988) and McConnell and Servaes (1990) provide some support for Jensen and Meckling's theory by documenting a nonlinear relationship between the percentage of equity held by the board and Tobin's Q. Mehran (1995), however, finds a positive relationship. Other studies have documented that CEOs' holdings of common stock have an important effect on their incentives in acquisitions (e.g., Walking and Long, 1984 and Agrawal and Mandelker, 1987). In addition, the success of leveraged buyouts in improving firm performance can be explained partially by the greater concentration of equity with CEOs (e.g., Baker and Wruck, 1990).

Some have suggested that when CEOs do not maximize shareholder wealth, control mechanisms align CEOs' and shareholders' interests. The first mechanism we study is the threat of takeover (e.g., Jensen and Ruback, 1983). The lesson from the market for corporate control is that the CEOs of efficient firms are free to take over firms whose current CEOs are producing subpar profits and that are consequently underpriced in the stock market. It has been documented that hostile targets underperform other firms (e.g., Morek, Shleifer, and Vishny, 1988). Moreover, a number of studies have shown that the probability of takeover decreases with the percentage of equity owned by boards (e.g., Stulz, Walking, and Song, 1990; Martin and McConnell, 1988; and Mikkelson and Partch, 1989).

Our second control mechanism is monitored by the board of directors (e.g., Fama and Jensen, 1983). There is growing evidence that outside directors are more independent of CEOs than inside directors and
thus better represent shareholders' interests (e.g., Weisbach, 1988 and Rosenstein and Wyatt, 1990). It has also been documented that the presence of outsiders on the board is negatively related to the percentage of equity ownership by boards (e.g., Weisbach, 1988; Brickley and van Drunen, 1988; and Mehran, 1992). Weisbach's interpretation is that monitoring by outside board members and the direct incentive created by boards' equity ownership may be substitute methods of controlling agency costs.

The third control mechanism is monitoring by outside blockholders (e.g., Shleifer and Vishny, 1986). Recent empirical work provides indirect support for the argument that ownership concentration creates stronger incentives to monitor boards (e.g., Brickley, Lease, and Smith, 1988).

The relationship between the characteristics of the firm's investment opportunity set [Level 4] and control mechanisms [Level 3] is indirect and mostly empirical. It has been documented that takeover targets are older and have fewer growth opportunities than other firms (e.g., Morek, Shleifer, and Vishny, 1988 and Servaes, 1991). Therefore, it is reasonable to assume that a larger proportion of the value of older firms is represented by assets in place. To our knowledge, no relationship between the probability of takeover and business risk has been established. The evidence on financial risk, however, is mixed. For a sample of Fortune 500 firms, Morek, Shleifer, and Vishny (1988) find that targets in hostile acquisitions have more debt in their capital structure. On the other hand, Servaes (1991), in an analysis of 700 targets, concludes that targets have lower median debt ratios than industry peers.

Mehran (1992) shows that the percentage of outside directors and the firm's growth opportunities are highly correlated. An interpretation is that growing firms tend to elect outsiders to the board to take advantage of their expert opinion on such issues as strategic planning and customer development (Brickley and James, 1987). A number of studies document a positive relationship between the percentage of outside directors and business risk. For example, Brickley and van Drunen (1987) find that the correlation between the percentage of outside directors and the firm's stock-return variance is positive.

The relationship between outside blockholders and the characteristics of the investment opportunity set has been shown to depend
on the blockholders’ identity (Mehran, 1992). The author documents a positive correlation between the ownership percentage held by individual investors and the firm's growth opportunities. He also documents a positive relationship between the percentage of equity held by institutional investors and the proportion of the firm's value in assets in place.

The theoretical argument on the relationship between the nature of the firm's assets and its CEO compensation structure has been established by Smith and Watts (1992). The authors argue that firms with larger options in future investments than assets in place use incentive plans more extensively, since their CEOs' decisions cannot easily be monitored. Thus, the percentage of CEOs' total compensation that is equity-based should increase with their firms' discretionary investment. Smith and Watts (1992) and Mehran (1992) provide empirical evidence supporting this argument. Alternatively, firms with a larger investment in assets in place than in growth opportunities compensate their CEOs with more cash remuneration. Smith and Watts suggest that incentive plans also affect CEOs' attitudes toward taking on more risk. In support of this argument, Lambert and Larcker (1985b) and DeFusco, Johnson, and Zorn (1990) document that the variance of equity returns increases after executive stock options are adopted.

CEO ownership also influences compensation structure. CEO equity ownership is expected to be related to the age of the CEO, as it is reasonable to assume that older CEOs have a larger equity investment in the firm. The reason is that most CEOs receive stock options early in their careers with a firm (Murphy, 1985), and the options granted over time result in the accumulation of shares. Mehran (1995) documents a positive relationship between the percentage of the firm's equity held by the CEO and his age. We expect age to be related to compensation structure. Older CEOs may prefer cash because of their shorter employment horizon. Mehran (1995) finds a positive relationship between the percentage of CEOs' compensation in cash and CEOs' age.

CEO ownership is also related to the portfolio of securities CEOs hold. CEOs are portrayed in the literature as risk-averse because they hold undiversified portfolios (e.g., Fama, 1980). High equity ownership could make their portfolios more undiversified. CEOs thus want their
compensation structured so that they bear less personal risk (e.g., Harris and Raviv, 1979). Consequently, holding the level of compensation constant, CEOs should prefer cash over equity-based compensation. Boards in general are concerned with CEOs' total incentives. Thus in structuring compensation packages, they take into account options previously granted to CEOs and their direct equity holdings. Mehran (1995) and Ofek and Yermack (1997) document that firms use more cash compensation when the CEOs own a large fraction of the firm or a significant amount of unexercised stock options or other equity-based compensation.

3.2 Omitted Variables

Our presentation of compensation structure hierarchy may ignore some potential variables influencing compensation mix. Smith and Watts (1992) argue that incentive plans should be used less in regulated than in unregulated firms, since regulation limits the firm's investment. In addition, they suggest that CEOs' decisions in regulated firms are more easily observable. We exclude regulation from the model, since we believe that regulation is highly correlated with the assets of the firm (i.e., growth opportunities versus assets in place), and its use creates redundancy. The way we can learn about regulation is by asking directors who serve on boards of both regulated and unregulated firms how regulation affects their compensation decisions.

There is also a belief among academics that corporate and personal tax rates and the tax treatment of various compensation plans play a role in the design of compensation packages (see Scholes and Wolfson, 1992). For example, if CEO's personal tax rate is higher than that of the corporation, the executive has an option to defer the incentive portion of his/her total compensation. It has been suggested that differential tax treatment of various compensation plans may be important in the design of compensation structure, but we do not believe that compensation decisions are generally made to minimize corporate tax obligations. Nevertheless, we asked the directors who participated in the survey about the role of taxes in the design of compensation.

Another variable not included in the model is the firm's capital structure. It has been documented that insider ownership and the leverage
ratio are highly correlated (e.g., Kim and Sorensen, 1986 and Mehran, 1992); the correlation between incentive plans and the leverage ratio is not significant (Mehran, 1992). We also did not include a variable to take account of cases where the CEOs are also the founders. We believe that in such cases the CEOs have a significant investment in their own companies' stock, so the two variables are highly correlated. We expect compensation packages of CEOs in founder companies to include more cash than those in nonfounder companies (see Kole, 1983).

Finally, Demsetz and Lehn (1985) have argued that board ownership is related to business risk. It is possible to construct a complex hierarchy by linking CEO ownership to business risk, and AHP can deal with complex hierarchy. We choose against using a complex hierarchy, however, since for the most part it is compensation that affects ownership. Moreover, the effect of business risk on ownership is through compensation. For example, the largest portion of CEO compensation in start-up companies is in the form of stock options. The exercise of these options over time increases CEO ownership. Also, newly appointed CEOs from outside, in mature companies, do not hold large shares of their companies. Equity-based compensation leads to their concentrated ownership.

3.3. Construction of Data for Pair-wise Comparisons

After the hierarchy is constructed, the next task is to make pairwise comparisons between elements in adjacent levels with respect to a criterion in the preceding level. The preference expressed through the pairwise comparison constitutes input for the model. Using the eigenvector method, we calculate the weights for each pairwise comparison matrix at each level of the hierarchy. To synthesize the results over all levels, we weight the normalized principal eigenvector of the pairwise comparison matrix at each level by the priority of the higher-level criterion against which the comparison is made. Pairwise comparisons are based on two sets of inputs. The first is a survey of the theoretical and empirical literature on corporate control and executive compensation. The second is our survey of boards of directors.
3.3.1. Results Based on Literature Survey

Table 2 shows a matrix of the pairwise comparison of elements in Level I with respect to wealth maximization, along with their local priorities, using our interpretation of the literature. In the matrix, rows indicate strength of dominance. To assign a value for A1-A2 ask: from the viewpoint of wealth maximization, between ownership and control mechanisms, which is more important and by how much? The assigned value of 1 denotes that the two are equally important.\textsuperscript{11}

Table 2

Matrix of the pairwise comparison of ownership and control mechanisms with respect to wealth maximization and their local priorities.

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<tr>
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<tbody>
<tr>
<td>[A1] Ownership</td>
<td>1</td>
<td>1</td>
<td>0.50</td>
</tr>
<tr>
<td>[A2] Control mechanisms</td>
<td>1</td>
<td>1</td>
<td>0.50</td>
</tr>
</tbody>
</table>

Consistency ratio = 0.000

Panel A of table 3 shows a matrix of the pairwise comparison of elements in Level 2 with respect to control mechanisms and their local priorities. To assign a value for A1-A2, ask: from the viewpoint of control mechanisms, between a takeover threat and board composition, which is more important and by how much? The assigned value of 8 denotes that the threat of takeover is "very strongly important" to "absolutely important" in relation to monitoring by outside directors. Since the input matrix in panel A is a reciprocal matrix, only three inputs are necessary -- A1-A2, A1-A3, and A2-A3. The consistency ratio that appears at the bottom of panel A is 0.070. Inconsistency arises from judgmental errors or intransitivity. To be 100% consistent, the value of A2-A3 should be equal to the A1-A3/A1-A2, or 6/8, not 1/3. Fortunately, the model is not very sensitive to these errors and tolerates considerable inconsistency without blurring the overall result. A consistency ratio of less than 0.10 is acceptable.

The local-priorities vector in panel A shows the model ranking of the elements. Ranking the elements requires computing the eigenvector. For the matrix, the weight of 0.761 indicates that the threat of takeover is by far the
Table 3
Panel A: Matrix of the pairwise comparison of takeover, board composition, and outside blockholders with respect to the control mechanisms and their local priorities.

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<th></th>
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</thead>
<tbody>
<tr>
<td>[A1] Takeover</td>
<td>1</td>
<td>8</td>
<td>6</td>
<td>0.761</td>
</tr>
<tr>
<td>[A2] Board composition</td>
<td>1/8</td>
<td>1</td>
<td>1/3</td>
<td>0.073</td>
</tr>
<tr>
<td>[A3] Outside blockholders</td>
<td>1/6</td>
<td>3</td>
<td>1</td>
<td>0.166</td>
</tr>
</tbody>
</table>

Consistency ratio = 0.070

Panel B: Matrix of the pairwise comparison of age and diversification with respect to the ownership and their local priorities.

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<tr>
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</thead>
<tbody>
<tr>
<td>[A1] Age</td>
<td>1</td>
<td>1/7</td>
<td>0.125</td>
</tr>
<tr>
<td>[A2] Diversification</td>
<td>7</td>
<td>1</td>
<td>0.875</td>
</tr>
</tbody>
</table>

Consistency ratio = 0.000
most important control mechanism, followed by outside block-holders and board composition (we provide the justification for some of the rankings in section 2.4.). Similarly, panel B of table 3 shows a matrix of pair-wise comparisons with respect to ownership. Panels A through H of Table 4 show data construction for the matrix of pair-wise comparisons of elements in Levels 3 through 5.

Table 5 summarizes the local priorities from tables 2-4. In addition, it shows the level priorities and overall priorities generated by the AHP model. The local priorities of table 5 show the importance of each element in any given level with respect to its preceding level. For example, in Level 4, cash compensation is most sensitive to age (the weight is 0.875). Equity-based compensation is most sensitive to growth opportunities (the weight is 0.900). The final results (the last two overall priorities in the last column) show that the wealth-maximizing weight is made up of 68.9% in salary plus bonuses and 31.1% in equity-based compensation. The sum of cash and equity-based compensation is nearly 90% of total compensation (see Murphy, 1993). Thus, the wealth-maximizing compensation package comprises 62.01% cash and 27.99% equity. These results were obtained with an overall consistency of 0.070, which is within the acceptable range.

3.3.2 Results Based on Board and Academic Surveys

A potential problem in interpreting previous results is whether our presentation of the compensation composition hierarchy is correct. Another potential problem is that pair-wise comparisons of the variables in the model are based on our interpretation of the literature. For example, we conclude that CEO ownership and control mechanisms are equally important in maximizing shareholder wealth. This suggests that the same two variables have equal influence on the subsequent level. Although we conduct sensitivity tests for all the variables in the hierarchy and discuss the results in the next section of the paper, we need to find out whether compensation committee members support our judgment.

To check the validity of our model and the robustness of the pairwise comparisons, we interviewed 31 directors who currently serve on 74 compensation committee. Table 6 shows the number of firms in each industry on whose boards directors in our survey sit, and the average book
Table 4

Panel A: Matrix of the pairwise comparison of business risk, growth opportunities, and assets in place with respect to the takeover and their local priorities.

<table>
<thead>
<tr>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>[A1] Business risk</td>
<td>1</td>
<td>5</td>
<td>1/3</td>
<td>0.279</td>
</tr>
<tr>
<td>[A2] Growth opportunities</td>
<td>1/5</td>
<td>1</td>
<td>1/7</td>
<td>0.072</td>
</tr>
<tr>
<td>[A3] Assets in place</td>
<td>3</td>
<td>7</td>
<td>1</td>
<td>0.649</td>
</tr>
</tbody>
</table>

Consistency ratio = 0.062

Panel B: Matrix of the pairwise comparison of business risk, growth opportunities, and assets in place with respect to the board composition and their local priorities.

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>[A1] Business risk</td>
<td>1</td>
<td>1/5</td>
<td>2</td>
<td>0.172</td>
</tr>
<tr>
<td>[A2] Growth opportunities</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>0.726</td>
</tr>
<tr>
<td>[A3] Assets in place</td>
<td>1/2</td>
<td>1/6</td>
<td>1</td>
<td>0.102</td>
</tr>
</tbody>
</table>

Consistency ratio = 0.028

Panel C: Matrix of the pairwise comparison of business risk, growth opportunities, and assets in place with respect to outside blockholders and their local priorities.

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>[A1] Business risk</td>
<td>1</td>
<td>1/5</td>
<td>1/3</td>
<td>0.101</td>
</tr>
<tr>
<td>[A2] Growth opportunities</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td>0.674</td>
</tr>
<tr>
<td>[A3] Assets in place</td>
<td>3</td>
<td>1/4</td>
<td>1</td>
<td>0.226</td>
</tr>
</tbody>
</table>

Consistency ratio = 0.082
value of the assets of the firms (computed from COMPSTAT) in each industry in our sample. Directors in our sample on average sit on nearly 2.4 boards (the maximum is five), and most of the firm are medium-sized or large.

In most cases, before we introduced our model to the directors, we asked them to tell us what factors influence their compensation structure decision and how they make their decision on the mix. We did so because we thought our model and the questionnaire might influence their responses. Directors in general believe that CEOs should hold a significant amount of the firm’s equity. All else being equal, boards tend to adopt equity-based compensation to increase CEOs’ ownership. Therefore, one can conclude that boards take into account the CEOs’ total incentives. In addition, directors indicated that the nature of the firm’s assets (growth opportunities versus assets in place) is an important determinant of compensation structure.

Then we asked the participants to respond a questionnaire. All but one questionnaire which was done over the telephone, were completed in our presence. Since our aim was to learn whether compensation structure decisions can be made with the AHP, the first question we asked each
Panel D: Matrix of the pairwise comparison of cash compensation and equity-based compensation with respect to the business risk and their local priorities.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>[A1] Cash compensation</td>
<td>1</td>
<td>1/5</td>
<td>0.167</td>
</tr>
<tr>
<td>[A2] Equity-based compensation</td>
<td>5</td>
<td>1</td>
<td>0.833</td>
</tr>
</tbody>
</table>

Consistency ratio = 0.000

Panel E: Matrix of the pairwise comparison of cash compensation and equity-based compensation with respect to the growth opportunities and their local priorities.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>[A1] Cash compensation</td>
<td>1</td>
<td>1/9</td>
<td>0.900</td>
</tr>
<tr>
<td>[A2] Equity-based compensation</td>
<td>9</td>
<td>1</td>
<td>0.100</td>
</tr>
</tbody>
</table>

Consistency ratio = 0.000

Panel F: Matrix of the pairwise comparison of cash compensation and equity-based compensation with respect to the assets in place and their local priorities.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>[A1] Cash compensation</td>
<td>1</td>
<td>6</td>
<td>0.857</td>
</tr>
<tr>
<td>[A2] Equity-based compensation</td>
<td>1/6</td>
<td>1</td>
<td>0.143</td>
</tr>
</tbody>
</table>

Consistency ratio = 0.000
Table 5
Summary of local priorities presented in tables 2-4 and the elements’ respective level and overall priorities.

<table>
<thead>
<tr>
<th>Level 1:</th>
<th>Local priorities</th>
<th>Level priorities</th>
<th>Overall priorities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control mechanisms</td>
<td>0.50</td>
<td>0.500</td>
<td>0.500</td>
</tr>
<tr>
<td>Ownership</td>
<td>0.50</td>
<td>0.500</td>
<td>0.500</td>
</tr>
<tr>
<td>Consistency ratio</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level 2:</th>
<th>Control mechanisms</th>
<th>Level priorities</th>
<th>Overall priorities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Takeover</td>
<td>0.761</td>
<td>0.761</td>
<td>0.381</td>
</tr>
<tr>
<td>Board composition</td>
<td>0.073</td>
<td>0.073</td>
<td>0.036</td>
</tr>
<tr>
<td>Outside blockholders</td>
<td>0.166</td>
<td>0.166</td>
<td>0.083</td>
</tr>
<tr>
<td>Consistency ratio</td>
<td>0.070</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level 3:</th>
<th>Takeover</th>
<th>Board comp.</th>
<th>Outside blockholders</th>
<th>Level priorities</th>
<th>Overall priorities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business risk</td>
<td>0.279</td>
<td>0.172</td>
<td>0.101</td>
<td>0.184</td>
<td>0.120</td>
</tr>
<tr>
<td>Growth opportunities</td>
<td>0.072</td>
<td>0.726</td>
<td>0.674</td>
<td>0.491</td>
<td>0.208</td>
</tr>
<tr>
<td>Assets in place</td>
<td>0.649</td>
<td>0.102</td>
<td>0.226</td>
<td>0.326</td>
<td>0.283</td>
</tr>
<tr>
<td>Consistency ratio</td>
<td>0.056</td>
<td>0.082</td>
<td>0.062</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ownership</td>
<td></td>
<td></td>
<td></td>
<td>0.125</td>
<td>0.063</td>
</tr>
<tr>
<td>Diversification</td>
<td>0.875</td>
<td></td>
<td></td>
<td>0.875</td>
<td>0.438</td>
</tr>
<tr>
<td>Consistency ratio</td>
<td></td>
<td></td>
<td></td>
<td>0.000</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level 4:</th>
<th>Business Risk</th>
<th>Growth opportunities</th>
<th>Assets in place</th>
<th>Age</th>
<th>Diversification</th>
<th>Level priorities</th>
<th>Overall priorities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash comp.</td>
<td>0.167</td>
<td>0.100</td>
<td>0.857</td>
<td>0.875</td>
<td>0.857</td>
<td>0.586</td>
<td>0.689</td>
</tr>
<tr>
<td>Equity-based comp.</td>
<td>0.833</td>
<td>0.900</td>
<td>0.143</td>
<td>0.125</td>
<td>0.143</td>
<td>0.414</td>
<td>0.311</td>
</tr>
<tr>
<td>Consistency ratio</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.070</td>
<td></td>
</tr>
</tbody>
</table>

| Overall consistency ratio |                | 0.070               |                    |
participant was whether our compensation structure hierarchy accurately portrays the way he/she makes a decision, and if not, why not. Thirty participants agreed with the model.  

Next, we asked the directors to make pairwise comparisons of the variables in the hierarchy. We then calculated overall priorities for cash and equity-based compensation for each individual survey. Finally, we calculated the descriptive statistics of overall priorities for the entire sample. The mean of the overall priorities (i.e., the wealth-maximizing weight) for equity-based compensation is 32.3%, compared with our 31.1%. The minimum weight for equity-based compensation in the survey sample is 8.3% and the maximum is 39.7%. These results suggest that boards in general recognize the importance of equity-based compensation. In addition, the maximum weight suggests that there is an upper bound for equity-based compensation. In addition to calculating the mean of overall priorities, we calculated the geometric means of each pairwise comparison for all the variables in the hierarchy across all respondents and then computed overall priorities for cash and equity-based compensation. The final results on overall priorities, however, are not significantly different from each other.

We also asked each participant whether any variable(s) affecting compensation structure is (are) missing from our model. Specifically, we are interested in the effect of regulation and taxes on compensation design. Outside directors serving on the boards of regulated firms suggested that

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**Table 6**

Industry representation of members of compensation committees participating in the survey and average size of the firms in each industry in the sample.

<table>
<thead>
<tr>
<th>Industry</th>
<th>Frequency in the sample</th>
<th>Mean total assets (in millions of $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>45</td>
<td>914</td>
</tr>
<tr>
<td>Retail</td>
<td>7</td>
<td>890</td>
</tr>
<tr>
<td>Banking and finance</td>
<td>9</td>
<td>2,752</td>
</tr>
<tr>
<td>Insurance</td>
<td>4</td>
<td>1,137</td>
</tr>
<tr>
<td>Public utilities</td>
<td>6</td>
<td>1,488</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>3</td>
<td>2,683</td>
</tr>
</tbody>
</table>
The use of equity-based compensation is discouraged by regulation (Smith and Watts, 1992), but directors indicated that the tax code does not play a role in executive compensation structure decisions.

Finally, we interviewed 14 academics and found a mean weight of equity-based compensation of 31.7%.

3.4. Sensitivity Tests

One of the strengths of the AHP model is its robustness. Minor changes in inputs do not alter the output significantly. To test the robustness of the results based on our judgments, we alter the second level of weights, which are the most crucial in determining the final output of the compensation package, by 20%. We increase the local priority of control mechanisms from 0.50 to 0.60 and decrease the priority for ownership from 0.50 to 0.40. These changes result in wealth-maximizing weights of 65.4% and 34.6% (as opposed to 68.9% and 31.1%) for salary plus bonus and equity-based compensation plans. The wealth-maximizing compensation package based on these weights consists of 59.76% cash and 31.14% equity-based compensation. Thus, a 20% increase in the relative importance of control mechanisms in maximizing shareholder wealth increases the fraction of compensation that is equity-based by 3.15%. Next we decrease the local priority of control mechanisms to 0.40 and increase the local priority of ownership to 0.60. The wealth-maximizing weights resulting from these changes are 72.3% and 27.7% for cash and equity-based compensation. These results suggest that minor changes in inputs do not affect our final results significantly.

We also performed sensitivity tests on all the variables in the hierarchy. Since changes in the relative importance of the variables in lower levels have a weaker impact on the final outcome, we discuss only the results for the five variables in Levels 3 and 4 of figure 1. First, we alter the relative importance of takeover, board composition, and outside blockholders with respect to control mechanisms presented in panel A of table 3. Earlier, we assigned a value of 8 to the importance of takeover in relation to board composition, because we believe that boards in general are reactive rather than active. Our understanding of the role of the board in monitoring CEOs is consistent with a number of studies (e.g., Weisbach,
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1988) and discussions in the popular press (e.g., Business Week, September 8, 1986). One can argue, however, that boards are more active today and that takeover activity has declined substantially since the late 1980s. Therefore, in our sensitivity test we consider takeover to be only slightly more important than board composition and assign it a value of 3. With this change, we find wealth-maximizing weights of 67% and 33% for cash and equity-based compensation. Again these weights are not significantly different from previous results.

We also change the relative importance of takeover to outside blockholders from 6 (in panel A of table 3) to 3. Our justification for assigning a value of 6 initially was that outside block ownership is not generally the same as a takeover. For example, Barclay and Holderness (1991) have shown that the effect of large blockholders on firm value also depends on the specific skills the blockholders bring to the firm (see Mehran, 1995) for more discussion. Although it can be argued that the effectiveness of takeover threats as a source of discipline has declined as a result of state antitakover laws, we believe takeover threats are still more effective than outside block ownership. The wealth-maximizing weights as a result of this change are 67.4% for cash and 32.6% for equity. In addition, we simultaneously incorporate the changes in the relative importance of takeover with respect to board composition and outside blockholders. The resulting cash and equity-based compensation weights are 65.4% and 34.6%. Overall, these changes do not alter the results significantly.

Finally, we conduct sensitivity tests on the age and portfolio diversification variables. Earlier we considered diversification to be more important than age with respect to insider ownership. Although we argued that managers can accumulate shares over time by exercising their stock options or through restricted stock plans, that accumulation depends on whether these plans are available. For example, Polariod Corporation does not have equity-based compensation plans for its top managers. Moreover, share accumulation depends on managers' other asset holdings. Consider a manager who receives a fixed number of shares every year by exercising his stock options. If these shares are a nontrivial portion of his wealth, he has to rebalance his portfolio by selling some of the shares of his company (see Lambert, Larcker, and Verrecchia, 1991). Thus unless he has a diversified
portfolio, stock options and restricted stock plans will not increase his ownership significantly. To check the effect of changes in the local priorities of age and diversification on wealth-maximizing weights, we alter them first by 20% and then by 30%. The change in overall cash and equity-based compensation priorities, however, is not significant.

3.5. Comparison with the Observed Compensation Structure

We compare the wealth-maximizing compensation package calculated with our judgments and with the board survey with the package reported in Murphy's survey of the 1,000 largest U.S. corporations in 1993. Murphy reports that 62.9% of CEOs' total compensation is in salary and annual bonus and 27.3% is in equity-based compensation. Our results are very similar.

4. Conclusions

To determine the CEO compensation structure that maximizes shareholder wealth, we construct a model based on the analytic hierarchy process (AHP) developed by Saaty (1980). The advantage of the AHP is in its ability to deal with the effect of unobservable attributes on the composition of executive pay packages and its flexibility in incorporating a large number of variables and their interactions within the firm. The inputs for our model are based on a literature survey as well as a survey of 31 members of compensation committees who serve on 74 boards. Using the literature survey, we find that cash accounts for 62.01% and equity-based compensation for 27.99% of executives' total compensation. The results are similar when we average board members' opinions. We also find that the empirical findings are generally robust to minor changes in inputs. The empirical findings from our model are consistent with the observed compensation structure reported by Murphy (1993) for the 1,000 largest U.S. corporations.

Many have argued that most firms in the U.S. should increase the equity-based portion of their CEOs' compensation packages (e.g., Jensen and Murphy, 1990). Although this paper does not contribute to the debate over whether the U.S. compensation structure is effective, it does provide evidence that boards in general are aware of the importance of equity-based
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compensation and managers' equity investment in the firm in improving managerial incentives.

Although we find that a wealth-maximizing compensation package on average consists of 62.01% cash and 27.99% equity-based compensation, we are not suggesting that all boards adopt this mix for their CEOs. Compensation structure is only one means of reducing conflicts of interest between managers and shareholders. Equilibrium pay packages can vary across firms in the same business environment in response to self-interested managerial decisions. For example, firms with more effective boards have more equity-based compensation, and firms with more equity ownership by CEOs have more cash compensation. Higher equity-based compensation or higher equity ownership ties rewards more closely to firm performance and motivates managers to enhance shareholders' wealth.

Endnotes

*The authors would like to acknowledge the helpful comments of Elizabeth Strock Bagnani, Judith Gordon, Kathleen Hevert, Clifford Holderness, Jamshid Hosseini, Edward Kane, Steven Kaplan, Alan Marcus, Robyn McLaughlin, Timothy Mech, Kevin Murphy, Jeffrey Ringuest, Hossein Safizadeh, Thomas L. Saaty, Robert Taggart, Sandra Waddock on an earlier draft of the paper and/or questionnaire, and seminar participants at Boston College, Northwestern University, and University of Pittsburgh for helpful discussion. Special thanks are due to the directors who participated in the survey and Frank Morris and John Neuhauser for their assistance in contacting boards of directors. An earlier version of this paper was presented at the joint meeting of the American Economic Association and Association of Managerial Economists and at the annual meeting of the Decision Science Institute in 1994.

1 Other studies also suggest that accounting measures of performance are important in determining executive compensation (e.g., Ely, 1991). In addition, some researchers find that executives report income in such a way as to affect their compensation (e.g., Healy, 1985).
The analytic hierarchy process has been applied to a number of issues in financial economics. See Arpington, Hillison, and Jensen (1984); Bahmani, Yamoah, Basser, and Rezvani (1987); Blair, Nachtmann, Olson, Saaty (1987); Golden, Wasil, and Levy (1989); Javalgi, Armacost, and Hosseini (1989); Jensen (1987); Khaksari, Kamath, and Grieves (1989); Saaty, Rogers, and Pell (1980); and Srinivasan and Kim (1987).


Although annual bonuses are contingent on reaching certain targets, these targets are specified in such a way that they can be reached with certainty. Moreover, the targets are based on accounting performance, and accounting methods are determined by CEOs.

Although the AHP has proven successful approach in practice, there are a number of problems with the AHP and these problems have led to considerable controversy. A number of solutions have been proposed for overcoming the difficulties (for a discussion see Zionts, 1992).

The AHP is similar to conjoint analysis in that it uses an axiomatic foundation. Unlike conjoint analysis, however, the AHP does not require direct estimation of utility functions, since it is concerned with stating preferences at each level of the decision process (Harker and Vargas, 1987).

Often the only way to improve consistency is to gather additional information about the subjects for which the estimates are made. The number of elements in a group also has a bearing on consistency. In making estimates and keeping comparisons relevant, the decision maker has to keep all elements in mind. Yet psychological experiments have shown that in general it is not possible for one to simultaneously compare more than seven (plus or minus two) objects without confusion. When the number of elements is large, breaking them into groups of seven or fewer, using their common characteristics, improves consistency.

Although this scale has been validated by Saaty for effectiveness through theoretical comparisons with other scales and through applications, any other bonded scale can also be used.
In addition to those mentioned, it is argued that other competitive market mechanisms, such as "ex-post settling up" by external labor and capital markets (Jensen and Meckling, 1976 and Fama, 1980), and competition in the product market (Hart, 1983) discipline managers and induce them to pursue the shareholders' interests. The reason they do not appear in the hierarchy is that they are not empirically supported. Gilson (1989) finds some support for an "ex-post settling up" argument for CEOs of bankrupt firms, but there is no evidence for continuing firms. In the absence of sufficient evidence, we are not able to rank the relative importance of these variables. Moreover, we do not believe these two variables are as important in disciplining CEOs as those that already appear in the model.

Some researchers have shown that managers have a substantial amount of investment in the equity of their own firms (e.g., Comment, 1985; Murphy, 1986; and Mehran, 1992). For example, Mehran finds that CEOs on average hold $14 million in the equity of their own firms (excluding the value of stock options and restricted stock plans). To suggest that managers hold suboptimal portfolios, however, would require knowledge of their other assets. A survey of 500 CEOs (Newsweek, October 13, 1986) indicates that the average CEO earns $288,910 in salary, and owns $1,987,689 of her/his company's stock, $826,014 in the stock of other companies, and $1,009,511 in real estate (excluding his/her personal home). Such large investments by executives in their own firms' stock might make them undiversified.

In the next section, we relax this assumption and perform a sensitivity analysis.

The overall priority of cash (0.689) is obtained by multiplying its local priorities (0.167, 0.100, 0.857, 0.875, and 0.857) with respect to each criterion by the overall priority of the corresponding criterion (0.120, 0.208, 0.283, 0.063, and 0.438). The resulting products are then added over all criteria to obtain the overall priority for each, i.e., \[(0.167 \times 0.120) + (0.100 \times 0.208) + (0.857 \times 0.283) + (0.875 \times 0.063) + (0.857 \times 0.438)\] = 0.689.

These people have served over time on more than 74 boards. We asked them, however, to rely on their most recent experience in responding to our questions.

All the people we approached participated in the study, so there is no participation...
bias in our sample.

One director who serves on the boards of an insurance company and a public utility indicated that our model is a presentation of the way compensation decisions should be made, but does not reflect actual practice in the companies of which he is a director.

A number of researchers have shown that antitakeover laws adversely affect shareholders' wealth (e.g., Szewczyk and Tsetsekos, 1992). Although these laws and other regulations can significantly constrain takeover activities, they cannot eliminate control-market effects. McLaughlin and Mehran (1995) examine hostile tender offers for electric utilities during the 1960-1990 periods and find that only one was completed. Announcement-period returns to target utilities, however, are positive and significant. The presence of positive returns is seemingly puzzling, since the probability of completion is so low. Closer examination reveals that one third of the offers are followed by additional bids, control changes, and/or divestitures.

References


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