# Determinants of the Size and Structure of Corporate Boards: 1935-2000

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## Abstract

In both the scholarly literature on boards of directors and the public debate over corporate governance, there is little explicit recognition that the size and structure of boards have evolved endogenously over time. We argue that the size and structure of boards are determined by tradeoffs involving the incremental information that directors bring to boards versus the incremental coordination costs and free rider problems engendered by their additions to boards. Our hypotheses lead to predictions that firm size and growth opportunities are important determinants of the size and structure of boards. Using a unique sample of 81 publicly traded U.S. firms that survived over the period of 1935 through 2000, we find strong support for the hypotheses. Board size is directly related to firm size and inversely related to proxies for growth opportunities, whereas insider representation is inversely related to firm size and directly related to proxies for growth opportunities. We find no robust relation between firm performance and either board size or structure when the board characteristics are treated as endogenous variables. The results are consistent with the proposition that board size and structure are endogenously determined in ways consistent with value maximization.

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*Key words:* Board size, board composition, endogeneity, firm size, growth opportunities and tangibility of assets.

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## 1. Introduction

Much of the public debate over corporate governance in recent years has focused on the size and structure of corporate boards of directors. Many scholars, investors, and regulators argue that corporate boards should be small and comprised largely of independent directors. Scholarly research is often cited to support board reform, including papers documenting an inverse relation between board size and firm value, and others documenting a relation between the mix of inside versus outside directors and various indicators of firm performance.

In both the scholarly literature on boards of directors and the public debate over corporate governance, there is little explicit recognition that the size and structure of boards have emerged endogenously over time.[1] If there are tradeoffs associated with different board sizes and structures (we presume there are) and if capital and product markets provide incentives for firms to maximize value (we presume they do), then we expect firms to choose board sizes and structures that are suitable for their circumstances, at least on average. This perspective shifts the analysis of boards of directors from one of reforming boards to one of explaining the variation in their size and structure, according to a value-maximizing calculus.

Adopting the view that boards are endogenously chosen, this paper examines the size and structure of boards for a unique sample of firms – 81 publicly traded U.S. firms that survived over the period of 1935 through 2000. We deliberately choose these firms because they have survived for so long, suggesting to us that their governance structures are likely to be appropriate for their purposes. The sample allows us to address several questions about the size and structure of corporate boards. How have the boards of these companies evolved? What determines the size

[1] Prominent exceptions are Williamson (1975), Fama and Jensen (1983), and Hermalin and Weisbach (1998).

and structure of their boards? Is there evidence of path dependence in the size and structure of boards? Our analysis reveals the following results:

o Board size follows a hump pattern over time. Median board size is 11 in 1935, peaks at 15 in 1960, and falls back to 11 in 2000.

o There has been a convergence in board size over time. The standard deviation in board size falls steadily over the sample period, from 5.5 in 1935 to 2.7 in 2000.

o The average responsibility of directors has increased enormously over time. The median value of equity per director, adjusted for inflation, increases from $39.5 million in 1935 to $696 million in 2000.

o Insider representation on boards has fallen over time, from 43% of boards in 1935 to 13% of boards in 2000.

o More than 60% of the variation in board size is explained by proxies for firm size, which is directly related to board size, and growth opportunities, which are inversely related to board size. This evidence supports the view that board sizes are selected rationally and in accordance with value maximization.

o More than 50% of the variation in insider representation on boards is explained by proxies for firm size, which is inversely related to insider representation, and growth opportunities, which are directly related to insider representation. This evidence supports the view that insider representation on boards is governed by rationality and is consistent with value maximization.

o Some persistence exists in both board size and structure, beyond what the variables in our model predict, suggesting the possibility of path dependence in board size and structure.

o No robust relation exists between firm performance and either board size or structure after the board characteristics are endogenized.

The results support the proposition that board size and structure are determined endogenously in ways consistent with value maximization. The results suggest caution in interpreting empirical evidence that purports to draw causal links between board variables and firm performance when board variables are treated as exogenous (e.g., Yermack (1996)). They also suggest that a “one size fits all” approach to board size and structure is misguided, since a

large part of the considerable variation in board size and structure is explained by variables that suggest an underlying economic logic at work in determining the size and structure of boards.

The paper is organized as follows. Section 2 develops hypotheses and reviews relevant literature. In Section 3 we describe the data set and present descriptive statistics for the key variables. Section 4 presents regression results of the determinants of board size and structure. In Section 5 we examine the relation between board characteristics and firm performance. Section 6 discusses the results and provides concluding comments.

## 2. Hypotheses and review of relevant literature

Boards of directors serve two general functions. First, they advise managers about a firm's business strategy (Williamson (1975), Fama and Jensen (1983)), which we refer to as the advisory function of boards. Second, they monitor the performance of managers (Fama (1980), Hermalin and Weisbach (1998), Monks and Minow (2000)), which we refer to as the monitoring function of boards. We take the perspective that the costs and benefits of the two functions are likely to vary across firms in ways that result in systematic relations between the attributes of firms and the size and structures of their boards.

### *2.1 Board size*

Very little literature exists on the determinants of optimal board size. Several scholars simply assert that small boards operate more effectively than large boards because of the high coordination costs and free rider problems associated with large boards. For example, Lipton and Lorsch (1992, 65) argue that "[w]hen a board has more than ten members it becomes more difficult for them all to express their ideas and opinions." Similarly, Jensen (1993, 865)

conjectures that "keeping boards small can help improve their performance. When boards get beyond seven or eight people they are less likely to function effectively…'. In a recent theoretical paper, Raheja (2003) develops a model which shows the conditions under which small boards mitigate the agency conflict between managers and stockholders. In empirical studies Baker and Gompers (2001) report that board size is increasing in asset tangibility for a sample of U.S. firms conducting initial public offerings ("IPOs") and Mak and Roush (2000) find an inverse relation between board size and growth opportunities for a sample of New Zealand IPOs. More recently, Coles, Daniel, and Naveen (2004); Yang, Linck & Netter (2004); and Boone, Field, Karpoff, and Raheja (2004) model board size and composition as functions of asset characteristics and other firm governance characteristics.

We take the perspective that there are tradeoffs associated with different board sizes, tradeoffs that are likely to vary across firms and industries. The major advantage of large boards is the collective information that the board possesses about factors that affect the value of firms, such as product markets, technology, regulation, mergers and acquisitions, and so forth. This information is valuable for both the advisory (Haleblian and Finkelstein (1993)) and monitoring functions of boards.

The major disadvantages of large boards are the coordination costs and free rider problems referred to above. We presume that coordination costs increase in board size. Economic analyses of constitutional democracies typically cite the costs of making collective decisions with the entire population as the *raison d'etre* of representative government. Buchanan and Tullock (1974) generalize this to all cases of collective decision-making, stating that "the expected costs of organizing decisions, under any given rule, will be less in the smaller unit than in the larger." To our knowledge, no formal or empirical work has been done heretofore on the relation between

group decision making costs and group size, but like others in the literature, we presume such a relation exists.

The free rider problems associated with large boards stem from the observation that the average influence of a board member varies inversely with board size. With less influence, board members have reduced incentives to bear the private costs of investing in information and actively monitoring the firm's managers. Just as the free rider problem among stockholders increases with the diffusion of stock ownership, the free rider problem among board members increases as boards become larger.

In short, we take the perspective that the choice of board size is governed by the tradeoff between the aggregate information that large boards possess and the increased costs of decision-making associated with large boards. The tradeoff is likely to vary across firms and industries in systematic ways that result in different optimal board sizes across firms and industries. We examine two attributes of firms that are likely to affect this tradeoff, and hence, the optimal size of boards: firm size and growth opportunities.

*Firm size*. We expect a direct relation between the size of firms and the size of their boards. Large firms are, by definition, engaged in a higher volume of activities than small firms. In addition, large firms are likely to be engaged in a greater diversity of activities than small firms, such as operating in different product and geographic markets, engaging in more merger and acquisition activity, using more sophisticated financial and marketing techniques, and so forth. Because of the higher volume and greater diversity of activities, large firms have more demand for information than do small firms, including information about product markets, foreign markets, mergers and acquisitions, technology, and labor relations.

As an illustrative example, consider the cases of Wal-Mart and Cost-U-Less, two companies that operate retail discount department stores. Wal-Mart, with a market capitalization of $256 billion and 1.4 million employees, has 14 members on its board. Cost-U-Less, with a corresponding market capitalization of only $11 million and 500 employees, has only 5 members on its board. In addition to being substantially larger than Cost-U-Less, Wal-Mart is engaged in more diverse activities. Whereas Cost-U-Less is quite focused, operating 11 warehouse clubs only in island markets, Wal-Mart is quite diverse, operating thousands of stores of various formats in the U.S. and many foreign markets. In addition to its retail operations, Wal-Mart owns a food distribution subsidiary.

We presume that the greater size and diversity of Wal-Mart's activities accounts for most of the difference in the size of the two companies' boards. A closer look at the two companies' boards is consistent with the conjecture.

The Cost-U-Less board consists of one inside director, the company's chief executive officer ("CEO"), and four outside directors, including a venture capitalist, the chairman of a food distributor, a certified public accountant, and a private equity investor. All of the outside directors are male and three of the four live in the Seattle area, only 22 miles from the Preston, Washington headquarters of Cost-U-Less.

In contrast, the Wal-Mart board consists of three inside directors, eight outside directors, one retired Wal-Mart executive, and two sons of Wal-Mart's founder, Sam Walton. In addition to the company's CEO, the inside directors include the former CEO who chairs the executive committee and the vice chairman of the board who has worked in the loss prevention, human resources, and Sam's Club units of Wal-Mart. The eight outside directors include a venture capitalist, a lawyer, and six executives from large corporations, including Goodyear Tire & Rubber, General Electric,

Delta Airlines, Charles Schwab, Metro-Machine, and Telemundo Group. The outside directors are ethnically more diverse than those at Cost-U-Less, including two females and two with Spanish surnames. All of Wal-Mart's outside directors live far from the company's Bentonville, Arkansas headquarters, with the closest being 805 miles away and the farthest being 1,845 miles away.

We draw the inference that the greater size and diversity of Wal-Mart's operations accounts for the larger size and diversity of its board. The various product and geographic markets in which it operates makes the attributes of its outside directors more valuable and suitable than they would be at a smaller highly focused company such as Cost-U-Less. As a general matter, we predict a direct relation between the size of firms and the size of their boards. In our empirical tests, we check for nonlinearity in this direct relation.

*Growth opportunities.* We expect an inverse relation between growth opportunities and board size for two reasons. First, it is widely held that the costs of monitoring managers increase with a firm's growth opportunities (Smith and Watts (1992), Gaver and Gaver (1993)). As a result, the free rider problem associated with large boards is more severe in firms with high growth opportunities. In order for board members to have sufficient private incentives to bear the high monitoring costs in high growth firms, boards must be small.

Second, firms with higher growth opportunities generally require nimbler governance structures. Since these firms usually are younger and operate in more volatile business environments than low growth firms, they require governance structures that facilitate rapid decision-making and redeployment of assets. By more volatile business environments, we refer to markets characterized by frequent technological change, unstable market shares, rapidly changing relative prices, and so forth. As the costs of altering corporate strategy in response to these factors

is likely to be inversely related to board size, we expect that the more volatile the environment in which a firm operates, the smaller will be its board.[2]

An illustration of how growth opportunities are related to board size might be the example of two companies with different growth opportunities, Honeywell, a diversified manufacturing firm, and Genentech, a biotechnology company. Honeywell generally would be viewed as a lower growth company than Genentech. This is borne out by various proxies for growth opportunities. For example, the ratio of the market value of Honeywell's equity to the book value of its equity is 2.7, compared with a corresponding ratio of 7.6 for Genentech. Honeywell has a market capitalization of $26 billion, versus $44 billion for Genentech, making Honeywell considerably smaller than Genentech, at least in terms of market capitalization. All else equal, this would tend to cause its board to be smaller than Genentech's.

Notwithstanding the size difference in the two companies, Honeywell's board is more than twice as large as Genentech's. Honeywell has 13 directors, including only one inside director. The 12 outside directors include one academic, one executive with an investment firm and ten executives or former executives with large corporations spanning a variety of industries, including Deere (machinery), Continental Airlines (airline), Telefonos de Mexico (telecommunications), Kraft Foods (food processing), Xcel (energy), KB Home (residential and commercial building), Verizon (telecommunications), Schering-Plough (pharmaceuticals and consumer products), Wyeth (pharmaceutical, health care and animal health care products), and SUPERVALU (food distributor and retailer). Genentech has only six directors, including its founder, its chief executive officer, two officers of the Roche Group, with which Genentech has numerous

[2] Kole and Lehn (1999) find that board sizes of airlines declined after the industry was deregulated in 1978, which is consistent with our hypothesis since deregulation creates less stable business environments, thereby enhancing the value of both nimbleness and the monitoring function of boards. Frye & Smith (2003) similarly find that regulated firms,

collaborative and royalty agreements, a scientist at University College London, and the former chief executive officer of Glaxo Inc. Each of the board members has extensive scientific knowledge. Four have Ph.Ds, one has an M.D., and one has a Doctor of Law degree. All have backgrounds in the pharmaceutical or biotechnology industry, in contrast to the wide disparity of industries represented on Honeywell's board.

The data from the anecdote are consistent with the hypothesis. Despite its size advantage, Genentech's board is considerably smaller than Honeywell's, which gives it a nimbler governance structure and stronger incentives to monitor. Both of these features of small boards are expected to be valued more highly at Genentech, which has higher growth opportunities and, presumably, more information asymmetries. In addition to the difference in board size, the greater homogeneity of knowledge represented on Genentech's board is likely to enhance both its decision-making and monitoring ability, which leads to our consideration of the determinants of board composition.

### *2.2 Board composition*

As is the case with board size, there is scant literature on the determinants of board composition, which for our purposes refers to the mix of inside versus outside directors[3]. Hermalin and Weisbach (1988, 1998), perhaps the most prominent exceptions, focus on the relation between board composition and CEO tenure, firm performance, and the product markets in which firms operate. An empirical paper, Bathala and Rao (1995) documents an inverse relationship between growth opportunities and the proportion of boards consisting of outsiders. Otherwise, we are only aware of normative arguments regarding optimal board composition.

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which have less need for nimble boards, increase their boards more than unregulated firms following initial public offerings.

Lipton & Lorsch (1992) suggest that there be a ratio of at least two independent directors for every potentially affiliated director. Jensen (1993) argues that since inside directors will be virtually ineffective in critically evaluating the CEO they should not find place on the board. Jensen argues that the only inside director on the board should be the CEO.

We have two hypotheses regarding the determinants of board composition based on the same two firm characteristics, size and growth opportunities, that we suggest as determinants of board size.

*Firm size*. The potential for agency conflicts between managers and shareholders is expected to increase in firm size (Barclay and Smith (1995a,b)). The principal reason for this is that the percent of equity held by top managers is expected to vary inversely with firm size. In addition, larger firms may have greater agency costs of free cash flow (Jensen (1986)) and less transparency with respect to the performance of its individual units (Scharfstein (2000), Scharfstein and Stein (2000)). We expect a direct relation between the independence of boards and firm size as a means to mitigate the agency problems associated with firm size.

*Growth opportunities*. The information asymmetries associated with high growth firms, as discussed before, are expected to affect board composition. First, information asymmetries impair the ability of outside directors to fulfill their advisory function in high growth firms. Either the outside directors make decisions based on less information than their counterparts in low growth firms, or they incur high costs of obtaining information to allow them to make more informed decisions. Perhaps the major way of obtaining the information is through discussions with the firm's CEO. However, the opportunity cost of the CEO's time is especially high for high growth firms, making this a highly inefficient means of mitigating information asymmetries. Furthermore, since the director also serves a monitoring function, the CEO may have incentives to

[3] We presently do not have sufficient data for other standard definitions of composition (detailed in the next section).

obscure certain types of information. For this reason, we expect an inverse relation between growth opportunities and the proportion of boards consisting of independent directors.

Relatedly, high growth firms require more nimble governance structures than their low growth counterparts, for reasons discussed above. One of the major costs of an outsider dominated board in firms with substantial information asymmetries is that the board's decision-making is likely to be deliberate, not nimble. Since the optimal exercise of flexibility options often requires speedy decisions, insider domination of boards may be desirable for high growth firms.

The costs associated with the monitoring function of boards also differ for high growth versus low growth firms. Myers (1977) argues that agency costs can be fairly high for growth firms as managers have greater flexibility with regard to future investments. As discussed above, managerial actions are less observable and managerial discretion is greater in high growth firms. The greater information asymmetry inherent in high-growth firms increases the potential for wealth transfers from potential investors to inside owners (Gaver and Gaver (1993)).

To mitigate the potential agency problems associated with high growth firms one might expect to find greater representation of outside directors on the boards of high growth firms. On the other hand, the information asymmetries that raise the costs of external monitoring of managers are likely to result in higher insider ownership of equity (Holmstrom (1979), Smith and Watts (1992)). If so, higher insider ownership of equity is likely to result in less demand for outside directors on the board. If insider ownership of equity is a more effective remedy for the agency costs associated with information asymmetries in high growth firms, then high growth firms are likely to have more insider representation on boards. This is ultimately an empirical issue.

To summarize, we expect board size and insider representation on boards to evolve in ways consistent with value maximization. This leads us to the predictions that (i) board size is directly related to firm size and inversely related to growth opportunities and (ii) insider representation on boards is inversely related to firm size and directly related to growth opportunities. We turn now to tests of these predictions.

## 3. Sample and descriptive statistics

### *3.1 Sample and data*

To test the hypotheses discussed in the previous section, we compile time series data for a sample of manufacturing firms that survived from 1935 through 2000. The sample consists of all firms in the Center for Research on Security Prices ("CRSP") database which survive from 1935 through 2000 and for which data is available in the Moody's Industrial Manual. We deliberately impose a high survivorship requirement since firms that survive over long periods of time are presumed to have governance structures that are appropriate for their circumstances. We acknowledge that our sample selection criterion considerably reduces cross-sectional variation in asset and governance characteristics, which biases against finding statistical significance in our tests.

A list of the 81 firms in the sample is contained in Appendix A. Not surprisingly, the sample includes many prominent large U.S. corporations, such as General Electric, Procter & Gamble, and Coca-Cola, as well as smaller companies such as Tootsie Roll Industries, Foster Wheeler, and L.S. Starrett. The companies span a wide range of manufacturing industries, including coal mining, oil and gas extraction, food and kindred products, tobacco products, chemical and allied products, petroleum refining, electronic and other electrical equipment and

components, rubber and miscellaneous plastic products, metal products, transportation equipments, etc.

Accounting and board information is collected from various editions of Moody's Manuals[4]. We collect data at 5-year intervals beginning with year 1935. Although COMPUSTAT data is available from the early 1950s, we use Moody's as the source of accounting data throughout the sample period to maintain consistency in the reporting of these data. We collect the following data items from the Moody's Manuals for each firm in each year: (i) the number of directors, (ii) the number of inside directors (i.e., directors who are officers of the firm), (iii) total sales, (iv) total assets, (v) property, plant and equipment, (vi) book value of equity, (vii) book value of long term debt and (viii) book value of preferred stock.

The Moody's Manuals do not provide adequate information to be able to consistently classify directors as "gray," or not, as is customary in the literature on boards[5]. However there is sufficient information to consistently identify insider directors. As a result, in this paper we measure board composition as the percentage of the board consisting of inside directors.

We use monthly stock prices and stock returns from the CRSP tape to calculate market values of equity and volatility of returns. Data on inflation, which is used to deflate variables denominated in dollar values is obtained from the Bureau of Labor Statistics (U.S. Department of Labor) website. Complete data for all 14 years exists for 76 firms of the 81 firms.

### *3.2 Descriptive statistics*

[4] Prior to 1955, Moody's Manual was titled "Moody's Manual of Investments and Security Rating Service". Post 1955, there are several editions of Moody's Manual including Moody's Bank and Finance manual, Moody's Industrial Manual, Moody's Municipal & Government Manual, Moody's Public Utility Manual, and Moody's Transportation Manual. Our data for the current sample is primarily collected from Moody's Industrial Manual.

[5] As defined in Hermalin and Weibach (1988) and (2001), inside directors are employees and former employees of the firm; outside directors are not employees of the firms and usually do not have any business ties to the firm aside from

Table 1 reports descriptive statistics for the key variables by year.

Panel A displays the mean, median, standard deviation and the coefficient of variation of three variables measuring firm size - sales, book value of assets and market value of equity. All values are inflation-adjusted using constant 2000 dollars. Mean and median equity value grow substantially over time, from $2.2 billion and $476 million, respectively, in 1935 to $32.1 billion and $6.9 billion, respectively, in 2000. Similar patterns exist for sales and book asset value. The cross-sectional variation in firm size also increases substantially over time. The standard deviation in the market value of equity increases from $4.7 billion in 1935 to $69.2 billion in 2000. The corresponding standard deviations of sales and book asset value show a similar trend.

Panel B of Table 1 reports descriptive statistics of three measures of growth opportunities: (i) market-to-book value of assets, (ii) market-to-book value of equity and (iii) the ratio of property, plant and equipment (PPE) to the book value of total assets. The variables show an increase in growth opportunities from 1935-1965, a decline in growth opportunities from 1965-1980, and an increase in growth opportunities from 1980-2000. For example, the median market-to-book value of assets increases, in a non-monotonic way, from 1.3 in 1935 to 1.7 in 1965, declines to 1.1 in 1980, and increases to 1.5 in 2000. The pattern is more dramatic in the market-to-book value of equity. The median value of this variable increases from 1.4 in 1935 to 2.0 in 1965, falls to 1.3 in 1980, and increases to its maximum value of 2.7 in 2000. The ratio of property plant and equipment to total assets, which is inversely related to growth opportunities, declines from 0.389 in 1935 to 0.315 in 1965, increases to 0.369 in 1980, and falls to 0.282 in 2000. Hence, all three measures reflect considerable variation in growth opportunities over time.

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their directorship; “gray” directors are those directors who are attorneys or business persons having long standing relationships with the firm.

Panel B of Table 1 also reports stock return volatilities for the sample, measured as the standard deviation of monthly stock returns calculated over the prior five years, inclusive of the years listed in the Table. Median stock return volatility is highest in the depression year of 1935 (0.114), declines substantially in the 1950s, increases slightly in the 1960s, remains in a range of 0.062 to 0.072 during 1970-1995, and then jumps to 0.092 in 2000. Insofar that stock return volatility serves as a proxy for the stability of the business environment, the data reveals that the periods around 1935, a depression year, and 2000 to be the least stable and the period of the 1950s and 1960s to be the most stable.

Panel C of Table 1 provides descriptive statistics for the board variables. Median board size increases from 11 in 1935 to a peak of 15 in 1960, and declines rather steadily thereafter to a low of 11 in the most recent year, 2000. Mean board size reveals a similar pattern. It peaks at 14.48 in 1960 and takes its minimum value of 11.16 in 2000. Mean board size is substantially lower in 2000 than it is at the beginning of the sample period in 1935, when it takes the value of 12.43.

A fascinating pattern exists in the standard deviation of board size – it declines substantially and rather steadily from 5.545 in 1935 to 2.682 in 2000. Similarly, the coefficient of variation in board size also decreases almost monotonically, from 0.446 in 1935 to 0.240 in 2000. These data suggest a convergence towards smaller boards over time. This might have occurred because the firms in the sample became more similar over time, although the cross-sectional standard deviations in firm size and growth opportunities suggest otherwise, or because firms mimic best board practices from other firms, resulting in less variation over time.

A discernible pattern exists in the representation of insiders on boards over time. The mean number of insiders increases from 5.19 in 1935 to approximately 6 throughout the 1950s and 1960. Since 1960, the mean number of insiders has declined steadily, from 6.03 in 1960 to 1.77

in 2000. A similar pattern exists for the median number of insiders, with the median number of insiders declining from six in 1960 to only one in 2000. Unlike board size, however, board composition does not display a converging pattern over time. The standard deviation of the number of insiders declines from 2.881 in 1935 to 1.123 in 2000, but the coefficient of variation increases from 0.556 in 1935 to 0.636 in 2000. Figure 1, Figure 2 and Figure 3 plot the mean and standard deviation of board size, the number of insiders and percentage of insiders on the board evolved through years.

Although board size follows a hump pattern over the period of 1935 through 2000, we observe sharp and monotonic increases in the ratio of firm size to the number of directors over this period. Panel D of Table 1 reports summary statistics for sales per director, assets per director and market value of equity per director, all expressed in constant 2000 dollars. The median equity value per director increases rather steadily from $40 million in 1935 to $254 million in 1965, declines to less than $200 million during 1970-1980, and then increases steadily to $696 million in 2000. The mean value of this variable shows even more growth, increasing from $137 million in 1935 to $2.5 billion in 2000. Similar results hold for the mean and median values of sales per director and assets per director. We infer from these data that the responsibilities of directors, and the complexity of their work, have increased substantially over time. Figure 3, Figure 4 and Figure 5 show how the per director sales, assets and market capitalization have evolved during the sample period.

Table 2 reports data on the serial correlation of board size (Panel A) and insider representation (Panel B). Most of the correlations in Panel A are high and significant at the 1% level or better. In addition there are some interesting patterns. The correlation coefficients (column 2) of board size in year 1935 with other years decrease from 0.936 (year 1940) to 0.270

(year 2000). A similar pattern holds for other years. Also, the correlations of one period lags (e.g., year 1935 with year 1940, year 1940 with year 1945, and so forth) decreases over time (e.g., from 0.936 for year 1935 with year 1940 to 0.614 for year 1995 with year 2000). This data are consistent with the conjecture that that although there is some path dependence in board size, it has become less pronounced over time.

Panel B of Table 2 reports the corresponding correlations for the number of inside directors. The data reveal a similar pattern as the one detected for board size – there is a decreasing trend in the serial correlations as the time period gets longer and the correlation between one period lagged values declines over time. These results are consistent with the view that there is some path dependence in board composition, although this also has become less pronounced over time. We examine the persistence of board size and structure in more detail in the regression analyses discussed in the next section.

## 4. Hypothesis testing and regression results

To test the hypotheses that board size and structure are determined by firm size and growth opportunities, we estimate a series of fixed effects regression models on the panel data consisting of the 81 firms over the period from 1935 through 2000. Since we measure the values of variables over five-year intervals, we have 14 years of data for each firm, except for the five for which some data were not available[6]. We use firm dummies as regressors to account for persistent firm-specific determinants of board structure (e.g., whether the firm is a family firm, ownership characteristics, etc.) which are not modeled in our analysis.

[6] We are unable to find Sonesta International Hotels (1960-00), ITT Industries (1940-60 and 1990), NL Industries (1945,1955, 1985, 1990, 1995), Inco Ltd. (1945, 1955, 1975 and (1985-00) and Schlumberger Ltd. (1975 and 1985-00) for different years in our sample period. Missing years are indicated in the parentheses.

The independent variables of interest are firm size and growth opportunities. In the reported regression results we use the market value of equity as the proxy for firm size (Mkt. Cap.). We have replicated the regressions with sales and book value of assets as the proxies for firm size and the results are similar. Growth opportunities are measured by the ratio of the market to book value of assets (MTB Assets) and the ratio of property plant and equipment to total assets (PPE Ratio). All independent variables enter the equation in log form. Given board size and composition have changed substantially after 1980, as demonstrated in Panel C of Table 1, in some specifications we include a dummy variable that takes the value of 1 if the observation is after 1980 and zero otherwise. This variable is included to test whether there is a secular trend towards smaller boards and fewer inside directors for reasons unrelated to changes in firm size and growth opportunities.

The regression results are displayed in Table 3. Panels A and B of the Table provide estimates of the determinants of board size and percentage of inside directors on the board, respectively.

Panel A of Table 3 reveals that the regression models explain considerable variation in board size, as the adjusted R-square's range from 59% to 67%. The coefficients on the market value of equity are positive and significant at the 0.01 level in each model, which is consistent with the hypothesis that firm size is directly related to board size. The market value of equity alone explains almost 60% of the variation in board size. Column (1) shows that a strong nonlinear relation exists between market value of equity and board size, with board size attaining a maximum value when market value of equity is approximately $250 billion. The negative sign on firm size beyond a market capitalization of $250 billion is a bit puzzling, but because very few observations have market capitalizations above this level, we surmise that it is an artifact of the

small number of observations. Also this result conforms with the observation that firm size exhibits considerably more variation than board size. For example, firm size in 2000 ranges from $7.7 million (Raytech Corp) to $475 billion (General Electric), a multiple of 60,000. Yet, board size ranges from 4 (Tootsie Roll) to 21 (Exxon Mobil), a multiple of only 5. We infer from the data that beyond a relatively low number of board members, the coordination costs and free rider problems associated with additional board members are prohibitively large, regardless of firm size.

Both proxies for growth opportunities enter with the anticipated signs and are significant at the 0.01 level. When the market value of equity is specified linearly, the coefficients on MTB assets and the PPE ratio are -0.111 and 0.031, respectively, and both are significant at the 0.01 level. The absolute value of the coefficient on MTB assets is higher than the coefficient on the market value of equity, indicating that board size is more elastic with respect to this measure of growth opportunities than it is to firm size. Unlike the case for firm size, we had no *a priori* view that a nonlinear relation exists between board size and growth opportunities and none was found in a regression model that is not reported. The coefficients on MTB assets and PPE ratio do change appreciably when the proxy for firm size enters the equation in nonlinear form. Taken together the results indicate a robust relation between growth opportunities and board size.

Column (4) of Table 3 Panel A reveals a significant decrease in board size after 1980, for reasons unrelated to the proxies for firm size and growth opportunities. The coefficient on the post-1980 dummy variable is -0.156 and highly significant (t-statistic of 10.455), indicating a 14.55% reduction in board size after controlling for the other independent variables. This strikes us as a rather large effect and raises the obvious question as to the reason for this result. We present some possible explanations in the next section. Column (5) of Table 3 presents similar

results with coefficients on interaction variables consisting of the product of the post-1980 dummy variable and each of the other three independent variables. The interaction variables reveal that the elasticity of board size (i) declined significantly with respect to the market value of equity after 1980 and (ii) increased significantly with respect to PPE ratio after 1980.

Panel B in Table 3 shows the regression results for the models explaining the variation in the percent of boards consisting of inside directors. The models do a good job of explaining the variation in this measure of board composition, as the adjusted R-squares range from 37% to 52%. The coefficient on the market value of equity, when it is specified in linear form (Column (2)), is -0.059 and significant at the 0.01 level, consistent with the hypothesis that firm size is inversely related to insider representation on boards. The nonlinear specification (Column (1)) reveals that insider representation is actually increasing in firm size until the market value of equity reaches $39 million and then it declines. It seems odd that board size would be increasing in growth opportunities over any range, but only 2% of the observations have market capitalizations of less than $39 million. The predominance of firms with market capitalizations above this threshold level explains why the coefficient on growth opportunities is negative when the variable is specified in linear form.

The panel also reveals a highly significant relation between growth opportunities and insider representation, in the direction that we anticipate. The coefficient on MTB assets enters all equations with a positive coefficient that is significant at the 0.01 level. The coefficients range from 0.041 to 0.077, depending on the specification, on par with the coefficients on the proxy for firm size. The coefficients on PPE ratio have the anticipated negative sign and are significant at the 0.01 level in three of the four equations. Taken together the results reveal a strong association

between growth opportunities and board composition, which supports the hypotheses developed in Section 2.

The coefficients on the post-1980 dummy variable in columns (4) and (5) reveal a secular trend towards less insider representation after controlling for the proxies for firm size and growth opportunities. The coefficient on this variable is high: -0.186 when it is not interacted with the other independent variables, and -0.372 when it is. The adjusted R-squares increase substantially when this variable is added as an independent variable, from approximately 38% to more than 52%, further indicating its importance as a determinant of insider representation. The results show that the elasticity of insider representation with respect to MTB assets has become more pronounced after 1980, and this result is highly significant.

As discussed earlier, both board size and board composition show a high degree of serial correlation, suggesting the possibility of path dependence in these board characteristics. To examine this in more detail, we include lagged values of board size in the board size regressions and lagged values of insider representation in the insider representation regressions as independent variables. If board size and composition are path dependent, then significant and positive relations should exist between the contemporaneous and lagged values of these variables, after controlling for firm size and growth opportunities. Table 4 reports the results from the regressions.

Panel A of Table 4 contains results from 13 separate regressions in which the dependent variable in each is the natural log of board size in 2000. In each regression we include the nonlinear specification of the market value of equity and the two proxies for growth opportunities, the MTB assets and PPE ratio, as independent variables. In each of the 13 regressions, a different lagged value of the board size variable is included as an independent variable. For example, in

one regression 1995 board size is included as an independent variable, in another 1990 board size is included, and so forth. Insofar that board size is path dependent, we expect some of the lagged values to enter positively and significantly.

The results reported in Panel A are consistent with the conjecture that there is some path dependence in board size. The coefficients on both the 1990 and 1995 lagged values of board size are approximately 0.388 and both are highly significant, indicating a fairly high elasticity of board size with respect to board size ten years earlier. Inclusion of the 1995 and 1990 board sizes increases the adjusted R-squared by 7.8% over the adjusted R-squared of the model that does not include any lagged board size (results not reported), further indicating the high degree of intertemporal correlation in board size. The coefficient drops to 0.245 for 1985 board size, but it remains highly significant. In the absence of other explanatory variables that explain board size and given that board size is highly correlated over time, these results suggest path dependence in board size.

Panel B of Table 4 contains the corresponding results for insider representation on boards. The results show that inclusion of the 1995 lagged value of insider representation to the model compared with the model including no lagged values of insider representation as independent variables increases the adjusted R-squared from 10.82% (result not reported) to 31.37%, indicating a high degree of serial correlation. The coefficient on the 1995 value of insider representation is 0.502 and highly significant, indicating a high intertemporal correlation of insider representation over the five year interval. The coefficient on the 1990 lagged value of insider representation drops substantially to 0.166, and is significant at the 0.05. None of the other lagged values of insider representation are significant, indicating substantially less serial correlation, and perhaps path dependence, in insider representation than in board size.

## 5. Revisiting the relation between firm performance and the size and structure of boards

Previous literature has documented a relation between different measures of firm performance and the size and structure of boards (e.g., Yermack (1996)). Until recently, the studies had estimated the relation in a single equation OLS or fixed effects model, in which a measure of firm performance, such as the firm's market-to-book ratio is regressed on, among other variables, the size or structure of boards. The experimental design in these studies treats the attributes of boards as if they are determined exogenously, which we argue, for reasons discussed earlier, is not appropriate.[7]

To examine whether the relation between firm performance and board characteristics is affected when board characteristics are treated as endogenous variables, we estimate the relation for a panel dataset consisting of the sample of 81 firms during 1935-2000. We use a fixed effects model in which dummy variables for firms are included as independent variables. We first report results for a fixed effects regression model in which firm performance is the dependent variable and board characteristics are treated as exogenous variables, as they generally have been in the published literature to date. We then report results from two-stage least squares (2SLS) estimates, in which board size and structure are treated as endogenous variables.

### *5.1. Treating board characteristics as exogenous*

Table 5 reports results from various models in which firm performance is regressed on, among other variables, the size and structure of boards. We use a fixed effects model that controls for inter-firm variation in performance. Two measures of firm performance are used: (i) the ratio of the market value of assets to the book value of assets and (ii) operating margin (i.e., the ratio of

[7] Three recent papers treat board characteristics as endogenous variables. See Coles, Daniel & Naveen (2004), Boone Field, Karpoff, and Raheja (2004), and Yang, Linck, and Netter (2004).

operating income to sales)[8] Independent variables include a proxy for firm size (i.e., either firm market value or sales), board size, and board composition, defined as the percentage of the board consisting of inside directors. When the market-to-book ratio serves as the dependent variable, we also include operating margin and the ratio of property plant and equipment to total assets, and subsequent sales growth (measured as the natural log of the ratio of realized sales five years hence to sales in the contemporaneous year) in as independent variables.

Panel A of table 5 reports the results for the model in which the dependent variable is the market-to-book ratio. When firm market value is used as the proxy for firm size, the coefficient on board size in all equations is negative and significant, consistent with prior literature. However, when sales is used as the proxy for firm size, the coefficient on board size is not significant. Board composition enters with a positive and significant coefficient, indicating a direct association between the percent of insiders on the board and market-to-book ratios, when the proxy for firm size is firm market value. When the proxy for firm size is sales, the coefficient on board composition is not significant. All of the control variables enter with significant coefficients. Firm market value, sales, operating margin and subsequent sales growth enter with positive coefficients, and the ratio of property plant and equipment to total assets enters with a negative and significant coefficient.

Panel B presents the corresponding results for the models in which operating margin serves as the dependent variable. The coefficient on board size is negative and not significant at the 0.05 level in all equations. The coefficient on board composition is positive and significant at the 0.01 level. The coefficient on firm market value and sales are positive, and significant, in all equations. Property plant and equipment enters with coefficients that are not significant in any of the equations.

[8] The results do not change significantly when return on assets is used instead of operating margin.

Some results reported in table 5 are consistent with prior literature that documents an inverse relation between board size and proxies for firm performance. Similarly, table 5 documents a positive association between board composition and firm performance in several equations, which, by similar reasoning, is consistent with the hypothesis that more insiders on the board cause better firm performance. We next examine whether the results in table 5 change significantly when board size and composition are treated as endogenous, rather exogenous, variables.

*5.2. Treating board characteristics as endogenous*

Table 6 presents results from a two stage least squares ("2SLS") model in which the dependent variables are board characteristics and firm performance. In panel A, we estimate (i) the determinants of board size and market-to-book ratio in two sets of simultaneous equations and (ii) the determinants of board composition and market-to-book ratio in two other sets of simultaneous equations. Panel B presents the corresponding results for a recursive model in which the dependent variables are the two board variables and operating margin as the measure of firm performance.

Panel A reveals that both market-to-book ratio and firm size enter the board size equation with significant coefficients that have the anticipated signs. After board size is endogenized, its estimated coefficient in the market-to-book equation is either positive and significant (when the proxy for firm size is firm market value) or positive and not significant (when the proxy for firm size is sales). The absence of a negative relation between board size and firm performance is inconsistent with the view that small board size causes increases in firm performance, which is the inference frequently drawn from empirical models that treat board size as exogenous. .

Panel B shows the results when operating margin is used as the measure of firm performance. Both market-to-book ratio and firm size enter the board size equation with coefficients that are significant and have the anticipated signs. After endogenizing board size, its

coefficient in the operating margin equation is negative and not significant. In contrast, the coefficient on board size was negative and significant at the 0.10 level when board size is treated as an exogenous variable (see table 5). The absence of a relation between board size and operating margin is consistent with the view that firms generally select board sizes that suit their purposes.

Panels A and B present the corresponding results for board composition. When market-to-book ratio is used as the proxy for firm performance, as seen in panel A, board composition enters with a positive coefficient that is significant at the 0.01 level when firm size is proxied by firm market value and significant at the 0.10 level when sales is used as the proxy for firm size. When operating margin is used as the proxy for firm performance, as seen in panel B, the coefficient on board composition enters with a positive sign and it is significant at the 0.01 level. The results are inconsistent with the view that more outside directors cause increases in firm performance..

## 6. Discussion and conclusion

The evidence presented in this paper is consistent with the view that the size and structure of boards of directors are determined by tradeoffs involving the incremental information that directors bring to boards versus the incremental coordination costs and free rider problems engendered by their additions to the boards. We find that two variables, firm size and growth opportunities, explain a large amount of the cross-sectional and intertemporal variation in the size and structures of boards. Board size increases in firm size and decreases in growth opportunities, whereas insider representation decreases in firm size and increases in growth opportunities. The results suggest that an underlying logic explains the variation in board size and structure, one consistent with value maximization.

The evidence on the endogeneity of board size and structure has important implications for both the scholarly literature on boards and the public discourse on reform of corporate boards. First, many scholarly empirical papers treat board characteristics as exogenous and infer from their results that certain board sizes and structures cause differences in firm value and other measures of firm performance (e.g., Yermack (1996), Eisenberg, et al (1998)). In light of our results, and other studies that attempt to control for endogeneity of board characteristics (Hermalin and Weisbach (1991), Bhagat and Black (1999)), we are skeptical that one can infer causality from studies that treat board characteristics as exogenous. We find that after treating board size and structure as endogenous variables, no robust relation exists firm performance and these board characteristics.

Second, the results suggest that "one size fits all" approaches to reform of corporate boards are likely to impair the effectiveness of boards. For example, advocates of small boards (e.g., Lipton and Lorsch (1992), Jensen (1993)) appear to be underestimating the informational advantage of large boards for firms that are large, relatively easy to monitor, and less in need of nimble governance. Similarly, those who advocate that boards consist of a minimum number of outside directors (or a maximum number of inside directors) are underestimating the costs that such boards would have on firms with high growth opportunities, large information asymmetries, and a greater need for nimbleness. For example, such constraints could impose high costs on firms such as Genentech, where scientific knowledge and nimble decision-making are highly valued.

Other interesting topics emerge from the evidence compiled in this paper. For example, the sample for this paper consists of firms that survived over a long period. Do the results hold with the same strength for a sample of firms that do not survive, i.e., firms that become extinct during

1935-2000 via either bankruptcy or takeover? If not, can we infer that board size and structure are important variables that affect Darwinian survival in competitive markets. Are firms that are slow to adapt their boards to changes in the environment less likely to survive?

Second, what other variables explain variation in size and structure of boards, either cross-sectionally or over time? We find that, after controlling for firm size and growth opportunities, there has been a secular decline in board size and insider representation over time. What explains this pronounced result? Have changes in directors' liability increased the costs of large boards, thereby contributing to a decline in board size over time? Has deregulation across a wide range of industries contributed to a contraction in board sizes over time? Have public pressures and changes in exchange listing standards contributed to the decline in insider representation on boards? What role have advances in information technology had on board size and structure?

Third, does the geographic proximity of outside directors to headquarters vary systematically across firms? For example, proximity to headquarters can affect monitoring costs for certain types of activities, such as activities involving large information asymmetries. Is there a relation between growth opportunities and the physical location of directors? Have advances in transportation and communications over time increased the distance of outside directors from headquarters? Have these advances contributed to better governance by expanding the pool of outside directors for individual firms?

Fourth, what is the relation between board characteristics and other dimensions of a firm's governance structure and have these relations changed over time? For example, do firm size and growth opportunities affect board characteristics and ownership structure jointly? Has the growth in institutional ownership over time affected the size and structure of boards?

Fifth, is there path dependence in board size and structure? If so, what are the sources of the path dependence? Can firms get stuck with boards that are "out of equilibrium?" If so, is there evidence that these "out of equilibrium" boards are associated with poor performance? How long does it take to adapt to a new equilibrium? The residuals from our models of board size and insider representation can be used to identify firms that might serve as an interesting sample for studying these questions.

## References


Adams, R. and Mehran, H. 2003 "Is Corporate governance different for bank holding companies?" Federal Reserve Bank NY Economic Policy Review 9, Number 1.

Agrawal, A. and Knoeber, C.R. 1996 "Firm performance and mechanisms to control agency problems between managers and shareholders" Journal of Financial and Quantitative Analysis, 31(3), 377-397.

Arthur, N. 2001 "Board Composition as the Outcome of an internal bargaining process: empirical evidence" Journal of Corporate Finance 7, 307-340.

Baker, M. and Gompers, P.A. 2001 "The determinants of board structure at the initial public offering" Working paper, Harvard University and NBER.

Barclay, M. J. and Smith, C. W. 1995a "The maturity structure of corporate debt" Journal of Finance 50, 609-632.

Barclay, M. J. and Smith, C. W. 1995b "The priority structure of corporate liabilities" Journal of Finance 50, 899-917.

Bathala, C. and Rao, R. P., 1995 "The determinants of board composition: an agency theory perspective". Managerial and Decision Economics 16, 59-69.

Bhagat, S. and Black, B. S. 1999 "The uncertain relationship between board composition and firm performance" Business Lawyer 54, 921-963.

Boone, A., Field, Laura C., Karpoff, J., and Raheja, C.G., "The determinants of corporate board size and composition: an empirical analysis," 2004.

Buchanan, J. M. and Tullock, G. 1974 "The calculus of consent" The University of Michigan Press, Ann Arbor, Michigan.

Coles, J. L., Daniel, N., and Naveen, L., "Boards: does one size fit all," working paper, 2004.

Coles, J. L., Lemmon, M. L. and Meschke, J. F. "Structure models and endogeneity in corporate finance" working paper, Financial Management Association, 2003.

Cornett, M. M., Hovakimian, G., Palia, D. and Tehranian, H. 2003 "The impact of the manager-shareholder conflict on acquiring bank returns" Journal of Banking and Finance 27, 103-131.

Crutchley, C. E., Garner, J. L. and Marshall, B. B. 2003 "Volatile or entrenched? A comparison of board stability between newly public and mature firms" Working paper.

Dalton, D.R. and Kesner, I.F., 1987 “Composition and CEO duality in boards of directors: an international perspective” Journal of International Business Studies 18, 33-42.

Del Guercio, D., Dann, L. Y. and Partch, M. M. 2003 “Governance and boards of directors in closed-end investment companies” Journal of Financial Economics 69, 111-152.

Demsetz, H. and Lehn, K., 1985 “The structure of corporate ownership: causes and consequences” Journal of Political Economy 93, 1155-1177.

Demsetz, H. and Villalonga, B., 2001 “Ownership structure and corporate performance” Journal of Corporate Finance 7, 209-233.

Denis, D. and Sarin, A. 1999 “Ownership and board structure in publicly traded corporations” Journal of Financial Economics, 48, 35-54

Fama, E. 1980 “Agency problems and the theory of the firms” Journal of Political Economy 88, 288-307.

Fama, E., and M. Jensen, 1983 “Separation of ownership and control” Journal of Law and Economics 26, 301-325.

Frye, M. and Smith, D.S. 2003 “IPO shocks to corporate governance: stockholder vs. stakeholder Firms” Working Paper.

Eisenberg, T., Sundgren, S. and Wells, M. T. 1998 “Larger boards size and decreasing value in small firms” Journal of Financial Economics 48, 35-54.

Gaver, J. J. and Gaver, K. M., 1993 "Additional evidence on the association between the investment opportunity set and corporate financing, dividend and compensation policies," The Journal of Accounting and Economics (January/April/July) 125-160.

Haleblian, J. and Finkelstein, S. 1993 “Top management team size, CEO dominate, and firm performance: the moderating roles of environmental turbulence and discretion”. Academy of Management Journal, August, 844-863.

Hermalin, B. and Weisbach, M. S. 2001 “Boards of directors as an endogenously determined institution: a survey of the economic literature” NBER working paper 8161.

Hermalin, B. and Weisbach, M. S 1998 “Endogenously chosen boards of directors and their monitoring of the CEO” The American Economic Review 88, 96-118.

Hermalin, B. and Weisbach, M. S 1991 “The effects of board composition and direct incentives on firm performance” Financial Management 20 (4), 101-112.

Hermalin, B. and Weisbach, M. S 1988 “The determinants of board composition” The Rand Journal of Econonomics 19 (4), 589-606.

Himmelberg, C. P., Hubbard, R. G. and Palia, D., 1999 “Understanding the determinants of managerial ownership and the link between ownership and performance” Journal of Financial Economics 53, 353-384.

Holmstrom, B. 1979 “Moral hazard and observability” Bell Journal of Economics 10, 74-91.

Jensen, M. C. 1986 “Agency costs of free cash flow, corporate finance and takeovers” American Economic Review, Vol. 76 (2), 323-29.

Jensen, M. C. 1993 “The modern industrial revolution, exit, and the failure of internal control systems” Journal of Finance, 831-880.

Klein, A. 2002 “Economic determinants of audit committee independence”. The accounting Review, April, 435-452.

Kole, S., 1996 “Managerial ownership and firm performance: incentives or rewards? Advances in Financial Economics 2, 119-149.

Kole, S. and Lehn, K. M., 1999 “Deregulation and adaptation of governance structure: the case of the U.S. airline industry” Journal of Financial Economics 52, 79-117.

Lehn, K., Mandelker, G. and Patro, S. 2003 “Determinants of board Size – Evidence from mergers in the banking Industry” Working Paper, University of Pittsburgh

Lipton, M. and Lorsch, J. W. 1992 “ A modest proposal for improved corporate governance” Business Lawyer 48, 59-77.

Mak, Y. T. and Li, Y., 2001 “Determinants of corporate ownership and board structure: evidence from Singapore”. Journal of Corporate Finance 7, 235-256.

Mak, Y. T. and Kusnadi, Y. 2002 “Size really matters: further evidence on the negative relationship between board size and firm value” Working paper

Mak, Y. T. and Roush, M. L., 2000 “Factors affecting the characteristics of boards of directors: an empirical study of New Zealand initial public offering firms”. Journal of Business Research 47, 147-159.

Monks, R. A. G. and Minow, N. 2000 “Corporate Governance” 2nd. Edition Blackwell Publishing Co.

Morck, R., Shleifer, A. and Vishny, R., 1988 “Management ownership and market valuation: An empirical analysis” Journal of Financial Economics 20, 293-315

Myers, S. C. 1977 “Determinants of corporate borrowing” Journal of Financial Economics 5, 147-176.

Narasimhan, K. 2002 “Are bigger boards less efficient? Evidence from investment and debt policies during the ‘Great Depression’” Working paper, Duke University.

Prevost, A. K., Rao, R. P. and Hossain, M., 2002 “Determinants of board composition in New Zealand: a simultaneous equations approach” Journal of Empirical Finance 9, 373-397.

Raheja, C. 2003 “The interaction of insiders and outsiders in monitoring: A theory of corporate boards” Working Paper, Vanderbilt University.

Scharfstein, David S. 2000 “The dark side of internal capital markets II: evidence from diversified conglomerates” NBER working paper.

Scharfstein, David S. and Stein, J. C. 2000 “The dark side of internal capital markets: divisional rent-seeking and inefficient investment” NBER working paper.

Schwartz, E.S. and M. Moon, 2000 "Rational Pricing of Internet Companies", Financial Analysts Journal 56:3, 62-75

Smith, C., and Watts, R., 1992. “The investment opportunity set and corporate financing, dividend, and compensation policies” Journal of Financial Economics 32, 263-292.

Tufano, P. and Sevick, M. 1997 “Board structure and fee-setting in the U.S. mutual fund industry” Journal of Financial Economics 46, 321-355.

Van Ees, H., Postma, T. J. and Sterken, E. 2003 “Board characteristics and corporate performance in the Netherlands”. Eastern Economic Journal, Winter, 29-41.

Wu, Y. 2003 “The impact of public opinion on board structure changes, director career progression, and CEO turnover: evidence from CalPERS’ corporate governance program” Journal of Corporate Finance 184, 1-29.

Williamson, O. E. 1975 "Markets and hierarchies: Analysis and antitrust implications: studies in the economics of internal organization". New York, NY: The Free Press

Yang, T., Linck, J.S., and Netter, J.M., “A large sample study on board changes and determinants of board structure,” working paper, 2004.

Yermack, D. 1996 “Higher market valuation of companies with a small board of directors” Journal of Financial Economics 40, 185-211.

**Appendix A**
**List of sample firms**

| Name of Company* | Name of Company* |
|---|---|
| HONEYWELL INTERNATIONAL INC | GOODYEAR TIRE & RUBR CO |
| FORTUNE BRANDS INC | UNIVERSAL CORPORATION |
| A T & T CORP | HERSHEY FOODS CORP |
| ARCHER DANIELS MIDLAND CO | KROGER COMPANY |
| BROWN SHOE INC NEW | STANDARD COMMERCIAL TOBACCO |
| BRUNSWICK CORP | MELVILLE CORP (CVS) |
| UNISYS CORP | GENERAL MILLS INC |
| COCA COLA CO | MCGRAW HILL COS INC |
| DANA CORP | SPARTON CORP |
| DU PONT E I DE NEMOURS & CO | CROWN CORK & SEAL INC |
| EASTMAN KODAK CO | KIMBERLY CLARK CORP |
| EATON CORP | PHELPS DODGE CORP |
| EXXON MOBIL CORP | UNITED TECHNOLOGIES CORP |
| G A T X CORP | BRIGGS & STRATTON CORP |
| GENERAL DYNAMICS CORP | HERCULES INC |
| GENERAL ELECTRIC CO | AMPCO PITTSBURGH CORP |
| GENERAL MOTORS CORP | CURTISS WRIGHT CORP |
| GOODRICH CORP | FOSTER WHEELER LTD |
| INGERSOLL RAND CO LTD | PROCTER & GAMBLE CO |
| RYERSON TULL INC NEW | RAYTECH CORP DE |
| INTERNATIONAL BUSINESS MACHS COR | PHARMACIA CORP |
| NAVISTAR INTERNATIONAL CORP | PENNEY J C INC |
| I T T INDUSTRIES INC IND | STARRETT L S CO |
| MAY DEPARTMENT STORES CO | CATERPILLAR INC |
| MAYTAG CORP | PITTSTON COMPANY |
| OLIN CORP | COLGATE PALMOLIVE CO |
| PEPSICO INC | F M C CORP |
| PHILIP MORRIS COS INC | W H X CORP |
| CONOCOPHILLIPS | MESTEK INC |
| PHILLIPS VAN HEUSEN CORP | DEERE & CO |
| SEARS ROEBUCK & CO | BRISTOL MYERS SQUIBB CO |
| CHEVRONTEXACO CORP | WALGREEN CO |
| SUNOCO INC (Sun Oil) | BOEING CO |
| TIMKEN COMPANY | INTERNATIONAL PAPER CO |
| TOOTSIE ROLL INDS INC | WYETH |
| UNOCAL CORP | GILLETTE CO |
| MARATHON OIL CORP | SCHLUMBERGER LTD. |
| U S T INC | NL INDUSTRIES |
| VULCAN MATERIALS CO | INCO LTD. |
| FOOT LOCKER INC | ITT INDUSTRIES INC. |
| WRIGLEY WILLIAM JR CO | STANDARD COMMERICAL |
| RADIOSHACK CORP | |
| TEXAS INSTRUMENTS INC | |

*The names provided in this Table are the most recent firm name.

**Figure 1 - Size of Board of Directors**

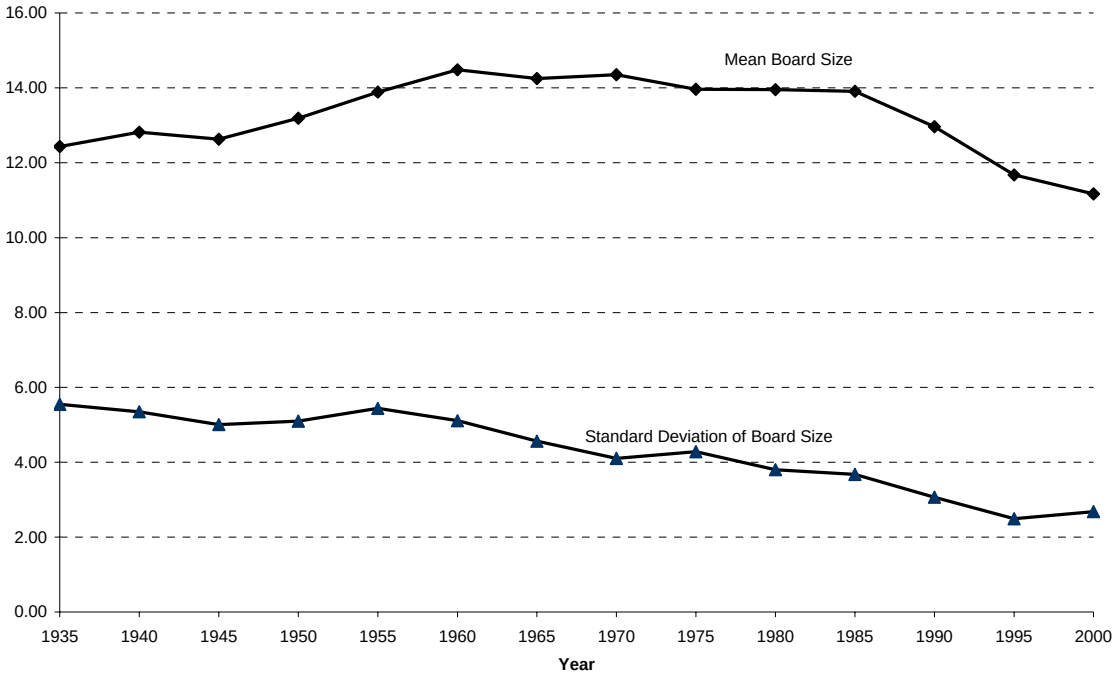



**Figure 2 - Indsier Representation on the Board**

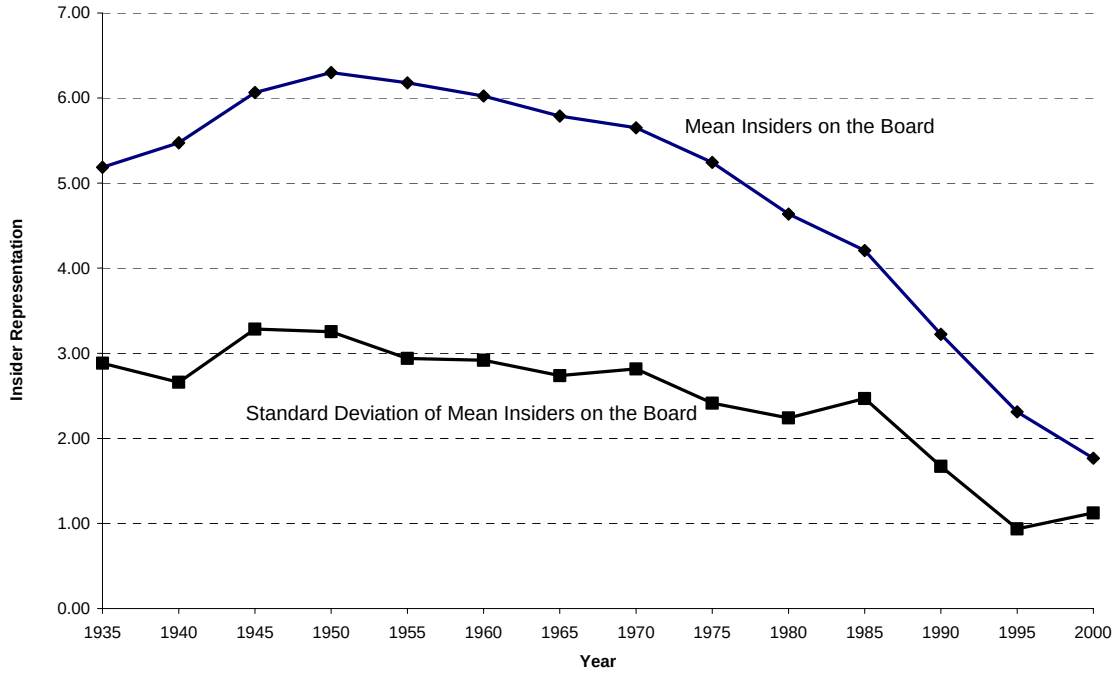


Figure 3 - % of Inside Directors on the board

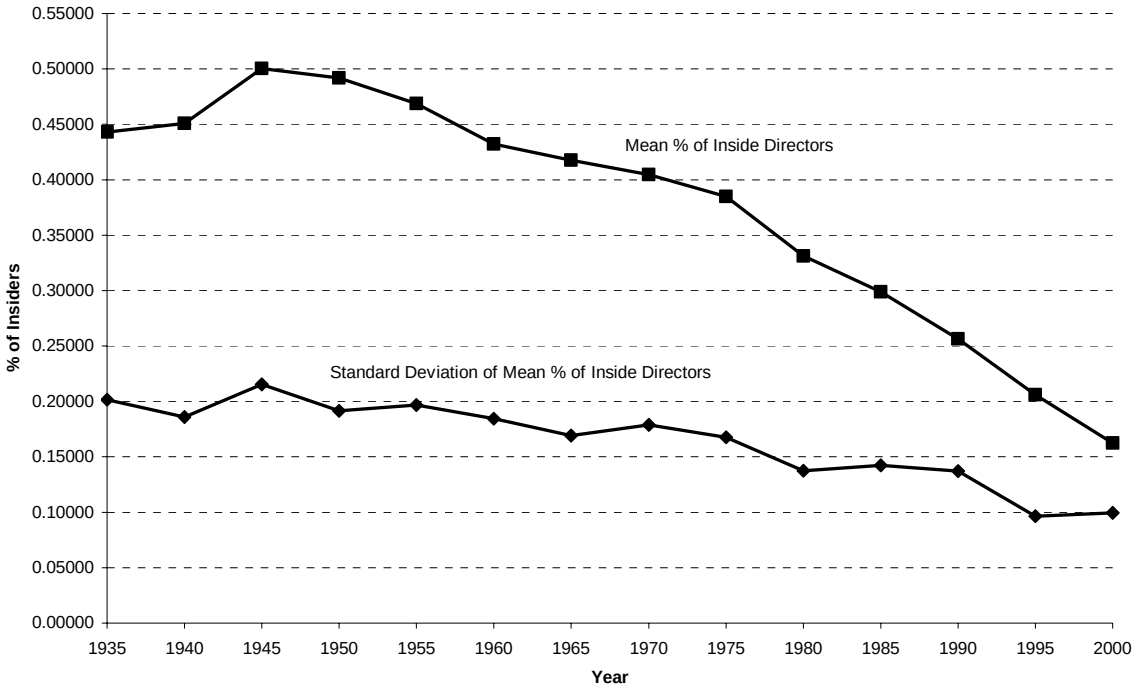



**Figure 4 - Sales Per Director**

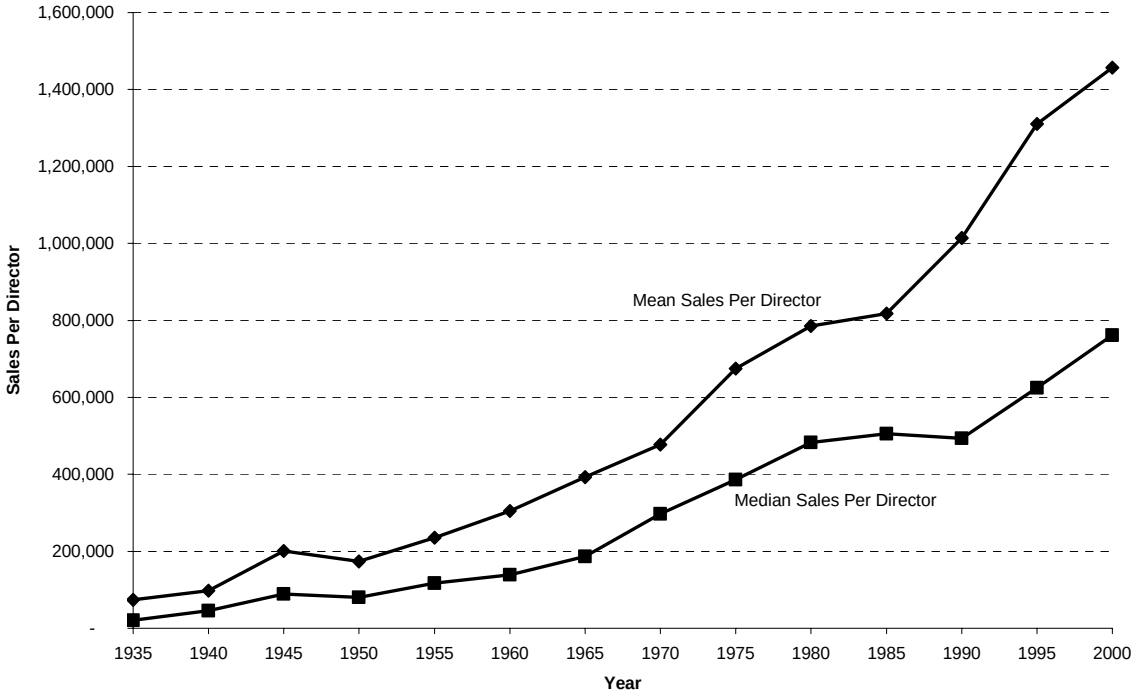


**Figure 5 - Assets Per Director**

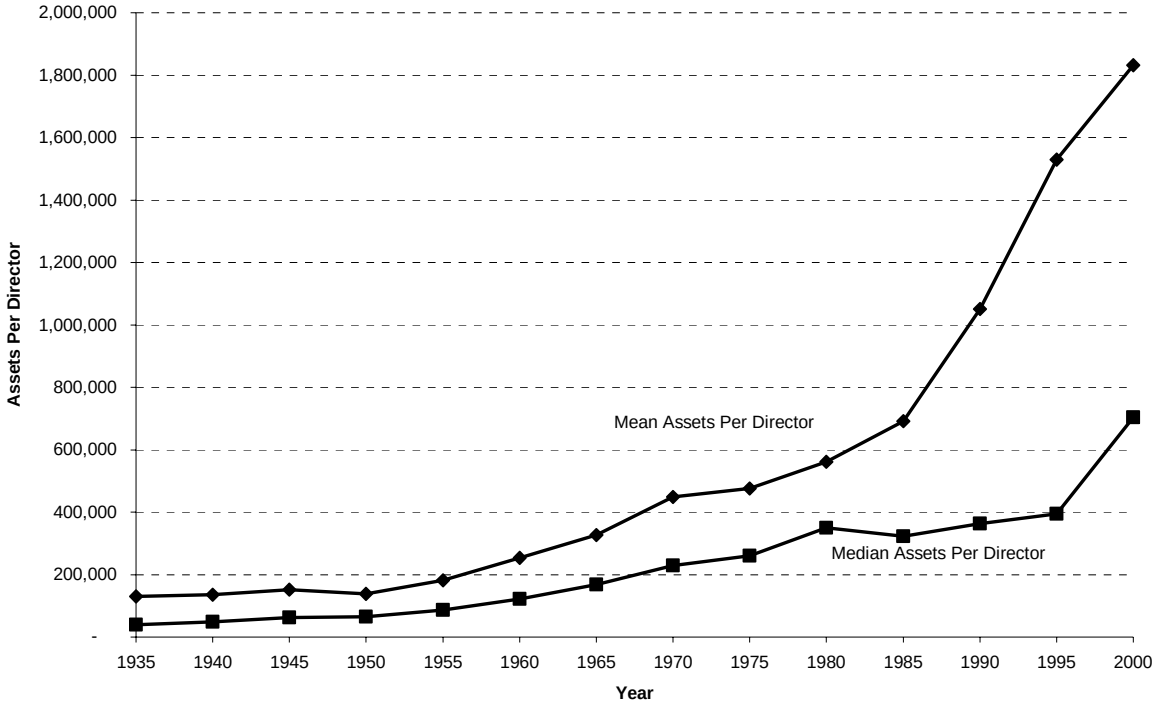
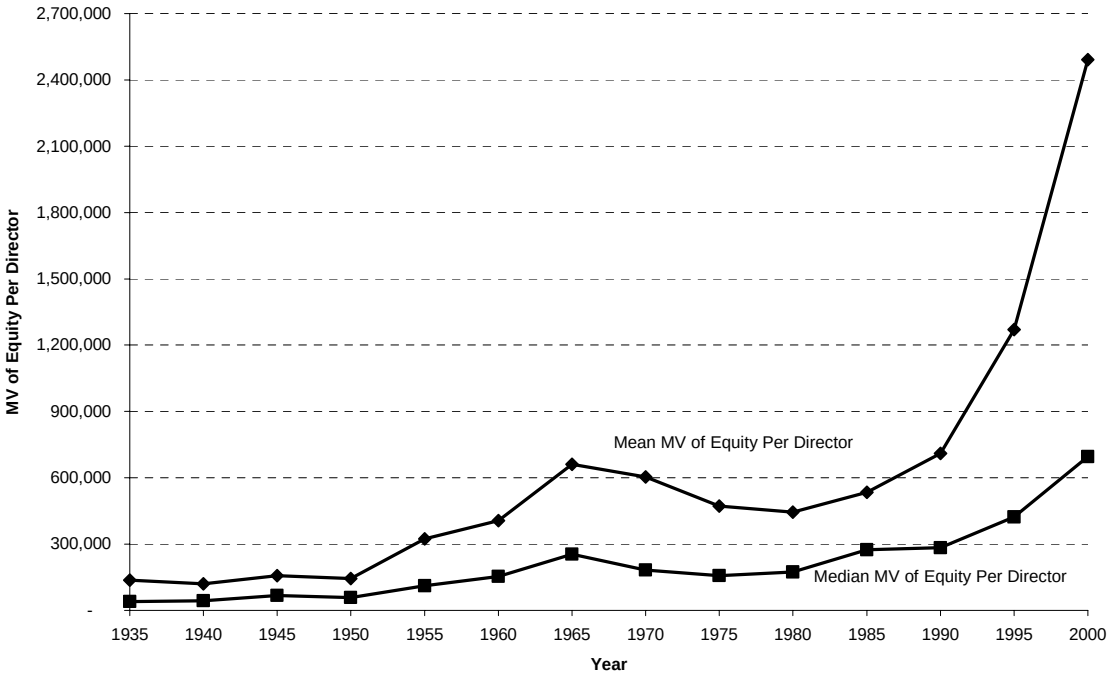



**Figure 6 - MV of Equity Per Director**



## Table 1 Descriptive statistics of sample firms

This Table displays descriptive statistics of sample firms with a five year frequency between 1935 and 2000. It contains four panels. Panel A reports the mean, median, standard deviation and coefficient of variation of sales, assets and market value of equity (MV Equity) of sample firms from 1935 to 2000. Data in Panel A is in '000s of constant dollars of 2000. Panel B reports descriptive statistics of measures of growth options – market-to-book ratio of assets (MTB of Assets), market-to-book ratio of equity (MTB of Equity), ratio of tangible assets (PPE/Assets) and volatility of stock returns (Volatility). Panel C provides descriptive statistics of board size and insider representation (both number of insiders and percentage of insiders) on the board of directors. Panel D lists the similar statistics of sales per director, assets per director and market value of equity per director (MVEquity per director).

### Panel A

| Year | Freq. | Sales | | | | Assets | | | | MV Equity | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Median | Stdev | CV | Mean | Median | Stdev | CV | Mean | Median | Stdev | CV |
| 1935 | 81 | 1,017,467 | 215,404 | 2,234,813 | 2.20 | 1,827,852 | 422,658 | 4,396,770 | 2.41 | 2,159,673 | 476,112 | 4,743,860 | 2.20 |
| 1940 | 80 | 1,448,908 | 493,014 | 2,705,569 | 1.87 | 2,036,289 | 592,471 | 4,477,984 | 2.20 | 1,953,011 | 470,941 | 4,202,588 | 2.15 |
| 1945 | 78 | 2,895,017 | 1,108,347 | 5,299,534 | 1.83 | 2,199,956 | 723,340 | 4,326,643 | 1.97 | 2,407,152 | 787,245 | 4,827,858 | 2.01 |
| 1950 | 80 | 2,754,029 | 993,887 | 5,500,386 | 2.00 | 2,125,313 | 712,593 | 4,293,545 | 2.02 | 2,377,628 | 663,567 | 4,947,785 | 2.08 |
| 1955 | 78 | 3,955,497 | 1,378,823 | 8,622,188 | 2.18 | 2,932,411 | 1,111,383 | 6,352,165 | 2.17 | 5,708,921 | 1,272,644 | 14,224,400 | 2.49 |
| 1960 | 79 | 5,204,883 | 1,998,413 | 9,688,297 | 1.86 | 4,309,736 | 1,802,395 | 8,677,302 | 2.01 | 7,049,835 | 2,193,778 | 13,680,277 | 1.94 |
| 1965 | 80 | 6,618,700 | 2,934,937 | 12,910,535 | 1.95 | 5,458,754 | 2,517,000 | 10,638,850 | 1.95 | 11,465,132 | 4,010,515 | 25,235,052 | 2.20 |
| 1970 | 80 | 7,884,922 | 4,061,516 | 13,563,742 | 1.72 | 7,186,618 | 3,193,778 | 12,453,470 | 1.73 | 10,113,805 | 2,811,963 | 23,320,422 | 2.31 |
| 1975 | 78 | 11,008,578 | 4,998,068 | 20,374,249 | 1.85 | 7,867,898 | 3,873,485 | 14,477,442 | 1.84 | 7,928,133 | 2,281,891 | 16,136,154 | 2.04 |
| 1980 | 80 | 12,884,161 | 6,013,654 | 24,853,897 | 1.93 | 9,212,657 | 4,229,706 | 15,162,624 | 1.65 | 7,139,060 | 2,365,449 | 13,573,269 | 1.90 |
| 1985 | 77 | 13,895,766 | 6,669,310 | 24,452,726 | 1.76 | 11,723,074 | 4,158,011 | 20,255,469 | 1.73 | 8,965,938 | 3,731,918 | 19,808,962 | 2.21 |
| 1990 | 76 | 15,221,134 | 6,439,782 | 26,735,826 | 1.76 | 16,281,331 | 4,324,305 | 35,814,345 | 2.20 | 10,683,233 | 3,756,746 | 18,231,520 | 1.71 |
| 1995 | 77 | 16,225,452 | 6,880,878 | 27,834,562 | 1.72 | 19,362,917 | 5,367,916 | 40,839,422 | 2.11 | 16,116,086 | 5,237,256 | 26,891,795 | 1.67 |
| 2000 | 79 | 19,067,800 | 8,402,000 | 33,028,678 | 1.73 | 23,979,772 | 7,423,100 | 58,932,299 | 2.46 | 32,073,461 | 6,870,615 | 69,170,211 | 2.16 |

**Table 1 (Continued)**

**Panel B**

| Year | Freq | MTB of Assets | | | | MTB of equity | | | | PPE/Assets | | | | Volatility | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Median | Stdev | CV | Mean | Median | Stdev | CV | Mean | Median | Stdev | CV | Mean | Median | Stdev | CV |
| 1935 | 81 | 1.766 | 1.304 | 1.250 | 0.708 | 2.000 | 1.352 | 1.706 | 0.853 | 0.422 | 0.389 | 0.304 | 0.721 | 0.157 | 0.114 | 0.119 | 0.761 |
| 1940 | 80 | 1.381 | 1.080 | 0.914 | 0.662 | 1.522 | 1.096 | 1.274 | 0.837 | 0.383 | 0.367 | 0.211 | 0.551 | 0.088 | 0.072 | 0.049 | 0.557 |
| 1945 | 78 | 1.697 | 1.402 | 1.071 | 0.631 | 2.115 | 1.643 | 1.669 | 0.789 | 0.265 | 0.205 | 0.199 | 0.754 | 0.063 | 0.051 | 0.037 | 0.586 |
| 1950 | 80 | 1.398 | 1.203 | 0.705 | 0.504 | 1.567 | 1.280 | 1.011 | 0.645 | 0.338 | 0.319 | 0.165 | 0.488 | 0.059 | 0.051 | 0.026 | 0.435 |
| 1955 | 78 | 1.891 | 1.671 | 1.088 | 0.575 | 2.411 | 1.995 | 1.779 | 0.738 | 0.339 | 0.328 | 0.164 | 0.482 | 0.051 | 0.045 | 0.019 | 0.371 |
| 1960 | 79 | 2.062 | 1.470 | 1.600 | 0.776 | 2.682 | 1.759 | 2.573 | 0.959 | 0.379 | 0.332 | 0.370 | 0.976 | 0.056 | 0.052 | 0.018 | 0.322 |
| 1965 | 80 | 2.299 | 1.653 | 1.628 | 0.708 | 2.966 | 2.020 | 2.334 | 0.787 | 0.351 | 0.315 | 0.182 | 0.519 | 0.054 | 0.050 | 0.017 | 0.319 |
| 1970 | 80 | 1.759 | 1.355 | 1.172 | 0.666 | 2.256 | 1.618 | 1.837 | 0.814 | 0.381 | 0.365 | 0.155 | 0.406 | 0.064 | 0.062 | 0.019 | 0.291 |
| 1975 | 78 | 1.525 | 1.160 | 1.201 | 0.788 | 2.195 | 1.279 | 4.312 | 1.964 | 0.378 | 0.335 | 0.294 | 0.778 | 0.077 | 0.072 | 0.024 | 0.308 |
| 1980 | 80 | 1.337 | 1.134 | 0.751 | 0.562 | 1.891 | 1.298 | 2.335 | 1.235 | 0.376 | 0.369 | 0.144 | 0.383 | 0.064 | 0.061 | 0.018 | 0.278 |
| 1985 | 77 | 1.478 | 1.335 | 0.646 | 0.437 | 2.022 | 1.607 | 1.825 | 0.903 | 0.392 | 0.393 | 0.165 | 0.420 | 0.069 | 0.063 | 0.021 | 0.301 |
| 1990 | 76 | 1.543 | 1.246 | 0.984 | 0.638 | 1.883 | 1.478 | 2.703 | 1.435 | 0.346 | 0.334 | 0.178 | 0.515 | 0.070 | 0.061 | 0.029 | 0.422 |
| 1995 | 77 | 1.940 | 1.524 | 1.369 | 0.706 | 2.985 | 2.557 | 2.854 | 0.956 | 0.345 | 0.320 | 0.171 | 0.495 | 0.071 | 0.062 | 0.036 | 0.503 |
| 2000 | 79 | 2.237 | 1.509 | 1.778 | 0.795 | 4.530 | 2.705 | 4.811 | 1.062 | 0.316 | 0.282 | 0.166 | 0.524 | 0.098 | 0.092 | 0.026 | 0.269 |

**Table 1 (Continued)**

**Panel C**

| Year | FREQ | Board Size | | | | # of Insiders on the board | | | | % of Insiders on the board | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Median | Stdev | CV | Mean | Median | Stdev | CV | Mean | Median | Stdev | CV |
| 1935 | 81 | 12.43 | 11.00 | 5.545 | 0.446 | 5.19 | 5.00 | 2.881 | 0.556 | 0.443 | 0.429 | 0.201 | 0.455 |
| 1940 | 80 | 12.81 | 11.50 | 5.346 | 0.417 | 5.48 | 5.00 | 2.658 | 0.485 | 0.451 | 0.441 | 0.186 | 0.413 |
| 1945 | 78 | 12.63 | 11.00 | 5.007 | 0.396 | 6.06 | 5.50 | 3.285 | 0.542 | 0.500 | 0.485 | 0.215 | 0.430 |
| 1950 | 80 | 13.19 | 12.00 | 5.097 | 0.386 | 6.30 | 6.00 | 3.255 | 0.517 | 0.492 | 0.513 | 0.191 | 0.389 |
| 1955 | 78 | 13.88 | 13.00 | 5.439 | 0.392 | 6.18 | 6.00 | 2.940 | 0.476 | 0.469 | 0.444 | 0.197 | 0.419 |
| 1960 | 79 | 14.48 | 15.00 | 5.109 | 0.353 | 6.03 | 6.00 | 2.918 | 0.484 | 0.432 | 0.400 | 0.184 | 0.427 |
| 1965 | 80 | 14.25 | 14.00 | 4.566 | 0.320 | 5.79 | 5.00 | 2.736 | 0.473 | 0.418 | 0.389 | 0.169 | 0.405 |
| 1970 | 80 | 14.35 | 14.00 | 4.106 | 0.286 | 5.65 | 5.00 | 2.815 | 0.498 | 0.405 | 0.387 | 0.179 | 0.442 |
| 1975 | 78 | 13.96 | 13.00 | 4.281 | 0.307 | 5.24 | 4.50 | 2.413 | 0.460 | 0.385 | 0.333 | 0.168 | 0.436 |
| 1980 | 80 | 13.95 | 14.00 | 3.802 | 0.273 | 4.64 | 5.00 | 2.240 | 0.483 | 0.331 | 0.333 | 0.137 | 0.415 |
| 1985 | 77 | 13.91 | 13.00 | 3.675 | 0.264 | 4.21 | 3.00 | 2.467 | 0.586 | 0.299 | 0.273 | 0.142 | 0.476 |
| 1990 | 76 | 12.96 | 13.00 | 3.066 | 0.237 | 3.22 | 3.00 | 1.670 | 0.518 | 0.256 | 0.250 | 0.137 | 0.536 |
| 1995 | 77 | 11.68 | 12.00 | 2.494 | 0.214 | 2.31 | 2.00 | 0.936 | 0.405 | 0.206 | 0.182 | 0.097 | 0.468 |
| 2000 | 79 | 11.16 | 11.00 | 2.682 | 0.240 | 1.77 | 1.00 | 1.123 | 0.636 | 0.162 | 0.125 | 0.099 | 0.611 |

**Table 1 (Continued)**

**Panel D**

| Year | Freq | Sales per director | | | | Assets per director | | | | MV Equity per director | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Median | Stdev | CV | Mean | Median | Stdev | CV | Mean | Median | Stdev | CV |
| 1935 | 81 | 73,777 | 20,154 | 172,778 | 2.34 | 130,181 | 39,586 | 340,417 | 2.61 | 137,357 | 39,534 | 244,115 | 1.78 |
| 1940 | 80 | 97,186 | 45,922 | 160,719 | 1.65 | 135,472 | 49,445 | 304,547 | 2.25 | 120,193 | 43,400 | 188,774 | 1.57 |
| 1945 | 78 | 200,952 | 89,188 | 298,396 | 1.48 | 152,291 | 62,462 | 303,835 | 2.00 | 156,973 | 68,008 | 256,838 | 1.64 |
| 1950 | 80 | 174,085 | 79,851 | 270,852 | 1.56 | 138,614 | 65,697 | 277,730 | 2.00 | 144,105 | 58,093 | 239,404 | 1.66 |
| 1955 | 78 | 235,379 | 117,656 | 393,253 | 1.67 | 181,168 | 87,248 | 378,305 | 2.09 | 324,639 | 111,760 | 681,127 | 2.10 |
| 1960 | 79 | 305,350 | 139,122 | 452,452 | 1.48 | 253,870 | 122,273 | 474,821 | 1.87 | 405,982 | 153,255 | 700,882 | 1.73 |
| 1965 | 80 | 392,578 | 186,680 | 604,415 | 1.54 | 327,258 | 168,323 | 579,154 | 1.77 | 661,366 | 253,743 | 1,248,695 | 1.89 |
| 1970 | 80 | 476,890 | 296,994 | 635,519 | 1.33 | 448,967 | 228,735 | 757,332 | 1.69 | 603,597 | 182,159 | 1,253,072 | 2.08 |
| 1975 | 78 | 674,188 | 385,630 | 1,118,852 | 1.66 | 476,498 | 260,080 | 787,850 | 1.65 | 472,779 | 157,678 | 802,407 | 1.70 |
| 1980 | 80 | 784,842 | 482,676 | 1,259,879 | 1.61 | 561,502 | 349,270 | 777,016 | 1.38 | 444,611 | 174,344 | 761,965 | 1.71 |
| 1985 | 77 | 818,088 | 505,433 | 1,176,912 | 1.44 | 691,580 | 323,346 | 1,041,124 | 1.51 | 534,057 | 275,094 | 976,213 | 1.83 |
| 1990 | 76 | 1,013,778 | 493,405 | 1,588,801 | 1.57 | 1,050,977 | 363,608 | 2,060,576 | 1.96 | 710,604 | 284,382 | 1,103,746 | 1.55 |
| 1995 | 77 | 1,310,332 | 625,115 | 2,207,539 | 1.68 | 1,530,117 | 394,192 | 3,040,164 | 1.99 | 1,271,225 | 423,514 | 1,980,464 | 1.56 |
| 2000 | 79 | 1,456,796 | 761,308 | 2,160,533 | 1.48 | 1,831,267 | 703,083 | 4,275,005 | 2.33 | 2,491,831 | 695,954 | 5,041,995 | 2.02 |

**Table 2 Board size and board composition correlation**

This table provides Pearson correlation coefficients of board size and board composition across different years from 1935 to 2000. All the coefficients are significant at 10% or higher. **B1935** indicates board size in the year of 1935 and so on (Panel A), **C1935** indicates insider representation in the year of 1935 and so on (Panel B)

**Panel A**

| | **B1935** | **B1940** | **B1945** | **B1950** | **B1955** | **B1960** | **B1965** | **B1970** | **B1975** | **B1980** | **B1985** | **B1990** | **B1995** | **B2000** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **B1935** | 1.000 | | | | | | | | | | | | | |
| **B1940** | 0.936 | 1.000 | | | | | | | | | | | | |
| **B1945** | 0.898 | 0.929 | 1.000 | | | | | | | | | | | |
| **B1950** | 0.859 | 0.885 | 0.943 | 1.000 | | | | | | | | | | |
| **B1955** | 0.719 | 0.764 | 0.799 | 0.858 | 1.000 | | | | | | | | | |
| **B1960** | 0.703 | 0.712 | 0.742 | 0.818 | 0.824 | 1.000 | | | | | | | | |
| **B1965** | 0.636 | 0.634 | 0.695 | 0.753 | 0.714 | 0.903 | 1.000 | | | | | | | |
| **B1970** | 0.552 | 0.551 | 0.608 | 0.662 | 0.674 | 0.794 | 0.855 | 1.000 | | | | | | |
| **B1975** | 0.598 | 0.601 | 0.612 | 0.646 | 0.579 | 0.726 | 0.778 | 0.733 | 1.000 | | | | | |
| **B1980** | 0.429 | 0.459 | 0.513 | 0.552 | 0.523 | 0.564 | 0.625 | 0.66 | 0.758 | 1.000 | | | | |
| **B1985** | 0.444 | 0.426 | 0.471 | 0.496 | 0.475 | 0.600 | 0.627 | 0.604 | 0.716 | 0.823 | 1.000 | | | |
| **B1990** | 0.349 | 0.311 | 0.379 | 0.401 | 0.369 | 0.506 | 0.526 | 0.549 | 0.624 | 0.701 | 0.781 | 1.000 | | |
| **B1995** | 0.234 | 0.204 | 0.268 | 0.281 | 0.221 | 0.419 | 0.481 | 0.542 | 0.491 | 0.495 | 0.551 | 0.624 | 1.000 | |
| **B2000** | 0.270 | 0.197 | 0.224 | 0.287 | 0.245 | 0.414 | 0.437 | 0.403 | 0.460 | 0.473 | 0.59 | 0.647 | 0.614 | 1.000 |

**Table 4 (Continued)**

**Panel B**

| | C1935 | C1940 | C1945 | C1950 | C1955 | C1960 | C1965 | C1970 | C1975 | C1980 | C1985 | C1990 | C1995 | C2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **C1935** | 1.000 | | | | | | | | | | | | | |
| **C1940** | 0.702 | 1.000 | | | | | | | | | | | | |
| **C1945** | 0.684 | 0.792 | 1.000 | | | | | | | | | | | |
| **C1950** | 0.645 | 0.762 | 0.811 | 1.000 | | | | | | | | | | |
| **C1955** | 0.486 | 0.688 | 0.679 | 0.691 | 1.000 | | | | | | | | | |
| **C1960** | 0.374 | 0.451 | 0.547 | 0.616 | 0.622 | 1.000 | | | | | | | | |
| **C1965** | 0.399 | 0.387 | 0.411 | 0.505 | 0.445 | 0.706 | 1.000 | | | | | | | |
| **C1970** | 0.576 | 0.463 | 0.527 | 0.508 | 0.457 | 0.590 | 0.676 | 1.000 | | | | | | |
| **C1975** | 0.411 | 0.410 | 0.362 | 0.373 | 0.422 | 0.455 | 0.493 | 0.765 | 1.000 | | | | | |
| **C1980** | 0.239 | 0.316 | 0.237 | 0.306 | 0.262 | 0.221 | 0.431 | 0.494 | 0.607 | 1.000 | | | | |
| **C1985** | 0.260 | 0.335 | 0.333 | 0.291 | 0.389 | 0.276 | 0.290 | 0.409 | 0.636 | 0.725 | 1.000 | | | |
| **C1990** | 0.174 | 0.230 | 0.215 | 0.143 | 0.260 | 0.164 | 0.269 | 0.400 | 0.507 | 0.586 | 0.667 | 1.000 | | |
| **C1995** | 0.130 | 0.068 | 0.170 | 0.097 | 0.279 | 0.200 | 0.218 | 0.254 | 0.220 | 0.234 | 0.340 | 0.588 | 1.000 | |
| **C2000** | 0.092 | 0.159 | 0.164 | 0.063 | 0.131 | 0.152 | 0.152 | 0.128 | 0.116 | 0.134 | 0.078 | 0.256 | 0.537 | 1.000 |

## Table 3 Panel model estimate for board size and insider representation

This Table reports results of panel data analyses of determinants of both board size and insider representation on the board. The dependent variable is the Log (Board Size) for Panel A, % of insiders for Panel B, and independent variables include market capitalization (MktCap), market-to-book ratio of assets (MTB Ass), PPE/Assets (PPE Ratio), and Dummy variable equal to 1 if the data is post 1980, equal to 0, otherwise. T-statistics are presented in parentheses.

### Panel A

| | Dependent Variable – Log(Board Size) | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Intercept | 1.237 | 1.739 | 0.646 | 0.754 | 1.049 |
| | (3.916) | (15.821) | (2.030) | (2.493) | (3.411) |
| Log (Mkt Cap) | 0.166*** | 0.069*** | 0.227*** | 0.180*** | 0.109*** |
| | (3.767) | (10.943) | (5.216) | (4.316) | (2.500) |
| Log Mkt Cap^2 | -0.004*** | | -0.006*** | -0.003* | 0.001 |
| | (-2.750) | | (-3.671) | (-1.864) | (0.315) |
| Log MTB Ass | | -0.111*** | -0.117*** | -0.152*** | -0.168*** |
| | | (-6.576) | (-6.928) | (-9.264) | (-9.542) |
| Log PPE Ratio | | 0.031*** | 0.033*** | 0.025** | -0.016 |
| | | (2.315) | (2.493) | (1.965) | (-1.026) |
| Post 80 Time Dummy | | | | -0.156*** (-10.521) | 0.413*** (3.274) |
| Log Mkt Cap & Time Dum | | | | | -0.031*** (-3.698) |
| Log MTB Ass & Time Dum | | | | | -0.037 (-1.149) |
| Log PPE Ratio & Time Dum | | | | | 0.085*** (4.165) |
| Adj R-squared | 59.41% | 61.14% | 61.61% | 65.35% | 66.55% |

*** Significant at 1% level;
**Significant at 5% level;
*Significant at 10% level.

**Table 3 (Continued)**

**Panel B**

| | Dependent Variable – % of Insiders | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Intercept | -0.298 | 1.120 | 0.060 | 0.189 | 0.179 |
| | (12.00) | (13.182) | (0.247) | (0.879) | (0.808) |
| Log Mkt Cap | 0.131*** | -0.059*** | 0.094*** | 0.038 | 0.042 |
| | (3.899) | (-12.020) | (2.810) | (1.296) | (1.332) |
| Log Mkt Cap Sq | -0.006*** | | -0.005*** | -0.002** | -0.002** |
| | (-5.229) | | (-4.624) | (-1.990) | (-2.044) |
| Log MTB Ass | | 0.077*** | 0.071*** | 0.031*** | 0.041*** |
| | | (5.890) | (5.494) | (2.654) | (3.227) |
| Log PPE Ratio | | -0.018* | -0.015 | -0.025*** | -0.025*** |
| | | (-1.690) | (-1.495) | (-2.779) | (-2.308) |
| Post 80 Time Dummy | | | | -0.183*** | -0.372*** |
| | | | | (-17.333) | (-4.084) |
| Log Mkt Cap & Tim Dum | | | | | 0.014*** (2.329) |
| Log MTB Ass & Tim Dum | | | | | -0.037* (-1.661) |
| Log PPE Ratio & Tim Dum | | | | | 0.009 (0.531) |
| Adj R-squared | 34.23% | 36.67% | 37.92% | 52.08% | 52.25% |

*** Significant at 1% level;
**Significant at 5% level;
*Significant at 10% level.

## Table 4 Regression analyses on board size evolution

### Panel A

This panel reports the regression analyses of board size on lagged board size in addition to earlier explanatory variables. The dependent variable is Log (Board size 2000), the independent variables are the board sizes in years of 1935, 1940, 1945, 1950, 1955, 1960, 1965, 1970, 1975, 1980, 1985, 1990, and 1995. T-statistics are presented in parentheses.

| | Intercept | Log(MV) of Equity | Log Mkt Cap Sq | Log(MTB) of Assets | Log(PPE Ratio) | Lag(log( Board Size)) | Adj $R^2$ |
|---|---|---|---|---|---|---|---|
| Lag board size in year 1935 | 1.168 | 0.054 | 0.001 | -0.174*** | 0.055 | 0.074 | **43.36%** |
| | (1.644) | (0.581) | (0.472) | (-3.426) | (1.444) | (1.170) | |
| Lag board size in year 1940 | 1.118 | 0.064 | 0.001 | -0.180*** | 0.058 | 0.049 | **43.80%** |
| | (1.548) | (0.682) | (0.418) | (-3.506) | (1.504) | (0.745) | |
| Lag board size in year 1945 | 1.629 | -0.007 | 0.004 | -0.174*** | 0.065* | 0.072 | **41.00%** |
| | (1.935) | (-0.062) | (0.970) | (-3.407) | (1.685) | (1.063) | |
| Lag board size in year 1950 | 1.081 | 0.062 | 0.001 | -0.169*** | 0.056 | 0.075 | **44.30%** |
| | (1.517) | (0.666) | (0.413) | (-3.212) | (1.490) | (1.087) | |
| Lag board size in year 1955 | 1.203 | 0.055 | 0.002 | -0.183*** | 0.056 | 0.038 | **43.35%** |
| | (1.690) | (0.582) | (0.506) | (-3.436) | (1.437) | (0.551) | |
| Lag board size in year 1960 | 1.192 | 0.043 | 0.002 | -0.163*** | 0.055 | 0.093 | **44.56%** |
| | (1.719) | (0.463) | (0.569) | (-3.041) | (1.467) | (1.230) | |
| Lag board size in year 1965 | 1.198 | 0.038 | 0.002 | -0.157*** | 0.059 | 0.114 | **44.92%** |
| | (1.752) | (0.411) | (0.610) | (-2.890) | (1.591) | (1.369) | |
| Lag board size in year 1970 | 1.257 | 0.033 | 0.002 | -0.167*** | 0.056 | 0.092 | **44.29%** |
| | (1.832) | (0.354) | (0.690) | (-3.108) | (1.495) | (1.030) | |
| Lag board size in year 1975 | 1.129 | 0.047 | 0.002 | -0.161*** | 0.059 | 0.113 | **44.54%** |
| | (1.617) | (0.511) | (0.516) | (-2.947) | (1.553) | (1.289) | |
| Lag board size in year 1980 | 1.065 | 0.057 | 0.001 | -0.160*** | 0.052 | 0.105 | **44.32%** |
| | (1.493) | (0.625) | (0.403) | (-2.832) | (1.401) | (1.049) | |
| Lag board size in year 1985 | 0.765 | 0.060 | 0.001 | -0.122** | 0.043 | 0.245** | **47.20%** |
| | (1.078) | (0.665) | (0.227) | (-2.076) | (1.186) | (2.011) | |
| Lag board size in year 1990 | 0.744 | 0.032 | 0.001 | -0.114*** | 0.052 | 0.387*** | **51.28%** |
| | (1.100) | (0.369) | (0.387) | (-2.167) | (1.438) | (3.499) | |
| Lag board size in year 1995 | 1.136 | -0.029 | 0.003 | -0.128*** | 0.039 | 0.398*** | **51.47%** |
| | (1.764) | (-0.325) | (1.167) | (-2.638) | (1.132) | (3.696) | |

***Significant at 1% level;
**Significant at 5% level;
*Significant at 10% level.

**Table 4 (Continued)**

**Panel B**

This panel reports the regression analyses of board composition on lagged board composition in addition to earlier explanatory variables. The dependent variable is % of insiders in 2000, the independent variables are the % of insiders in years of 1935, 1940, 1945, 1950, 1955, 1960, 1965, 1970, 1975, 1980, 1985, 1990, and 1995. T-statistics are presented in parentheses.

| | Intercept | Log(MV) of Equity | Log Mkt Cap Sq | Log (MTB Ass) | Log (PPE) | Lag (%Insiders) | Adj $R^2$ |
|---|---|---|---|---|---|---|---|
| Lag % Insiders in 1935 | 1.075 | -0.108*** | 0.003** | 0.020 | 0.021 | 0.022 | **9.36%** |
| | (3.163) | (-2.358) | (2.006) | (0.823) | (1.160) | (0.379) | |
| Lag % Insiders in 1940 | 1.087 | -0.113*** | 0.003*** | 0.018 | 0.019 | 0.066 | **10.48%** |
| | (3.176) | (-2.455) | (2.122) | (0.751) | (1.005) | (0.799) | |
| Lag % Insiders in 1945 | 1.642 | -0.183*** | 0.006*** | 0.019 | 0.025 | 0.062 | **17.94%** |
| | (4.127) | (-3.486) | (3.167) | (0.798) | (1.363) | (1.185) | |
| Lag % Insiders in 1950 | 1.093 | -0.108*** | 0.003** | 0.020 | 0.020 | 0.002 | **9.02%** |
| | (3.163) | (-2.335) | (1.975) | (0.822) | (1.095) | (0.027) | |
| Lag % Insiders in 1955 | 1.056 | -0.108*** | 0.003** | 0.014 | 0.021 | 0.062 | **10.30%** |
| | (3.052) | (-2.310) | (1.987) | (0.565) | (1.060) | (1.001) | |
| Lag % Insiders in 1960 | 1.075 | -0.112*** | 0.003*** | 0.014 | 0.016 | 0.089 | **11.55%** |
| | (3.160) | (-2.455) | (2.110) | (0.573) | (0.873) | (1.397) | |
| Lag % Insiders in 1965 | 1.072 | -0.111*** | 0.003** | 0.017 | 0.017 | 0.069 | **10.71%** |
| | (3.149) | (-2.439) | (2.098) | (0.699) | (0.921) | (1.031) | |
| Lag % Insiders in 1970 | 1.092 | -0.112*** | 0.003*** | 0.018 | 0.017 | 0.044 | **9.89%** |
| | (3.199) | (-2.448) | (2.104) | (0.757) | (0.854) | (0.651) | |
| Lag % Insiders in 1975 | 1.090 | -0.112*** | 0.003** | 0.020 | 0.013 | 0.066 | **10.72%** |
| | (3.202) | (-2.448) | (2.077) | (0.821) | (0.655) | (0.928) | |
| Lag % Insiders in 1980 | 1.098 | -0.114*** | 0.003*** | 0.020 | 0.018 | 0.085 | **10.73%** |
| | (3.241) | (-2.499) | (2.143) | (0.822) | (0.996) | (1.037) | |
| Lag % Insiders in 1985 | 1.117 | -0.114*** | 0.003*** | 0.020 | 0.021 | 0.079 | **10.43%** |
| | (3.258) | (-2.481) | (2.116) | (0.840) | (1.140) | (0.995) | |
| Lag % Insiders in 1990 | 1.046 | -0.111*** | 0.003*** | 0.013 | 0.018 | 0.166** | **13.40%** |
| | (3.103) | (-2.449) | (2.163) | (0.517) | (0.968) | (2.027) | |
| Lag % Insiders in 1995 | 0.741 | -0.083** | 0.003* | -0.001 | 0.011 | 0.502*** | **31.37%** |
| | (2.444) | (-2.076) | (1.881) | (-0.065) | (0.702) | (4.700) | |

***Significant at 1% level;
**Significant at 5% level;
*Significant at 10% level.

## Table 5 Panel model estimates for board size/composition and firm performance

This table reports the panel data analyses of the association between board size/composition and firm performance. The dependent variables are log of market-to-book ratio (Log (MTB Ass)) (Panel A) and operating margin (Panel B). Independent variables include firm size as measured by log of market value of the firm, Log (sales), Log (board size), % of insiders, operating margin, Log (PPE), and Sales growth (post). Sales growth (post) is measured as the natural log of the ratio of realized sales five years hence to sales in the contemporaneous year. T-statistics are presented in parentheses. Our results do not change when we use alternative accounting performance measures.

**Panel A**

| Dependent Variable – Log (MTB Ass) | | | | | | |
|---|---|---|---|---|---|---|
| Intercept | -1.914<br>(-8.82) | -2.255<br>(-10.41) | -3.121<br>(-16.69) | -3.177<br>(-16.74) | -0.893<br>(-3.30) | -0.935<br>(-3.60) |
| Log (MV of firm) | 0.177***<br>(19.72) | 0.181***<br>(18.54) | 0.197***<br>(20.82) | 0.188***<br>(18.94) | | |
| Log (sales) | | | | | 0.050***<br>(3.55) | 0.048***<br>(3.41) |
| Log (board size) | -0.274***<br>(-4.66) | -0.255***<br>(-4.23) | | | -0.025<br>(-0.35) | |
| % of insiders | | | 0.585***<br>(7.37) | 0.438***<br>(5.44) | | -0.002<br>(-0.02) |
| Operating Margin | | 0.857***<br>(9.45) | | 0.830***<br>(9.18) | 1.019***<br>(9.66) | 1.022***<br>(9.67) |
| Log (PPE) | | -0.089***<br>(-3.56) | | -0.085***<br>(-3.41) | -0.093***<br>(-3.16) | -0.093***<br>(-3.18) |
| Sales growth (post) | | 0.170***<br>(9.08) | | 0.166***<br>(8.88) | 0.142***<br>(5.82) | 0.141***<br>(5.80) |
| Adj R-squared (%) | 53.63 | 59.25 | 55.11 | 59.75 | 44.40 | 44.41 |

**Panel B**

| Dependent Variable – Operating Margin | | | | | | |
|---|---|---|---|---|---|---|
| Intercept | 0.048<br>(0.68) | 0.051<br>(0.72) | -0.120<br>(-1.94) | 0.119<br>(-1.92) | 0.040<br>(0.54) | -0.136<br>(-1.96) |
| Log (MV of firm) | 0.010***<br>(3.52) | 0.010***<br>(3.53) | 0.014***<br>(4.59) | 0.014***<br>(4.61) | | |
| Log (sales) | | | | | 0.012***<br>(3.31) | 0.015***<br>(4.23) |
| Log (board size) | -0.030<br>(-1.53) | -0.030<br>(-1.56) | | | -0.033*<br>(-1.70) | |
| % of insiders | | | 0.099***<br>(3.76) | 0.100***<br>(3.79) | | 0.094***<br>(3.58) |
| Log (PPE) | | 0.003<br>(0.33) | | 0.004<br>(0.52) | 0.002<br>(0.18) | 0.002<br>(0.27) |
| Adj R-squared (%) | 15.33 | 15.26 | 16.34 | 16.28 | 15.57 | 16.42 |

*** Significant at 1% level; **Significant at 5% level; *Significant at 10% level.

## Table 6 Board structure and firm performance in a system of equations

Panel A of this table reports regression results of two-stage least square (2SLS) estimation. The dependent variables are Log (board size), % of insiders and Log (market-to-book) ratio. Exogenous variables are defined similar as Table 3 and Table 5. Panel B of this table is the recursive estimate of board size, % of insiders and operating margin. Independent variables are defined similar as Tale 3 and Table 5.

**Panel A**

| Independent Variables | Dependent Variables | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Log (board size) | Log (MTB Ass) | Log (board size) | Log (MTB Ass) | % of insiders | Log (MTB Ass) | % of insiders | Log (MTB Ass) |
| Intercept | 0.040<br>(0.11) | -2.683<br>(-8.33) | 0.254<br>(0.80) | -0.832<br>(-3.50) | 0.448<br>(1.78) | -2.854<br>(-13.51) | 0.353<br>(1.63) | -1.140<br>(-4.28) |
| Log (board size) | | 0.642***<br>(2.81) | | 0.098<br>(0.49) | | | | |
| % of insiders | | | | | | 1.356***<br>(5.83) | | 0.466*<br>(1.82) |
| Log (MTB Ass) | -0.216***<br>(-5.86) | | -0.171***<br>(-10.30) | | 0.125***<br>(4.63) | | 0.042***<br>(3.68) | |
| Log (MV of firm) | 0.227***<br>(4.92) | 0.063***<br>(2.89) | 0.203***<br>(4.77) | | 0.026<br>(0.76) | 0.155***<br>(15.81) | 0.029<br>(0.99) | |
| Log (MV of firm) squared | -0.003***<br>(-2.28) | | -0.003**<br>(-1.96) | | -0.002*<br>(-1.75) | | -0.002*<br>(-1.71) | |
| Log (sales) | | | | 0.035<br>(1.46) | | | | 0.062***<br>(4.82) |
| Log (PPE) | -0.016<br>(-1.16) | -0.115***<br>(-4.50) | -0.010<br>(-0.77) | -0.082***<br>(-3.31) | 0.009<br>(0.90) | -0.100***<br>(-4.17) | -0.005<br>(-0.59) | -0.080***<br>(-3.20) |
| Sales growth (Post) | | 0.174***<br>(6.96) | | 0.160***<br>(5.75) | | 0.149***<br>(6.22) | | 0.167***<br>(6.48) |
| Operating margin | | 1.603***<br>(11.99) | | 1.624***<br>(13.65) | | 1.173***<br>(10.04) | | 1.533***<br>(12.84) |
| Time80Dummy | -0.203***<br>(-9.49) | | -0.195***<br>(-9.49) | | -0.148***<br>(-10.14) | | -0.148***<br>(-10.45) | |
| Adj R-squared (%) | 36.34 | 30.96 | 39.28 | 20.80 | 17.83 | 34.54 | 18.53 | 20.66 |

*** Significant at 1% level; **Significant at 5% level; *Significant at 10% level

**Table 6 (Continued)**

**Panel B**

| Independent Variables | Dependent Variables | | | |
|---|---|---|---|---|
| | Log (board size) | Operating Margin | % of insiders | Operating Margin |
| Intercept | 0.120<br>(0.43) | 0.096<br>(0.76) | 0.289<br>(1.53) | -0.245<br>(-3.30) |
| Log (board size) | | -0.050<br>(-1.00) | | |
| % of insiders | | | | 0.248***<br>(4.65) |
| Log (MTB Ass) | -0.175***<br>(-11.21) | | 0.039***<br>(3.70) | |
| Log (MV of firm) | 0.227***<br>(6.06) | 0.011***<br>(3.34) | 0.037<br>(1.46) | 0.020***<br>(5.51) |
| Log (MV of firm) squared | -0.004***<br>(-2.99) | | -0.002***<br>(-2.29) | |
| Log (PPE) | 0.000<br>(-0.01) | 0.00<br>(0.43) | -0.007<br>(-0.87) | 0.009<br>(1.07) |
| Time80Dummy | -0.233***<br>(-12.44) | | -0.167***<br>(-13.22) | |
| Adj R-squared (%) | 38.73 | 7.33 | 24.34 | 8.65 |

*** Significant at 1% level; **Significant at 5% level; *Significant at 10% level.