The Flattening Firm:
Evidence from Panel Data on the Changing Nature of Corporate Hierarchies

Raghuram G. Rajan   Julie Wulf
GSB, University of Chicago   Wharton School
                                                           University of Pennsylvania

Abstract:

Using a detailed database of managerial job descriptions, reporting relationships, and compensation structures in over 300 large U.S. firms we find that the number of positions reporting directly to the CEO has gone up significantly over time. We also find that the number of levels between the lowest managers with profit center responsibility (division heads) and the CEO has decreased and more of these managers are reporting directly to the CEO. We do not find that divisions within the firm are becoming larger so the proximate explanation of these findings is not that organizational restructuring is making more divisional heads important enough to report directly. Instead, our findings suggest that layers of intervening management are being eliminated and the CEO is coming into direct contact with more managers in the organization, even while managerial responsibility is being extended downwards. Consistent with this, we find that the elimination of the intermediate position of Chief Operating Officer accounts for a significant part (but certainly not all) of the increase in CEO reports.

Accompanying the flattening of organizations is a change in the structure of pay. Pay and long term incentives are becoming more like that in a partnership. Salary and bonus at lower levels are lower than in comparable positions in a tall organization, but the pay differential is steeper to the top. At the same time, employees in flatter organizations seem to have more long term pay incentives like stock and stock options offered to them.

Drawing on theories, we offer some conjectures to explain these patterns.

Corporations in the United States have been changing the nature of their activities. Peripheral businesses have been divested as corporations focus more on core areas, and peripheral activities have been outsourced (see, for example, the account in Powell (2001)). At the same time, large corporations have been merging at a historically unprecedented rate (see Pryor (2000)). Even while corporate boundaries are being redrawn, there is some suggestion that the very nature of employment relationships is changing (see, for example, Osterman (1996), Holmstrom and Kaplan (2001), Rajan and Zingales (2000)). How have all these changes affected the way corporations are organized?

In this paper we examine how corporate hierarchies have changed in the recent past. We use a detailed database of job descriptions of top managers, reporting relationships, and compensation structures in over 300 large U.S. firms tracked over a period of up to 14 years. Our objective is to establish some facts about changes over time in the structure of the hierarchy at senior management levels.

Our first finding is that the number of managers reporting to the CEO has increased steadily over time, from an average (median) of 4.4 (4) in 1986 to 7.2 (7) in 1999.[1] We consider several simple explanations for the increase in CEO span of control including firm growth, addition of new positions (e.g. Chief Information Officer), and mergers. Taken together, these explanations account for only part of the trend. Our second finding is that the depth, which is the number of positions between the CEO and the lowest managers with profit center responsibility (division heads), has decreased by

---

[1] Others have found using smaller datasets, and focusing on particular industries, that the manager's span of control seems to be increasing (see, for example, Scott, O' Shaughnessy and Cappelli (1996)), but these studies typically use an indirect measure of span (the number of managers at one level divided by the number of managers in the next level) and focus at levels below the CEO. Our measure of CEO span is potentially more precise because we know who reports to the CEO.

more than 25% over the period.[2] Moreover, the number of division heads reporting directly to the CEO has tripled. One possible explanation of all this is that the organizational hierarchy is becoming flatter.

Another possible explanation, however, is that fewer but larger units are being given profit center responsibility. In other words, it may be that firms have regrouped units into larger divisions so that division heads have become important enough to report to the CEO. But far from becoming larger, the average size of divisions (in terms of the number of employees) has been decreasing even while firm size has remained relatively constant. Instead of becoming more concentrated, managerial responsibility is being extended down the hierarchy to the heads of even smaller units.

This suggests that the increasing span and the decreasing depth indeed reflects the flattening of the managerial hierarchy. One way organizations become flatter is by eliminating intermediary positions between the CEO and division heads. We do find evidence of this. For instance, the Chief Operating Officer, who typically stood between the CEO and the rest of the firm, is increasingly rare. The number of firms with COOs has decreased by approximately 20% over the period.

Flattening of organizations, decentralization of decision-making authority, and the elimination of middle-management layers are certainly consistent with anecdotal evidence in the business press. In fact, General Electric's recent decision to break-up GE Capital into four business units is a case in point. The former chairman of GE Capital, who reported directly to the CEO, is leaving the firm and the four business unit heads

---

[2] Baker, Gibbs & Holmstrom (1994) find that the number of levels is constant over time for the single firm in their study. Using detailed personnel records they infer the number of levels from information about moves between job titles and consider all levels within the firm. By contrast, we focus only on the levels between senior management positions, but have a potentially more accurate measure because of information on reporting levels.

will report directly to the CEO. Jeffrey Immelt (CEO of GE) explained the decision with the statement "the reason for doing this is simple—I want more contact with the financial services teams."[3] This is an example of flattening of GE's organization: the CEO's span increased by 3 (the loss of the Chairman and the gain of 4 unit heads) and the average number of reporting levels between unit heads and the CEO in GE declined.

There is always a possibility that organizational structure simply is a way of conveying status and is otherwise meaningless. For example, some sociologists argue that informal networks play a much more important role than formal titles and positions in determining information flows, coalition formation, and the location of power. To see whether the change in organizational form has effects outside the minds of managers, we examine the structure of pay and how it changes with organizational structure.

We find that compensation in flatter organizations moves closer to that in a partnership, with significant pay increases associated with promotion and a greater emphasis on long-term incentives relative to short-term compensation, especially at the top. The salary and bonus levels for division managers in organizations with wider CEO span are lower in comparison to managers in similar positions in firms with narrow span. The "prize" for promotion defined as the differential in salary and bonus between the CEO position and the division manager position is larger in organizations with wider CEO span. This differential is almost double in firms with 10 or more positions reporting to the CEO as compared to those with less than 4. Finally, flatter organizations pay proportionately more in long-term incentives particularly for CEOs. The value of long-term incentives relative to salary and bonus for CEOs in firms with CEO span of 10 or greater is more than 2 .5 times that in firms with span less than 4.

---

[3] Quote from "G.E. Is Breaking Its Largest Unit Into Four Parts", NY Times, July 27, 2002.

After establishing the facts, we discuss several classes of organizational theories to see if they can account for the facts: agency, information, changes in organizational rents, increasing need for incentives, and increases in the human-capital intensity of work. While space constraints force us to leave a detailed test of the specific explanatory power of each theory to future work, preliminary analysis suggests that some theories show promise.

We are, of course, not the first to point out that organizations might be becoming flatter. This certainly is conventional wisdom in the business press, and a number of academic papers have also alluded to it (see, for example, Powell (1990), Osterman (1996), Scott, O'Shaughnessy & Cappelli (1996) and Useem (1996)). However, there is limited research that systematically characterizes the structure of hierarchies across firms and quantifies changes over time. In addition, we also provide facts on how organizational changes relate to changes in compensation. This then provides a challenging set of patterns for theories to match.

The remainder of the paper is outlined as follows. Section 1 describes the data, Section 2 establishes the facts, and Section 3 considers the facts in light of several theories. A brief conclusion follows.

1. Data Description

Empirical work on the organizational structure of firms is relatively limited. This is primarily due to the lack of detailed information on structures and the difficulty in finding measures that allow comparisons across firms. As a result, previous research relies on either detailed datasets of a single firm (e.g. personnel records in Baker, Gibbs &

Holmstrom, 1994) or less detailed data on a smaller sample of firms (e.g. compensation

survey data of 11 insurance firms in Scott, O'Shaughnessy & Cappelli, 1996).[4] As

alluded to earlier, these studies typically infer the number of levels in the hierarchy from

promotions between positions or define span of control in terms of ratios of the number

of employees at different organizational levels. By contrast, the primary dataset used in

this study includes a panel of more than 300 publicly traded U.S. firms over the years

1986-1999, spanning a number of industries. We use detailed information on job

descriptions, titles, reporting relationships and reporting levels of senior and middle

management positions that allow us to characterize organizational structures of firms in a

potentially more accurate way than previous research.

The primary data used in this study are collected from a confidential compensation

survey conducted by Hewitt Associates, a leading human resources consulting firm

specializing in executive compensation and benefits. The survey is the largest private

compensation survey (as measured by the number of participating firms) and is

comprehensive in that it collects data on more than 50 senior and middle management

positions including both operational positions (e.g. Chief Operations Officer and

Divisional CEO) and staff positions (e.g. Chief Financial Officer and Head of Human

Resources).[5] The survey typically covers all the positions at the top of the hierarchy and

a sample of positions lower down. An observation in the dataset is a managerial position

within a firm in a year. The data for each position include all components of

compensation including salary, bonus, restricted stock, stock options, and other forms of

---

[4] There are several early empirical papers on organizational structure using cross-sectional techniques (e.g. Child (1973) and Pugh, Hickson, Macdonald, Turner, Turner and Lupton (1968)).
[5] In this study we use a subset of the survey's benchmark positions: position descriptions are listed in the Appendix.

long-term incentives (e.g. performance units). To ensure consistency in matching these positions across firms, the survey provides benchmark position descriptions and collects additional data for each position including: job title, number of employees under the position's jurisdiction, the title of the position that the job reports to (i.e. the position's boss), and the number of reporting levels between the position and the board of directors.

We believe the survey data are accurate for several reasons. First, Hewitt consultants are knowledgeable about survey participants because they are assigned to client teams and typically work with specific clients for several years. Moreover, while the participating firms initially match their positions to the benchmark positions in the survey, the consultant follows up to verify accuracy and spends an additional 8-10 hours on each questionnaire evaluating the consistency of responses with public data (e.g. proxy statements) and across years.[6] Potentially of more importance, participants have an incentive to match positions correctly and provide accurate data because they use the survey results to set pay levels and design management compensation programs.

In Table 1, we present descriptive statistics for the firms in the sample. While the dataset includes more than 300 firms, the exact number varies over the period, as firms enter and exit as survey participants. We report statistics on both the whole sample (unbalanced) and the subset of 51 firms that are included in the sample for the entire 14-year period (balanced). The firms in the sample are large, well established and profitable with average size of approximately 48000 employees, age of 85 years since founding, and return on sales of 19% (see Table 1a). The typical firm in the sample is thus a large mature stable firm, not one whose organizational structure is likely to be in flux. The

---

[6]For example, a first-time participating firm reads the position descriptions and is shown examples like the one in figure 1 in order to match their positions to those covered in the survey.

sample firms span many industrial sectors of the economy, with some concentration in the food, paper, chemical, machinery, electrical, transportation equipment, instrumentation, communications and utilities industries (Table 1b).

Our study focuses on two measures of organizational structure: the breadth and depth of the hierarchy. Breadth is represented by the Chief Executive Officer's span of control (SPAN) and is defined as the number of positions reporting to the CEO. Since we know the title of the position that each position reports to (i.e. the position's boss), we can determine which positions report directly to the CEO.[7] Our other measure, depth, represents a vertical dimension of the hierarchy and is defined as the number of positions between the CEO and the divisional CEO. In the survey, a division is defined as "the lowest level of profit center responsibility for a business unit that engineers, manufactures and sells its own products." We focus on the divisional CEO position (hereafter referred to as divisional manager) for two reasons: (i) it is the position furthest down the hierarchy that is most consistently defined across firms; and (ii) it is informative about the extent to which responsibility is delegated in the firm. Figure 1 displays an (edited) example from the survey that demonstrates to participants how to determine the number of reporting levels for each position. The management reporting relationships are clearly illustrated with the line of authority starting with the CEO as the most senior position, moving down to the Chief Operating Officer, Group CEO, Divisional CEO and finally the Plant Manager as the most junior management position.

---

[7] Since the survey is based on benchmark jobs, it is possible that non-standard positions are excluded from the survey. Companies may differ systematically as to the percentage of management positions that are benchmark jobs and this might bias our measure of span. However, since the positions reporting to the CEO are the most senior positions and the primary focus of the survey, we expect the bias to be minimal.

In this example, our measure of depth equals 2 — there are two positions between the CEO and the divisional manager.

Other positions that might be informative about the depth of the hierarchy are Group CEOs (managers with multiple profit center responsibility) and Plant Managers (managers with budget or cost center responsibility), but there are limitations to using either. Group CEOs are defined on the basis of their position in the hierarchy (proximity to CEO or COO). Hence it is harder to infer facts about depth or responsibility from their position. By contrast, divisional managers are defined on the basis of their responsibility, and hence we can infer more about hierarchies from where they are placed. The definition of plant managers is not consistent across industries, especially when one moves from manufacturing to service firms.

The survey data are supplemented with information from several other datasets (Compustat for financial and segment information, Securities Data Company for mergers, Spectrum for institutional shareholdings, and Directory of Corporate Affiliations for year of founding and several industry datasets such as the Bureau of Economic Analysis for information technology capital stock). While the survey is conducted in April of each year and the organizational data describe the firm in the year of survey completion, some statistics (e.g. number of employees in a division) represent the end of the most recent fiscal year. To maintain consistency, we match the supplemental datasets using the year prior to the year of the survey. Finally, not all variables are available for all positions, firms and years, and due to limitations in matching with the supplemental datasets, our samples are smaller for some parts of the analysis.

2. The Facts

2.1. Increasing Span

Having described the data and its sources, let us now examine how firm hierarchies are changing over time. In Table 2, we describe how the number of positions reporting directly to the CEO moves over the period. The number of positions reporting has gone up from a mean (median) of 4.46 (4) in 1986 to 6.70 (6) in 1999, an increase of about 50 percent. One might worry that some of the change is induced by changes in the firms that fall into our sample over time. If we restrict ourselves to the 51 firms that appear throughout the 14 years of our panel, the change is even more dramatic. From a mean (median) of 4.39 (4) it goes up to 7.16 (7), an increase of 63 percent.

Is this simply "hardwired"? Could increasing CEO span reflect the natural growth of firms? No, because firms usually accommodate growth by adding layers to the hierarchy rather than increasing span of control and because firms have not grown significantly over this period. In fact, the average size of the 51 firms appearing throughout, as measured by the number of employees, has fallen from 86000 in 1986 to 70000 in 1999 (see Table 1 a). In the unbalanced panel, the size of firms is constant over time – approximately 47500 in both 1986 and 1999.

An obvious question is whether the growth in CEO reports is a result of mergers – are firms simply stitched together at the seams under a common CEO and would the merger wave account for our findings. To address this we drop from the balanced sample all firms that undertook a significant acquisition(s) (amounting to more than 20% percent of assets in any year) in the previous 3 years. CEO reports still increase from 4.4 in 1986 to 7.0 in 1999. We also drop from the sample all firms that undertook significant

acquisitions at any time during the period covered. Again, CEO reports increase from 4.4 in 1986 to 6.6 in 1999.

Another obvious question is whether the growth in CEO reports is due to increases in diversification. In fact, the average number of segments reported by Compustat (one measure of diversification) for the balanced sample increases from 3.3 in 1986 to 4.8 in 1999 (Table 1a). However, in a firm fixed effects regression of the number of CEO reports on (the logarithm of) the number of employees, the number of segments and a trend variable, the coefficient on the number of segments is insignificant suggesting that the increase in span is not primarily related to increases in diversification.

As an aside, in what follows we have the option of reporting data for the balanced panel of firms reporting throughout or also reporting data for the unbalanced panel. The balanced panel has the virtue of allowing comparisons to be made for the same firms over time. It has the demerit of focusing only on survivors and therefore introducing potential biases. Fortunately, the patterns from the balanced panel look qualitatively like those in the unbalanced panel.

Could the increased span be a result of the creation of new positions such as Chief Information Officer (CIO) or the increasing importance of existing positions such as Head of Human Resources (HHR), who now join more traditional positions such as Chief Financial Officer in reporting directly to the CEO? The data do not support this explanation.[8] In Table 3, we report for the balanced panel the average number of direct reports to the CEO of a particular position. Each CEO had, on average, 0.02 CIOs and

---

[8] Chief Information Officer (CIO or position #8 in the appendix) is defined as the highest level of operating management over the combined functions of programming, data processing, machine operation, and systems work related to data processing. Head of Human Resources (HHR or position #7 in the appendix) is defined as the head of all human resources with responsibility for establishing and implementing corporate-wide policies.

0.37 HHRs reporting in 1986. By 1999, each CEO had 0.18 CIOs and 0.69 HHRs

reporting to them. Thus these two positions account for only about 0.5 of the increased

reports to the CEO. Where do the rest of the reports (equal approximately to 7.16-4.39-

0.5=2.27) come from?

The answer seems to be that they come from traditionally more junior positions.

The average number of group managers reporting directly to the CEO went up from 1.03

in 1986 to 1.49 in 1999 (see Table 3). The number of division managers reporting

directly to the CEO went up from 0.21 in 1986 to 0.66 in 1999. Thus the increase in

direct reports from positions traditionally lower down in the organization accounts for

approximately 40% of what is unaccounted for (0.91 of 2.27).

The number of divisional manager positions reported by survey participants has

increased over time.[9] So perhaps as important as knowing the average number of group

or divisional managers who report to the CEO is knowing what fraction of the group or

divisional managers covered by the survey report to the CEO. Call this the probability of

reporting to the CEO. For group managers this probability increased slightly over the

period, from 0.43 in 1986 to 0.61 in 1998 (but declined to 0.46 in 1999). The probability

that a divisional manager reports to the CEO consistently trended upwards over the

period from 0.05 in 1986 to 0.31 in 1998 (and 0.19 in 1999).

Parenthetically, some traditionally senior positions have also become closer to the

CEO. While 67 percent of CFOs reported to the CEO in 1986, 88 percent report in 1999.

A similar pattern is seen for the General Counsel. Law and finance seem to have become

more important! So have public relations: Only 0.2 public relations officers reported to

---

[9]The average number of divisional manager positions per firm reported in the survey has increased from 4.6
in 1986 to 6.9 in 1999 for the balanced sample.

the CEO in 1986, now it is 0.51. By contrast, strategic planning has not increased in importance: On average, only 0.27 planning officers reported to the CEO both in 1986 and 1999.[10]

2.2. Decreasing Depth and Increasing "Empowerment"

Even though only some division managers report directly to the CEO, the trend for them to be closer to the CEO is more general. Table 4 b column (ii) (balanced sample) suggests that the average depth at which the division manager is located below the CEO (the number of managers between the CEO and the division manager) has fallen, from 1.58 in 1986 to 1.15 in 1999, approximately 27 percent. Interestingly, the correlation between CEO Span and Depth is significantly negative (correlation = -.27 for the whole sample). Wider organizations are also less tall, or put in a time series context, organizations are becoming flatter.

Perhaps then the increasing number of reports to the CEO reflects increasing centralization: Perhaps profit center responsibility has been taken away from smaller units, and they are now part of a larger, more important, unit whose manager is, not surprisingly, closer to the CEO and now may even report directly to him. Again, this hypothesis does not seem consistent with the data. The average size of a division (the lowest level of profit center responsibility) has decreased from approximately 6000 employees in 1986 to 3600 employees in 1999 (see Table 4 b, column (iii)). So divisions are becoming closer, on average, to the CEO even though they are becoming smaller. Managerial responsibility is being pushed further down the organization and yet the top is getting closer to the bottom of the managerial hierarchy. This does suggest flattening.

---

[10] Corporate Research and Development and Manufacturing positions account for approximately 0.20 of the remaining increase in the number of CEO reports.

Of course, there may be a simpler explanation for our findings. The survey is not exhaustive, except at the highest levels in the organization. Perhaps as the survey expanded over time it picked up lower, more obscure, divisional manager positions. This would explain why divisions are getting smaller (but not why their depth is decreasing). Nevertheless, even the premise is incorrect: the survey has expanded in terms of the number of divisional manager positions reported but not in terms of the fraction of the firm covered. For the constant sample, we calculate the ratio of total number of employees under divisional manager positions sampled by the survey to the total number of employees in the firm. As Table 4 b indicates, this ratio was 0.42 in 1986 and 0.4 in 1999. The coverage of the survey has not changed significantly.[11]

Taken together, these findings suggest that corporate hierarchies are becoming flatter. It is not easy to ascribe the label "centralization" or "decentralization" to this. On the one hand, the CEO is getting directly connected deeper down in the organization, a form of centralization. On the other hand, responsibility (and presumably, decision making authority) is also being pushed further down to smaller units, a form of decentralization or using the jargon, "empowerment".

2.3. "Delayering"

That the CEO is getting more directly connected – increasing span, reduced distance from managers -- is consistent with anecdotal evidence that organizations have been getting rid of entire layers of middle management. In general, it is hard to find direct evidence of this without the level of detail our data set offers on reporting relationships –

---

[11] A similar conclusion is reached if one examines the coverage of group positions reported (results available on request from the authors).

simply because positions disappear does not mean that reporting has become more direct, for other positions could insinuate themselves in the middle.[12]

Not only do our data suggest that reporting has become more direct (for instance, that more division managers now report directly to the CEO), but they also suggest that the CEO is becoming more directly connected precisely because of the elimination of intermediate positions: Consider the position of Chief Operating Officer (COO), who has historically served as an intermediary between the CEO and the rest of the organization. As Table 3 indicates, the average number of COO reports to the CEO per firm has fallen from 0.55 to 0.45 over the same period. The position of Chief Administrative Officer (CAO) also seems to exhibit a similar decline. The decline in COO and CAO reports to the CEO is primarily because these intermediate positions are being eliminated, and not necessarily because these officers have less access to the CEO. Conditional on a firm having a COO, the percentage of COOs that reported to the CEO didn't change over the period (very close to 100%). This suggests that the decline in COO reports to the CEO is due to the position being eliminated in the sample firms.

In Table 5 column (i), we return to the unbalanced sample and regress CEO Span against a constant, firm size (the log of the number of employees in the firm), a trend, and firm indicators. The trend is significantly positive. CEO Span increases, on average, by about 0.17 every year. Interestingly, the coefficient on firm size is negative. Since we include firm fixed effects, this suggests growing firms seem to decrease span once we correct for the trend. In column (ii), we also include an indicator for whether the firm has

---

[12] Earlier work has inferred reporting relationships from organizational positions (managers in lower layers are assumed to report to managers in the immediate higher layer). In this case, the elimination of some, but not all, positions in intermediate layers would not allow us to conclude that there is a change in reporting relationships.

a COO and another indicator if it has a CAO. The coefficient on the time trend falls slightly. Interestingly, the coefficient on the presence of a COO is negative, statistically significant, and large (-1.06). Assuming the COO always reports to the CEO, this coefficient suggests her presence reduces the number of CEO reports because an average of 2.06 managers who would otherwise report to the CEO now report to her. In other words, the COO is truly an intermediary.

By contrast, the presence of a CAO increases CEO reports, but by less than 1. Since the CAO also typically reports directly to the CEO, the coefficient estimate of 0.342 suggests that the CAO also intermediates between lower positions and the CEO, but typically fewer than the COO.

Columns (iii) and (iv) suggest the presence of intermediaries like the COO and the CAO unambiguously increase the average depth at which division managers are positioned. If the COO stood between the CEO and all managers, the coefficient on the COO indicator would be 1. That it is lower suggests some divisional managers do not report via the COO. Note that the coefficient on firm size is positive suggesting that growing firms seem to have greater depth. This is consistent with Calvo and Wellisz (1978) who emphasize that growth takes place by adding layers in a hierarchy.

Finally, while the coefficient on the trend falls when we include indicators for the presence of these positions, it does not become insignificant. Thus the elimination of the COO and CAO positions accounts for part, but not all, of the trend. The flattening of organizations is more than the elimination of just a few key intermediate positions.

2.4. The Correlation with Wages

Are increasing span and decreasing depth simply changes on paper with no "real" consequences whatsoever? Does the ostensible proximity to the CEO simply reflect a greater desire on the part of managers for status, with no greater increase in access? We think not. But one strong piece of evidence suggesting that these changes are not all form without any function is from data on compensation. As we shall see shortly, the changes in organizational form seem to be accompanied by systematic changes in pay. Still later, we will see that changes in underlying "technology" correlate well with both the changes in structure and the changes in compensation. This suggests that there might be method in both the organizational changes and the changes in compensation. But we go ahead of ourselves. Let us first establish patterns in compensation.

The data set we have has extensive data on compensation. We would like to see if the flattening of the hierarchy we have described has any correlation with pay patterns. The first question we have is whether divisional managers in flatter organizations are paid more or less than their counterparts in steeper organizations.

The aspects of pay we will consider first are salary and bonus. Before examining the relationship with CEO span, we have to correct, no doubt crudely, for factors that affect pay. [13] We estimate a division manager's excess pay as follows: First, year by year, we find the residual in the regression of the log of the manager's salary and bonus on the firm's size and division size (both measured by the log of the number of employees). We then normalize the residual by the log of the manager's salary and bonus (the qualitative results hold even without this step). We average the residual across all divisional

---

[13] Importantly, the compensation consulting firm controls for differences in division manager positions (for example, differences in t itle or reporting levels) in their attempt to identify similar jobs across companies.

managers in the firm at a depth of 1. We then tabulate means and medians for firms with different levels of CEO Span.

Table 6a column (i) suggests excess pay decreases with CEO reports except for the highest category of CEO reports. Excess pay (multiplied by 1000) has a median (means are also reported in the table in panel b) of 8.6 when CEO span is between 1-3 and -0.8 when CEO span is 10 and above. Divisional managers appear to be paid less in flatter organizations.

Is this compensated for with greater pay as the employee is promoted? So a natural follow-up question is whether the steepness of pay up the hierarchy is higher in flatter organizations. To check this, we compute the steepness of pay, which is the difference between the salary and bonus of the CEO and the salary and bonus of the divisional manager divided by the salary and bonus of the divisional manager and the depth of the divisional manager (in computing steepness, we do not restrict the divisional manager's level). This therefore represents the fractional change in pay per unit of depth. As Table 6a column (ii) indicates, the steepness of wages increases as CEO span increases, going from 2.16 for firms with CEO span of 1-3 to 4.27 for firms with CEO span of 10 and above.[14]

Finally, it is interesting to see if the lower level of salary and bonus in organizations with high CEO span is compensated for by a greater degree of long term incentive pay like stock and stock options. We compute the ratio of the value of incentive

---

[14] Even if we consider divisional managers at depth 1 only, median steepness increases from 2.77 to 4.78. Also, it is interesting to see if steepness is an artifact of the previous result – divisional managers seem to be paid less in flatter organizations. What is interesting is that CEO pay does not seem to adjust down commensurately. While CEO long term incentive pay is positively correlated with span, and CEO salary and bonus negatively correlated, total CEO pay and organization span are uncorrelated.

pay for divisional managers to the value of salary and bonus.[15] Table 6a columns (iii) and

(iv) suggest a positive relationship between CEO span and the degree of long-term

incentive pay (typically stock and stock options) for divisional managers and for CEOs.

Median long-term incentive pay for divisional managers at depth 1 goes up from 0.35 to

0.60. For CEOs, median pay goes up from 0.51 to 1.32. Thus there seems to be more

long-term incentive pay as CEO span goes up, and it is proportionally more at the top.

Employees do seem to be treated more like owners in organizations that have larger CEO

span.[16]

　While we have pooled the data across all years in creating the table, the patterns

are representative of individual years also. It helps to establish statistical significance

because the eye can always discern patterns it wants to see. So in Table 7, we present

regressions of the pay variables against CEO Span and log of firm size. These regressions

should be seen as establishing the sign and significance of the partial correlations rather

than as causal. We report the estimates from OLS, fixed effects, and between regressions.

　The regressions suggest that divisional manager excess pay is strongly negatively

related to CEO Span (Table 7 columns (i)-(iii)). Based on the fixed effects regressions in

column (ii), a one standard deviation increase in Span decreases divisional manager

excess pay by approximately 2.4, which almost eliminates the pay premium for the

average firm with CEO Span of 4-6 (mean of 2.73 in Table 6b column (i)).

---

[15]The value of long-term incentive pay is computed by the consulting firm. Stock options are valued using a modified version of Black-Scholes that takes into account vesting and termination provisions in addition to the standard variables of interest rates, stock price volatility, and dividends. As is standard practice among compensation consulting firms, the other components of long-term incentives are valued using an economic valuation similar to Black-Scholes that takes into account vesting, term provisions, and the probability of achieving performance goals.

[16] The correlations between organizational structure and wages are qualitatively similar using different definitions of components of pay. For example, the patterns in Table 6 are robust when excess pay is defined as base salary (as opposed to base salary plus bonus) and incentive pay is defined as bonus plus long-term incentive pay.

The steepness of pay profiles is positively related to CEO Span (columns (iv)-(vi)). A one standard deviation increase in Span is associated with a 14% increase in steepness for the average firm with CEO Span of 4-6. Therefore, divisional managers in flatter organizations have lower pay and face a more steeply increasing pay profile. It is also clear that long-term pay incentives for the CEO are stronger in organizations with high CEO Span (columns (x)-(xii)). A one standard deviation increase in Span is associated with a 6% increase in long term incentives at the CEO Level. However, long-term pay incentives for divisional managers do not seem to be related to CEO Span (columns (vii)-(ix)).[17]

All this suggests that as organizations are becoming flatter, and even as more responsibility is being hived off to lower levels, pay and incentives are becoming more like that in a partnership. Salary and bonus at lower levels are lower than in comparable positions in a tall organization, but the pay differential is steeper to the top. At the same time, flatter organizations seem to have more long term pay incentives like stock and stock options associated with them, especially at the top. Let us now try and make sense of these facts on organization structure and pay using the theory.

3. Making Sense of the Facts

Perhaps all that we see is a consequence of management fads. Or perhaps organizational change is related to changes in the environment or changes in technology. We will rely on theories of organizational structure and change to guide our choice of

---

[17] However, the fraction of long-term incentives for the CEO is strongly positively correlated with the fraction of long-term incentives for the divisional manager (correlation = 0.72 in the entire sample).

environmental or technological factors that might explain the change. Of course, our analysis should only be viewed as exploratory and suggestive.

3.1. Agency

One possibility is that middle management was always redundant, as the "agency" explanation emphasizes: In the past top management indulged its empire building tendencies (see, for example, Jensen (1986), Jackall (1988), Osterman (1996), Parkinson (1958), and Useem (1996)) by hiring legions of useless middle managers. Equivalently, because competition was limited or governance poor, firms did not fire incompetent managers but simply hired new ones to take their place.

The reason then agency theory would offer for firms getting rid of substantial chunks of middle management is that competition and the governance environment have changed, putting pressure on top management to do better. While competition seems to have been increasing steadily, corporate governance in the United States has also changed. In the 1980s, the hostile takeover stepped up pressure on the large firms that constitute our sample. The corporate raider, Carl Icahn, described his goal as eliminating "layers of bureaucrats reporting to bureaucrats".[18] In the 1990s, large institutional investors replaced the hostile takeover as the source of governance (see, for example, Kaplan (1996)). Useem (1996) suggests that the growing dominance of institutional investors in the stock market has forced structural change in corporations: the elimination of layers of middle management and the restructuring of firms into more autonomous business units.

One crude proxy for the extent of governance pressure on a firm is the extent of institutional shareholding in that firm. In Table 8 columns (i)-(ii), we first present

---

[18] Quoted in Osterman (1996, p17).

regressions with CEO Span and Depth as dependent variables and the log of firm size, a time trend, firm fixed effects, and the lagged percent of shares held by institutions in the firm as explanatory variables. The theory implies that increases in institutional holding put more pressure on management and forced de-layering so we would expect a strong positive correlation between lagged institutional shareholding and CEO Reports and a strong negative correlation between lagged institutional shareholding and Depth. Contrary to the theory, we find there is no significant relationship.[19]

Of course, there is very little consensus in the finance literature on what might be a good measure of governance. So maybe the fault is with the measure and our tests may have weak power. Perhaps also, to sharpen the test we should be focusing more on events where a specific action has been taken, rather than broad measures of organizational change. One such event is when the COO is dropped. When we regress the event that the COO is dropped (firm years where the COO is dropped are coded one and other firm years are coded zero) against log of firm size, trend, firm fixed effects, and the lagged institutional shareholding, we find a negative but insignificant relationship (unreported). When we lag institutional shareholding by two years, we find a significant negative relationship. Such a finding runs counter to the standard agency explanation – the greater the institutional pressure, the less likely a CEO is to drop the COO. Of course, this may reflect a different form of agency where the CEO drops a potential successor whenever oversight by outsiders is weak.

On theoretical grounds also, agency theory may not be a complete explanation. If agency problems had resulted in overstaffing, the solution would be to prune the layers of

---

[19] Instead, we find the only significant relationship is between lagged institutional shareholding and CEO span in the between estimates: On average, institutions seem to be associated with firms with wider CEO span. It is hard to offer a causal interpretation for this association.

middle management, not get rid of them entirely. It seems hard to believe that an entirely inappropriate organizational structure was systematically created only to indulge top management. If this is the case, why do owner-managed or controlled firms like Ford also have steep hierarchical structures?

3.2. Information Technology

Another possibility is that the environment has changed to render middle management redundant. The prime agent of change, according to many, is the growth in information technology. For example, in a classic article, Leavitt and Whisler (1958) predicted that the introduction of Information Technology into organizations would reduce the number of middle managers because their information gathering and coordinating role would be eliminated. While there is some evidence that the introduction of information technology leads to smaller firms (see, for example, Brynjolfsson, Malone, Gurbaxani, and Kambil (1994)), others have argued that the introduction of information technology increases the richness of data to be analyzed and acted upon, and therefore creates more of a role for middle managers (for an excellent discussion, see Pinsonneault and Kraemer (1997)). Thus whether middle management are rendered redundant by information technology turns, in part, on their precise role – whether they simply gather information and transmit it up or whether they also make decisions. Moreover, as recent models suggest, it also depends on whether information technology reduces the cost of communication or whether it increases the capability of lower managers to access information to make decisions.

Garicano (2000) constructs a simple but illuminating model where production workers solve problems and kick problems they cannot solve up the hierarchy. The

greater the ease of communication (one offshoot of investment in Information Technology), the less time a supervisor spends in communicating, and the more problems she can solve, so the greater her span of control. However, the effects of lower costs of communication on the depth (or height) of a hierarchy are more ambiguous. It is easier for a worker to kick a problem upstairs, but she also has more time to solve it herself. Garicano also examines how greater ease of access to databases can affect the optimal hierarchy. Greater the ease of access, the more problems the production worker can solve himself without referring to his superiors, and the less he needs the hierarchy. Therefore, a superior can service more subordinates (increased span), and fewer layers are needed to solve problems.

In sum, the theory suggests increases in the use of information technology increases the span of control for managers, but has ambiguous predictions about its effects on the depth of hierarchies (predictions depend on whether the technology primarily eases communication or access to information). Note finally the ambiguous effects of information technology on the extent to which problems are solved by production workers (that is, the extent of decentralization). A lower cost of communication means the worker solves fewer problems himself, while greater access to databases means he solves more problems.

Here again, it is useful to take a preliminary step to see whether the data are broadly consistent with this explanation. We obtain from the Bureau of Economic Analysis (BEA) the average real stock of the components of capital at the industry level over the time period. The BEA industry data are based on data from the Census Bureau in the benchmark years (1982, 1987, and 1992) and interpolations in the intervening years

24

are made based on data from the Survey of Manufactures and the Annual Capital

Expenditures Survey. These data are used in Stiroh (2001). Using a similar approach, we

determine the change in the importance of Information Technology in a 2-digit industry

by calculating the growth in IT capital stock (normalized by total capital stock) between

the current and prior year. We also calculate this measure for three components of IT:

hardware, software, and communications. The averages of IT-intensity (and its

components) for several industries are summarized in Table 1b columns (v)-(viii). We

include these measures one at a time in our standard fixed effects regression reported in

Table 8.[20]

Given the difficulty of estimating depreciation rates in this industry, and given

how the lines between software, hardware, and communications are becoming fuzzy, the

findings should be viewed with caution. Nevertheless, there does seem to be a strong

relationship between the increasing use of information technology and an increase in

CEO span. This holds when we substitute information technology stock with the stock of

hardware or the stock of software. However, there does not seem to be a significant

relationship between the increasing use of communications technology and the increase

in CEO span. This is troublesome because the positive relationship between the use of

communications technology and CEO span seems, a priori, to be one of the least

ambiguous predictions of the theory.

---

[20]Data on total capital costs are estimates of real non-residential fixed assets (all corporations and proprietorships) from Detailed Fixed Assets Tables available on the BEA website. Series are adjusted using the quality-adjusted PPI deflator. Information technology capital stock includes hardware, software, and communications with components in each category as follows: (i) Hardware includes mainframe computers, personal computers, direct access storage devices, printers, terminals, tape drives, storage devices, integrated systems, and office/ accounting equipment, (ii) software includes prepackaged, custom, and own-account software, and (iii) communications includes communication equipment.

We also do not find that the depth of the organization is related to the use of information technology. Here, of course, the predictions of the theory are more ambiguous. The bottom line is that the use of information technology seems to have some bearing on the changes we see, but the relationship seems a little more complex than our proxies allow us to discern (or the theories predict).[21]

3.3. Change in the Nature of Organizational Rents

Perhaps the explanation lies in a change in the nature of the organization or the nature of work or both. For example, in the large, vertically integrated Chandlerian firms that dominated industries till recently, production technologies and processes were highly firm specific, perhaps making it difficult for firms to recruit at a lateral level. In these firms, surplus middle managers may have been the internal "reserve army", keeping the rents extracted by middle managers in check (see Stole and Zwiebel (1996)). The "deconstruction" of the vertically integrated corporation – caused by a variety of forces like globalization and increased competition -- and the consequent increased reliance on outsourcing, has been accompanied by a standardization of technologies. Potential job mobility has increased, giving workers and firms more outside options. Firms no longer need to keep an internal reserve army, they can simply replace the uncooperative by hiring from the outside (see Rajan and Zingales (2000)).

Explanations like these are not without attraction. For example, perhaps the COO is becoming more of a threat to the CEO in these times when CEO turnover has increased (for evidence on increased CEO turnover, see Parrino (1997)). Perhaps then there is more reason for a CEO to get rid of a COO today than in the past, which may account for the

---

[21] For an illustration of the difficulty in disentangling the complex relationship between IT and work practice, see Bresnahan, Brynjolfson, and Hitt (2002).

(weak) evidence we find that firms with low lagged institutional shareholders are more likely to drop their COO. However, like the Agency explanation, this one cannot be complete. It can account for why some middle managers have been dismissed, but not for why entire layers have been dispensed with. It cannot account for why responsibility is penetrating further down in the hierarchy.

3.4. The Need for Better Incentives

Perhaps the cause is the same – greater competition – but it works through a different channel: it forces firms to provide lower level managers and workers better incentives: Competition induces the need for new products and services. It also increases the pace of change. To foster product innovation and customization, firms have to provide better incentives to their employees. They also have to give them more autonomy so that they can respond more quickly to change.

Autonomy may itself be a source of incentive. The presence of senior management overseeing every move can destroy incentives to innovate (see, for example, Aghion and Tirole (1997)), while the necessity of having decisions approved by higher authorities can make it hard for employees to acquire or use the soft information necessary for customization (Stein (2002)). So the changing nature of the work would mean greater decentralization, less work for superiors and hence greater span and lower depth. Autonomous employees are harder to control and therefore require high-powered incentives in their compensation (Williamson (1985)). This could explain why we find

lower salary and bonus in flat organizations at the divisional level, but a greater fraction of incentive pay.[22]

However, these theories would also suggest – unless further refined – that the top echelons of the managerial hierarchy should become less important if the primary need is to provide self-motivating incentives to lower level workers and managers.[23] In fact, as we have seen in Tables 6 and 7, wages (salary and bonus) go up much more steeply up the hierarchy in flat hierarchies. Moreover, long-term incentives such as stock and stock options do not seem less important for top management. Even as workers and lower-level managers are becoming more critical, top management incentive pay is also growing.

3.5. Growing Human Capital Intensity of Work

So perhaps a better way of characterizing the change is that human capital is becoming more important throughout the firm. In turn, this should affect the way the firm can exercise control. According to the Property Rights theory of Grossman, Hart, and Moore (1986, 1990), the firm obtains control over its employees because of its ownership of critical physical assets. Rajan and Zingales (1998, 2001) argue that it is better to view alienable assets as just one (though perhaps the most important historically) of the critical resources firms can be built around.[24] Rajan and Zingales (2001) show that when a firm can fully appropriate the value of its critical resources – as, for example, when they are alienable physical assets -- hierarchies tend to be tall and narrow. Managers are paid

---

[22] The view of the firm as an incentive system has been emphasized by Holmstrom and Milgrom (1994) and Holmstrom (1999). The link between the power of incentives and delegation of authority (particularly in uncertain environments) is analyzed by Prendergast (2002).

[23] For example, one could argue that effort by top management is also becoming more important but in ways that do not imply the day-to-day coordination and control of subordinates.

[24] There is therefore a strong link between the Property Rights view of Grossman, Hart and Moore, and the Resource Dependence view of the firm (see, for example, Wernerfelt (1984)).

according to their positional power, for example, based on the number of subordinates they command.

When, however, a firm does not have critical assets it can own – as, for example, when value resides in client relationships – it cannot risk giving lower managers too much access to the critical resource (or too many subordinates) and thus too much positional power. Hierarchies become wider, middle managers are eliminated, and the firm bifurcates into top management who are owners/partners and can be trusted with access to clients and worker/managers who cannot till they have served time in the firm (see Rebitzer and Taylor (1997) for an early study of the structure of law firms suggesting this pattern). The wages of divisional managers in these flat firms are lower because they do not enjoy the positional power that their counterparts in tall firms enjoy. But wage profiles going up the hierarchy are much steeper. In addition, managers get substantial ownership rights, especially at the top, giving managers an incentive to stay with the firm despite having many competitors for the top positions.

A specific implication of Rajan and Zingales' development of the property rights literature is that firms that are more physical capital intensive should have a narrower, deeper, hierarchy. One measure of the physical capital intensity of a firm is the real value of fixed assets per employee (RFASSEMP). In Table 8 column (xi), we include this measure along with the other explanatory variables. We find that CEO Span is significantly negatively correlated with the RFASSEMP. The magnitude is also large. A one standard deviation increase in RFASSEMP decreases the number of CEO Span by 0.60 which is approximately an 11% decrease at the mean of 5.29 (Table 2). The estimates in column (xii) indicate that RFASSEMP is also positively and significantly

correlated with Depth. Thus as firms become less physical capital intensive, they become flatter.

There are, however, aspects of the empirical puzzle that the theory does not explain. Rajan and Zingales (2001) suggest responsibility in lower echelons in human capital intensive firms will be more finely divided, perhaps explaining why divisions are becoming smaller. However, there seems to be little correlation between the size of divisions and the physical capital intensity of the firm.

Conclusion

In sum then, we have unearthed a set of facts about the changing nature of corporate hierarchies. The CEO's span of control is increasing even while the number of layers separating managers from the CEO is decreasing, and responsibility is being pushed further down the organization. Furthermore, as organizations are becoming flatter, salary and bonus profiles across the hierarchy are becoming steeper, and long-term incentive pay is spreading through the organization. While there has been work suggesting some of these facts, and while some facts have been widely hinted at in the business press, the nature of our data enables us to establish the widely known facts more firmly and add new ones.[25]

We have also listed a set of theories that might account for the facts: Agency, information, changes in the nature of organizational rents, the need for better incentives, and the increasing human capital intensity of work. While no single theory is fully persuasive, collectively they explain all the facts (and probably their opposite also). Nevertheless, it is plausible that as firms are becoming less physical capital intensive,

---

[25] Scott, O' Shaughnessy and Cappelli (1996), Useem (1996).

their organizational structure and pay patterns are looking more like those in partnerships – flatter organizations, with a period of apprenticeship at lower salary and bonus, large pay increases with promotion, and a significant use of long term incentives like stock options and stock.[26] Establishing the extent of explanatory power of each of the theories is a task for future work.

---

[26] See Scott (1965) for an early account of why professional organizations may have this character.

References

Aghion, Philippe and Tirole, Jean. 1997. "Formal and Real Authority in Organizations" *Journal of Political Economy,* Vol. 105(1). p 1-29.

Baker, G., Gibbs, M. and Holmstrom, B. 1994."The Internal Economics of the Firm: Evidence from Personnel Data" *The Quarterly Journal of Economics.* Vol. 109 (4). pp. 881-919.

Bresnahan, Timothy F; Brynjolfsson, Erik; Hitt, Lorin M. Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm-Level Evidence. *The Quarterly Journal of Economics.* Vol. 117 (1). p 339-76. February 2002.

Brynjolfsson, Erik, Malone, Thomas W., Gurbaxani, Vijay, and Kambil, Ajit. 1994. "Does Information Technology Lead to Smaller Firms?" *Management Science,* Vol. 40, Iss. 12. pp. 1628, 17 pgs.

Calvo, G. and S. Wellisz. 1978. "Supervision, Loss of Control, and the Optimal Size of the Firm" *Journal of Political Economy* (87), pp. 943-952

Child, J. 1973. "Predicting and Understanding Organization Structure" *Administrative Science Quarterly* (18), pp. 168-185.

Garicano, Luis. 2000. "Hierarchies and the Organization of Knowledge in Production" *Journal of Political Economy,* Vol. 108(5). p 874-904.

Grossman, Sanford J and Hart, Oliver D. 1986. "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration" *Journal of Political Economy.* Vol. 94 (4). p 691-719.

Hart, Oliver and Moore, John. 1990. "Property Rights and the Nature of the Firm" *Journal of Political Economy,* Vol. 98(6). pp. 1119-58.

Holmstrom, B. and Kaplan, S. N. 2001. "Corporate Governance and Merger Activity in the United States: Making Sense of the 1980s and 1990s" *Journal of Economic Perspectives,* Vol. 15(2). pp. 121-44.

Holmstrom, Bengt, 1999, ``The Firm as a Subeconomy", *Journal of Law, Economics and Organization*, 15, 74-102.

Holmstrom, Bengt and Paul Milgrom, 1994, ``The Firm as an Incentive System" *American Economic Review,* 84, 972-991.

Jensen, Michael C., 1986, Agency costs of free cash flow, corporate finance, and takeovers, *American Economic Review* 76, 323-329.

Kaplan, S., "Are We All Becoming Henry Kravis Now? The Evolution of US Corporate Governance", 1996, University of Chicago Working Paper.

Lambert, R., Larcker, D. and Weigelt, K. , 1993, "The Structure of Organizational Incentives," *Administrative Science Quarterly*, 38: 438-461.

Lazear, Edward P. and Sherwin Rosen , ``Rank-Order Tournament as Optimum Labor Contracts", *Journal of Political Economy*, 89, (1981): 841-864.

Leavitt, H.H., and T.I. Whisler, "Management in the 1980s", *Harvard Business Review*, Nov-Dec 1958, 41-48.

Osterman, P. 1996. *Broken ladders: Managerial careers in the new economy.* New York: Oxford University Press.

Parkinson, C. Northcote, 1958, *Parkinson's Law or the Pursuit of Progress*, J. Murray: London.

Parrino, Robert. 1997. "CEO Turnover and Outside Succession a Cross-Sectional Analysis" *Journal of Financial Economics*, Vol. 46 (2). p 165-97.

Pinsonneault, Alain and Kraemer, Kenneth L. 1997. "Middle Management Downsizing: An Empirical Investigation of the Impact of Information Technology" *Management Science,* Vol 43 (5). pp. 659-679.

Powell, Walter, 1990, "Neither Market Nor Hierarchy: Network Forms of Organization." In *Research in Organizational Behavior*, edited by Barry Straw and Lawrence Cummings, 295-336. Greenwich, Conn: JAI Press.

Powell, Walter, 2001, "The Capitalist Firm in the Twenty-First Century: Emerging Patterns in Western Enterprise", pp33-68 in Paul Di Maggio ed. *The Twenty-First Century Firm*, Princeton University Press, Princeton NJ.

Prendergast, Canice, 2002, "The Tenuous Trade-off Between Risk and Incentives" *Journal of Political Economy*, vol. 110, no. 5, pp. 1071-1102.

Pryor, Frederic L. 2000. "The Economics of the Good Society: The Variety of Economic Arrangements" *Journal of Economic Literature,* Vol. 38, Iss. 3. pp. 681-683.

Pugh, D.S., D.J. Hickson, C.R. Macdonald, K.M. Turner, C. Turner and T. Lupton. 1968. "Dimensions of Organization Structure" *Administrative Science Quarterly* (13), pp. 65-105.

Rebitzer, John B., and L.J. Taylor, 1997, ``When Knowledge is an Asset: Explaining the Organizational Structure of Large Law Firms," MIT Working Paper.

Rajan, R.G and Zingales, L. 1998. "Power in a Theory of the Firm" *The Quarterly Journal of Economics,* Vol. 113(2). pp. 387-432.

Rajan, R.G and Zingales, L. 2000. **"**The Governance of the New Enterprise", pp 201-227 in *Corporate Governance, Theoretical and Empirical Perspectives,* Xavier Vives ed., Cambridge University Press, 2000.

Rajan, R.G and Zingales, L. 2001. "The Firm as a Dedicated Hierarchy: A Theory of the Origins and Growth of Firms" *The Quarterly Journal of Economics,* Vol. 116 (3). pp. 805-51.

Scott, Elizabeth D, O'Shaughnessy, K C, and Cappelli, Peter. 1996. "Management Jobs in the Insurance Industry: Organizational Deskilling and Rising Pay Inequity" *Broken ladders: Managerial careers in the new economy.* Osterman, Paul, ed., New York and Oxford: Oxford University Press. p 126-54.

Scott, W. Richard, 1965, "Reactions to Supervision in a Heteronomous Professional Organization", *Administrative Science Quarterly*, 10: 65-81.

Stein, J.C., 2002, "Information Production and Capital Allocation: Decentralized vs. Hierarchical Firms", *Journal of Finance (Forthcoming).*

Stiroh, Kevin J., 2001, "Information Technology and the U.S. Productivity Revival: What Do the Industry Data Say? Working Paper, Federal Reserve Bank of New York

Stole, L. A and Zwiebel, J. 1996. "Organizational Design and Technology Choice under Intrafirm Bargaining" *American Economic Review, Vol. 86(1).* pp. 195-222.

Useem, M. 1996. "Corporate Restructuring and the Restructured World of Senior Management" *Broken ladders: Managerial careers in the new economy. Osterman, Paul, ed., New York and Oxford: Oxford University Press. p 23-54.*

Wernerfelt, Birger, 1984, ``A Resource Based View of the Firm," *Strategic Management Journal* 5, 171-180.

Williamson, O. 1985, *The Economic Institutions of Capitalism*. New York, NY: The Free Press

Table 1: Descriptive Statistics—Whole Sample (Unbalanced) and Balanced Sample

Panel A: Firm Characteristics of Sample

| | Whole Sample (Unbalanced) | | | | Balanced Sample | | | | |
| | Mean | | STD | N | Mean | | STD | N | N |
Variable	1986	1999	1999	(firm-years)	1986	1999	1999	(firm-years)	(firms)
Size (000's Emp.)	47.45	47.62	67.99	3440	85.86	69.92	87.36	694	51
Profitability	0.167	0.194	0.098	3464	0.162	0.206	0.096	689	51
Physical Asset-Intensity	164.19	178.85	353.98	3434	100.63	123.96	169.78	694	51
Age (Years)	--	84.8	40.81	3669	--	105.3	33.47	700	51
Number of Segments	2.99	4.00	2.07	2666	3.29	4.78	1.88	655	51

Panel B: Industry Characteristics of Sample

	Distribution of Sample by 2-digit SIC Code				Average IT-Intensity by 2-Digit SIC Codes (%)			
	Whole Sample		Balanced Sample		Whole Sample			
Industry	N	Percent of	N	Percent of	Information	Hardware	Software	Communications
(2-digit SIC)	(firm-yrs)	Sample	(firm-yrs)	Sample	Technology			
Food (20)	216	6.1	84	12.0	9.3	13.8	7.4	8.1
Paper (26)	136	3.9	28	4.0	8.4	13.7	7.8	6.6
Chemical (28)	495	14.1	182	26.0	9.5	15.6	9.8	5.5
Machinery (35)	354	10.1	28	4.0	6.8	13.1	6.8	0.3
Electrical (36)	161	4.6	28	4.0	2.0	10.2	4.4	-4.2
Transp. Equipment (37)	243	6.8	84	12.0	4.9	9.7	3.4	3.0
Instrumentation (38)	140	4.0	28	4.0	8.3	16.1	9.5	4.4
Communications (48)	167	4.6	14	2.0	0.6	17.8	12.9	0.1
Utilities (49)	415	11.8	14	2.0	2.7	10.7	5.3	1.1
Other	1197	34.0	210	30.0	--	--	--	--
Total	3524	100.0	700	100.0	--	--	--	--

Notes: Panel A: Whole sample includes all firms in the sample with no missing observations for each variable. Balanced sample includes firms that appear in the sample over the 14-year period. Age is defined as number of years since founding as listed in the Directory of Corporate Affiliations. Profitability is defined as Ebitda/Sales. Physical Asset-Intensity is defined as real fixed assets per employee in thousands of dollars. Panel B: Average IT-Intensity is defined as growth (%) in the ratio of IT capital stock to total capital stock between the current and prior year in an industry. Information Technology is defined as the sum of hardware, software and communications. Refer to the footnote in the text that describes the types of assets in each of these categories.

Table 2: Organizational Span (SPAN): Number of Positions Reporting to the Chief Executive Officer

Year	Whole Sample (Unbalanced)				Balanced Sample (N=51)		
	Mean	Median	STD	N (firms)	Mean	Median	STD
1986	4.46	4	2.05	210	4.39	4	1.89
1987	4.61	4	2.12	231	4.65	5	1.97
1988	4.75	4	2.67	236	4.65	4	2.09
1989	5.07	5	2.53	228	4.71	5	1.95
1990	4.91	5	2.60	276	4.98	5	1.74
1991	4.81	4	2.96	289	5.25	5	2.08
1992	4.89	5	2.50	290	4.96	5	2.12
1993	5.01	5	2.24	304	5.53	5	2.10
1994	5.38	5	2.45	298	5.82	5	2.15
1995	5.65	5	2.54	288	6.47	6	2.64
1996	5.46	5	2.56	280	6.31	6	2.32
1997	6.10	6	2.94	248	7.08	6	2.75
1998	6.79	6	3.90	213	8.16	7	4.02
1999	6.70	6	3.80	178	7.16	7	3.10
Average	5.29	5	2.78	255	5.73	5	2.64

Notes: Whole sample includes all firms in the sample with no missing observations for each variable. Balanced sample includes firms that appear in the sample over the 14-year period.

Year	Corporate Staff Positions						Intermediaries		Unit Heads			
	Chief Information Officer	Human Resources	Chief Financial Officer	General Counsel	Strategic Planning	Public Relations	Chief Operating Officer	Chief Administrative Officer	Group Manager		Division Manager	
	Average Number						Average Number		Avg. No.	Probability	Avg. No.	Probability
1986	0.020	0.373	0.667	0.667	0.275	0.196	0.549	0.392	1.026	0.434	0.205	0.052
1987	0.078	0.451	0.686	0.667	0.255	0.235	0.529	0.353	0.897	0.432	0.340	0.097
1988	0.039	0.490	0.686	0.686	0.255	0.294	0.549	0.392	0.789	0.417	0.213	0.063
1989	0.020	0.490	0.706	0.725	0.255	0.333	0.510	0.314	0.947	0.407	0.205	0.073
1990	0.039	0.510	0.667	0.725	0.294	0.431	0.588	0.333	0.970	0.419	0.229	0.084
1991	0.039	0.549	0.706	0.745	0.314	0.451	0.529	0.392	1.143	0.490	0.255	0.108
1992	0.020	0.471	0.745	0.667	0.255	0.294	0.549	0.412	1.029	0.431	0.298	0.121
1993	0.039	0.529	0.863	0.784	0.255	0.275	0.412	0.314	1.353	0.545	0.609	0.215
1994	0.039	0.549	0.882	0.784	0.255	0.275	0.392	0.353	1.472	0.583	0.783	0.213
1995	0.039	0.627	0.902	0.784	0.275	0.353	0.392	0.353	1.737	0.619	0.860	0.213
1996	0.039	0.667	0.961	0.843	0.235	0.314	0.412	0.275	1.721	0.556	0.581	0.179
1997	0.078	0.706	0.941	0.902	0.235	0.412	0.431	0.275	2.051	0.670	0.535	0.159
1998	0.176	0.647	0.902	0.961	0.392	0.569	0.451	0.294	1.733	0.606	0.953	0.314
1999	0.176	0.686	0.882	0.902	0.275	0.510	0.451	0.216	1.488	0.457	0.659	0.191

Notes: Balanced sample includes firms that appear in the sample over the 14-year period. Positions are described in the Appendix. For the group and divisional manager positions, the averages and probabilities are calculated for the subset of firms reporting these positions. Probability is the fraction of group or divisional manager positions reported by the survey that report to the CEO.

Table 4: Descriptive Statistics—Firm and Business Unit (Division) Characteristics (Means)

Year	Whole Sample (Unbalanced)					Balanced Sample (N=51)			
	Firm Size	Depth	Division Size	Division Coverage	N (firms)	Firm Size	Depth	Division Size	Division Coverage
	(000s emp.)		(000s emp.)			(000s emp.)		(000s emp.)	
1986	47.5	1.49	3.8	0.53	260	85.9	1.58	6.0	0.42
1987	43.4	1.39	3.5	0.68	268	82.8	1.45	5.9	0.38
1988	42.0	1.43	3.4	0.46	278	84.3	1.51	5.2	0.38
1989	46.2	1.34	3.3	0.44	269	86.8	1.46	5.2	0.36
1990	44.7	1.28	3.1	0.39	299	86.2	1.36	5.1	0.33
1991	42.1	1.26	3.1	0.40	308	86.9	1.33	4.2	0.35
1992	41.3	1.29	3.1	0.37	306	83.2	1.35	4.4	0.33
1993	38.9	1.19	2.8	0.37	316	81.6	1.20	4.6	0.33
1994	41.1	1.08	3.1	0.42	313	81.8	1.19	5.1	0.37
1995	39.3	1.09	3.4	0.41	302	81.5	1.25	4.8	0.33
1996	42.6	1.14	3.6	0.43	298	79.6	1.30	5.5	0.37
1997	45.2	1.18	3.3	0.38	265	75.4	1.41	2.8	0.34
1998	49.5	1.14	3.7	0.39	231	73.8	1.18	4.7	0.40
1999	47.6	1.09	2.6	0.38	211	69.9	1.15	3.6	0.40
Average	43.3	1.24	3.3	0.43	280	81.4	1.34	4.8	0.36

Notes: Whole sample includes all firms in the sample with no missing observations for each variable. Balanced sample includes firms that appear in the sample over the 14-year period. Firm (division) size is the number of employees in the firm (division) in thousands. Depth is defined as the number of positions between the CEO and the Divisional Manager (see figure 1 for an example). Division coverage is defined as the ratio of the number of employees under divisional manager positions sampled by the survey to the total number of employees in the firm.

Table 5: Organizational Span and Depth-- Firm Fixed Effects Regressions (Whole Sample)

Dependent variables are SPAN (number of positions reporting to the CEO) and DEPTH (number of positions between the CEO and the Divisional Manager)

Independent Variables	SPAN		DEPTH	
	(i)	(ii)	(iii)	(iv)
Log (employees)	-0.387***	-0.370***	0.306***	0.292***
	(0.137)	(0.134)	(0.039)	(0.035)
COO		-1.064***		0.454***
		(0.092)		(0.023)
CAO		0.342***		0.047*
		(0.102)		(0.025)
Trend	0.168***	0.158***	-0.022***	-0.016***
	(0.011)	(0.011)	(0.003)	(0.003)
Constant	5.171***	5.582***	0.479***	0.256**
	(0.411)	(0.405)	(0.120)	(0.111)
Observations	3434	3434	2495	2495
Number of firms	369	369	324	324
R-squared	0.08	0.12	0.05	0.20

Notes: Whole sample includes all firms in the sample with no missing observations for each variable. Log (employees) is defined as the log of the number of employees in the firm. COO and CAO are dummy variables equal to one if the firm reports a Chief Operating Officer (COO) and Chief Administrative Officer (CAO), respectively. Trend takes on the values of 1 through 14 for the years 1986 through 1999. Results are robust to including additional dummy variables to evaluate whether an addition of a COO (CAO) is significantly different than elimination of a COO (CAO) and year dummy variables in place of trend. ***/**/* represent significance at the 1%/5%/10% level.

Table 6: Compensation Structure by Categories of Organizational Span (SPAN)—Whole Sample

Categories of SPAN (No. of CEO reports)	Divisional Manager Excess Pay	Steepness	Divisional Manager Long-term Incentives	CEO Long-term Incentives
	(i)	(ii)	(iii)	(iv)
Panel A: Medians				
1 - 3	8.60	2.16	0.35	0.51
4 - 6	1.34	2.51	0.37	0.66
7 - 9	-5.29	3.12	0.40	0.82
> 10	-0.80	4.27	0.60	1.32
Average	0.06	2.61	0.40	0.67
Panel B: Means				
1 – 3	8.69	2.45	0.49	1.23
4 – 6	2.73	2.82	0.47	0.93
7 – 9	-4.08	3.45	0.54	1.12
> 10	3.44	4.85	0.82	1.78
Average	1.76	3.03	0.53	1.11
N	1616	2355	1752	3754

Notes: Whole sample includes all firms in the sample with no missing observations for each variable. SPAN is the number of positions reporting to the CEO. Divisional Manager Excess Pay is defined as the residual from the regression for divisional managers at depth of 1 of the (log) manager's salary and bonus on the both the (log) number of employees in the firm and the (log) number of employees in the division normalized by the (log) salary and bonus and averaged across divisional managers at depth of 1. Means and medians for divisional manager excess pay in the table above are calculated from divisional manager excess pay multiplied by 1000. Steepness is defined as the difference between the salary and bonus of the CEO and the salary and bonus of the divisional manager divided by the salary and bonus of the divisional manager and the depth of the divisional manager (in computing steepness, we do not restrict the divisional manager's level). Divisional manager long-term incentives (CEO long-term incentives) is defined as the ratio of the value of incentive pay for divisional managers at depth of 1 (CEO) to the sum of the salary and bonus. Long-term incentive pay includes restricted stock, stock options and other forms of long-term incentives (e.g. performance units, performance share plans, and phantom stock). Refer to the footnote in the text that describes the consulting firm's valuation of long-term incentives.

Table 7: Association of Components of Pay and Span—OLS, Firm Fixed Effects and Firm Between Estimator Regressions (Whole Sample)

Dependent Variables are Divisional Manager Excess Pay, Steepness, Divisional Manager LT Incentives, and CEO LT Incentives

Independent Variables	Divisional Manager Excess Pay			Steepness			Divisional Manager LT Incentives			CEO LT Incentives		
	OLS	Firm Fixed Effects	Firm Between Estimator	OLS	Firm Fixed Effects	Firm Between Estimator	OLS	Firm Fixed Effects	Firm Between Estimator	OLS	Firm Fixed Effects	Firm Between Estimator
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)
SPAN	-1.392***	-0.866***	-2.093***	0.163***	0.142***	0.158***	0.001	-0.006	0.005	0.030*	0.019***	0.053***
	(0.414)	(0.221)	(0.673)	(0.025)	(0.013)	(0.033)	(0.009)	(0.004)	(0.011)	(0.015)	(0.007)	(0.017)
Log (Employees)	2.011	0.498	2.737**	0.169***	-0.350***	0.215***	0.098***	0.118***	0.086***	0.238***	0.349***	0.216***
	(1.272)	(1.551)	(1.135)	(0.049)	(0.098)	(0.052)	(0.016)	(0.030)	(0.019)	(0.024)	(0.047)	(0.023)
Trend	0.541**	0.330**	0.540	0.096***	0.105***	0.063***	0.041***	0.039***	0.039***	0.093***	0.096***	0.076***
	(0.234)	(0.129)	(0.451)	(0.012)	(0.007)	(0.023)	(0.005)	(0.003)	(0.008)	(0.008)	(0.004)	(0.015)
Constant	-0.187	2.958	1.936	0.859***	2.546***	0.931***	-0.105	-0.108	-0.075	-0.604***	-0.895***	-0.556***
	(4.635)	(4.984)	(5.174)	(0.192)	(0.322)	(0.256)	(0.065)	(0.097)	(0.088)	(0.089)	(0.143)	(0.153)
Observations	1580	1580	1580	2235	2235	2235	1651	1651	1651	3516	3516	3516
Number of firms	280	280	280	299	299	299	282	282	282	369	369	369
R-squared	0.03	0.01	0.04	0.18	0.20	0.18	0.19	0.16	0.17	0.24	0.21	0.27

Notes: Whole sample includes all firms in the sample with no missing observations for each variable. All variables have been winsorized at the 99th percentile. Divisional Manager Excess Pay is defined as the residual from the regression for divisional managers at depth of 1 of the (log) manager's salary and bonus on the both the (log) number of employees in the firm and the (log) number of employees in the division normalized by the (log) salary and bonus and averaged across divisional managers at depth of 1. Divisional manager excess pay in regressions above is calculated from divisional manager excess pay multiplied by 1000. Steepness is defined as the difference between the salary and bonus of the CEO and the salary and bonus of the divisional manager divided by the salary and bonus of the divisional manager and the depth of the divisional manager (in computing steepness, we do not restrict the divisional manager's level). Divisional manager long-term incentives (CEO long-term incentives) is defined as the ratio of the value of incentive pay for divisional managers at depth of 1 (CEO) to the sum of the salary and bonus. Long-term incentive pay includes restricted stock, stock options and other forms of long-term incentives (e.g. performance units, performance share plans, and phantom stock). Refer to the footnote in the text that describes the consulting firm's valuation of long-term incentives. SPAN is the number of positions reporting to the CEO. Log (Employees) is the log of the number of employees in the firm. OLS specifications correct the standard errors for heteroskedasticity across firms and allows for the specification of the correlation structure among observations within firms. Results are robust to including year dummy variables in place of trend and to including COO and CAO dummy variables. ***/**/* represent significance at the 1%/5%/10% level.

Table 8: Organizational Span and Depth—Firm Fixed Effects Regressions

Dependent variables are SPAN (number of positions reporting to the CEO) and DEPTH (number of positions between the CEO and the Divisional Manager)

	Agency		Information Technology								Human Capital	
	Span	Depth	Span	Span	Span	Span	Depth	Depth	Depth	Depth	Span	Depth
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)
Log(Employees)	0.023	0.290***	-0.282**	-0.241*	-0.250**	-0.242*	0.297***	0.295***	0.298***	0.296***	-0.385***	0.350***
	(0.154)	(0.044)	(0.124)	(0.123)	(0.124)	(0.124)	(0.038)	(0.038)	(0.038)	(0.038)	(0.129)	(0.040)
Institutional Ownership (%)	-0.538	-0.083										
	(0.562)	(0.163)										
Information Technology			2.978***				-0.082					
			(0.866)				(0.246)					
Hardware				1.339***				0.091				
				(0.390)				(0.111)				
Software					1.190**				-0.199			
					(0.580)				(0.169)			
Communications						1.244				-0.099		
						(1.224)				(0.353)		
Physical Asset-Intensity											-0.002***	0.001**
											(0.001)	(0.000)
Trend	0.155***	-0.019***	0.157***	0.143***	0.170***	0.173***	-0.022***	-0.024***	-0.022***	-0.022***	0.170***	-0.023***
	(0.013)	(0.003)	(0.010)	(0.012)	(0.010)	(0.011)	(0.003)	(0.003)	(0.003)	(0.003)	(0.010)	(0.003)
Constant	4.429***	0.567***	4.699***	4.703***	4.627***	4.617***	0.502***	0.504***	0.511***	0.507***	5.422***	0.282***
	(0.518)	(0.157)	(0.366)	(0.366)	(0.367	(0.371)	(0.117)	(0.117)	(0.118)	(0.119)	(0.425)	(0.134
Observations	2662	2017	3497	3497	3497	3497	2525	2525	2525	2525	3592	2606
Number of firms	305	263	358	358	358	358	313	313	313	313	369	324
R-squared	0.07	0.05	0.09	0.09	0.09	0.09	0.05	0.05	0.05	0.05	0.09	0.06

Notes: Whole sample includes all firms in the sample with no missing observations for each variable. All variables have been winsorized at the 99th percentile. SPAN is the number of positions reporting to the CEO. Depth is number of positions between the CEO and the Divisional Manager. Log (Empl.) is the log of the number of employees in the firm. Institutional ownership is defined as the (lagged) percentage of stock in the firm that is held by institutional shareholders. Information Technology (hardware/ software/ communications) is the annual growth in the ratio of information technology ((hardware/ software/ communications) capital stock to total capital stock for the 2-digit SIC industry between the current year and the year prior and includes the three categories of IT: hardware, software, and communications. Refer to the footnote in the text that describes the types of assets in each of these categories. Physical Asset-Intensity is defined as real fixed assets per employee in thousands of dollars. Results are robust to including year dummy variables in place of trend and to including COO and CAO dummy variables. ***/**/* represent significance at the 1%/5%/10% level.

Figure 1: Example of Reporting Levels, Depth, Span and Descriptions of Types of Organizational Units

Management Position	Reporting Level	Depth	Span
Chief Executive Officer (CEO)	1		
Chief Operating Officer (COO)	2		
Group CEO	3	2	1
Divisional CEO	4		
Plant Manager	5		

Descriptions of Types of Organizational Units

- A **Corporate** unit is the highest management organization level of the parent company, responsible for its overall direction.

- A **Group** is the highest level of multiple profit center linking the Corporate Chief Executive Officer or Chief Operating Officer directly to two or more single profit center units (divisions).

- A **Division** is the lowest level of profit center responsibility for a business unit that engineers, manufactures, and sells its own products.

- A **Plant** is a budget or cost center whose general manager supervises manufacturing, as well as service functions, such as accounting, personnel, purchasing, and product engineering, but usually no R&D engineering. More important, the manager of a plant never has sales responsibility.

Appendix: Position Descriptions

1. Chief Executive Officer (CEO). The highest executive authority in the corporation. Reports to the Board of Directors. May also be Chairman or President.

2. Chief Operating Officer (COO). The corporation's second in command, provided the person's span of responsibility is as broad or almost as broad as the Chief Executive's, and provided he or she has line rather than staff or advisory responsibility. This person may be the President if the Chief Executive Officer is the Chairman of the Board.

3. Chief Administrative Officer(CAO). Functional head responsible for the administration of two or more major, nonrelated corporate staff functions such as finance, human resources, law, purchasing, data processing, public relations, and long-range planning and business development.

4. Chief Financial Officer (CFO). Functional head responsible for all financial operations of the corporation. Has responsibility for both the treasury and accounting functions. Indicate whether responsibilities also include data processing, investor relations, internal audit, and tax.

5. Long-Range Planning & Business Development. Functional head responsible for developing and obtaining agreement on overall corporate strategy to enhance sales and profits. Recommends the allocation of resources to existing businesses, acquisitions of new businesses, and disposition of existing businesses.

6. General Counsel. The head of all legal affairs of the company. Responsible for, or may be, Corporate Secretary; supervises outside legal counsel.

7. Human Resources. Head of all human resources with responsibility for establishing and implementing corporate-wide policies.

8. Chief Information Officer (CIO). The highest level of operating management over the combined functions of programming, data processing, machine operation, and systems work related to data processing.

9. Public Relations. Functional head responsible for the development and dissemination of favorable persuasive material in order to promote goodwill, develop credibility, and create a favorable public image for the company.

10. Group Chief Executive. The highest authority in the group.

11. Division Chief Executive. The highest authority in the division.