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Who Lives in the C-Suite? Organizational Structure and the Division of Labor in Top Management

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Abstract: Top management structures in large US firms have changed significantly since the mid-1980s. While the size of the executive team—the group of managers reporting directly to the CEO—doubled during this period, this growth was driven primarily by an increase in functional managers rather than general managers, a phenomenon we term "functional centralization." Using panel data on senior management positions, we show that changes in the structure of the executive team are tightly linked to changes in firm diversification and IT investments. These relationships depend crucially on the function involved: those closer to the product ("product" functions, e.g. marketing/R&D) behave differently from functions further from the product ("administrative" functions, e.g. finance/law/HR). We argue that this distinction is driven by differences in the information-processing activities associated with each function, and apply this insight to refine and extend existing theories of centralization. We also discuss the implications of our results for organizational forms beyond the executive team.

Key words: communication, organizational design, functions, centralization, M-form, hierarchy, top management team, C-Suite, information technology, activities, diversification.

I. Introduction

"We learned from experience that work of higher quality could be obtained by utilizing, corporation-wide, the highly developed talents of the [functional] specialists."

Alfred P. Sloan, Jr. "My Years with General Motors" (1963)

Modern corporations are typically run by a group of executives that go beyond the Chief Executive Officer (CEO). Although the executive team, commonly known as the C-Suite, is the focus of extensive research on top management teams by management scholars (e.g., Hambrick and Mason, 1984), we know less about the *structure* and the *allocation of roles* among the positions reporting directly to the CEO, and how these have changed over time.[1] This is important because the executive team is a reflection of the firm's organizational structure, as well as the governing body that sets firm strategy, coordinates activities and allocates resources across business units.

Using a unique panel dataset rich in details of managerial job descriptions, reporting relationships and compensation structures for senior management positions in large US firms over two decades (1987-2006), this paper documents the relationship between the executive team structure—a key organizational design choice—and strategy variables such as IT investments and diversification. We find that these relationships are nuanced in ways that are not fully explained by the existing literature. Guided by our findings, we introduce an analytical framework for modeling functional centralization that refines and extends existing theory. More broadly, our paper offers insight into the determinants of firm organizational structure – issues that have long been central to the strategy literature (e.g., Chandler, 1962; Lawrence and Lorsch, 1967).

Our analysis is motivated by the following novel observation, which we document in Section III: from the mid-1980s to the mid-2000s, the size of the executive team (defined as the number of positions reporting directly to the CEO) doubled from 5 to 10, with approximately three-quarters of the increase attributed to functional managers rather than general managers.[2] We interpret this trend as an increasing centralization of activities in the hands of corporate-level functional managers, who coordinate activities

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[1] While much of the empirical research in management on top management teams (TMT) focuses on the characteristics of the individual manager (e.g., tenure, education, experience and functional skills), we focus instead on the structure of the executive team and on the distribution of roles within the team. More recent research in management has analyzed individual TMT positions (e.g., COO, CMO, CIO), yet there is limited evidence on the structure of the functional TMT members as a group, their reporting relationship to the CEO, and what this implies about the underlying organizational structure of the firm (see Collis, Young and Goold, 2007; and surveys by Carpenter, Geletkanycz, and Sanders, 2004; Finkelstein, Hambrick, and Cannella, 2009; Menz, 2011; Beckman and Burton, 2011).

[2] In this paper, we define the executive team or members of the C-Suite (e.g., Groysberg, Kelly, and MacDonald, 2011) as the positions that report directly to the CEO in the organizational hierarchy; i.e. the CEO's span of control.

across multiple business units to realize synergies (e.g., Galbraith, 1971; Rivkin and Siggelkow, 2003; Hill and Hoskisson, 1987; Argyres, 1995). In what follows, we refer to the presence of a functional manager reporting to the CEO as "functional centralization," acknowledging that some functional activities may still be performed within the business unit.[3]

Our analysis seeks to tease out the determinants of such functional centralization and is informed by two organizational trends during the time period studied: a dramatic increase in firms' IT adoption due to falling IT costs, and a significant reduction in firm diversification in response to increasing global competition.

In particular, the paper addresses two important questions in the strategy literature. First: what is the relationship between the extent of firm centralization and the firm's investment in information technology (IT)? Existing research points out that the effect of IT on the centralization of decision-making is a priori ambiguous (e.g., Attewell and Rule, 1984; Gurbaxani and Whang, 1991): IT may serve as a *complement* to centralization if it facilitates information processing at the corporate level, whereas IT may serve as a *substitute* for centralization if it facilitates information processing at the divisional level. Second: what is the relationship between the extent of firm centralization and firm scope? An important strand of literature argues that less diversified firms present more opportunities for synergies between divisions (e.g. Rumelt 1982) and consequently exhibit more centralization (e.g. Hill and Hoskisson, 1987; Hill, Hitt & Hoskisson, 1992). However, some recent work has argued otherwise: for example, Cremer, Garicano and Prat (2007) point out that less diversified firms can coordinate across divisions through a common code that allows for horizontal communication, thus avoiding corporate-level centralization.

Our results show that the answer to these two longstanding questions is more nuanced than has been posited in the literature. In order to shed light on these questions, it is crucial to distinguish between the *type of function* or activities involved: without doing so, one may arrive at incorrect inferences about how IT investments and firm scope relate to centralization and organizational form. Empirically, we find no simple relationship between centralization and scope, or between centralization and IT. Instead, both depend crucially on the type of function: *product* or front-end functions (e.g. marketing and R&D) behave differently from *administrative* or back-end functions (e.g. finance and human resources). First, firms that become less diversified centralize product functions, but not administrative functions. Second, firms that invest more in IT centralize administrative functions, but only centralize product functions if they operate in related businesses. Having documented a set of novel and nuanced results that are not fully explained by existing theory, we then develop an analytical framework that, by refining and extending existing theory, successfully explains all of our findings.

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[3] Argyres and Silverman (2004), in a large sample of research-intensive firms, document different types of organizational structures where activities can be performed at the corporate level, divisional level, or both.

Our framework (described in Section VI) emphasizes the information-processing role that corporate-level functional managers play in exploiting synergies between business units. The framework introduces two key elements into the information-processing view of organizations (e.g. Simon, 1945; Galbraith, 1974; Tushman and Nadler, 1978 in the strategy literature, and Sah and Stiglitz, 1986; Radner, 1993 in the economics literature). First, it posits that to exploit synergies, information from various business units has to be *harmonized*, i.e. aggregated and synthesized in a way that enables comparisons between business units.[4] Second, it accounts for the *product-specificity* of relevant information: importantly, information that is more product-specific is harder to harmonize across business units. This framework allows us to interpret our findings. We argue that centralization of functional activities (i) increases with IT to the extent that IT eases harmonization (and thus improves the returns to centralization), but only for administrative functions where information is less product-specific and easier to harmonize, and (ii) decreases with broader scope, but only for product functions, where diversification increases the difficulty of harmonizing information across business units.

It is important to emphasize that our panel dataset allows for a very tight empirical identification over a long time span, which is unusual in this kind of study. We have detailed information on firm hierarchies and compensation in 300 'Fortune 500' companies over 14 years. Having this longitudinal dimension in the data means that we can identify all our effects by exploiting not only differences within firms and positions over time, but also differences between types of positions within firms, such that our results are not confounded by permanent unobserved heterogeneity across firms. In fact, we demonstrate the importance of eliminating such confounding effects: simple cross-sectional regressions may produce associations that are not robust once firm heterogeneity is controlled for, while at the same time overlooking more robust relationships in the data. The dataset also allows us to demonstrate the economic significance of our results in two different ways. First, it captures the reporting relationships of executive positions (i.e., CEO's span of control) thereby allowing a precise definition of the top team that does not rely on nominal titles and other measures that can vary significantly across firms and over time. Second, we show that our findings are correlated with pay changes in a way that suggests we are capturing functional centralization and a shift in activities from business unit managers to functional managers: pay of business unit managers (general managers) declines as functional managers join the executive team.

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[4] The concept of information harmonization is closely related to that of information standardization (see, e.g., Argyres, 1999; Jacobides, 2005). However, it applies to a broader range of settings, in the sense that information harmonization may take place even in the absence of a standardized information format. See Section VI.A. for a detailed discussion of how information is harmonized and how standardization relates to harmonization, as well as related literature on the information processing view of the firm. We thank an anonymous reviewer for encouraging us to clarify this distinction.

While we cannot argue causality in the absence of sources of exogenous variation, we can present a set of robust within-firm correlations, which is rare in this kind of analysis due to data limitations.

Taken as a whole, our empirical results and analytical framework bring some novel and empirically relevant ideas to the literature on the information-processing view of organizations and the link to organizational form – a literature lacking in strong empirical validation (e.g., Puranam et al., 2012). By using a large sample of firms and panel techniques over a long period, we go beyond existing empirical studies to more convincingly document these relationships and identify which are explained by existing theory and which are not. Furthermore, we think that the new insights we bring to the question of when organizations choose to centralize by adding functional mangers to the executive team and how that varies by function -- and the relation to IT investments and firm scope – are critical to our understanding of how organizations change over time to adapt to their shifting environment. In particular, this paper provides a new perspective on Chandler's insight that "structure follows strategy." In doing so, we link the existing top management team (TMT) literature -- which has generally focused on the demographics of senior managers or individual positions rather than the structure of the team -- to the strategy literature about organizational structure. Finally, our results have broader implications for organizational form beyond the C-Suite. Based on a large sample of US firms over two decades, they suggest a movement away from the pure multidivisional M-form, comprised of largely autonomous general managers (Chandler, 1962; Williamson, 1975, 1985), towards other forms of organization such as a matrix (Galbraith, 1971) or the centralized M-form (Hill, 1988) where functional and general managers coexist in an attempt to capture synergies across functions and business units. We highlight the nuanced way in which this evolution has taken place, which has not been systematically documented to date.

The paper proceeds as follows. Section II discusses two motivating examples that illustrate the strategic considerations linking, IT, firm diversification, and organizational structure. Section III discusses the roles and responsibilities of corporate-level functional managers in some detail, and presents some statistics about the composition of the top management team. Section IV describes our dataset. Section V presents our empirical findings. In Section VI, we discuss the implications of our findings, and introduce new theoretical insights to the information-processing view of the firm that allow us to extend existing theory and explain our results. Section VII concludes.

II Theoretical and Empirical Context: Examples

In this section we briefly review some related literature, followed by some motivating examples, to provide context for our empirical and theoretical analysis. Firms seek to realize synergies by coordinating activities across multiple business units (e.g., Rivkin and Siggelkow, 2003, Dessein,

Garicano and Gertner, 2010), and they often do so using corporate-level functional managers who coordinate activities firm-wide for specific functions such as marketing, sales, or finance (see, e.g., Galbraith, 1971). An example of how corporate-level functional managers are used to capture synergies is Procter & Gamble's shift in 1989 toward a matrix organization which included functional senior vice presidents to manage functions across business units in order to promote "the pooling of knowledge, transfer of best practices, elimination of intraregional redundancies, and standardization of activities."[5]

The idea that firms increasing their business relatedness also centralize activities at the corporate level is familiar to the management and strategy literatures (e.g. Hill and Hoskisson, 1987; Hill, Hitt & Hoskisson, 1992). One well-known example is Lou Gerstner's turnaround of IBM in the mid-1990s. Before Gerstner was hired as CEO, IBM operated in related information technology businesses, but with poor coordination across businesses. The executive team was comprised primarily of general managers of business units (e.g., mainframes) and very few functional managers. Gerstner joined IBM in 1993 and deliberately "centralized" select functional activities to move away from the "balkanized IBM of the early 1990's,"[6] which resulted partially from the inordinate power of the mainframes division (Argyres, 1995). Not long into his tenure, Gerstner changed the firm's strategy to one based on an integrated product and service offering to customers ("One IBM") while simultaneously narrowing firm scope. Since the new strategy required extensive coordination across business units, Gerstner reorganized the top team and added functional managers to facilitate corporate-wide coordination (see Exhibit 1). For example, he created a Chief Marketing Officer position (CMO) and filled the position with an external hire. Historically, all marketing activities had been performed within the individual business units, which led to 100 marketing campaigns, overseen by various advertising agencies.[7] To better coordinate marketing activities across all businesses and unify IBM's global brand, the new CMO consolidated all of IBM's buying, planning and direct marketing in the hands of one advertising agency. The IBM example illustrates the idea, confirmed by our empirical analysis, that corporate-level functional managers may be used to exploit potential synergies. Further, it suggests that such functional centralization may take place concurrently with a decrease in firm scope.

The relationship between centralization and IT is also discussed in the management and strategy literature (e.g. Gurbaxani and Whang, 1991; Brynolfsson, 1994; Malone, Benjamin and Yates, 1987). For a concrete example, consider Microsoft in the 1990s, which implemented a number of function-specific computerized systems to ease centralized (i.e. corporate-level) decision-making.[8] Prior to this

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[5] Procter & Gamble: Organization 2005 (A), (9-707-519, Piskorski, 2007, pg. 6-7).
[6] Gerstner, Louis, Jr., "Who Says Elephants Can't Dance," *Harper Collins*, New York, p. 77, 2002.
[7] International Business Machine (IBM), 1994 Annual Report, p.6.
[8] Herbold, Robert J., "Inside Microsoft: Balancing Creativity and Discipline," Harvard Business Review 1, p. 72-9. Note that this case describes the centralization of decision-making, but not the concomitant changes in

implementation, each business unit used unit-specific information systems and processes. For example, in the case of the finance function, individual business units would selectively "redefine or change, for their purposes, a key measure used in financial reporting." Harmonizing information between different divisions to make corporate-level decisions was difficult; "people in corporate finance … had to spend weeks *harmonizing* diverse data … at the end of a month or quarter." Consequently, centralized decision-making was stymied: "The top management team was often forced to make decisions with outdated financial information." Adoption of information systems—which used standardized reporting measures across divisions and processed information electronically -- shortened the time to harmonize data dramatically, from 21 days to 3 days. This allowed corporate management to instantaneously access and compare financial performance across divisions, which further eased centralized decision-making. Similar systems were adopted for other functions such as human resources. The implementation of these systems was made possible by the availability of affordable off-the-shelf IT systems. The Microsoft example highlights the role of IT in facilitating centralized decision-making, and suggests that IT investments may have a significant impact on functional centralization.

The IBM and Microsoft examples describe how diversification and IT investments may play significant roles in firm centralization. However, it is important to move beyond anecdotal evidence to understand systematic changes and driving mechanisms more broadly. In the next sections, we develop and refine these hypotheses by studying the relationship between diversification, IT investments, and functional centralization using a large panel dataset of firms. This systematic analysis will guide us towards a rigorous understanding of where, and how much, the mechanisms posited in this section are related to firm centralization.

III: Defining Positions and Identifying Changes in Executive Teams

We define the executive team of an organization as the CEO and the managers that report directly to him/her. To make concepts concrete, let us refer to the top team structure for IBM in 1994 (Figure 1). At the time, Lou Gerstner, the CEO, had 14 direct reports that can be classified into two broad types of positions: functional managers and general managers. Functional managers -- or corporate staff -- are responsible for corporate-wide activities of their specialized function (e.g., finance, legal, marketing, R&D); i.e., they centralize functional activities at the corporate level. In contrast, general managers -- or line managers -- are concerned with a broad range of functional activities within their business units and typically have profit and loss responsibility. Gerstner's executive team included nine functional managers

organizational structure. In contrast, our analysis uses observed changes in organizational structure (at the corporate level) to infer changes in the centralization of decision-making.

and five general managers, including the general managers of the personal computer business (General Manager -- Personal Systems) and the mainframe business (General Manager -- Systems), among others.

Not surprisingly, corporate-level functional managers perform different activities that vary by function. For example, in the marketing function as illustrated in IBM, CMO responsibilities include "leading the company's marketing organization; uniting and strengthening various departments' own marketing plans; directing global marketing efforts, including branding, product marketing, and customer relationship marketing." (Nath and Mahajan, 2008, pg. 67). As another example, the corporate R&D function of Du Pont involved "coordination of research, avoidance of duplication of effort, promulgation of results which are of interest to more than one department." (Hounshell and Smith, 1988, pg 108). Finally, for the finance function, Chandler's (1991) description states that: "tasks were to coordinate the flow of funds through the enterprise's many units and to provide a steady flow of information to enable top management to monitor performance and allocate resources" (Pg. 33).[9]

A number of scholars have proposed classifications of functions into categories. Chandler (1991) talks about entrepreneurial (value-creation) and administrative (loss prevention) functions; Porter (1985) distinguishes between support activities (finance, HR, systems) and primary activities (manufacturing, inbound and outbound logistics, sales, after-sales support); Hambrick and Mason (1984) differentiate between throughput, output, and peripheral functions. These classifications can be seen, at a broader level, as distinguishing between front-end functions (entrepreneurial, primary, output) and back-end functions (administrative, support, peripheral). In what follows we will retain this broad distinction and emphasize one dimension of these classifications that will be relevant in interpreting our results: the proximity of the function to the final product. Specifically, we categorize functions that are "close to the product" as product functions, and functions that are "far from the product" as administrative functions. We classify the following four functions as front-end or "product" functions: Marketing (Chief Marketing Officer, CMO), Research & Development (Chief R&D Officer), Sales, and Manufacturing. We classify the following six functions as back-end or "administrative" functions: Finance (Chief Financial Officer, CFO), Law (General Counsel), Human Resources (Chief Human Resources Officer, CHRO), Information Technology (Chief Information Officer, CIO), Strategy (Long-Range Planning & Business Development) and Public Relations (PR or Communications Officer). IBM's Gerstner had three product functional managers and six administrative functional managers reporting directly to the CEO.

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[9] In addition, it is well-known that managers at the top of the hierarchy have extensive visibility (both internal and external) and have direct access and interaction with the CEO, arguably the scarcest and most valuable human capital resource (Bandiera, Prat, Sadun and Wulf, 2011). Managers reporting directly to the CEO often comprise the Executive Committee which is the most influential decision-making body in large organizations. According to CEOs, managers that report directly to the CEO tend to "have a seat at the table" which means that they are important and influential members of the senior management team (Wulf, 2012; Neilson and Wulf, 2012).

As mentioned earlier, while the span of control of the CEO has increased substantially since the mid-1980s (Rajan and Wulf, 2006), less is known about the changes in the structure of the top executive team. Figure 2 shows the evolution of the executive team in our sample of large US firms (see data description in Section III). We plot the average size of the executive team (CEO span of control) in our data (1986-1999) and for a more recent time period using data collected from the Conference Board for 43 firms (we obtained the organizational chart for these firms for one year between 2004 and 2008; these 43 firms are larger than the rest of the firms in our study but are similar in terms of the CEO span of control and the number of functional managers). To minimize bias from using an unbalanced panel, the figures documenting trends are based on the sample of firms that appear for at least 10 years over the sample period (if we limit the sample to only the 43 firms for which we have data in the later period, the pattern over the time period is qualitatively similar). The average CEO span of control doubled from approximately 5 to 10 positions, and the novel trend documented in this paper was a shift in the structure of the executive team towards more functional managers. The average number of functional managers reporting directly to the CEO increased from 3.1 in the late 1980s to 6.7 in the mid 2000s—an increase of 3.6 positions. This is significantly larger than the 1.3 increase in general manager positions (from 1.6 to 2.9). This means that, on average, approximately three quarters of the five position increase were attributed to functional managers. [10]

To give a better sense of the details behind these averages, in Table 1 we report data on select individual positions that comprise the executive team. Column 1 reports the fraction of firms in the sample where the position reports directly to the CEO, and shows that CEOs in our sample had a higher number of administrative functions (especially finance, legal, HR) reporting directly in comparison to product functions. Columns 2 onwards report the (unconditional) correlation coefficients between positions reporting to the CEO. We find that functional positions that we classify as administrative appear together in the executive team (i.e., have large positive correlation coefficients), while the positions that we classify as product functions also appear together. For example, CFO and General Counsel tend to appear together in the executive team (0.29 correlation), and so do Sales/Marketing and Manufacturing (0.21 correlation). These correlations provide some support for our ex-ante classification of positions into the two types. Notice also that there is a positive correlation between the number of general managers and all functional manager positions, except for Sales/Marketing and Manufacturing, suggesting that functional managers are not necessarily replacing general managers. In Section IV, we analyze how the

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[10] There are various idiosyncratic reasons why functional manager positions have become more important over time. For example, the rise of the CFO position is related to the increasing complexity of financial markets and changes in accounting rules (Zorn, 2004). Or, as companies become more customer-focused and marketing techniques grow in sophistication, Chief Marketing Officers (CMOs) play a more important role in senior management. CEOs may also signal greater strategic importance of certain functions both inside the organization and to key external constituents through their choice of direct reports.

structure of the executive team changed over time within firms in response to changes in firm diversification and IT investments.

IV. Data Sources and Description

In order to analyze the drivers of the observed increased presence of functional managers in the executive team described in Section III, we draw on a number of datasets. First, our main dataset is based on a confidential compensation survey conducted by Hewitt Associates, a leading human resources consulting firm specializing in executive compensation and benefits. This allows us to identify how the number and type of positions that report directly to the CEO change over time. The dataset records information on managerial positions at the top of the organization, their compensation, their title/job description and who the individual reports to. Notice that the title/job description is categorized by Hewitt in order to make positions comparable across firms. That is, even if the same position has different titles in different firms, Hewitt groups them into positions that share job descriptions and responsibilities. This is essential for our study, since it implies that we can easily compare positions and their evolution across firms over time. In addition to the positions defined earlier, the dataset also records information on the Chief Executive Officer (CEO), the Chief Operating Officer (COO) and the Chief Administrative Officer (CAO). With this dataset we are able to define how many positions report directly to the CEO (span of control or the members of the executive team) and observe what positions those are.

The sample spans the 1987-1999 period and includes around 300 firms, of which 69% are in manufacturing and 31% are in services. The firms are typically leaders in their sector and representative of Fortune 500 firms (see Rajan and Wulf, 2006 for a detailed sample description).[11] Hewitt also records detailed compensation information for all positions, but we were only able to obtain the detailed data for a subset of positions. These include the CEO, Division Managers, the CFO, General Counsel and the Chief Human Resources Officer. For these positions, we have information on the level of salary, bonus and long-term compensation (this includes the Black-Scholes value of stock options grants, restricted stock and other long-term incentives).

This unique dataset allows us to characterize the structure of the executive team, as defined by the positions that report directly to the CEO, and analyze how this structure changes over 14 years. So, our definition and measure of the executive team is not dependent on titles, but instead is based on reporting relationships. This is not possible in any of the existing datasets we are aware of. However, in spite of its richness, our dataset has some limitations. First, functional positions may exist in other parts of the

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[11] Rajan and Wulf (2006) describes the sample representativeness relative to Compustat firms, discusses concerns about selection, and potential misreporting in the survey. It concludes that the sample is representative of large, Fortune 500 firms that are leaders in their sectors.

organization, and not report directly to the CEO (in that case, because we focus on top executive team positions, we would under-estimate the extent of centralization of functions). Second, we cannot definitively answer the question of whether the increase in functional positions at the top comes from newly-created or existing positions. For some functions (finance, law and HR), we know whether the position exists and its reporting level; however, we don't have this information for all functional positions. Third, we have no information on the functional positions at the group level (i.e. the hierarchical level above division managers). Finally, while the number of functional managers that report directly to the CEO is arguably related to the need to realize synergies within the firm, we do not observe how these synergies are realized, and in particular if the changes in functional managers are associated with changes in the allocation of activities, decision making, monitoring or aggregation of information towards the functional manager (and away from general or division managers).

We constructed a set of variables that measure the degree of diversification within firms (note that throughout the paper, we do not distinguish between the concepts of diversification and business relatedness: a lower degree of diversification corresponds to a higher degree of business relatedness). The first variable uses Compustat Segment data to measure firm entropy as defined in Palepu (1985) and conceptualized by Rumelt (1974). Intuitively, firm entropy measures the extent of diversification as captured by the different 2-digit SIC segments the firm operates in. We compute Palepu's measure for unrelated diversification; it is a transformation of a Herfindahl index (sum of squared shares of segment sales to firm sales) across different two-digit SIC segments reported by the firm that captures the extent of relatedness of the businesses the firm operates in.[12] The higher the entropy/unrelated diversification measure, the more diversified the firm is. The second set of diversification variables measure the degree of diversification/relatedness not just by whether two firm segments are close as defined by the SIC code, but by whether they use products that are related in Input-Output tables. Fan and Lang (2000) calculate inter-industry relatedness coefficients using input-output commodity flow tables and construct two basic measures of relatedness: vertical relatedness and complementarity. The vertical relatedness measure captures the extent to which the segments the firm operates in are inputs to one another, as defined in the Input-Output tables.[13] The higher the vertical relatedness value, the more related the firm's businesses along the production chain. For example, since semiconductors are an important input into personal

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[12] Unrelated diversification is the weighted average of all 2-digit SIC group share in sales, i.e. the summation of the share multiplied by the log of the inverse of the share. This measure is widely used (e.g., Hill, Hitt, and Hoskisson, 1992 for an early example).

[13] Vertical relatedness is the dollar value of industry i's output required to produce 1 dollars' worth of industry j's output, as stated in input-output tables (we use coefficients based on 1992 US input-output tables). Forward vertical relatedness is when i is the secondary segment and j is the primary segment. Backward vertical relatedness is the reverse. We denote the primary segment as the segment with the most sales. Our vertical relatedness measure is the simple average of the two.

computers, firms that operate in both sectors would score high on the vertical relatedness measure. The complementarity measure, in turn, captures whether the businesses the firm operates in are all inputs into the same industry, or alternatively whether they source their products from a common industry.[14] For example, a firm that operates in both semiconductors and LCD screens would score high on the complementarity measure since these are both inputs into personal computers. The higher the complementarity value, the more related the firm's businesses.

We also obtain information on IT investment at the firm-year level from the Harte-Hanks database (see details in Bresnahan, Brynjolfsson and Hitt, 2002). The database reports the number of personal computers in use in each firm in a given year, so that we can define IT-intensity of the firm as the number of PCs per employee. Since our sample covers the 1987-1999 period, this variable is particularly meaningful, given that this is the period where PC prices were falling and firms started adopting the new technology (Dunne et al, 2004). We exploit the panel nature of our dataset and the differential rate of adoption by different firms. In our use of this variable, we expect to capture the overall IT-intensity within the firm, including not just PCs themselves, but also other aspects of IT that are correlated with hardware, such as software, Enterprise Resource Planning (ERP) or different types of technologies that improve communication. While we are not able to distinguish between investments in hardware, software or communication technology, from 1993 onwards, the dataset also records the number of Local Area Network nodes. A Local Area Network (LAN) is a communication network that connects several devices and provides a means for information exchange among those devices. The "nodes" are the devices connected to the network that can directly exchange information and communicate. Therefore the number of LAN nodes is a better measure of IT as a communication-improving investment.[15]

Finally, using accounting information from Compustat data, we construct a number of control variables such as firm size (ln sales and ln employment), firm internationalization (defined as the ratio of sales by foreign segments to total sales, from Compustat Segment data), the average industry price cost margin at 3 digit SIC as an inverse measure of product market competition and R&D intensity (R&D over firm sales, where missing R&D is considered as zero). We include these as controls, because as product markets globalize and become more competitive, and US firms increasingly differentiate products, we

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[14] Following Fan and Lang (2000), we compute the percentage of an industry's output supplied to each intermediate industry, denoted b_{ik}. For each pair of industries i and j, compute the simple correlation between b_{ik} and b_{jk} across all k except i and j. Forward complementarity measures the overlap in markets to which a firm's various segments sells its products. Backward complementarity measures the overlap in markets for the input industries of the firm's segments. Our complementarity measure is the simple average of both measures.

[15] Bloom, et al. (2011) also uses Harte-Hanks data for a cross-section of firms in 2006. In that period Harte-Hanks collected information on the types of software adopted such that the authors are able to distinguish between information technology and communications technology. Unfortunately such information is not available in our time period (a 14 year panel).

might expect firms to change the structure of the top team for other reasons. We include a correlation table with the key variables in Appendix Table A1.

V. Results: Determinants of Executive Team Structure

The empirical analysis in what follows relies on the panel nature of our dataset to identify simultaneous changes in diversification, IT investments and organizational decisions.[16] We observe firms for up to 14 years, and we have information on changes in the structure of the executive team (defined by who reports directly to the CEO) along with measures of firm diversification and IT-intensity. We also have detailed year-by-year pay information for a subset of positions. Therefore, we are able to control for unobserved firm heterogeneity and do not have to rely on cross-sectional relationships to identify our results, thus improving on the literature that relies on cross-sectional evidence.[17]

V.A. Firm Diversification, IT, and Executive Team Structure

To study the correlates of executive team structure, we exploit the panel nature of our dataset and estimate fixed effects regressions. The basic structure of our empirical specification will be as follows:

$$Y_{it} = \alpha + \delta DIVERSIF_{it} + \beta IT_{it} + X_{it}'\theta + d_t + d_i + \varepsilon_{it}$$

where the dependent variable Y_{it} is the number of managers reporting to the CEO (in total, and by type -- general or functional) in firm i, and year t. $DIVERSIF_{it}$ and IT_{it} are the diversification and IT-intensity measures respectively, X_{it} are a large set of control variables: firm size (ln firm sales), the number of segments the firm operates in, the fraction of sales by foreign subsidiaries, the average price-cost margin in the industry as an (inverse) measure of product market competition, R&D intensity measured by total R&D expenses over sales, and controls for whether the firm has a CAO or a COO. d_t are year dummies and d_i are firm fixed effects. ε_{it} is white noise. We estimate this equation using panel fixed effects.

Table 3 explores the relationship between the size and structure of the executive team on the one hand, and diversification choices and IT investments on the other. The dependent variable in Column 1 is the total number of managers that report directly to the CEO (CEO span of control). Columns 2 to 5 split

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[16] Relatedly, a number of papers have documented complementarities between IT and various organizational choices (e.g. Brynolfsson et al, 1994; Bresnahan, Brynjolfsson and Hitt, 2002; Bartel, Ichiowski and Shaw, 2007; McElheran, 2010). The organizational choice we focus on here is the structure of the executive team.
[17] While we cannot argue that the relevant independent variables of interest (degree of firm diversification or IT investments) are purely exogenous, there are some clear exogenous forces (falling price of IT; globalization of trade and production and increasing competition) driving changes in these variables. However, it is difficult to find instruments that vary over time and by firms/industries. And even if we had such instruments, it would be hard to argue that they satisfy the exclusion restriction (that they only affect organizational choices through the instrumented variable). This is a common problem in this kind of work, so we rely on within firm and across position correlations to identify our results in this paper. For a reduced form analysis, with exogenous variation and arguably causal effects of competition on organizational structure, see Guadalupe and Wulf (2010).

the total number of managers into different types. First, we consider general managers (column 2), i.e. managers responsible for a broad set of functional activities within their business unit; Second, functional managers (column 3), i.e. managers responsible for corporate-wide activities for a specific function. We further distinguish between types of functional managers, i.e., product (front-end) functional managers (column 4) vs. administrative (back-end) functional managers (column 5).

Column 1 shows that unrelated diversification is positively related to the size of the executive team: diversifying firms increase the number of positions reporting to the CEO. In contrast, IT investments (as measured by the number of PCs per employee) are not significantly related to team size. However, as we shall see, the relationships between the executive team structure and diversification, and between executive team structure and IT investments, systematically vary by type of position. Column 2 shows that the number of general managers reporting directly to the CEO is positively related to firm diversification, but unrelated to IT investments. In fact, the estimate for IT is negative, suggesting that if anything, there are fewer general managers in the top team as the firm invests more in IT. In contrast, column 3 shows the opposite relationship for functional managers: the number of functional managers is positively related to IT investments but unrelated to firm diversification. Even further, when we distinguish between types of functional managers, the number of product functional managers is *negatively* related to diversification (the relationship is positive for general managers) but unrelated to IT investments (column 4). A one standard deviation increase in diversification is associated with a decrease of 0.11 product functional managers, which is 18 percent of the standard deviation in the number of product functional managers. In contrast, the number of administrative functional managers is strongly positively related to IT investments, but unrelated to diversification (column 5). A one standard deviation increase in IT is associated with a decrease of 0.12 administrative functional managers, or 8 percent of the standard deviation in the number of administrative functional managers.[18] Further, we tested for differences in the coefficient on diversification, and in the coefficient on IT, for product versus administrative functional managers (i.e. across the regressions in columns 4 and 5). The t-statistic for the difference between the unrelated diversification coefficients in columns 4 and 5 is 6.14 (hence significant at 1.3%). And the difference between the IT (PCs per employee) coefficients in columns 4 and 5 is 3.71 (hence significant at 5.4%). We can thus reject that the coefficients are the same across regressions (for this we take into account that the coefficients are from different regressions with different variance-covariance matrices).

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[18] We also tested and rejected the notion that the relationship between the number of functional managers and IT is just driven by the increasing importance of the Chief Information Officer (CIO) position, or by the Chief Financial Officer. In fact, it is not driven by any one position in particular.

The fact that these relationships vary by type of position allows us to rule out that we are just capturing a spurious correlation driven by the fact that the CEO span of control, diversification and investments in IT are all trending up over time. If the correlation was simply spurious, we shouldn't see these differences given that all types of positions increasingly report directly to the CEO over time.[19]

To further evaluate the relationship between diversification, IT and types of functional managers reporting to the top, we turn to Table 4 where we use additional measures of firm diversification and IT investments, and add as a further control the number of general managers to account for the possible overall increase in span. Note that the number of general managers is positively correlated with the number of both types of functional managers in each of our specifications. First, we evaluate the relationship between different measures of firm relatedness and the number of product functional managers reporting directly to the CEO. In column 1 we replace the entropy measure of unrelated diversification by the number of related and unrelated segments the firm operates in. We find that an increase in the number of related segments (i.e. in the same SIC 2 digit category as the primary segment), is associated with more product functional managers that report to the CEO, confirming that business relatedness matters for functional centralization of product functions. Second, in columns 2 and 3, we reproduce these results with two alternative measures of firm diversification. Using both measures of vertical relatedness (column 2) and of complementarity (column 3), we find that an increase in the businesses relatedness (less diversified) is associated with an increase in the number of product functional managers reporting directly to the CEO. The result is stronger for complementarity than vertical relatedness, suggesting that it is the overlap of businesses supplying to the same industries (or procuring inputs from similar industries) rather than their relationship in the vertical chain that matters for coordination and the realization of synergies. Yet, for administrative functional managers (columns 6 and 7), we find again the opposite sign on the coefficients of all diversification measures, although they are never statistically significant.

Regarding IT, all columns control for PCs per employee and confirm that IT adoption is positively correlated with the number of administrative functional managers (columns 6 to 8), but not with the number of product functional managers (columns 1 to 5). PCs per employee is a broad measure of IT that captures different aspects of IT-related information processing. We also have an additional

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[19] We also performed a number of additional robustness tests/additional specifications (unreported): The results are similar when using CEO rather than firm fixed effects, when controlling for firm employment, when introducing industry specific time trends, and when using a Poisson count model rather than OLS (or panel fixed effects). We also explored the time dimension of the changes and found that the effects are mainly contemporaneous (although some (smaller) effect also appears with a one year lag). Given that the relationship is mainly contemporaneous and that we lose 20% of the observations when including lags, we report the regressions using the contemporaneous variables. Results are available upon request.

measure of IT intensity that more closely captures the communication component of IT, but that is only available from 1993: this is the number of Local Area Network nodes. In columns 4 and 8 we add the logarithm of LAN nodes as an independent variable to our main specification (for the year prior to 1993 we impute a value of zero and dummy out the imputed observations in order to keep the number of observations constant between columns 1 and 4, and 6 and 8). We find that using the number of LAN nodes gives similar results as PCs per employee: an increase in LAN nodes increases the number of administrative functional managers reporting to the CEO, but has no effect on product functional managers. The magnitude of the effect is also significant: a one standard deviation increase in ln (nodes) leads to 0.15 more administrative functional managers. To evaluate the overall effect of IT intensity using the coefficients in column 8, we take into account the contribution of both PCs per employee and LAN nodes. A one percent increase in the standard deviation of PCs per employee and LAN nodes is associated with an increase of 0.26 administrative managers, which is 19% of the overall standard deviation in administrative functional managers. This suggests that the functional centralization of administrative positions is related to different dimensions of IT investments, as captured by our two IT variables.[20]

Finally, we explored the interaction between diversification and IT. Column 5 shows an association between increases in IT investments and increases in the number of product functional managers reporting directly to the CEO, but only in firms that are (or become) less diversified (i.e., with more related businesses). We found similar significant effects for product managers when using the other measures of diversification (vertical relatedness and complementarity), and found no significant interaction effects for administrative functional managers (unreported).

All these results are identified from within-firm variation in the relevant variables (hence we are controlling for permanent unobserved differences between firms). We also hold a large number of firm characteristics constant through the regression controls. Some interesting relationships emerge between the controls and the dependent variable. In particular, in Table 3 our control for the degree of competition (the price-cost margin) is related to the presence of general managers at the top: as competition intensifies, the number of general managers reporting to the CEO also increases, but there is no relationship with functional managers. This is consistent with the reduction in the number of management layers following a trade liberalization found in Guadalupe and Wulf (2010), which we interpret as increased involvement in decision making by division managers when competition, and hence the importance of fast, adapted responses to local information increases. We also find that as the share of

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[20] We calculated the economic significance of our results by evaluating how much of the overall standard deviation, within-firm standard deviation and time series change in the functional positions variables was explained by the variation in the corresponding IT and Diversification measures. We found that the fall in diversification can explain 10% to 28% of the variation in product functional managers and that the increase in IT intensity can explain 8% to 19% of the variation in administrative functional managers. In the text, we report the estimates using the overall standard deviation.

sales by foreign affiliates increases (a measure of the degree of internationalization of the firm), so does the span of control which is driven by a greater number of administrative functional managers. One interpretation is that as US firms increase operations in international product and labor markets, the importance of monitoring and compliance by administrative functional managers increases. Finally, over our sample period, firms have been eliminating both COO and CAO positions – which are typically intermediary positions between general managers and functional managers, respectively, and the CEO; we included controls for the presence of the COO and CAO in all regressions to ensure that the findings are not driven by these changes, and our results are robust to introducing these controls.[21]

Finally, we also demonstrate the benefits of controlling for time-invariant unobserved firm heterogeneity when estimating effects (i.e., identification from exploiting within firm variation over time and allowing for firm fixed effects) by comparing our results to analogous cross-sectional regressions that exclude firm fixed effects. Table A2 in the appendix shows our main regressions (columns 4 and 5 in Table 3) estimated using simple cross-sectional specifications: i.e. without firm or industry fixed effects (columns 1 and 2 in Table A2), or including only 3 digit industry dummies (columns 3 and 4 in Table A2). The comparison highlights two sets of issues with cross-sectional estimates: (i) some observed correlations may be driven purely by unobserved firm heterogeneity, while (ii) other, more robust relationships may be obscured. This is discussed in greater detail in the notes of Table A2.

V. B. Understanding Changes to the Executive Team through Changes in Pay

After showing how the executive team structure has changed over time with diversification and IT investments, next we explore the implications of functional centralization for managerial compensation for managers both in and below the executive team. In particular, we analyze how pay for different types of managers (general managers, functional managers and the CEO) changes as their position in the hierarchy (i.e., their reporting level), as well as executive team structure, changes. This will allow us to interpret how the allocation of activities within the firm is changing with changes in top team structure.

One advantage of our dataset is that for some positions (Division Managers, CFO, General Counsel, and Chief HR Officer and CEO), we have information on pay and reporting levels, even if the position is not directly reporting to the CEO.[22] So, all regressions in Table 5 have a position-year as the basic unit of observation, and have the following structure:

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[21] The number of Functional managers in Column 3 includes the CAO, whereas the CAO is not included in Product (column 4) or Admin. (column 5) functional managers. This explains why the coefficient on the CAO variable is positive and significant in column 3 but not in the following columns. Excluding the CAO from the number of Functional managers does not change the results on the other variables of Column 3.

[22] In our firm-level data, for each firm-year, we know which positions report directly to the CEO. For a select group of positions, we know, conditional on the existence of the position, whether it reports directly to the CEO or not. In 72% of the cases, for this subset of positions, functional managers report directly to the CEO.

$$\ln(W_{pit}) = \alpha + O_{pit}'\beta + F_{it}'\delta + X_{it}'\theta + d_t + d_{pi} + \varepsilon$$

The dependent variable $\ln(W_{pit})$, is the logarithm of either base compensation (salary) or total compensation (salary, bonus and long-term incentives) of position p in firm i, in year t. We analyze separately the correlates of pay for two types of position: general managers (division managers), and functional managers. The independent variables include a vector of variables that characterize the position itself (O_{pit}) such as whether the position reports to the CEO, and a vector of firm characteristics (F_{it}) such as how many functional and general managers report to the CEO, and the types of functional managers (i.e., product or administrative). All regressions include the same set of controls X_{it} as earlier tables in addition to firm-specific position fixed effects and time dummies, such that all the effects are identified within a firm and position as they change over time. We estimate the equation using a panel fixed effects estimator.

We start describing pay for functional managers, in columns 1 and 2. As mentioned, the only functional managers we have pay information for are the CFO, the General Counsel and the Chief HR Officer (administrative functional managers in our terminology). The variable "Reports to the CEO" is a dummy variable that equals 1 if the position reports directly to the CEO. Note that when this variable equals 0, it means that the position exists elsewhere in the firm, not in the top team. We find that there is an 11 percent increase in base compensation and a 15 percent increase in total compensation when the position joins the executive team (i.e. starts reporting directly to the CEO). One might argue that reporting to the CEO does not mean much; that it is simply a line on a chart with no real consequences. At the very least, our evidence indicates that reporting to the CEO has practical consequences in terms of pay and hence some economic meaning. We interpret this pay increase to suggest that the level of responsibility and authority of the manager is greater when the position becomes part of the executive team. We also find the base salary is 1.5 percent lower for functional managers with each extra functional position that reports to the CEO.

Interestingly, we also find that base compensation of each functional manager falls as the number of functional managers reporting directly to the CEO increases. Total compensation, in contrast, is not correlated with the number of functional managers (column 2 of Table 5). A possible interpretation for this result is as follows: there may be substantial overlap in the roles of different functional managers (e.g. CFOs may also have responsibilities in coordinating legal activities across business units). Consequently, an increase in the number of functional managers results in a decrease in the average responsibility of each functional manager, and thus a decrease in functional manager pay. The fact that this result is restricted to base pay (column 1) and is not present for total compensation (column 2) suggests that while

base compensation is designed taking into account the division of labor in top management, total compensation (which includes performance-related-pay) eliminates the differences in pay that are related to the composition of the executive team.

Columns 3 to 6 report pay changes for division (general) managers. Here again, we find that reporting directly to the CEO increases base pay (7 percent) and total compensation (13 percent) for these managers. But even more interestingly, we find strong evidence that division manager pay decreases as more functional managers report directly to the CEO (columns 3 and 4). In columns 5 and 6 we distinguish between the effect of two types of functional managers – administrative and product managers – on division manager pay. We find that the increase in the number of product functional managers is strongly associated with a decrease in division manager's pay: one more product functional manager reporting to the CEO is associated with a 2.4 percent lower salary and 5.4 percent lower total compensation for division managers. In contrast, we find no correlation between administrative functional managers and division manager pay.

While we do not observe the tasks/activities/decisions performed by each of our managers directly, one interpretation of these results is that when more activities/decisions are "centralized" (allocated to the functional manager), division manager pay declines. This effect is particularly strong for product-related activities like R&D or marketing (relative to administrative activities) that typically are a more substantial component of the division manager's job. To sum up: First, the role of the functional manager changes as the functional position joins the executive team since their pay increases. Second, since division manager pay declines as more product functional managers join the executive team, functional managers serve as substitutes for division managers in product functions, but not in administrative functions.

Using pay and reporting relationships, we have documented two relevant facts that illustrate what occurs inside the firm as the structure of the executive team changes: (i) functional manager and general manager (division manager) pay increases when the position moves closer to the CEO, and (ii) division manager pay decreases when more product functional managers report directly to the CEO. These findings are consistent with the interpretation that functional managers centralize functions that previously resided with the business unit or division managers. This is particularly true for product functions, and less so for administrative functions.

VI. Analytical Framework and Discussion

This section discusses our empirical findings in light of existing literature and presents an analytical framework to organize and interpret our results. We start with Section VI.A, where we

introduce the key elements of our framework: the role of functional managers in harmonizing information, and the distinction between product and administrative functions. We then discuss our main findings in Section VI.B and VI.C: we analyze the relationship between centralization and diversification in Section VI.B, and the relationship between centralization and IT investments in Section VI.C. We show that to fully understand our findings, it is crucial to distinguish between the nature of information relevant to product versus administrative functions. In doing so, we highlight how our framework refines and extends existing theory. Finally, in Section VI.D, we discuss the implications of our findings for broader questions about the determinants of organizational form.

VI. A. Enriching the Information-Processing View of the Firm

In this section, we introduce two key concepts that enrich the existing information-processing view of the firm:[23] the role of functional managers in harmonizing information, and the distinction between product and administrative functions. We demonstrate later (in Sections VI.B and VI.C) how these insights are crucial for understanding the details of our empirical findings.

First, the framework focuses on the role of functional managers in exploiting synergies between business units. In particular, we regard *harmonizing information* as the key information-processing task faced by functional managers. To exploit synergies, the functional manager has to compare the activities of each business unit so that he can properly weigh the tradeoffs involved in his synergistic activities. Therefore, the functional manager has to aggregate and synthesize information from the various business units in a way that facilitates comparison between them, so that optimal coordinated decisions can be made; we say that the functional manager has to *harmonize* information between business units. For example, in the finance function, harmonizing information may entail producing a standardized set of financial measures to compare financial performance across business units. In contrast, for the marketing function, harmonizing information may involve substantial subjective interpretation because marketing outcomes may be measured in qualitatively different ways (for example, online click-through rates for consumer products versus number of sales leads for corporate products) across business units.[24]

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[23] For a recent and more thorough description of the extensive body of literature on the link between information processing requirements of a firm and organizational design, see Puranam, Raveendran and Knudsen, 2012. Beyond the strategy literature, the link between organization information-processing and organizational design is also a topic of increasing interest in organization economics; see, e.g., van Zandt, 1999; Garicano, 2000; Dessein, Galeotti, and Santos, 2012.

[24] These examples highlight the subtle distinction between the concepts of information harmonization and information standardization, and demonstrate the point that harmonization is a broader concept than standardization. Information standardization entails converting information from disparate sources into a standardized format; this is one of the ways in which information may be *harmonized*. However, as our marketing example illustrates, information can be harmonized even in the absence of standardized formats.

Second, the framework makes the following distinction between product and administrative functions: product functions (such as marketing or R&D) involve activities that are highly product-specific, whereas administrative functions (such as finance or human resources) involve activities that are less product-specific. [25] High product-specificity exacerbates differences between business units' activities, which makes harmonizing information more difficult. [26] These differences are intensified for diversified firms and attenuated for firms that operate in related businesses. Thus, harmonizing information is relatively difficult in product functions, especially in more diversified firms. In contrast, information used by administrative functions (where activities are not product-specific) is relatively invariant to the products involved, so that the ease of harmonizing information has little dependence on the degree of firm diversification.

To demonstrate the utility of this framework, note that it is able to explain the fact that administrative functions are centralized more frequently than product functions (see Table 1): the returns to centralization (from exploiting synergies) are higher in administrative functions because information is less product-specific, and thus easier to harmonize across business units.

We are now ready to apply this framework to interpret our findings in the context of existing theory.

VI. B. Understanding the Centralization-Scope Relationship

In this section, we refine existing theory to address our findings on the centralization-diversification relationship. We start by revisiting relevant theoretical arguments in the existing literature.

First, consider the argument that exploiting synergies across business units requires centralization of activities in the hands of corporate-level functional managers. This claim is not *a priori* obvious; one might argue that business unit managers may effectively coordinate horizontally amongst themselves, without the need for corporate-level intervention. For example, Cremer, Garicano and Prat (2007) argue that less diversified firms may decentralize decisions to business unit managers and exploit synergies by developing a common code to facilitate horizontal communication and coordination. However, a number of scholars (notably Hill and Hoskisson, 1987; Hill, 1988; Argyres, 1995) argue that coordination is most effectively achieved with activities being centralized at corporate headquarters instead of being left in the

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[25] A related body of work considers how the nature of relevant information affects the ability to communicate; for example, soft vs. hard information (e.g. Stein 2002, Liberti and Mian 2009), or tacit versus explicit knowledge (e.g. Polanyi 1966). In contrast, the focus of our analysis is on the difficulty in aggregating, rather than communicating, information.

[26] To illustrate, compare finance (an administrative function) to marketing (a product function). Financial information is largely quantifiable and standardizable, and thus easy to harmonize across business units, whereas marketing information is often highly product-specific and subjective, and thus difficult to harmonize across business units.

hands of business units. This is because exploiting synergies requires the imposition of coordinated outcomes that business unit managers may disagree over; consequently, conflict and rent-seeking amongst business units will often arise unless coordination is imposed by fiat.[27] More generally, the view that capturing synergies (broadly construed) involves centralizing/integrating activities is quite common in both the management literature (e.g. Lawrence and Lorsch, 1967; Bartlett and Goshal, 1993) and the organizational economics literature (e.g. Qian, Roland and Xu, 2006; Dessein, Garicano and Gertner, 2010).[28]

Relatedly, it has long been argued that an increase in firm diversification reduces the extent of potential synergies across business units. A number of strategy papers (e.g., Rumelt 1974, 1982; Hill, Hitt and Hoskisson, 1992) suggest that as a firm's businesses become more diverse, opportunities for synergies between business units diminish. This idea is intuitive and often taken as a starting point for analysis, for example by Dessein, Garicano and Gertner, 2010.

The natural implication of these arguments is that increased firm diversification reduces the extent of potential synergies, and thus the returns to centralization. Consequently, we should expect a negative relationship between diversification and centralization. This logic is intuitive and compelling, but our findings indicate that it is incomplete: it does not explain our finding that the centralization-diversification relationship differs across product functions and administrative functions. Specifically, we find that centralization decreases with firm diversification, but only for product functions; there is no significant relationship between centralization and diversification with administrative functions.

Once we consider how the information processing involved in exploiting synergies may depend on the product-specificity of relevant information, a more nuanced explanation for observed features of the centralization-diversification relationship emerges naturally. For product functions (where activities are product-specific), the difficulty of harmonizing information is intensified when firms diversify, whereas diversification has no such effect on administrative functions (where activities are not product-specific). Consequently, given that the returns to functional centralization increase with the ease of harmonizing information, the relationship between firm diversification and functional managers depends on the type of function: the number of corporate-level functional managers decreases with firm diversification for product functions, but not for administrative functions. This is exactly what we find.

VI. C. Understanding the Centralization-IT Relationship

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[27] For more examples of such conflict, see Herbold's (2002) description of Microsoft's attempt to exploit synergies between divisions.

[28] Relatedly, Alonso, Dessein and Matouschek (2008) model strategic communication within organizations and show that coordination is more effectively achieved vertically rather than horizontally when the degree of potential conflict between divisions is large.

Existing research points out that the effect of IT on the centralization of decision-making is a priori ambiguous (e.g., Attewell and Rule, 1984; Gurbaxani and Whang, 1991).[29] IT improves the information-processing ability of headquarters, and thus may serve as a *complement* to centralization. For example, Gurbaxani and Whang (1991) argue that "IT enables organizations to process decision-relevant information in a more cost-effective way, thus improving the quality and speed of upper management's decision-making processes … leading to more centralized management." On the other hand, by improving the information-processing ability of individual business units, IT allows activities to be pushed down to the business-unit level and thus may serve as a *substitute* for centralization (e.g. Lawler, 1988).[30] Whether IT serves as a complement or substitute to centralized decision-making is therefore an empirical question.

Our results suggest a nuanced answer: IT and centralization are complements, but not in all settings. We find that administrative functions and product functions behave differently with respect to IT investments: as firms increase IT investments, they centralize administrative functions, whereas they centralize product functions only when they operate in related businesses.

To understand the nuances in our findings, we again turn to our framework. If we start with the argument (from Section VI.B) that exploiting synergies requires centralization, then IT may complement centralization since it makes it easier for functional managers to harmonize information. Further (and this is the key insight), the effect of IT may depend on the nature of information, and thus on the type of function as well as the degree of firm diversification. Specifically, the gains from IT investments under centralization are diminished in certain settings -- when activities are product-specific and the firm is diversified. Why? In such settings, information from different business units will take substantially different forms, so that harmonizing requires subjective interpretation and judgment.[31] IT is effective at automating the standardization and processing of easily-structured data, but plays little role in interpretation and judgment, and thus in harmonizing information when information cannot be easily standardized. So, even though IT investments increase the returns to functional centralization more generally, this effect is diminished for product-specific activities, especially in diversified firms. This logic and our framework explain our findings that, as firms increase IT investments, they centralize administrative functions (where activities are not product-specific) regardless of firm diversification, but

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[29] Relatedly, Garicano (2000) points out that the effect of IT on centralization depends on the role of IT: whether it is used to facilitate *communication* or *individual problem-solving*.

[30] A related literature argues that improvements in IT facilitate the use of markets rather than hierarchies to manage transactions (see, for e.g., Brynolfsson, 1994; Malone, Benjamin and Yates, 1987).

[31] For example, return to our marketing example from footnote 5. When measures of marketing outcomes are qualitatively different across business units (e.g. click-on rates versus sales leads), comparing outcomes across products (to, for example, examine tradeoffs involved in branding choices) becomes highly subjective.

they centralize product functions only when they operate in related businesses (because information from product-specific activities is easier to harmonize across business units when products are similar).

VI.D. Implications for Organizational Form

The findings discussed so far have documented relationships between centralization (as captured by the structure of the executive team) and strategy variables such as diversification and IT investments, and how these change over time. In this sub-section, we argue that changes in executive team structure offer insight about organizational form and decision-making; as Beckman and Burton (2011) point out, "The structure of the TMT can be a stand-in for the structure of the organization." To do so, we combine our findings on (i) pay within the executive team, and (ii) executive team structure. Note, however, that our analysis is limited by the absence of some reporting relationships and other proxies for decision-making in our dataset.

Let's start with our findings on pay. Not surprisingly, we find that functional managers who join the executive team are paid more, suggesting a broader job scope for managers who report directly to the CEO. This finding confirms that changes in hierarchical position have economic significance, and are not simply a meaningless movement of boxes on an organizational chart. More notably, and crucial to interpreting our results as an increase in functional centralization, general manager (division manager) pay declines as product or front-end functional managers join the executive team, but it is not affected by administrative or back-end functional managers. This suggests that functional managers serve as partial substitutes for general managers (resulting in lower pay for the latter), especially in activities that are close to the product, such as marketing or R&D. This evidence is consistent with the interpretation that functional managers centralize some activities that previously resided with the business unit or division manager; this is particularly true for product functions.

Having argued that corporate-level functional managers partially substitute for general managers, we ask the follow-up question: When functional managers join the executive team, do they replace general managers, or coexist with them? To elaborate: the presence of a corporate-level functional manager may achieve coordination across business units in two broad ways. First, by heading a centralized functional unit that performs most functional activities, with little being performed in the business units. Second, by coordinating functional activities, which continue to be performed within business units, to minimize redundancies and realize synergies. We should expect the number of general managers to decrease as functional managers join the executive suite in the first case, but not in the second. Our finding that the number of general managers is positively correlated with the number of (product and administrative) functional managers indicates that functional managers are coexisting with, rather than replacing, general managers. This suggests that our evidence is consistent with a move

towards matrix organizational forms (Galbraith 1971) or centralized M-form organizations (Hill and Hoskisson, 1987), as illustrated by the earlier example of Procter & Gamble.

VII. Conclusion

The core of our paper is a detailed set of findings about the relationship between executive team structure and key strategy choices. By using a large sample of firms and panel techniques over a long period, we go beyond existing empirical studies to more convincingly document these relationships. Our empirical results are in the spirit of the extensive literature in strategy and management on how changes in both strategy and structure relate to shifts in the environment in which firms operate (e.g., Lawrence and Lorsch, 1967). Our findings are obtained in a period characterized by dramatic environmental changes that include globalization, developing capital markets, and falling costs of information technology.

In developing and interpreting these findings, the paper makes a number of novel contributions. First, we study two important questions in the strategy literature: (i) Are IT and centralization complements or substitutes? (ii) What is the relationship between centralization and firm scope? For the first question, we contribute a set of clear results to a literature fraught with competing perspectives; for the second question, we show that the current, established understanding is incomplete. The richness of our data allows us to establish a number of novel and important nuances in these relationships. In particular, we show that relationships we document vary across functions – product vs. administrative -- and depend on the product-specificity of the information relevant to functional decision-making. These results are not well explained by existing theory, and thus highlight gaps in the current understanding of the determinants of centralization in firms.

Second, to explain all of the findings documented here, we develop an analytical framework that refines and extends existing theory and contributes to the literature on the information processing view of the firm and the link to organizational form. We argue that by recognizing that the functional manager serves as a harmonizer of information, and that the ease of harmonizing information depends on the product-specificity of relevant information, we obtain a richer understanding of how information processing and aggregation takes place across business units. Importantly, unlike our classification of information by product-specificity, earlier classifications of information types (e.g. tacit vs. explicit or hard vs. soft) cannot explain our full set of results. We hope that these ideas have broader applicability beyond the setting of the top management team, towards more general theories about decision-making within and across organizations; for example, one may potentially analyze firm boundaries as being chosen to maximize the ease of harmonizing information both within and across firms.

Third, our distinction between general managers, functional managers, and types of functional managers amongst the CEO's direct reports provides some texture to the determinants of span of control – another longstanding puzzle in the strategy literature. [32] We successfully tease out important determinants of the CEO's span of control over a particular subset of managers (functional managers). Our approach suggests that to understand span of control, it is necessary to move away from the study of span towards richer notions of hierarchical structure that acknowledge differences in the nature of the roles played by subordinates.

Finally, we document significant changes in executive team structure over approximately two decades in large US firms, with three-quarters of the doubling in the number of positions reporting directly to the CEO being driven by the increased presence of corporate-level functional managers. Notably, our findings suggest that as large US firms centralized corporate-level functions over the past couple of decades, they moved away from the pure M-form (Chandler, 1962) towards other forms of organization such as the matrix (Galbraith, 1971) or centralized M-form (Hill, 1988). While this may be consistent with small sample studies, it has not (to our knowledge) been systematically documented in a large sample of firms over the period of our study (mid-1980s to mid-2000s).

Taken as a whole, our paper contributes to three related, but often disconnected, fields of research: the study of centralization (and more broadly, the location of decision rights); the literature on top management teams (TMTs); and the information processing view of the firm. Given that these fields "meet" at the intersection of this new set of facts, our paper does not merely contribute to each individual field, but also highlights the connections between them. As such, we are hopeful that this work may guide future research within fields, but also bridge these often disconnected fields in insightful and interesting ways.

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[32] Puranam et al (2012) point out that "the evidence to date on the determinants of the span of control has not been encouraging."

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Figure 1: IBM Senior Executive Team, 1994
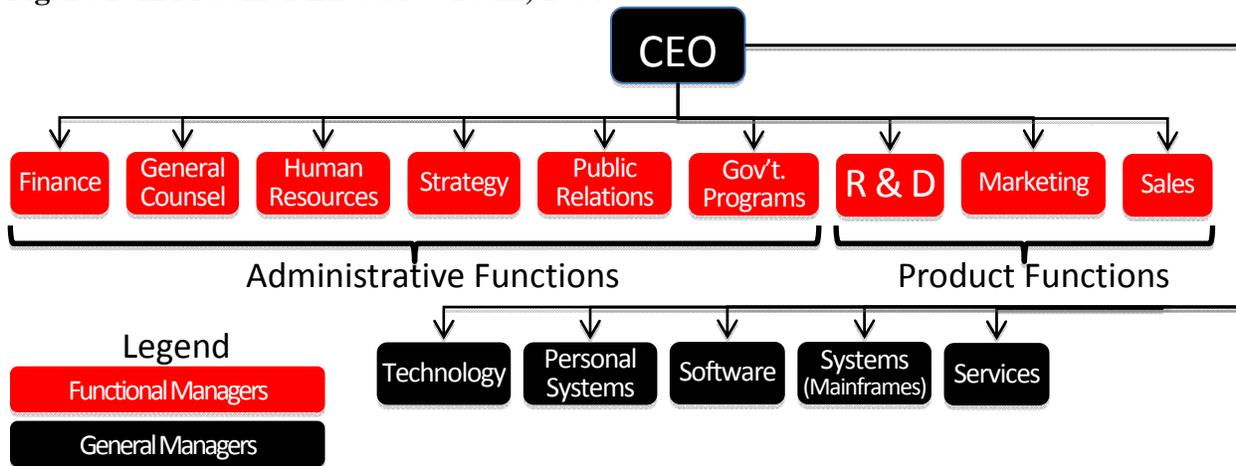
Source: IBM

Notes: Of the 14 managers that reported directly to the CEO, 5 were general managers and 9 were functional managers. The administrative functional managers are CFO, General Counsel, Human Resources, Strategy, Public Relations, and Gov't Programs. The product functional managers are Research & Development, Marketing, and Sales.

Figure 2: Span, Functional Managers and General Managers over Time (1986-2006) (sample averages)
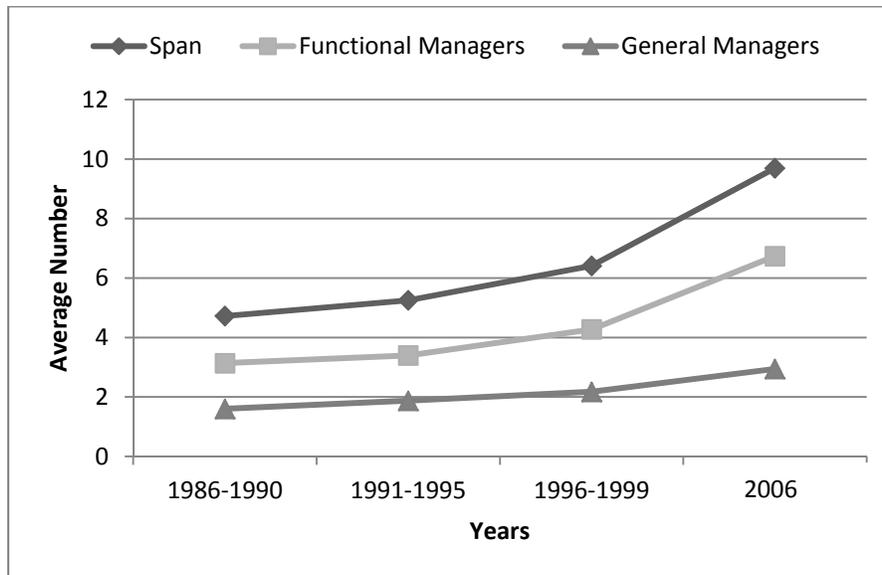
Notes: (i) The span [of control] is the size of the executive team. (ii) To minimize bias from using an unbalanced panel, the figure above is based on the sample of firms that appear for at least 10 years over the sample period. The first three time periods use data from the larger sample of firms (290), while the last time period (2006) is based on smaller sample (43 firms). If we limit the sample to only the 43 firms for which we have data in the later period, the pattern over the 20 years is qualitatively similar. Where we could not find 2006 data, we took the nearest year to 2006 between 2004 and 2008.

Table 1: Mean and Correlations between Executive Team Positions

	Mean	Gen. Mgrs.	CFO	General Counsel	CHRO	Strat. Planning	Sales & Marketing	R&D	Manufacturing
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
General Mgrs.	1.790	1							
Admin. Functions:									
CFO	0.728	0.12***	1						
General Counsel	0.672	0.11***	0.29***	1					
CHRO	0.522	0.13***	0.19***	0.29***	1				
CIO	0.063	0.08***	0.074***	0.04	0.14***				
Strat. Planning	0.237	0.14***	0.07**	0.03	0.08***	1			
Product Functions:									
Sales & Marketing	0.113	-0.02	-0.013	-0.03	0.02	-0.01	1		
R&D	0.150	0.10***	0.09***	0.04	0.06**	0.08***	0.08***	1	
Manufacturing	0.053	0.01	-0.04*	-0.06**	-0.01	0.03	0.21***	0.14***	1

Notes: ***, **, and * represent statistical significance at 1%, 5%, and 10% levels respectively. The following variables are included in this table: General managers is the number of general managers (includes COO, group managers and division managers) reporting directly to the CEO; All other variables are dummy variables for whether a given functional position reports directly to the CEO. CFO stands for Chief Financial Officer, CHRO stands for Chief Human Resource Officer, and CIO stands for Chief Information Officer. Sales and Marketing functions are pooled in this table because select firms report a position that combines these functional responsibilities. For each of these functions (Administrative and Product), the mean (Column 1) represents the fraction of the sample that has the position reporting directly to the CEO. Columns 2 through 10 show the correlation between pairs of positions. These correlations are calculated on our full sample (2321 firm-year observations)

	Mean	S.D.	10th pct.	90th pct.	Observations
Sales (000s)	9267.44	16106.13	1260.1	18925	2321
Assets (000s)	10826.57	21852.34	1118.3	24040	2321
Number of Employees (000s)	48.28	81.36	5.9	102	2321
Number of Segments	2.76	1.66	1	5	2321
Functional Managers	3.19	1.53	1	5	2321
Administrative Functional Managers	2.55	1.41	1	4	2321
Product Functional Managers	0.32	0.6	0	1	2321
General Managers	1.79	1.52	0	4	2321
Span (Size of Executive team)	4.98	2.34	2	8	2321
CAO	0.33	0.47	0	1	2321
COO	0.48	0.5	0	1	2321
PCs per Employee	0.22	0.21	0.03	0.48	2321
Industry Avg. Price-Cost Margin	0.18	0.1	0.08	0.33	2321
Foreign Affiliates Sales (%)	0.23	0.21	0	0.5	2321
ln Number of LAN nodes (1993-1999)	7.8	1.44	6.31	9.38	1268
Firm scope variables:					
Unrelated Diversif. (Entropy)	0.37	0.41	0	1.01	2321
Vertical Relatedness	0.02	0.04	0	0.05	1502
Complementarity	0.4	0.31	0.06	0.99	1502
Compensation variables:					
ln Func. Mgrs. Base Compensation	12.43	0.38	11.95	12.9	5317
ln Func. Mgrs. Total Compensation	13.28	0.7	12.43	14.18	5317
ln General Mgrs. Base Compensation	12.05	0.41	11.52	12.55	8866
ln General Mgrs. Total Compensation	12.75	0.65	11.96	13.58	8866

Notes: Reported statistics are based on the data for the 1987-1999 period, with the exception of Number of LAN Nodes. Number of segments is the number of business segments (COMPUSTAT segment data). Functional managers is the number of functional manager positions reporting directly to the CEO (this includes Administrative and Product Functional managers as well as the CAO). Administrative functional managers include CFO, General Counsel, Human Resources, Public Relations, Planning, and Chief Information Officer. Product functional managers include heads of R&D, marketing, sales, sales & marketing, and manufacturing. General managers is the number of general managers reporting directly to the CEO (COO, group managers and division managers). Span is the total number of positions reporting directly to the CEO. PCs per employee is PCs per 1000 employees. The Industry average price-cost margin is computed at 3-digit SIC (COMPUSTAT). Foreign Affiliate Sales (%) is the fraction of sales reported by foreign affiliates as a share of total firm sales (COMPUSTAT Geographic Segment data). ln Number of LAN nodes is the log of the number of Local Area Network nodes. Unrelated diversification is the entropy measure used in Palepu (1985). Vertical Relatedness and Complementarity are based on Fan and Lang (2000) definitions, using 1992 US Input-Output tables and COMPUSTAT segment data. See footnotes 12, 13 and 14 for exact definitions. Base Compensation is an employee's base salary, while Total Compensation includes base salary along with bonuses and long-term incentives.

	(1)	(2)	(3)	(4)	(5)
				Product	Admin.
VARIABLES	Span	Gen. Mgr.	Func. Mgrs.	Func. Mgrs.	Func. Mgrs.
Unrelated Diversif. (Entropy)	0.741*	0.625**	0.116	-0.262**	0.378
	(0.411)	(0.270)	(0.297)	(0.133)	(0.245)
PCs per Employee	0.268	-0.370	0.638**	0.0902	0.548**
	(0.440)	(0.245)	(0.301)	(0.134)	(0.236)
# of Segments	-0.0551	-0.0571	0.00205	0.0423**	-0.0402
	(0.0810)	(0.0534)	(0.0549)	(0.0194)	(0.0480)
CAO	0.464**	0.106	0.358***	0.0602	-0.702***
	(0.183)	(0.117)	(0.121)	(0.0532)	(0.0978)
COO	-0.870***	-0.412***	-0.459***	-0.190***	-0.269***
	(0.168)	(0.111)	(0.106)	(0.0403)	(0.0860)
Foreign Affiliates Sales (%)	1.595**	0.758	0.837**	0.103	0.734**
	(0.672)	(0.487)	(0.407)	(0.167)	(0.345)
Ln(Sales)	-0.381	-0.0186	-0.363	-0.122	-0.241
	(0.349)	(0.217)	(0.234)	(0.0809)	(0.205)
R & D / Sales	-5.389	-7.024	1.635	2.759	-1.124
	(7.430)	(5.077)	(4.458)	(1.755)	(3.990)
Industry Avg. Price-Cost Margin	-1.794	-1.784*	-0.0102	-0.386	0.376
	(1.616)	(1.062)	(1.019)	(0.439)	(0.847)
Observations	2,321	2,321	2,321	2,321	2,321
R-squared	0.156	0.084	0.128	0.059	0.168
Number of firms	290	290	290	290	290
Year Dummies	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes

Notes: ***, **, and * represent statistical significance at 1%, 5%, and 10% levels respectively. All regression models are panel fixed effects regressions, with firm fixed effects (Firm FE). Standard errors (in parentheses) are clustered by firm. Span is the total number of positions reporting directly to the CEO (i.e., the sum of functional managers and general managers). General managers is defined the number of general managers reporting directly to the CEO. General managers include COO, group managers and division managers. Functional manager is defined as the number of functional manager positions reporting directly to the CEO; note that this count includes the CAO. Product functional managers include heads of R&D, marketing, sales, sales & marketing, and manufacturing. Administrative functional managers include CFO, General Counsel, Human Resources, Public Relations, Planning, and Chief Information Officer.

Table 4: Types of Functional Managers, Diversification and IT

VARIABLES	(1) Product Func. Mgrs.	(2) Product Func. Mgrs.	(3) Product Func. Mgrs.	(4) Product Func. Mgrs.	(5) Product Func. Mgrs.	(6) Admin. Func. Mgrs.	(7) Admin. Func. Mgrs.	(8) Admin. Func. Mgrs.
# Related Segments	0.0291**							
	(0.0117)							
# Unrelated Segments	-0.0201							
	(0.0159)							
Vertical Relatedness		0.829				-0.648		
		(0.634)				(2.082)		
Complementarity			0.247**				-0.0410	
			(0.112)				(0.264)	
PCs per employees*Unrelated Diversif					-0.477**			
					(0.227)			
Unrelated Diversif. (Entropy)				-0.281**	-0.163			0.294
				(0.132)	(0.137)			(0.243)
Ln (# of LAN nodes)				-0.00634				0.104**
				(0.0203)				(0.0422)
PCs per Employee	0.105	-0.0138	-0.0188	0.111	0.212	0.927*	0.927*	0.430*
	(0.138)	(0.200)	(0.202)	(0.137)	(0.153)	(0.550)	(0.549)	(0.228)
Gen. Mgrs.	0.0293**	0.0255	0.0238	0.0323**	0.0323**	0.0951***	0.0957***	0.0850***
	(0.0140)	(0.0166)	(0.0165)	(0.0143)	(0.0140)	(0.0347)	(0.0347)	(0.0271)
# of Segments		0.0319	0.0297	0.0445**	0.0401**	-0.0246	-0.0239	-0.0419
		(0.0231)	(0.0229)	(0.0196)	(0.0192)	(0.0486)	(0.0485)	(0.0476)
Observations	2,321	1,494	1,494	2,321	2,321	1,494	1,494	2,321
R-squared	0.063	0.084	0.091	0.066	0.070	0.165	0.165	0.184
Number of firms	290	213	213	290	290	213	213	290
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: ***, **, and * represent statistical significance at 1%, 5%, and 10% levels respectively. All regression models are panel fixed effects regressions, with firm fixed effects (Firm FE). Standard errors (in parentheses) are clustered by firm. Since the LAN nodes variable is only available after 1993, we impute a value of zero for the year prior to 1993 and include a dummy variable for the imputed observations in columns 4 and 8 (unreported) All columns include controls for the number of segments, CAO, COO, Industry Avg. Price-Cost Margin, Foreign Affiliates Sales (%), ln(Sales) and R&D / Sales, as in Table 3. See Table 3 for more definitions.

Table 5: Pay and Changes in Executive Team Structure

VARIABLES	(1) Func. Mgrs. Only ln(Base Comp)	(2) Func. Mgrs. Only ln(Total Comp)	(3) Gen. Mgrs. Only ln(Base Comp)	(4) Gen. Mgrs. Only ln(Total Comp)	(5) Gen. Mgrs. Only ln(Base Comp)	(6) Gen. Mgrs. Only ln(Total Comp)
Func. Mgrs.	-0.0147***	-0.00282	-0.00789**	-0.00997		
	(0.00339)	(0.00737)	(0.00352)	(0.00640)		
Admin. Func. Mgrs.					-0.00462	-0.00107
					(0.00385)	(0.00789)
Product Func. Mgrs.					-0.0240**	-0.0539***
					(0.0102)	(0.0168)
Reports to CEO	0.106***	0.145***	0.0734***	0.127***	0.0745***	0.130***
	(0.0126)	(0.0244)	(0.0210)	(0.0406)	(0.0207)	(0.0396)
Division Depth			-0.0706***	-0.107***	-0.0705***	-0.107***
			(0.0111)	(0.0178)	(0.0111)	(0.0177)
PCs per Employee	0.0328	0.0871	0.00429	-0.0136	0.00233	-0.0189
	(0.0272)	(0.0557)	(0.0389)	(0.0851)	(0.0388)	(0.0854)
Unrelated Diversif. (Entropy)	-0.00204	-0.0342	-0.0182	-0.0303	-0.0214	-0.0390
	(0.0284)	(0.0703)	(0.0301)	(0.0580)	(0.0298)	(0.0580)
Ln(Sales)	0.140***	0.299***	0.0922***	0.209***	0.0931***	0.211***
	(0.0186)	(0.0386)	(0.0245)	(0.0502)	(0.0243)	(0.0489)
Observations	5,317	5,317	8,866	8,866	8,866	8,866
R-squared	0.580	0.598	0.644	0.554	0.645	0.556
Number of positions*firm	831	831	2,560	2,560	2,560	2,560
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Position*Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: ***, **, and * represent statistical significances at 1%, 5%, and 10% levels respectively. All regression models are panel fixed effects regressions, with position-firm fixed effects (Position*Firm FE). Standard errors (in parentheses) are clustered by firm. Columns 1 and 2 are for the only three functional manager positions for which we have compensation data (CFO, General Counsel, and Human Resources). Columns 3 through 6 only include division (general) managers. Base Compensation is an employee's base salary, while Total Compensation includes base salary along with bonuses and long-term incentives. All columns include controls for the number of segments, CAO, COO, Industry Avg. Price-Cost Margin, Foreign Affiliates Sales (%) and R&D / Sales, as in earlier tables. See Table 3 for other variable definitions.

Appendix Table A1: Pairwise Correlation between Main Variables

	ln Sales	Span	General Managers	Product Func. Mgrs.	Admin. Func. Mgrs.	PCs per Employee	ln # of LAN nodes	Unrelated Diversif. (Entropy)	R & D / Sales	Foreign Affiliates Sales (%)
ln Sales	1									
Span (Size of Executive Team)	0.0984***	1								
General Managers	0.0741***	0.767***	1							
Product Func. Mgrs.	-0.0215	0.333***	0.0483*	1						
Administrative Func. Mgrs.	0.0889***	0.684***	0.192***	0.0469*	1					
PCs per Employee	-0.139***	-0.00598	-0.0354	0.00979	0.0343	1				
ln # of LAN nodes	0.210***	0.192***	0.146***	0.0281	0.165***	0.345***	1			
Unrelated Diversif. (Entropy)	0.0864***	0.114***	0.127***	-0.0979***	0.0808***	-0.0813***	-0.0230	1		
R & D / Sales	-0.0108	0.0217	-0.0367	0.192***	-0.0182	0.108***	0.0195	-0.148***	1	
Foreign Affiliates Sales (%)	0.169***	0.0621**	0.00928	0.123***	0.0368	-0.102***	0.0516*	-0.0505*	0.424***	1

Notes: ***, **, and * represent statistical significance at 1%, 5%, and 10% levels respectively. Table shows correlation coefficients between pairs of variables.

Appendix Table A2: Cross-Sectional Relationships

	(1) Product Func. Mgrs.	(2) Admin. Func. Mgrs.	(3) Product Func. Mgrs.	(4) Admin. Func. Mgrs.
Unrelated Diversif. (Entropy)	-0.125	0.425**	-0.153*	0.300*
	(0.0878)	(0.177)	(0.0886)	(0.161)
PCs per Employee	-0.0528	0.00137	-0.150	0.283
	(0.109)	(0.246)	(0.124)	(0.213)
Number of Segments	-0.00405	-0.0484	0.0243	-0.0331
	(0.0223)	(0.0398)	(0.0205)	(0.0378)
CAO	0.106**	-0.855***	0.109**	-0.816***
	(0.0468)	(0.0984)	(0.0460)	(0.0900)
COO	-0.190***	-0.403***	-0.174***	-0.299***
	(0.0421)	(0.0964)	(0.0401)	(0.0904)
Foreign Affiliates Sales (%)	0.117	0.278	-0.140	0.219
	(0.127)	(0.330)	(0.161)	(0.406)
Ln(Sales)	-0.0187	0.0886	-0.00801	0.127*
	(0.0236)	(0.0600)	(0.0288)	(0.0723)
R & D / Sales	2.386***	-0.686	3.080***	-4.532*
	(0.653)	(1.627)	(1.140)	(2.452)
Industry Avg. Price-Cost Margin	-0.907***	-0.110	-0.609*	0.171
	(0.203)	(0.533)	(0.353)	(0.883)
Observations	2,321	2,321	2,321	2,321
R-squared	0.101	0.143	0.062	0.155
Year Dummies	Yes	Yes	Yes	Yes
Firm FE	No	No	No	No
SIC 3 digit	No	No	Yes	Yes
Number of sic3			99	99

Notes: ***, **, and * represent statistical significance at 1%, 5%, and 10% levels respectively. Regressions replicate the specifications in Columns 4 and 5 of Table 3, but do not include firm fixed effects. Standard errors (in parentheses) are clustered by firm. Product functional managers include heads of R&D, marketing, sales, sales & marketing, and manufacturing. Administrative functional managers include CFO, General Counsel, Human Resources, Public Relations, Planning, and Chief Information Officer.

This table allows us to demonstrate potential pitfalls in interpreting simple cross-sectional regressions. For example, consider the negative relationship between unrelated diversification and product functional managers: as we include additional controls across specifications, the coefficient on entropy increases in magnitude and precision. Specifically, in the first regression without industry or firm fixed effects (col. 1 above), we find a small and statistically insignificant coefficient (-0.125). When we include industry fixed effects (col. 3 above), precision increases and the coefficient is significant at 10%. In the firm fixed effects regression which we focus on in the paper (Table 3, col. 4), we estimate a larger, more precise coefficient (-0.262), significant at 5%. So, the magnitude and precision of the coefficient increases across specifications with additional controls. A similar pattern holds when we repeat this comparison exercise for our other main finding, i.e., a positive relationship between PC/employee and administrative functional managers (col. 2, col. 4 above and Table 3, col. 5). This trend suggests that the addition of controls is reducing noise in the data, as it controls for firm permanent unobserved heterogeneity that may be correlated with the observables.

A similar comparison of the product functional manager and admin functional manager regressions across specifications shows that, when we add firm fixed effects, we see the statistical significance of the coefficient on R&D/Sales in the cross-section diminish significantly. This suggests either that there is not enough variation in R&D for the correlation to be picked up in the panel specification, or that the correlation observed in the cross-section is driven by an omitted variable. This comparison highlights a drawback of relying solely on cross-sectional analysis (omitted variable bias may be overlooked). At the same time, it reveals an advantage of carefully studying both cross-sectional and panel specifications (the cross-sectional specification may provide suggestive evidence for certain relationships where there is insufficient variation in the panel specification).