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

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Top management structures in large U.S. firms have changed significantly since the mid-1980s. 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 information technology investments. These relationships depend crucially on the function involved; those closer to the product ("product" functions, e.g., marketing and R&D) behave differently from functions further from the product ("administrative" functions, e.g., finance, law, and human resources). 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.

Keywords: communication; organizational design; functions; centralization; M-form; hierarchy; top management team; C-Suite; information technology; activities; diversification
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1. Introduction

> We learned from the experience that work of higher quality could be obtained by utilizing, corporation-wide, the highly developed talents of the specialists.
> (Sloan 1963, p. 430)

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 (TMTs) 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 data set rich in details of managerial job descriptions, reporting relationships, and compensation structures for senior management positions in large U.S. 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 information technology (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,

[1] Although much of the empirical research in management on TMTs 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, and 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 et al. 2007, and surveys by Carpenter et al. 2004, Finkelstein et al. 2009, Menz 2012, Beckman and Burton 2011).

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 §3: from the mid-1980s to 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 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 as a result of falling IT costs and a significant reduction in firm diversification in response to increasing global competition.

In particular, this 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 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, or 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 et al. 1992). However, some recent work has argued otherwise; for example, Cremer et al. (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 long-standing questions is more nuanced than has been posited in the literature. 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. That is, *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 (HR)). First, firms that become less diversified centralize product functions but not administrative functions. Second, firms that invest more in IT centralize administrative functions, but they 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.

Our framework (described in §6) 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, and Tushman and Nadler 1978 in the strategy literature, and Sah and Stiglitz 1986 and 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

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

[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.

[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 §6.1 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.

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 data set allows for a 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 data set 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., the 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. Although 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 because of 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 literature on TMTs—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 U.S. firms over two decades, they suggest a movement away from the pure multidivisional M-form that consists of largely autonomous general managers (Chandler 1962; Williamson 1975, 1985), toward 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.

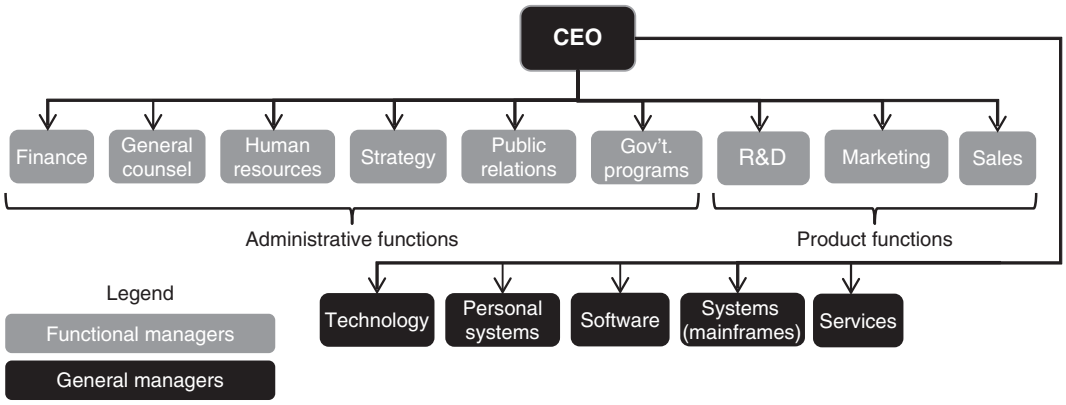
This paper proceeds as follows. Section 2 discusses two motivating examples that illustrate the strategic considerations linking, IT, firm diversification, and organizational structure. Section 3 discusses the roles and responsibilities of corporate-level functional managers in some detail and presents some statistics about the composition of the TMT. Section 4 describes our data set. Section 5 presents our empirical findings. Section 6 discusses the implications of our findings, and introduces new theoretical insights to the information-processing view of the firm that allow us to extend existing theory and explain our results. Section 7 concludes.

2. 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 et al. 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 that included functional senior vice presidents to manage functions across business units to promote "the pooling of knowledge, transfer of best practices, elimination of intraregional redundancies, and standardization of activities" (Piskorski 2007, pp. 6–7).

The idea that firms increasing their business relatedness also centralize activities at the corporate level

Figure 1 IBM Senior Executive Team, 1994



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 government programs. The product functional managers are R&D, marketing, and sales.

is familiar to the management and strategy literatures (e.g., Hill and Hoskisson 1987, Hill et al. 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 IT businesses but with poor coordination across businesses. The executive team was comprised primarily of general managers of business units (e.g., mainframes) and 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" (Gerstner 2002, p. 77), 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. Because the new strategy required extensive coordination across business units, Gerstner reorganized the top team and added functional managers to facilitate corporate-wide coordination (see Figure 1). For example, he created a chief marketing officer (CMO) position 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 (IBM 1994, p. 6). 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. Furthermore, 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, Brynjolfsson 1994, Malone et al. 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 (Herbold 2002).[5] Prior to this 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" (Herbold 2002, p. 75). 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" (Herbold 2002, p. 75). Consequently, centralized decision making was stymied: "The top management team was often forced to make decisions with outdated financial information" (Herbold 2002, p. 75). 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 HR. The implementation of these systems was made possible by the availability of affordable off-the-shelf IT systems. The Microsoft

[5] Note that this case from Herbold (2002) describes the centralization of decision making but not the concomitant changes in 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.

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 data set of firms. This systematic analysis will guide us toward a rigorous understanding of where, and how much, the mechanisms posited in this section are related to firm centralization.

3. 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 or 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 could 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, and R&D); i.e., they centralize functional activities at the corporate level. In contrast, general managers—or line managers—are concerned with a range of functional activities within their business units and typically have profit and loss responsibility. Gerstner's executive team included nine functional managers and five general managers, including the general managers of the personal computer business (general manager of personal systems) and the mainframe business (general manager of systems), among others.

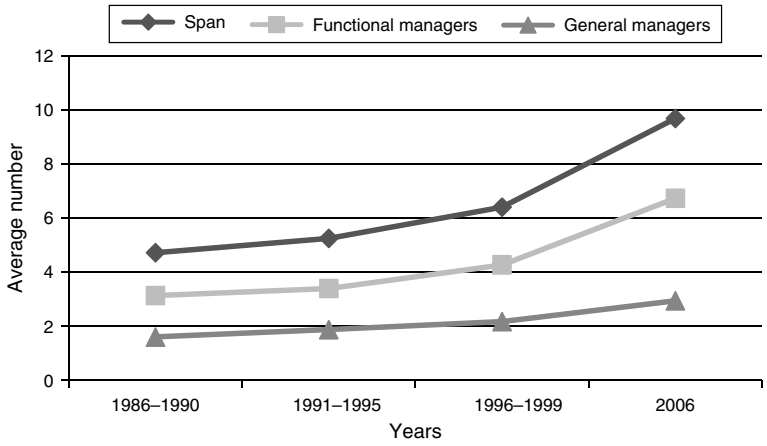
Not surprisingly, corporate-level functional managers perform different activities that vary by function. For example, in the marketing function as illustrated in IBM, CMO responsibilities include "leading the company's marketing organization; uniting and strengthening various departments' own marketing plans; directing global marketing efforts, including branding, product marketing, and customer relationship marketing" (Nath and Mahajan 2008, p. 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, p. 108). Finally, for the finance function, Chandler's (1991, p. 33) 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."[6]

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); and 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 those that are "far from the product" as administrative functions. We classify the following four functions as front-end or product functions: marketing (CMO), R&D (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), HR (chief HR officer (CHRO)), IT (chief information officer (CIO)), strategy (long-range planning and business development), and public relations (communications officer). IBM's CEO Gerstner had three product functional managers and six administrative functional managers reporting directly to him.

As mentioned earlier, although 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 U.S. firms (see data description in §3). 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

[6] 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 et al. 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).

Figure 2 Span, Functional Managers, and General Managers over Time (1986–2006) (Sample Averages)



Notes. The span (of control) is the size of the executive team. To minimize bias from using an unbalanced panel, the figure 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), and the last time period (2006) is based on a 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.

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 five to 10 positions, and the novel trend documented in this paper was a shift in the structure of the executive team toward 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 increases were attributed to functional managers.[7]

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 compared with product functions. Columns (2)–(9) 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), and 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), as 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 §4, we analyze how the structure of the executive team changed over time within firms in response to changes in firm diversification and IT investments.

[7] 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). Also, as companies become more customer focused and marketing techniques grow in sophistication, 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.

4. Data Sources and Description

To analyze the drivers of the observed increased presence of functional managers in the executive team described in §3, we draw on a number of data sets. First, our main data set is based on a confidential compensation survey conducted by Hewitt Associates, a leading HR 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 data

Table 1 Mean and Correlations Between Executive Team Positions

	(1) Mean	(2) *General managers*	(3) *CFO*	(4) *General counsel*	(5) *CHRO*	(6) *Strategic planning*	(7) *Sales and marketing*	(8) *R&D*	(9) *Manufacturing*
General managers	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 and 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. The following variables are included in this table: *General managers* is the number of general managers (including 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)–(9) show the correlation between pairs of positions. These correlations are calculated on our full sample (2,321 firm-year observations).

*, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

set 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 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 because it implies that we can easily compare positions and their evolution across firms over time. In addition to the positions defined earlier, the data set also records information on the CEO, chief operating officer (COO), and chief administrative officer (CAO). With this data set, 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 approximately 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).[8] 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, CFO, general counsel, and the CHRO. For these positions, we have information on the level of salary, bonus, and long-term compensation, including the Black–Scholes value of stock options grants, restricted stock, and other long-term incentives.

This unique data set 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 data sets we are aware of. However, in spite of its richness, our data set has some limitations. First, functional positions may exist in other parts of the organization and not report directly to the CEO. (In that case, because we focus on top executive team positions, we would underestimate 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, but we do not 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, although 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 toward 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

[8] 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.

that throughout this 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 two-digit Standard Industrial Classification (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.[9] The higher the entropy/unrelated diversification measure is, the more diversified the firm. 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 interindustry 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.[10] The higher the vertical relatedness value is, the more related the firm's businesses along the production chain. For example, because semiconductors are an important input into personal computers (PCs), 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.[11] For example, a firm that operates in both semiconductors and liquid-crystal display screens would score high on the complementarity measure because these are both inputs into PCs. The higher the complementarity value is, 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 et al. 2002). The database reports the number of PCs in use in each firm in a given year so that we can define the IT intensity of the firm as the number of PCs per employee. Because 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 data set 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, or different types of technologies that improve communication. Although we are not able to distinguish between investments in hardware, software, or communication technology, from 1993 onward, the data set also records the number of local area network (LAN) nodes. An 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.[12]

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 three-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 U.S. firms increasingly differentiate products, we might expect firms to change the structure of the top team

[9] Unrelated diversification is the weighted average of all two-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 (see Hill et al. 1992 for an early example).

[10] Vertical relatedness is the dollar value of industry i's output required to produce \$1 worth of industry j's output, as stated in input-output tables. (We use coefficients based on 1992 U.S. 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.

[11] 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.

[12] 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 IT and communications technology. Unfortunately, such information is not available in our time period (a 14-year panel).

Table 2 Descriptive Statistics

	Mean	SD	10th pct.	90th pct.	Observations
Sales (000s)	9,267.44	16,106.13	1,260.1	18,925	2,321
Assets (000s)	10,826.57	21,852.34	1,118.3	24,040	2,321
Number of employees (000s)	48.28	81.36	5.9	102	2,321
Number of segments	2.76	1.66	1	5	2,321
Functional managers	3.19	1.53	1	5	2,321
Administrative functional managers	2.55	1.41	1	4	2,321
Product functional managers	0.32	0.6	0	1	2,321
General managers	1.79	1.52	0	4	2,321
Span (*size of executive team*)	4.98	2.34	2	8	2,321
CAO	0.33	0.47	0	1	2,321
COO	0.48	0.5	0	1	2,321
PCs per employee	0.22	0.21	0.03	0.48	2,321
Industry average price-cost margin	0.18	0.1	0.08	0.33	2,321
Foreign affiliates sales (%)	0.23	0.21	0	0.5	2,321
ln(*Number of LAN nodes*, 1993–1999)	7.8	1.44	6.31	9.38	1,268
Firm scope variables					
Unrelated diversif. (*entropy*)	0.37	0.41	0	1.01	2,321
Vertical relatedness	0.02	0.04	0	0.05	1,502
Complementarity	0.4	0.31	0.06	0.99	1,502
Compensation variables					
ln(*Functional mgrs. base compensation*)	12.43	0.38	11.95	12.9	5,317
ln(*Functional mgrs. total compensation*)	13.28	0.7	12.43	14.18	5,317
ln(*General mgrs. base compensation*)	12.05	0.41	11.52	12.55	8,866
ln(*General mgrs. total compensation*)	12.75	0.65	11.96	13.58	8,866

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). *CAO* and *COO* are, respectively, dummy variables for whether the chief administrative officer and chief operating officer positions report directly to the CEO. *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 and 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 1,000 employees. *Industry average price-cost margin* is computed at three-digit SIC (Compustat). *Foreign affiliates 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 LAN 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 U.S. input-output tables and Compustat segment data. See Footnotes 9–11 for exact definitions. *Base compensation* is an employee's base salary, and *total compensation* includes base salary along with bonuses and long-term incentives.

for other reasons. We include a correlation table with the key variables in Table A.1 in the appendix.

Table 2 reports descriptive statistics for our data set.

5. Results: Determinants of Executive Team Structure

The empirical analysis in what follows relies on the panel nature of our data set to identify simultaneous changes in diversification, IT investments, and organizational decisions.[13] 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.[14]

5.1. Firm Diversification, IT, and Executive Team Structure

To study the correlates of executive team structure, we exploit the panel nature of our data set and estimate

[13] Relatedly, a number of papers have documented complementarities between IT and various organizational choices (e.g., Brynjolfsson et al. 1994, Bresnahan et al. 2002, Bartel et al. 2007, McElheran 2014). The organizational choice we focus on here is the structure of the executive team.

[14] Although 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 (such as the 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).

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} is 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 COO; d_t are year dummies; d_i are firm fixed effects; and 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 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)–(5) split 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, and 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)) versus 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

Table 3 Changes in Executive Team Structure

Variables	(1) Span	(2) General mgrs.	(3) Functional mgrs.	(4) Product functional mgrs.	(5) Admin. functional 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)
Number 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 fixed effects	Yes	Yes	Yes	Yes	Yes

Notes. All regression models are panel fixed effects regressions, with firm fixed effects. 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 as the number of general managers reporting directly to the CEO. General managers include COO, group managers, and division managers. Functional managers is defined as the number of functional manager positions reporting directly to the CEO (which includes the CAO). Product functional managers include heads of R&D, marketing, sales, sales and marketing, and manufacturing. Administrative functional managers include CFO, general counsel, human resources, public relations, planning, and chief information officer.

*, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

CEO is positively related to firm diversification, but it is 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% 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 it is 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% of the standard deviation in the number of administrative functional managers.[15] Furthermore, 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 chi-squared 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.)

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.[16]

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 two-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)–(8)) but not with the number of product functional managers (columns (1)–(5)). PCs per employee is a broad measure of IT that captures different aspects of IT-related information processing. We also have an additional measure of IT intensity that more closely captures the communication component of IT, the number of LAN nodes, but that is only available from 1993. In columns (4) and (8) we add the logarithm of LAN

[15] 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 CIO position or CFO. In fact, it is not driven by any one position in particular.

[16] 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 ordinary least squares (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.

Table 4 Types of Functional Managers, Diversification, and IT

Variables	(1) Product functional mgrs.	(2) Product functional mgrs.	(3) Product functional mgrs.	(4) Product functional mgrs.	(5) Product functional mgrs.	(6) Admin. functional mgrs.	(7) Admin. functional mgrs.	(8) Admin. functional mgrs.
No. of related segments	0.0291**							
	(0.0117)							
No. of 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(*No. 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)
General managers	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)
No. 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
No. of firms	290	213	213	290	290	213	213	290
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes. All regression models are panel fixed effects regressions, with firm fixed effects. Standard errors (in parentheses) are clustered by firm. Because 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 average price-cost margin, foreign affiliates sales (%), ln sales, and R&D/sales, as in Table 3. See Table 3 for more definitions.

*, **, and *** represent statistical significance at 10%, 5%, and 1% levels, respectively.

nodes as an independent variable to our main specification. (For the years prior to 1993, we impute a value of zero and dummy out the imputed observations to keep the number of observations constant between columns (1) and (4) and columns (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 1% 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.[17]

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).

[17] 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.

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 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 U.S. 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.[18]

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 A.2 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 A.2) or including only three-digit industry dummies (columns (3) and (4) in Table A.2). The comparison highlights two sets of issues with cross-sectional estimates: (i) some observed correlations may be driven purely by unobserved firm heterogeneity and (ii) other, more robust relationships may be obscured. This is discussed in greater detail in the notes for Table A.2.

5.2. 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 data set is that for some positions (division managers, CFO, general counsel, CHRO, and CEO), we have information on pay and reporting levels, even if the position is not directly reporting to the CEO.[19] So, all regressions in Table 5 have a position-year as the basic unit of observation and have the following structure:

$$\ln(W_{pit}) = \alpha + O'_{pit}\beta + F'_{it}\delta + X'_{it}\theta + d_t + d_{pi} + \varepsilon.$$

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 by describing pay for functional managers in columns (1) and (2). As mentioned, the only functional managers we have pay information for are the CFO, general counsel, and CHRO (administrative

[18] The number of functional managers in column (3) includes the CAO, whereas the CAO is not included in product (column (4)) or administrative (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).

[19] 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 or not it reports directly to the CEO. In 72% of the cases, for this subset of positions, functional managers report directly to the CEO.

Table 5 Pay and Changes in Executive Team Structure

Variables	(1) Functional mgrs. only ln (base comp)	(2) Functional mgrs. only ln (total comp)	(3) General mgrs. only ln (base comp)	(4) General mgrs. only ln (total comp)	(5) General mgrs. only ln (base comp)	(6) General mgrs. only ln (total comp)
Functional mgrs.	−0.0147***	−0.00282	−0.00789**	−0.00997		
	(0.00339)	(0.00737)	(0.00352)	(0.00640)		
Admin. functional mgrs.					−0.00462	−0.00107
					(0.00385)	(0.00789)
Product functional 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 fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes. All regression models are panel fixed effects regressions, with position-firm fixed effects. 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 HR). Columns (3)–(6) only include division (general) managers. Base compensation is an employee's base salary, and total compensation includes base salary along with bonuses and long-term incentives. All columns include controls for the number of segments, CAO, COO, industry average price-cost margin, foreign affiliates sales (%), and R&D/sales, as in earlier tables. See Table 3 for other variable definitions.

*, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

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% increase in base compensation and a 15% 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, 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 that the base salary is 1.5% 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 whereas base compensation is designed to account for 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)–(6) report pay changes for division (general) managers. Here again, we find that reporting directly to the CEO increases base pay (7%) and total compensation (13%) 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% lower salary and 5.4% lower total compensation for division managers. In contrast, we find no correlation between administrative functional managers and division manager pay.

Although 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 such as R&D or marketing (relative to administrative activities) that typically are a more substantial component of the division manager's job. To summarize: (1) The role of the functional manager changes as the functional position joins the executive team because their pay increases. (2) Because 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.

6. 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 §6.1, 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 §§6.2 and 6.3; we analyze the relationship between centralization and diversification in §6.2 and the relationship between centralization and IT investments in §6.3. 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 §6.4, we discuss the implications of our findings for broader questions about the determinants of organizational form.

6.1. Enriching the Information-Processing View of the Firm

In this subsection, we introduce two key concepts that enrich the existing information-processing view of the firm: the role of functional managers in harmonizing information and the distinction between product and administrative functions.[20] We demonstrate later (in §§6.2 and 6.3) 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 trade-offs 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 (e.g., online click-through rates for consumer products versus the number of sales leads for corporate products) across business units.[21]

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

[20] 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 et al. (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 et al. 2013).

[21] 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.

or HR) involve activities that are less product specific.[22] High product specificity exacerbates differences between business units' activities, which makes harmonizing information more difficult.[23] 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.

6.2. Understanding the Centralization-Scope Relationship

In this subsection, 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 among themselves without the need for corporate-level intervention. For example, Cremer et al. (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 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 among business units will often arise unless coordination is imposed by fiat.[24] More generally, the view that capturing synergies (broadly construed) involves centralizing/integrating activities is common in both the management literature (e.g., Lawrence and Lorsch 1967, Bartlett and Goshal 1993) and the organizational economics literature (e.g., Qian et al. 2006, Dessein et al. 2010).[25]

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 et al. 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 et al. (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

[22] A related body of work considers how the nature of relevant information affects the ability to communicate; for example, soft versus 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.

[23] To illustrate, compare finance (an administrative function) with 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.

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

[25] In related work, Alonso et al. (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.

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.

6.3. Understanding the Centralization-IT Relationship

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).[26] IT improves the information-processing ability of headquarters and thus may serve as a *complement* to centralization. For example, Gurbaxani and Whang (1991, p. 69) 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).[27] 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 §6.2) that exploiting synergies requires centralization, then IT may complement centralization because it makes it easier for functional managers to harmonize information. Furthermore (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 harmonizing requires subjective interpretation and judgment.[28] IT is effective at automating the standardization and processing of easily structured data, but it 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 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).

6.4. 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 as well as how these change over time. In this subsection, we argue that changes in executive team structure offer insight about organizational form and decision making; as Beckman and Burton (2011, p. 52) 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 data set.

Let us 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

[26] 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*.

[27] Related literature argues that improvements in IT facilitate the use of markets rather than hierarchies to manage transactions (see, for e.g., Brynjolfsson 1994, Malone et al. 1987).

[28] For example, return to our marketing example from Piskorski (2007). When measures of marketing outcomes are qualitatively different across business units (e.g., click-on rates versus sales leads), comparing outcomes across products (e.g., to examine trade-offs involved in branding choices) becomes highly subjective.

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

7. 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 IT.

By developing and interpreting these findings, this 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 the relationships we document vary across functions—product versus administrative—and depend on the product specificity of the information relevant to functional decision making. These results are not explained well by existing theory and thus highlight gaps in the current understanding of the determinants of centralization in firms.

Second, to explain all 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 versus explicit or hard versus soft) cannot explain our full set of results. We hope that these ideas have broader applicability beyond the setting of the TMT, toward 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 among the CEO's direct reports provides some texture to the determinants of span of control—another long-standing puzzle in the strategy literature.[29] 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 toward 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 U.S. 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 U.S. firms centralized corporate-level functions over the past couple

[29] Puranam et al. (2012, p. 433) point out that "the evidence to date on the determinants of the span of control has not been encouraging."

of decades, they moved away from the pure M-form (Chandler 1962) toward other forms of organization such as the matrix (Galbraith 1971) or centralized M-form (Hill 1988). Although 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 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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Appendix

Table A.1 Pairwise Correlation Between Main Variables

	ln(*Sales*)	*Span*	*General managers*	*Product functional mgrs.*	*Admin. functional mgrs.*	*PCs per employee*	ln(*No. 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 functional mgrs.	−0.0215	0.333***	0.0483*	1						
Administrative functional 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(*No. 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

Note. This table shows correlation coefficients between pairs of variables.
*, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A.2 Cross-Sectional Relationships

	(1) Product functional mgrs.	(2) Admin. functional mgrs.	(3) Product functional mgrs.	(4) Admin. functional 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)
No. 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)

Table A.2 (Continued)

	(1) Product functional mgrs.	(2) Admin. functional mgrs.	(3) Product functional mgrs.	(4) Admin. functional mgrs.
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 fixed effects	No	No	No	No
SIC 3 digit	No	No	Yes	Yes
No. of sic3			99	99

Notes. 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 and 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 (column (1)), we find a small and statistically insignificant coefficient (−0.125). When we include industry fixed effects (column (3)), precision increases and the coefficient is significant at 10%. In the firm fixed effects regression, which we focus on in this paper (Table 3, column (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 (column (2) and (4) here and column (5) in Table 3). This trend suggests that the addition of controls is reducing noise in the data because it controls for firm permanent unobserved heterogeneity that may be correlated with the observables. A similar comparison of the product functional manager and administrative 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).

*, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

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