

STRUCTURAL INTERDEPENDENCE WITHIN TOP MANAGEMENT TEAMS: A KEY MODERATOR OF UPPER ECHELONS PREDICTIONS

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Studies of the effects of top management team (TMT) composition on organizational outcomes have yielded mixed and confusing results. A possible breakthrough resides in the reality that TMTs vary in how they are fundamentally structured. Some are structured such that members operate independently of each other, while others are set up such that roles are highly interdependent. We examine the potential for three facets of structural interdependence—horizontal, vertical, and reward interdependence—to resolve ambiguities regarding effects of TMT heterogeneity. Based on a sample of TMTs in technology firms, we find that the three facets of structural interdependence are potent moderators of two classic predictions: the positive association between TMT heterogeneity and member departures, and between TMT heterogeneity and firm performance. Copyright © 2014 John Wiley & Sons, Ltd.

INTRODUCTION

Researchers have devoted great effort to examining the attributes of top management teams (TMTs) and their effects on organizational strategy and performance. Within this stream, the prevailing idea has been that TMT composition, especially TMT heterogeneity (or diversity of member attributes), influences proximal team processes, such as conflict, as well as more distal organizational outcomes, such as innovation and profitability (Carpenter, 2002; Simons, Pelled, and Smith, 1999; Smith *et al.*, 1994).

Although this large body of research has yielded some recurrent patterns (summarized in Finkelstein,

Hambrick, and Cannella, 2009), for the most part it has not provided cumulative insights. Indeed, findings have been mixed and confusing.

A possible breakthrough, however, resides in the reality that TMTs vary widely in how they are fundamentally structured. At the extremes, some are structured such that members operate largely independently and hold little salience for each other, whereas others are structured such that executives' roles and responsibilities are highly interdependent. Clearly, TMT heterogeneity will only affect TMT processes to the extent that members deal with or affect each other. Given that prior studies have rarely acknowledged, much less controlled for the pivotal role of interdependence, it is not surprising that findings have been inconsistent.

Barrick, Bradley, and Colbert (2007) introduced the concept of interdependence to the TMT literature, but stopped short of considering the origins, or determinants, of TMT interdependence.

Keywords: top management teams; interdependence; group heterogeneity; upper echelons theory

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Building on the premise that interdependence arises primarily from role arrangements (Thompson, 1967; Wageman, 1995), we examine the structural origins of TMT interdependence (or “structural interdependence” for ease of exposition), defined as *the degree to which roles and administrative mechanisms are arranged such that members of an executive group affect each other*. Drawing from prior literature, we specify three distinct facets of structural interdependence. *Horizontal interdependence* is the degree to which members’ tasks and responsibilities bear on each other. *Vertical interdependence* is the degree to which members are hierarchical peers (recognizing that some TMTs include individuals of varying ranks). *Reward interdependence* is the degree to which members receive payoffs for collective accomplishment. As we argue and empirically show, TMT interdependence is not a unidimensional construct that can be captured by any single team attribute.

We anticipate that the three facets of structural interdependence will prove to be key moderators in resolving a host of ambiguities regarding the effects of TMT heterogeneity (and of TMT composition more generally). As an initial empirical demonstration, however, we examine a single form of TMT heterogeneity: tenure heterogeneity, which has been the most common form of diversity studied by TMT scholars. First, we examine the association between TMT tenure heterogeneity and member turnover. We start with the same baseline hypothesis as in the classic study by Wagner, Pfeffer, and O'Reilly (1984): tenure heterogeneity will cause high rates of TMT member departures (due to unobserved conflict). When we examine the main effect of heterogeneity on departures, we find no association. But when the three facets of interdependence are included as moderators, all three interaction terms are significantly positive. Second, we examine the effect of TMT tenure heterogeneity on firm performance. In dynamic industries, such as we sample, this relationship is commonly hypothesized to be positive (as heterogeneity engenders group creativity and innovation), but prior results have been decidedly mixed. Here again, when we examine the main effect of tenure heterogeneity on performance, we find no link. But when we add the three elements of structural interdependence as moderators, two of the three interactive effects are strongly positive. In sum, we show that the three elements of structural interdependence—horizontal, vertical, and reward

interdependence—hold great potential for clarifying a host of TMT-related phenomena.

Although it would be ideal to gather primary survey data on interdependence, we will show that just a few archival indicators of TMT structural arrangements are extremely powerful in clarifying otherwise ambiguous predictions about the effects of TMT composition. In light of the great difficulty in obtaining survey data on TMT conditions and processes, researchers understandably have relied on archival indicators; our ideas, measures, and findings will allow such research, which has largely stalled, to advance appreciably once again.

STRUCTURAL ORIGINS OF INTERDEPENDENCE

Hambrick and Mason's (1984) upper echelons perspective, which emphasizes the role of TMTs in shaping organizational outcomes, provides a complement to the typical focus of leadership research on individual executives. The central logic of upper echelons theory is that executives perceive situations and alternatives through individualized lenses shaped by their personal attributes, including both observable (such as professional experiences and demography) and unobservable characteristics (such as values and personalities) (Hambrick, 2007). Extending this logic to TMTs produces an additional social element because of the potential for dynamics within teams. As such, the typical theoretical model is as follows: the composition of a TMT affects its internal processes, which in turn affect its decisions and other outcomes.

Within the large body of research on TMT composition, team heterogeneity has been a central construct. Following work by small-groups researchers (e.g., Hoffman and Maier, 1961; Tajfel and Turner, 1979), indicating that diversity engenders conflict and tension on one hand, but ferment and creativity on the other, TMT scholars have been keenly interested in the implications of group dispersion for an array of outcomes. The results from dozens of such studies, however, have been mixed and confusing (summarized in Finkelstein *et al.*, 2009), raising legitimate concerns about the general viability of this research domain (Priem, Lyon, and Dess, 1999). Instead of giving up, perhaps it is time to reconsider the basic contours of TMTs.

An implicit assumption of most research on TMT heterogeneity is that executive groups collectively

shape their companies' strategic decisions, perhaps even regularly convening around conference tables to discuss and decide relevant issues. After all, heterogeneity can only be expected to affect social processes to the extent that members have periodic and significant dealings with each other. And heterogeneity can only influence more distal outcomes, such as company innovation or strategic boldness, to the extent that group processes somehow give rise to such outcomes. But it is well known that TMTs vary greatly in the degree to which they are structured, or set up, to operate or think of themselves as social entities.

The concept of interdependence—or the degree to which units or individuals affect each other—has long standing in the administrative sciences (Thompson, 1967; Wageman, 1995), but its importance for theory and research on TMTs has only recently been introduced (Barrick *et al.*, 2007). The *origins* of TMT interdependence, however, have yet to be considered. When small-groups researchers manipulate interdependence in their experiments, they usually do so by varying structural conditions: the basic nature of the task, rules about solo vs. group work, or individual vs. group reward criteria (e.g., Saavedra, Earley, and Van Dyne, 1993). Accordingly, we consider a TMT's structural arrangements to be a primary basis for interdependence. Structure may not fully determine TMT interdependence, but it sets the basic contours of a team, greatly shaping the degree to which members affect each other.¹

A TMT's structure has multiple elements that can determine the group's degree of interdependence. Here, we draw on theories of structuration (Burns and Stalker, 1961; Deutsch, 1949) to articulate three of the critical facets of team structure (Johnson *et al.*, 2006) that shape interdependence: horizontal, vertical, and reward interdependence.

Horizontal interdependence is the degree to which roles are arranged such that the actions and effectiveness of peers affect each other. Of particular relevance in the TMT context is the distinction between a divisional and a functional

structure. With a divisional structure, several TMT members—by design—have self-contained autonomy (Hill and Hoskisson, 1987), requiring minimal interactions with peers. With a functional structure, in contrast, every executive is responsible for only a piece of the firm's value-creation process, in a way that hinges on the behaviors and effectiveness of essentially all fellow executives. The greater the horizontal interdependence, the more that TMT members are influenced by each other's actions and attributes, and thus the more that heterogeneity will influence social processes and outcomes.

Vertical interdependence refers to the degree to which members are peers, as opposed to hierarchically disparate. The implied image of a TMT is a CEO and a set of direct reports with the same hierarchical stature, say all with the title of executive vice president. In these cases, we can readily envision a great sense of peer salience. But consider how this quality diminishes if some of the CEO's direct reports are executive vice presidents but others are senior vice presidents, or even plain vice presidents. Because rank designations typically carry significance, such title variations convey that the TMT has a pecking order, possibly a distinct inner and outer circle. Or consider the common instance in which a chief operating officer (COO) is present. In this case, some TMT members report directly to the CEO, but others report to the COO, almost amounting to two teams in one (Hambrick and Cannella, 2004). When hierarchical distinctions are minimal, members will think of each other as part of the same social and task entity; when hierarchical gradations are elongated, members will hold less salience for each other. The greater the vertical interdependence, the more that TMT members will view each other as fellow group members, the more that their actions and attributes will hold significance for each other, and thus the more that group heterogeneity will influence social processes and outcomes.

Reward interdependence is the degree to which members receive payoffs for firm (or group) performance rather than subunit or individual performance. As a key form of interdependence (Wageman, 1995), shared-fate rewards have been discussed comprehensively by executive compensation scholars (Devers *et al.*, 2007). In some companies, bonuses are largely based on firm performance, rising and falling for everyone in unison; in other companies, bonuses are primarily based on subunit performance, with executives receiving widely differing payoffs in a given year. Also

¹ Interdependence is distinct from the actual processes TMTs engage in as a *result* of their interdependence. For instance, if interdependence is high, teams might meet often, share a great deal of information, and engage in collective decision-making—attributes that Hambrick (1994) referred to as “behavioral integration.” Similarly, interdependence is distinct from “social integration,” or the degree to which members enjoy and take pride in the team (Smith *et al.*, 1994).

contributing to a shared-fate perspective, some firms pay their executives largely with restricted stock and stock options, which causes executives to be mindful of the effectiveness of all their fellow team members. The greater the reward interdependence, the more that TMT members will be alert to each other's actions and attributes, and thus the more that group heterogeneity will influence social processes and outcomes.

In sum, we anticipate that each of these three forms of structural interdependence will moderate essentially any relationship between TMT heterogeneity and team processes or outcomes. Namely, TMT heterogeneity will matter, or have an effect, in proportion to the presence of (1) horizontal, (2) vertical, and (3) reward interdependence. When these forms of interdependence are minimal (or even absent), an executive group is less of a meaningful social entity; heterogeneity, in turn, will be less consequential. Thus, we see these three facets of interdependence as moderating the basic strength of relationships between TMT heterogeneity and various outcomes.

It is interesting to consider the possible interrelationships and joint effects of the three facets of interdependence. At this early point in our theorizing, we see little reason to expect the three forms of interdependence to covary, as they each tap somewhat different TMT conditions. Similarly, we anticipate that each form exerts its own moderating effect, and that combinations do not yield patterns that differ from the simple additive effects of the three. Still, in our empirical analysis, we will be alert to the possibilities of covariation.

ILLUSTRATIVE IMPLICATIONS: INTERDEPENDENCE MODERATES THE EFFECTS OF TMT TENURE HETEROGENEITY

As an empirical demonstration of the importance of horizontal, vertical, and reward interdependence as moderators of the effects of TMT diversity, we focus specifically on the dimension of heterogeneity that has been most prevalent in empirical research on TMTs: *tenure heterogeneity*, or the degree to which TMT members have spent widely varying amounts of time in their companies.² Dating at least

to Wagner *et al.* (1984), scholars have had considerable interest in the implications of TMT tenure heterogeneity, recognizing that individuals who enter an organization at about the same time tend to develop shared perspectives, ease of communication, and overall cohesion, and that individuals tend to be skeptical or even dismissive of those with different tenures (Ancona and Caldwell, 1992).

Some studies have yielded results that adhere to generally theorized consequences of tenure heterogeneity. For instance, Wagner *et al.* (1984) found that TMT tenure heterogeneity was associated with executive departures, presumably due to (unobserved) group conflict and strain. Jackson *et al.* (1991) obtained the same result in a sample of banks; and O'Reilly, Snyder, and Boothe (1993) relatedly found that tenure heterogeneity was negatively associated with rapport within TMTs, further suggesting that tenure heterogeneity diminishes cohesion. As evidence of the advantages of tenure diversity, presumably stemming from the benefits of cognitive variety and constructive ferment, Hambrick, Cho, and Chen (1996) showed that TMT tenure heterogeneity was positively associated with firm performance of airlines. Finally, as examples of the mixed and confusing results obtained in this stream, Smith *et al.* (1994) found that TMT tenure heterogeneity was negatively associated with informal communication, as expected, but was not associated with social integration. Moreover, whereas Marcel (2009) found no relationship between tenure heterogeneity and firm performance, Nadolska and Barkema (2013) found that tenure heterogeneity affected the success of firm acquisitions. In sum, there are mixed results surrounding the impact of TMT tenure heterogeneity.

TMT heterogeneity and member departures

In a classic study of TMT tenure heterogeneity, Wagner *et al.* (1984) proposed and found that such diversity propels member departures. Drawing from prior literature on "the cohort effect" (Ryder, 1965), the authors argued that, when team members enter an organization at roughly the same time, they experience similar identity-shaping events together in a way that enhances their cohesion (Pfeffer, 1983; Sherif *et al.*, 1954). In contrast, if team members have divergent tenures, their cohesion and rapport

² Among the nine most highly cited empirical papers on TMT heterogeneity (those with over 200 citations in Google Scholar),

tenure heterogeneity is by far the most commonly examined form (list available from the authors).

will be diminished. In such cases of heterogeneity, both voluntary and involuntary departures will be relatively likely; members will leave voluntarily because of their own discomfort, and dismissals will occur because of conflict and scapegoating that occur in diverse groups (Barker, 1993; Dess and Shaw, 2001). Thus:

Hypothesis 1: There will be a positive association between TMT tenure heterogeneity and member departure rates.

This baseline hypothesis carries an implicit assumption that all TMTs are structured such that tenure heterogeneity affects group processes. As we have argued throughout, this is not always the case. Some TMTs are indeed structured such that members have a great deal to do with each other; in these cases, tenure heterogeneity will tend to generate the conflicting processes that Wagner *et al.* (1984) envisioned as causing departures. In other cases, however, TMTs may be structured such that members have little interdependence; in such instances, group heterogeneity will not matter.

Specifically, in cases of strong horizontal interdependence, group members must rely on each other for effective fulfillment of their own respective responsibilities; in cases of strong vertical interdependence, members see each other as fellow group members; and in cases of strong reward interdependence, members' payoffs greatly depend on the actions and effectiveness of the whole group. Under each of these conditions, *ceteris paribus*, group members are instrumentally and socially salient for each other; matters of trust and mistrust, liking and disliking, acceptance and rejection are important. To the extent that tenure heterogeneity brings about mistrust, disliking, and rejection—in turn, fueling voluntary and involuntary departures—this tendency will be most pronounced under high levels of each of the three forms of interdependence. In contrast, in cases where TMTs are structured such that members have little interdependence, where members have minimal salience for each other, tenure differentials will not affect social processes or, in turn, departures. Thus:

Hypotheses 2a, b, c: The greater a TMT's degree of (a) horizontal interdependence, (b) vertical interdependence, and (c) reward interdependence, the stronger the positive

association between TMT tenure heterogeneity and member departure rates.

It is critical to note that interdependence does not cause interpersonal conflict to evaporate. Interdependence means that individuals may work together and/or spend more time together. But it does not mean that these individuals will necessarily like each other more. As Hackman (1987) noted, a team's level of performance and the extent to which members like each other and are willing to work together in the future are not necessarily correlated (and, in fact, may be diametrically opposed). Under conditions of low interdependence, team members who dislike each other may find that they can minimize interaction. In contrast, with high interdependence, those factors that cause annoyance and mistrust become more pronounced, exacerbating the problems between team members. It is in this way that we expect that the negatives associated with tenure heterogeneity will lead to turnover within the TMT.

TMT tenure heterogeneity and firm performance

Researchers have long been interested in the effects of TMT heterogeneity, including tenure heterogeneity, on firm performance. Eschewing the idea that heterogeneity might be universally good or bad, theorists instead have pursued a contingent logic, arguing that TMT heterogeneity will be beneficial in dynamic environments (but less so or even harmful in stable environments). Commencing with Hambrick and Mason's (1984) initial inventory of upper echelons hypotheses, and continuing in a number of empirical studies, scholars have invoked a two-part logic: (1) dynamic environments call for broad-gauged environmental scanning and creative idea generation, as well as a balance of innovation and organizational pragmatism; and (2) TMT heterogeneity confers precisely these qualities (e.g., Glick, Miller, and Huber, 1993; Hambrick *et al.*, 1996; Murray, 1989; O'Reilly and Flatt, 1989). According to these theorists, executives of diverse experiences, including varying tenures, bring varied frames of reference to a TMT's deliberations, and this richness of perspective will be especially valuable when the environment calls for ongoing innovation and change. Thus, we can set a baseline hypothesis:

Hypothesis 3: In a dynamic context, there will be a positive association between TMT tenure heterogeneity and firm performance.

Despite its logical appeal, this hypothesis has not been consistently supported in empirical research. As with many TMT predictions, some studies have found evidence that tenure heterogeneity is beneficial in dynamic environments (e.g., Hambrick *et al.*, 1996), whereas others have failed to find such a pattern (e.g., West and Schwenk, 1996). Recognizing that these studies omitted any consideration of the structural attributes of TMTs, we posit that some of the inconsistencies are due to unobserved differences in structural interdependence.

Under conditions of strong interdependence—horizontal, vertical, or reward interdependence—group members have abundant reasons to interact, and their personal attributes, including their respective tenures, become reflected in their joint exchanges and deliberations. To the extent that diverse perspectives engender healthy ferment and group creativity (as envisioned in Hypothesis 3), such processes will especially arise when interdependence is strong. Conversely, when the three facets of interdependence are minimal, any advantages (or disadvantages) of member variety are largely lost, as members have little occasion to interact or influence each other. As argued earlier, TMT heterogeneity will only be manifested in group processes or outcomes to the extent that structural attributes engender interdependence. Thus:

Hypotheses 4a, b, c: The greater a TMT's degree of (a) horizontal interdependence, (b) vertical interdependence, and (c) reward interdependence, the stronger the positive association between TMT tenure heterogeneity and firm performance (in a dynamic context).

We do not posit any theoretical connections between our two dependent variables: member departures and firm performance. Although we control for interrelationships (for instance, departures may be more likely under conditions of poor performance), our chief aim is to illustrate the importance of structural interdependence by showing that its three facets (horizontal, vertical, and reward interdependence) moderate the association

between TMT tenure heterogeneity and two distinct outcomes that have been hypothesized by prior researchers but inconsistently observed.

METHODS

Sample

We analyzed a sample of TMTs in the computer software (primary SIC 737) and hardware (SIC 357) industries. We chose these related industries because they have substantial numbers of publicly listed firms and they are highly dynamic (Henderson, Miller, and Hambrick, 2006), as required for testing Hypotheses 3 and 4. We included all companies that were in the ExecuComp database for all five years 2002–2006 (after the collapse of the tech bubble but before the worldwide financial crisis) and for which TMT data were available in the *Standard & Poor's Register of Corporations, Directors and Executives* (S&P), the most comprehensive source of information on top executives. We used S&P to identify TMT members and their titles; ExecuComp, LinkedIn profiles, and media clippings to confirm executives' tenures and ages; and Compustat and ExecuComp for company financial and compensation data.

We constructed a pooled sample, observing our dependent variables in every year t and independent and moderator variables in $t-1$. After listwise deletion to handle missing data, our overall pooled sample consisted of 109 firms and 365 firm years.

We operationalized each top management team as consisting of executives who were senior vice presidents or higher. Thus, we included the chief executive officer, and (whenever they appeared) chief operating officer, executive vice presidents (EVPs), and senior vice presidents (SVPs).³ In the rare case that a group consisted of only five or fewer individuals, we included the next level of executives (i.e., vice presidents).⁴

³ In our sample, all chief financial officers and general counsels held additional titles of EVP or SVP, and thus were always included in the team rosters.

⁴ To confirm that our selective inclusion of these cases (in which we included VPs) did not introduce any bias, we conducted two sensitivity tests. First, we re-ran all our analyses excluding firms that had five or fewer TMT members (using our core operationalization of SVP and higher). Second, we included all firms, but added a control dummy variable to indicate whether VPs were included in a TMT roster. These two sensitivity tests did not substantively alter the results.

Measures

Our two outcomes were TMT departures and performance. *Departures* was the number of members who left the TMT in year t . Performance was measured using *return on assets (ROA)* in year t , or the ratio of net income to total assets (adjusted for operating leases; Ely, 1995). We measured *tenure heterogeneity* as the standard deviation of members' tenures in the firm (in $t-1$).

Horizontal interdependence was created by standardizing and averaging the following two indicators for each TMT each year: (1) functional structure was whether the team was based entirely on functional posts (coded 1) or consisted of multiple general managers (coded 0), and (2) functional titles was the proportion of executives with titles indicating they were primarily functional managers. *Vertical interdependence* was created by standardizing and averaging the following two indicators for each TMT each year, and reversing it so that higher scores reflected greater interdependence: (1) number of distinct hierarchical levels was created by counting the number of title gradations in the TMT each year (always including a CEO, a TMT could also include a COO, EVPs, SVPs, and possibly VPs), and (2) presence of a COO reflected whether there was this additional level in the TMT. *Reward interdependence* was created by standardizing and averaging the following three indicators for each TMT each year: (1) co-movement of bonuses reflects the extent to which members' bonuses move up and down in unison (reversed from the formula below)⁵; (2) co-movement of noncash pay was captured similarly to bonuses, except using noncash pay—i.e., the value of stock options and restricted stock grants; and (3) proportion of noncash pay reflected the extent to which TMT members received pay that tied their ultimate financial rewards to company performance, measured as the ratio of the TMT's sum of noncash pay divided by total pay. A confirmatory factor analysis verified that the interdependence items loaded onto the expected three-factor structure: goodness of fit (0.97), McDonald's measure of centrality (0.95), and standardized root mean-square residual (0.06)

⁵ We measured this by examining the percentage change in bonus for each executive, and then computing the coefficient of variation (CoV) of these changes among team members. To increase reliability, we averaged the CoV from $t-2$ to $t-1$ and from $t-1$ to t (e.g., for year $t = [\text{CoV}(t_i - (t-1)_i) + \text{CoV}((t-1)_i - (t-2)_i)]/2$.)

indexes all met the criteria for a sample size of 250–500 (Sivo *et al.*, 2006).

We controlled for TMT size, average member age, average member tenure, average pay level, gender composition (% female), functional background heterogeneity, and education heterogeneity.⁶ At the firm level, we controlled for firm size (logarithm of revenues), prior year ROA, and diversification (coded 3 if the company had only one SIC; 2 if there were multiple related SICs; 1 if there were any unrelated SICs). For the predictions of ROA, we controlled for departures. Finally, we controlled for temporal conditions by including calendar year dummies.

Estimation

Because we had multiple observations for each firm, we used generalized estimating equations (GEE) (Liang and Zeger, 1986), which derive maximum likelihood estimates and accommodate non-independent observations. For predicting executive departures, we specified a Poisson distribution (the commonly used distribution for low base-rate count data); for predicting ROA, we specified a Gaussian distribution (given that ROA was normally distributed). For our tests of Hypotheses 2 and 4, we included interaction terms between the alternate forms of interdependence and tenure heterogeneity (using mean-centered values).

RESULTS

Table 1 presents the means, standard deviations, and correlations. Notably, we found only modest correlations among the three elements of structural interdependence (0.04–0.20). These dimensions were largely orthogonal, such that each element may have its own distinct effect on the relationship between tenure heterogeneity and hypothesized outcomes.

In our examination of executive departures, we first tested the baseline Hypothesis 1. As shown in Model 1 of Table 2, tenure heterogeneity did

⁶ Functional heterogeneity was calculated as the Herfindahl-Hirschman index for the proportions of TMT members who had primary backgrounds in the eight functional categories specified by Carpenter and Fredrickson (2001). Educational level heterogeneity was the coefficient of variation of the number of years of formal education of TMT members (Ling *et al.*, 2008). Both variables were collected from the BoardEx database.

Table 1. Means, standard deviations, and intercorrelations among study variables

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Departure _{year t}	1.91	2.21															
2. ROA _{year t} (logged)	1.20	1.01	-0.07														
3. ROA (logged)	1.28	0.84	0.00	0.43**													
4. Sales (logged)	6.68	1.78	0.17**	-0.11*	-0.09†												
5. TMT size	8.58	3.88	0.41**	-0.11*	-0.08	0.40**											
6. Average age of TMT	48.57	4.53	0.06	-0.21**	-0.26**	0.33**	0.03										
7. Average pay level	716.25	541.34	0.12*	-0.02	-0.09	0.64**	0.25**	0.23**									
8. Organizational diversification	2.38	0.69	0.03	0.09†	0.10†	-0.25**	0.02	-0.04	-0.11*								
9. Functional heterogeneity	0.70	0.18	0.09†	-0.05	-0.02	0.17**	0.12*	0.11*	0.08	0.00							
10. Education heterogeneity	0.07	0.03	0.13*	-0.02	0.03	0.08	0.11*	0.09†	-0.01	0.25**	0.33*						
11. Gender composition	0.11	0.15	-0.01	0.04	-0.01	0.05	-0.08	0.06	0.05	0.08	0.09†	0.00					
12. Average tenure of TMT ^a	9.00	4.38	-0.04	-0.05	0.00	0.20**	0.06	0.29**	0.03	-0.01	0.07	-0.03	0.00				
13. Tenure heterogeneity ^a	5.20	3.26	0.09†	-0.12*	-0.09†	0.28**	0.27**	0.38**	0.18**	0.00	0.10*	0.07	-0.01	0.67**			
14. Horizontal interdependence	0.00	1.00	-0.11*	0.13*	-0.04	-0.31**	-0.39**	-0.13*	-0.23**	0.08	0.10†	0.03	0.06	-0.14**	-0.28**		
15. Vertical interdependence	0.00	1.00	-0.09†	0.03	0.00	-0.05	-0.16**	-0.03	-0.04	-0.10†	0.06	-0.11*	-0.01	-0.14**	-0.11*	0.20**	
16. Reward interdependence	0.00	1.00	0.10†	0.12*	0.08	0.08	0.00	-0.03	0.12*	0.01	0.12*	-0.02	0.01	-0.03	-0.10†	0.04	0.04

n=365.^a These variables were centered in the multivariate analysis.***p*<0.01; **p*<0.05; †*p*<0.10 (All variables are measured in year *t*-1, unless noted otherwise).

Table 2. Generalized estimating equation results

	Explaining executive departures					Explaining return on assets				
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Constant	-1.68* (0.54)	-1.61** (0.52)	-1.76** (0.55)	-1.64** (0.54)	-1.68** (0.53)	2.12** (0.81)	1.96* (0.78)	1.94* (0.81)	2.10** (0.80)	1.90* (0.79)
Year 2002 (dummy)	-0.14 (0.12)	-0.16 (0.12)	-0.14 (0.12)	-0.09 (0.12)	-0.13 (0.13)	0.03 (0.13)	0.01 (0.13)	0.09 (0.13)	0.04 (0.13)	0.04 (0.13)
Year 2003 (dummy)	0.07 (0.11)	0.07 (0.11)	0.06 (0.11)	0.07 (0.11)	0.05 (0.11)	0.11 (0.12)	0.12 (0.12)	0.12 (0.12)	0.11 (0.12)	0.11 (0.12)
Year 2004 (dummy)	0.09 (0.10)	0.12 (0.11)	0.09 (0.10)	0.07 (0.11)	0.10 (0.11)	0.08 (0.11)	0.10 (0.11)	0.08 (0.11)	0.10 (0.11)	0.10 (0.11)
ROA	0.07 (0.05)	0.05 (0.05)	0.08 (0.04)	0.07 (0.05)	0.07 (0.05)	0.31** (0.07)	0.31** (0.06)	0.28** (0.07)	0.31** (0.07)	0.28** (0.06)
Sales	0.05 (0.03)	0.05 [†] (0.03)	0.05 [†] (0.03)	0.05 [†] (0.03)	0.05 (0.03)	0.05 (0.03)	-0.03 (0.05)	-0.04 (0.05)	-0.03 (0.05)	-0.04 (0.05)
TMT size	0.10** (0.01)	0.11** (0.01)	0.10** (0.01)	0.10** (0.01)	0.12** (0.01)	-0.01 (0.02)	0.01 (0.02)	0.01 (0.02)	-0.02 (0.02)	0.01 (0.02)
Average age of TMT	0.02* (0.01)	0.02* (0.01)	0.02* (0.01)	0.02* (0.01)	0.02* (0.01)	-0.03 [†] (0.01)	-0.02 (0.01)	-0.02 (0.01)	-0.03 [†] (0.01)	-0.02 (0.01)
Average pay level	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Organizational diversification	0.01 (0.06)	0.00 (0.06)	0.04 (0.06)	0.02 (0.06)	0.02 (0.06)	0.09 (0.10)	0.09 (0.09)	0.13 (0.10)	0.08 (0.10)	0.11 (0.09)
Functional heterogeneity	0.16 (0.24)	0.09 (0.24)	0.13 (0.24)	0.11 (0.24)	0.04 (0.24)	-0.16 (0.34)	-0.23 (0.34)	-0.23 (0.34)	-0.16 (0.34)	-0.27 (0.34)
Education heterogeneity	3.12 (1.33)	2.36 [†] (1.31)	3.34 (1.35)	2.82 (1.32)	2.15 (1.32)	-0.90 (1.88)	-1.31 (1.84)	-0.44 (1.88)	-0.65 (1.87)	-0.65 (1.85)
Gender composition	0.02 (0.27)	0.03 (0.26)	-0.10 (0.28)	0.02 (0.27)	-0.10 (0.26)	0.29 (0.38)	0.23 (0.37)	0.19 (0.38)	0.36 (0.38)	0.20 (0.38)
Departures						-0.02 (0.02)	-0.03 (0.02)	-0.03 (0.02)	-0.02 (0.02)	-0.04 (0.02)
Average tenure of TMT	-0.06** (0.01)	-0.06** (0.01)	-0.05** (0.01)	-0.06** (0.01)	-0.06** (0.01)	0.01 (0.02)	0.00 (0.02)	0.01 (0.02)	0.00 (0.02)	0.01 (0.02)
Tenure heterogeneity	0.03 (0.02)	0.04** (0.02)	0.02 (0.02)	0.03 [†] (0.02)	0.04* (0.02)	-0.01 (0.02)	0.00 (0.02)	-0.02 (0.02)	-0.01 (0.02)	0.00 (0.02)
Horizontal interdependence						0.09 (0.04)	0.09 (0.06)	0.09 (0.06)	0.08 (0.06)	0.08 (0.06)
Tenure heterogeneity × horizontal interdependence	0.04** (0.01)				0.03*** (0.01)	0.05*** (0.02)			0.04** (0.02)	
Vertical interdependence						-0.03 (0.04)	-0.05 (0.04)		0.05 (0.05)	0.04 (0.05)
Tenure heterogeneity × vertical interdependence	0.05** (0.01)				0.04** (0.01)	0.05** (0.02)			0.05** (0.02)	0.05** (0.02)
Reward						0.06 (0.04)	0.02 (0.04)		0.08 (0.06)	0.06 (0.05)
Tenure heterogeneity × reward	0.02 [†] (0.01)				0.03** (0.01)				-0.02 (0.02)	-0.02 (0.02)
Valid χ^2	218.56	255.95	230.68	224.27	264.29	42.84	59.49	51.64	47.93	49.99

ⁿ=365.* $p < 0.01$; ** $p < 0.05$; [†] $p < 0.10$.

not significantly affect departures, indicating no support for Hypothesis 1.

Hypotheses 2a–c predicted that the relationship between tenure heterogeneity and executive departures would be stronger under each of the three forms of high structural interdependence. As shown in Model 2, there was a significant positive interaction between horizontal interdependence and tenure heterogeneity ($p < 0.01$). Next, in Model 3, the interaction between vertical interdependence and tenure heterogeneity was significantly positive ($p < 0.01$). Third, as shown in Model 4, there was a marginally significant positive relationship between the interaction of reward interdependence and tenure heterogeneity ($p = 0.07$). Finally, in the fully specified Model 5, we found strong evidence that all three interactions mattered (all at $p < 0.01$). Thus, we found substantial support for Hypotheses 2a–c.

Regarding our investigation of performance, as shown in Model 6, tenure heterogeneity did not significantly affect ROA. Thus, Hypothesis 3 was not supported.

Hypotheses 4a–c predicted that the relationship between tenure heterogeneity would be amplified by each of the three forms of structural interdependence. As shown in Model 7, the interaction of horizontal interdependence and tenure heterogeneity was significantly positively related to ROA ($p < 0.01$). In Model 8, the interaction of vertical interdependence and tenure heterogeneity was significantly positively related to ROA ($p < 0.01$). As shown in Model 9, there was no significant interaction effect of reward interdependence and tenure heterogeneity on ROA. As shown in Model 10, these findings remained consistent when we simultaneously tested all three dimensions of structural interdependence on ROA. Thus, we found strong support for Hypotheses 4a and 4b, but no support for Hypothesis 4c.

To better interpret the significant interactions, we plotted the results, using one SD above and below the mean for both tenure heterogeneity and each element of interdependence. As shown in Figure 1a–c, the dashed lines depict a strongly positive relationship between tenure heterogeneity and TMT departures under each of the three structural forms of high interdependence; in contrast, the relationships were near zero under conditions of low interdependence. In Figure 1d–e, the relationship between tenure heterogeneity and ROA was strongly

positive under high horizontal and high vertical interdependence (the dashed lines), whereas the relationship was negative under low interdependence (the solid lines). These results graphically support our moderation hypotheses, indicating that the effects of TMT heterogeneity hinge greatly on the presence (or absence) of structural interdependence.

DISCUSSION AND SUMMARY

Our study shows that three elements of structural interdependence are pivotal moderators of the relationships between TMT tenure heterogeneity and team/firm outcomes. When omitting consideration of interdependence, there was no apparent link between tenure heterogeneity and team departures or performance. The results would have simply added to the considerable confusion about the implications of TMT tenure heterogeneity, or they would have gone into a file drawer, which we suspect has been the fate of many studies of TMT diversity. However, after incorporating structural independence, the results became appreciably more meaningful.

Our analysis of executive departures completely conformed to our expectations. We found that TMT tenure heterogeneity affected departures in proportion to the presence of all three forms of interdependence. If we assume that TMT heterogeneity influences executive departures through a social process—of interpersonal likes and dislikes, of mutual perceptions of fit and misfit—and we assume that TMT heterogeneity only carries these social consequences to the extent that members affect each other, our results are compelling.

Importantly, each of the three facets of interdependence significantly moderated the association between tenure heterogeneity and departures, but the three elements were not highly correlated themselves. It seems, then, that structural interdependence is useful as an umbrella construct, but is comprised of distinct constituent elements that need to be considered each in their own right.

Results for firm performance were generally supportive of our expectations, but were more complex. Although the results conformed to our predictions under high interdependence, where tenure heterogeneity was beneficial, we were surprised to see that tenure heterogeneity was negatively related to firm performance under conditions of low

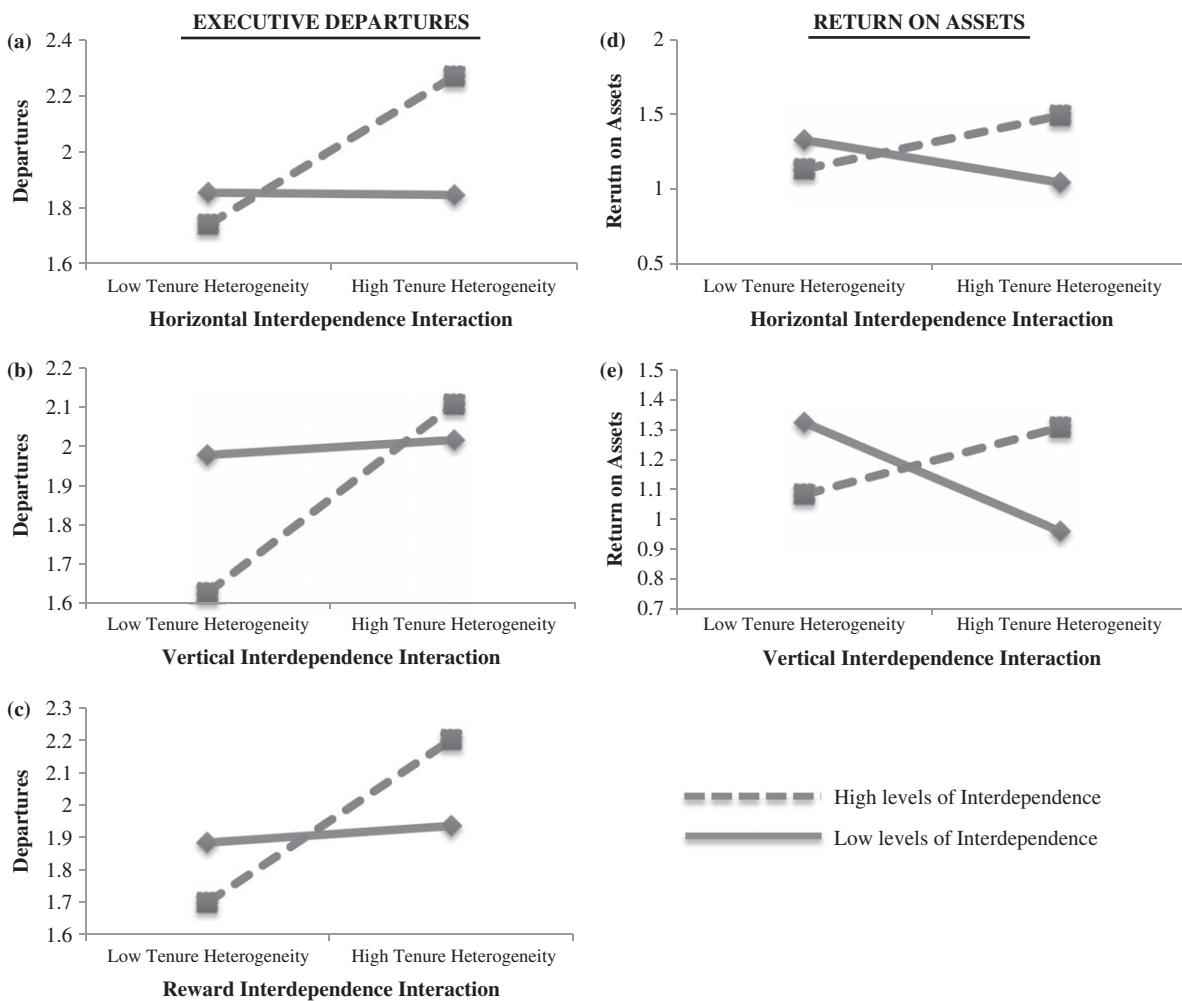


Figure 1. Interactions with forms of structural interdependence. Executive departures: (a) horizontal interdependence interaction, (b) vertical interdependence interaction, (c) reward interdependence interaction. Return on assets: (d) horizontal interdependence interaction, (e) vertical interdependence interaction

horizontal and low vertical interdependence. One possible interpretation is that structural arrangements and TMT demography are substitute ways for achieving a requisite amount of cohesion within a TMT. When the structure is designed such that there is little “teamness” (i.e., low horizontal or vertical interdependence) *and* the team is demographically heterogeneous, TMTs may operate in a highly fragmented, atomistic manner, with unfavorable performance implications. Although future research is needed to explore this relationship, it is only by paying attention to structural attributes that such patterns can even be brought to light.

Our study also shows the promise of relying on archival measures of the three facets of structural interdependence. With just a few indicators,

we were able to construct highly potent moderator variables that should prove valuable in future archival-based TMT research. Nonetheless, researchers might conduct survey research to validate our indicators, and they might fruitfully identify more or better archival indicators of structural interdependence. For example, the index for horizontal interdependence might be strengthened by examining the intersection of both TMT structure and the firm’s strategy; a TMT consisting of multiple general managers (M-form structure) who run highly related businesses might be more horizontally interdependent than a group that has general managers running unrelated businesses (Rumelt, 1974). Similarly, perhaps researchers can identify additional indicators of vertical

interdependence, including between-level pay ratios or other measure of hierarchical closeness (or separation). Our indicators provide merely a start for what might eventually prove to be very robust archival indices of the several forms of structural interdependence.

Our study shows the importance of structural attributes as moderators of two relationships: TMT tenure heterogeneity's effect on both turnover and performance; however, interdependence is expected to be highly pertinent in clarifying a host of TMT predictions. Most obviously, the elements of structural interdependence will be crucial moderators in any study attempting to link TMT heterogeneity—on any demographic or psychological dimension—to group outcomes. Again, heterogeneity can only affect group processes (conflict, tension, shared learning, etc.) to the extent that members are structurally arranged so as to affect each other. If group members have little to do with each other, heterogeneity will not matter.

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REFERENCES

- Ancona DG, Caldwell DF. 1992. Demography and design: predictors of new product team performance. *Organization Science* **3**: 321–341.
- Barker JR. 1993. Tightening the iron cage: coercive control in self-managing teams. *Administrative Science Quarterly* **38**: 408–437.
- Barrick MR, Bradley BH, Colbert AE. 2007. The moderating role of top management team interdependence: implications for early teams and working groups. *Academy of Management Journal* **50**: 544–557.
- Burns TE, Stalker GM. 1961. *The Management of Innovation*. Tavistock: London, UK.
- Carpenter MA. 2002. The implications of strategy and social context for the relationship between top management team heterogeneity and firm performance. *Strategic Management Journal* **23**: 275–284.
- Carpenter MA, Fredrickson JW. 2001. Top management teams, global strategic posture, and the moderating role of uncertainty. *Academy of Management Journal* **44**: 533–545.
- Dess GG, Shaw JD. 2001. Voluntary turnover, social capital, and organizational performance. *Academy of Management Review* **26**: 446–456.
- Deutsch M. 1949. A theory of co-operation and competition. *Human relations* **2**: 129–152.
- Devers CE, Cannella AA, Reilly GP, Yoder ME. 2007. Executive compensation: a multidisciplinary review of recent developments. *Journal of Management* **33**: 1016–1072.
- Ely KM. 1995. Operating lease accounting and the market's assessment of equity risk. *Journal of Accounting Research* **33**: 397–415.
- Finkelstein S, Hambrick DC, Cannella AA. 2009. *Strategic Leadership: Theory and Research on Executives, Top Management Teams, and Boards*. Oxford University Press: New York.
- Glick WH, Miller CC, Huber GP. 1993. The impact of upper-echelon diversity on organizational performance. In *Organizational Change and Redesign: Ideas and Insights for Improving Performance*, Huber GP, Glick WH (eds). Oxford University Press: New York; 176–214.
- Hackman JR. 1987. The design of work teams. *Handbook of Organizational Behavior* **129**: 315–342.
- Hambrick DC. 1994. Top management groups: a conceptual integration and reconsideration of the "team" label. *Research in Organizational Behavior* **16**: 171–213.
- Hambrick DC. 2007. Upper echelons theory: an update. *Academy of Management Review* **32**: 334–343.
- Hambrick DC, Cannella AA. 2004. CEOs who have COOs: contingency analysis of an unexplored structural form. *Strategic Management Journal* **25**: 959–979.
- Hambrick DC, Cho TS, Chen M-J. 1996. The influence of top management team heterogeneity on firms' competitive moves. *Administrative Science Quarterly* **41**: 659–684.
- Hambrick DC, Mason PA. 1984. Upper echelons: the organization as a reflection of its top managers. *Academy of Management Review* **9**: 193–206.
- Henderson AD, Miller D, Hambrick DC. 2006. How quickly do CEOs become obsolete? Industry dynamism, CEO tenure, and company performance. *Strategic Management Journal* **27**: 447–460.
- Hill CWL, Hoskisson RE. 1987. Strategy and structure in the multiproduct firm. *Academy of Management Review* **12**: 331–341.
- Hoffman LR, Maier N. 1961. Quality and acceptance of problem solutions by members of homogeneous and heterogeneous groups. *Journal of Abnormal and Social Psychology* **58**: 27–32.
- Jackson S, Brett J, Sessa V, Cooper D, Julin J, Peyronnin K. 1991. Some differences make a difference: Individual dissimilarity and group heterogeneity as correlates of recruitment, promotions, and turnover. *Journal of Applied Psychology* **76**: 675–689.
- Johnson MD, Hollenbeck JR, Humphrey SE, Ilgen DR, Jundt DK, Meyer CJ. 2006. Cutthroat cooperation: asymmetrical adaptation of team reward structures. *Academy of Management Journal* **49**: 103–119.
- Liang SL, Zeger K-Y. 1986. Longitudinal data analysis using generalized linear models. *Biometrika* **73**: 13–22.
- Ling YAN, Simsek Z, Lubatkin MH, Veiga JF. 2008. Transformational leadership's role in promoting corporate entrepreneurship: examining the CEO-TMT

- interface. *Academy of Management Journal* **51**: 557–576.
- Marcel JJ. 2009. Why top management team characteristics matter when employing a chief operating officer: a strategic contingency perspective. *Strategic Management Journal* **30**: 647–658.
- Murray AI. 1989. Top management group heterogeneity and firm performance. *Strategic Management Journal* **10**: 125–141.
- Nadolska A, Barkema HG. 2013. Good learners: How top management teams affect the success and frequency of acquisitions. *Strategic Management Journal*. doi: 10.1002/smj.2172
- O'Reilly CA, Flatt SF. 1989. Executive team demography, organizational innovation, and firm performance. In *Paper Presented at the Academy of Management*, Washington, DC.
- O'Reilly CA, Snyder R, Boothe J. 1993. Effects of executive team demography on organizational change. *Organizational Change and Redesign*: 147–175.
- Pfeffer J. 1983. Organizational demography. In *Research in Organizational Behavior* (Volume 5), Cummings LL, Staw BM (eds). JAI Press: Greenwich, CT; 299–357.
- Priem RL, Lyon DW, Dess GG. 1999. Inherent limitations of demographic proxies in top management team heterogeneity research. *Journal of Management* **25**: 935–953.
- Rumelt RP. 1974. *Strategy, Structure, and Economic Performance*. Harvard Business School: Boston, MA.
- Ryder NB. 1965. The cohort as a concept in the study of social change. *American Sociological Review* **30**: 843–861.
- Saavedra R, Earley PC, Van Dyne L. 1993. Complex interdependence in task-performing groups. *Journal of Applied Psychology* **78**: 61–72.
- Sherif M, Harvey OJ, White BJ, Hood WR, Sherif CW. 1954. *Intergroup Cooperation and Competition: The Robbers Cave Experiment*. University Book Exchange: Norman, OK.
- Simons T, Pelled LH, Smith KA. 1999. Making use of difference: diversity, debate, and decision comprehensiveness in top management teams. *Academy of Management Journal* **42**: 662–673.
- Sivo SA, Fan X, Witt EA, Willse JT. 2006. The search for ‘optimal’ cutoff properties: fit index criteria in structural equation modeling. *Journal of Experimental Education* **74**: 267–288.
- Smith KG, Smith KA, Olian JD, Sims HP, O'Bannon DP, Scully JA. 1994. Top management team demography and process: the role of social integration and communication. *Administrative Science Quarterly* **39**: 412–438.
- Tajfel H, Turner JC. 1979. An integrative theory of intergroup conflict. In *The Social Psychology of Intergroup Relations*, Austin WG, Worchel S (eds). Brooks/Cole: Monterey, CA; 33–47.
- Thompson JD. 1967. *Organizations in Action: Social Science Bases of Administrative Theory*. McGraw-Hill: New York.
- Wageman R. 1995. Interdependence and group effectiveness. *Administrative Science Quarterly* **40**: 145–180.
- Wagner WG, Pfeffer J, O'Reilly CA. 1984. Organizational demography and turnover in top-management groups. *Administrative Science Quarterly* **29**: 74–92.
- West CT, Schwenk CR. 1996. Top management team strategic consensus, demographic homogeneity and firm performance: a report of resounding nonfindings. *Strategic Management Journal* **17**: 571–576.