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Competitive Repertoire Complexity: Governance Antecedents and Performance Outcomes

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Research summary: Past inquiry has found that implementing complex competitive repertoires (i.e., diverse and dynamic arrays of actions) is challenging, but firms benefit from doing so. Our examination of the antecedents and outcomes of complex competitive repertoires develops a more nuanced perspective. Data from 1,168 firms in 204 industries reveal that complexity initially harms performance, but then becomes a positive factor, except at high levels. We use agency and tournament theories, respectively, to examine how key governance mechanisms—ownership structure and executive compensation—help shape firms' competitive repertoires. We find that the principals of agency theory and the pay gap of tournament theory are both important antecedents of competitive complexity, and an interaction exists wherein firms build especially complex repertoires when both influences are strong.

Managerial summary: In boxing, the fight does not always go to the bigger or stronger person, or even to whomever throws the most punches—the fight is sometimes won by the boxer who is unpredictable, such as throwing an uppercut when the opponent expected a right hook. Similarly, when companies compete in the marketplace, advantage is afforded not only to those with more resources or who engage in more competitive activity, but also to those whose actions are unpredictable. In this study, we develop the notion of "competitive complexity," which describes the diversity and changing

nature of a company's competitive moves. Implementing complex competitive repertoires can be painful in the short term but, if done correctly, can help company performance in the long run.

Keywords: competitive dynamics; institutional investors; executive compensation; agency theory; tournament theory

Introduction

In their quest to improve performance, firms battle one another via competitive moves (Ferrier, Smith, and Grimm, 1999; Miller and Chen, 1994). While individual high-stakes actions, such as AT&T's recent $48 billion purchase of DirecTV, tend to grab headlines, many firms seek to gain advantage by relying on a diverse and dynamic mix of competitive moves, such as price reductions, marketing campaigns, acquisitions, alliances, and new products and services. For instance, in 2010 alone, healthcare company Baxter International initiated five different types of competitive actions. Others try to succeed by picking one or two of these moves and using them aggressively and persistently (Ferrier, 2001). Baxter's competitor Endo Health, for example, initiated more than twice as many competitive moves as Baxter in 2010, but concentrated its competitive activity within just two types. As competition continues over time, engaging rivals with a complex set of actions allows a firm to respond better to changing environmental conditions, take advantage of emerging opportunities, defy imitation by rivals, and keep opponents off guard. Strategy researchers call this *competitive repertoire complexity*,[1] and studies have found it to be positively associated with firm performance (Ferrier, 2001; Ferrier and Lyon, 2004; Ferrier *et al.,* 1999; Ndofor, Sirmon, and He, 2011; Yu, Subramaniam, and Cannella, 2009).

Our study challenges the received wisdom about the benefits of competitive repertoire complexity. While scholars generally portray complexity as beneficial, we offer a more nuanced perspective wherein understanding the effects of complexity requires accounting for the role of time. Indeed, firms may struggle to orchestrate and benefit from a diverse set of competitive action types in short order (Miller and Chen, 1994). Therefore, we develop and test a model wherein

1. For ease of exposition, we use the terms "complexity," "competitive complexity," and "competitive repertoire complexity" interchangeably throughout this article.

competitive repertoire complexity has differential effects on firm performance in the short-term compared to its effects over time, controlling for firms' competitive aggressiveness (i.e., their level of competitive activity).

In order to build understanding of why some firms embrace the inherent trade-offs of competitive complexity while others avoid them, we also investigate factors that may influence whether firms rely on complex repertoires of competitive actions. Studies of the antecedents to complexity have mainly focused on competitive/industry environments and managerial/organizational characteristics (cf. Ferrier, 2001; Ferrier and Lyon, 2004; Ndofor *et al.,* 2011; Yu *et al.,* 2009). However, in their recommendations for future competitive dynamics research, Chen and Miller (2012: 173) note that "increasingly insightful results may be forthcoming were we to move more to micro-conceptions that lie between ownership structure and performance— specifically, just who are the owners and what types of competitive initiatives are they most apt to sponsor?" We leverage this guidance by examining how governance mechanisms, such as ownership structures and executive compensation, shape a firm's competitive repertoire.

Our study offers two main potential contributions to the literature. First, we develop a textured, temporal perspective on the relationship between competitive complexity and firm performance that sheds light on how complexity influences firm outcomes, revealing both positive and negative consequences. Second, we make strides toward integrating governance research with work on competitive dynamics (Chen, 1996). Although governance is believed to affect firms' competitive moves, surprisingly few studies develop or test theory about how shareholders and compensation structures affect competitive activity (Chen and Miller, 2012). Doing so can uncover a set of previously obscured relationships and expose hidden forces that influence the extent to which firms engage in diverse competitive actions.

Conceptual Development

The concept of competitive complexity has its roots in competitive dynamics research. This body of inquiry has long focused on describing, explaining, and predicting both the competitive interactions among firms as well as how these interactions shape firm performance (Chen

and MacMillan, 1992; Grimm, Lee, and Smith, 2005). For example, much of the early competitive dynamics research focused on action-response dyads wherein the characteristics of a given firm's initial competitive action influence the likelihood and speed of a rival's response and in turn these action-response sequences influence firms' fates in the marketplace (Chen and MacMillan, 1992; Smith *et al.,* 1991).

Scholars later focused attention on competitive action repertoire, a concept that centers on the portfolio of moves a firm makes in a given time period (Miller and Chen, 1994, 1996a, 1996b). This depiction of competitive action is consistent with views of strategy as a stream of decisions (Mintzberg, 1978), a coordinated series of actions (MacCrimmon, 1993), or a simultaneous, sequential thrust of competitive maneuvers (D'Aveni, 1994). Researchers have examined which organizational, market, and perceptual antecedents shape a firm's competitive repertoire (Ferrier, 2001; Gnyawali, He, and Madhavan, 2006; Yu *et al.,* 2009) as well as how attributes of a firm's repertoire affect performance (Deephouse, 1999; Ferrier and Lee, 2002; Ndofor *et al.,* 2011). By leveraging the repertoire concept, these studies provide a holistic depiction of how characteristics of a firm's body of competitive activity allow it to compete effectively or cause it to struggle in the marketplace.

The origins of portraying competitive complexity as an important dimension of repertoires can be traced to Miller's (1993) discussion of its antonym: competitive simplicity.[2] Scholars have conceptualized competitive complexity in subtly different ways, but these depictions share the common trait that complexity involves a firm's *diversity* of competitive actions (i.e., a firm's range of actions and they are dominated by specific types—Basdeo *et al.,* 2006; Chi, Ravichandran, and Andrevski, 2010; Ferrier, 2001; Gnyawali *et al.,* 2006; Yu *et al.,* 2009).

2. Miller (1993: 117) introduced the notion of competitive simplicity, defining it as "an overwhelming preoccupation with a single goal, strategic activity, department, or world view—one that increasingly precludes consideration of any others." This spawned studies that focused on *simplicity*, or the tendency for the firm to carry out a narrow set of actions, as a key attribute of a firm's competitive action repertoire (Ferrier and Lyon, 2004; Ferrier *et al.,* 1999; Miller and Chen, 1996a). Over time, most competitive dynamics scholars embraced the concept of competitive repertoire *complexity* to represent the opposite pole of a simplicity/complexity continuum (Basdeo *et al.,* 2006; Chi *et al.,* 2010; Ferrier and Lee, 2002;Yu *et al.,* 2009). For example, Ndofor *et al.* (2011: 644) note that "competitive complexity is the inverse of competitive simplicity" and Ferrier (2001: 866) refers to the construct as "competitive complexity/simplicity."

Empirical investigations have yielded valuable insights about competitive complexity's antecedents and outcomes. In terms of antecedents, prior performance (Miller and Chen, 1996a), top management team (TMT) heterogeneity and experience (Ferrier, 2001; Miller and Chen, 1996a), interorganizational networks (Chi *et al.,* 2010; Gnyawali *et al.,* 2006), and multimarket contact (Yu *et al.,* 2009) all influence the complexity of firms' competitive repertoires. In terms of outcomes, studies have found a robust relationship between competitive repertoire complexity and firm performance across a variety of industries (Ferrier, 2001; Ferrier and Lee, 2002; Ferrier *et al.,* 1999; Miller and Chen, 1996a).

The prevailing conceptualization of complexity has served the literature well, but it also presents an opportunity for improvement because it is limited to considering competitive repertoires at a snapshot in time (Smith, Ferrier, and Ndofor, 2001). Such an approach ignores the inter-temporal change and newness of a firm's repertoire of actions. For example, suppose a firm engages in a broad range of actions distributed evenly among different types, but it relies on that same set of actions repeatedly. A traditional definition would label this as complex, but consideration of repertoire change over time reveals a repetitive pattern that rivals could easily diagnose and counteract. Thus, we suggest that a more comprehensive conceptualization of competitive complexity should account for inter-temporal *change* and *newness*.[3]

At various junctures, competitive dynamics researchers have broadly discussed the principles underlying inter-temporal change and newness in competitive activity. For example, Miller and Chen (1994) proposed the concept of "competitive inertia," which describes the extent to which a firm alters its competitive stance over time. Lamberg *et al.* (2009) explore aspects of "strategic consistency," by which they mean the stability of competitive behavior over time. A related concept is the degree of "surprise" or "unpredictability" (Ferrier, 2001; Ferrier and Lee, 2002; Rindova, Ferrier, and Wiltbank, 2010), which refer to a competitor's relative inability to determine what is coming next. These ideas collectively point to the concept of inter-temporal change and newness of a firm's competitive activity as important characteristics of competitive repertoire complexity. Consistent with these ideas, we view complexity as encompassing the diversity, change, and newness of a firms' competitive action repertoire.

3. We thank an anonymous reviewer for this important observation.

Hypotheses

Performance outcomes

In his seminal article on competitive simplicity, Miller (1993) introduced the notion that a firm's decisions about the simplicity/complexity of its competitive activities could have differential short- and long-term consequences. He posited that simplicity (complexity) would at first increase (decrease) performance, but over long periods of time should lead to lower (higher) performance. More specifically, firms that rely on a narrow repertoire of competitive actions may enjoy immediate success, but in doing so they could be tethering themselves to a confined set of skills that will not allow them to grow and change with a changing competitive landscape.

To explain this in more detail, first consider how low levels of competitive complexity (i.e., high simplicity) can benefit a firm in the short term. Firms must develop a distinctive competence, and doing so often demands that they be committed to doing a few things extremely well (Selznick, 1949). Parsimony in the types of competitive actions in which a firm repeatedly engages allows for simple, efficient routines and orchestrated configurations that can create competitive advantage (D'Aveni and MacMillan, 1990). Managers can exploit what they do best and minimize the chance of error that comes with change. Relatedly, carrying out simple competitive action repertoires can be reassuring to external stakeholders. Competitive complexity makes buying decisions more difficult, which can alienate customers. In addition, the stock market discounts uncertainty about firm activity because investors are unable to evaluate fully the earnings potential of their actions (Healy and Palepu, 2001). Thus, low levels of competitive complexity can save costs, avoid disturbing customers (and provoking rivals), appease shareholders, and allow managers to capitalize on their strengths (Amburgey, Kelly, and Barnett, 1993). Accordingly, our initial prediction is:

> *Hypothesis 1a: The complexity of a firm's competitive action repertoire over a given year (year t) is negatively associated with short-term performance (at the end of year t).*

In considering longer performance horizons, organizational learning helps explain why a certain amount of competitive complexity is

likely to be beneficial to a firm's performance trend (i.e., the direction performance is headed over the course of several years).When firms successfully and repeatedly leverage a narrow set of actions, executives can wrongly gain confidence in simplistic recipes, providing them with a rationale for ascribing merit to their favorite actions and decreasing comparative regard for other competitive moves (Levitt and March, 1988; Miller, 1993). This "superstitious learning" inhibits firm performance over time because managers become myopic with respect to their choices of competitive action types (Zollo, 2009). In contrast, complex competitive repertoires outfit managers with more tools in their metaphorical tool belt. Because complexity engenders changing repertoires, valuable learning occurs as managers tease out which actions brought about which outcomes under differing circumstances (Miller, Droge, and Vickery, 1997). As new challenges arise, having a range of skills, resources, and experiences from which to draw allows the firm to address these challenges by carrying out the most appropriate combination of competitive actions (Easterby-Smith, Crossan, and Nicolini, 2000).

Moreover, complex competitive repertoires also serve as a signal to external entities about the firm's underlying quality and their changing mix of resources, allowing them to build a reputation over time (Basdeo *et al.,* 2006).Miller and Chen (1996a) argue that competitive repertoire complexity operates as a positive signal to stakeholders about the management skills of top executives, and Ferrier *et al.* (1999) suggest that it signals a broader range of underlying firm capabilities. This signaling process takes time as stakeholders receive, process, and interpret signals, act accordingly (e.g., shareholders buying stock, information intermediaries upgrading their analyses, potential partners establishing alliances), and provide feedback about the signals (Bergh *et al.,* 2015). Taken together, these arguments about improved adaptation, learning, and signaling suggest that increased levels of competitive complexity can result in improved firm performance over time (i.e., an upward performance trend).

One important caveat is that organizations can go too far, such that as competitive complexity reaches high levels its disadvantages can begin to outweigh its advantages.[4] Theory on resource orchestration

4. We thank an anonymous reviewer for this key recommendation about the nonlinear relationship.

helps explain why. Building on Sirmon, Hitt, and Ireland's (2007) contention that how firms select, bundle, and leverage their resources via their strategic actions is a key determinant of performance, Ndofor *et al.* (2011) found that superior performance arises when a firm's actions appropriately capitalize on its resources. Subsequently, the same author team provided evidence that the TMT is an important determinant of how well a firm is able to attain "the conversion of resources to competitive actions (i.e., type of actions designed to leverage the firm's resource base) and the conversion of those actions to performance (i.e., executing those actions)" (Ndofor, Sirmon, and He, 2015: 1657).

In considering competitive repertoires, we contend that if a firm's array of actions become excessively complex (i.e., too diverse, changing, and new), the firm's ability to orchestrate the associated managerial resources could become overwhelmed such that its effectiveness declines. This parallels arguments offered in Penrose's (1959) seminal book. Penrose suggested that firms often cannot grow as much as market opportunities allow because they do not have enough managers to effectively implement the growth. New managers can be hired, but it takes time for these newcomers to be effective in their jobs. Like an army that penetrates deeper into enemy territory than its personnel and supply lines can support, a firm that ignores its managerial constraints and grows beyond them is likely to suffer decreased performance. Drawing on the logic offered by Penrose (1959); Sirmon *et al.* (2007), and Ndofor *et al.* (2011, 2015), we contend that a firm will experience a downward performance trend if it enacts a bigger variety of competitive moves than the managerial resources provided by its executives can support.

Further, with respect to learning, an overly diverse and constantly changing competitive action repertoire makes it difficult for managers to connect actions or sets of actions with particular outcomes (Levitt and March, 1988). Signaling, too, could be adversely affected by high levels of competitive repertoire complexity. If a firm changes its repertoire too quickly, external stakeholders may question whether the firm has a coherent pattern of actions, and thus, wonder if it lacks a cohesive strategy (Mintzberg, 1978). In sum, too much competitive complexity can bring about unintended consequences that bring about a downward performance trend. Therefore, we hypothesize the following:

Hypothesis 1b: The complexity of a firm's competitive action repertoire over a given year (year t) exhibits a curvilinear (inverted U-shape) relationship with a firm's performance trend over time (the direction of performance over several years beginning at the end of year t). That is, increasing levels of competitive complexity are associated with increases in the firm's performance trend, up to a certain level of competitive complexity, after which further increases in competitive complexity are associated with decreases in the firm's performance trend.

Given our prior hypotheses, firms likely desire to implement competitive action repertoires near the optimum inflection point between simplicity and complexity. However, managers make decisions within the context of corporate constraints that can inhibit their range of choices (Lavie and Rosenkopf, 2006). Scholars seeking to explain the antecedents of managerial decisions about the competitive actions in which they engage have looked external to the firm, at the competitive environment, and internal to the firm, at organizational characteristics, but few have looked upward, at the firms' governance structures.

In strategic management, the most commonly investigated corporate governance structures are boards of directors, ownership structures, and mechanisms of executive compensation (Aguilera *et al.,* 2015).[5] The dominant means of explaining the first two is agency theory (Jensen and Meckling, 1976) and the dominant means of explaining the last one is tournament theory (Lazear and Rosen, 1981). To obtain a multifaceted picture of corporate governance influences, we examine antecedents from both theoretical perspectives.

Agency theory antecedents

Agency theory acknowledges that executives' actions at times deviate from the interests of shareholders. In response, shareholders rely on

5. Agency theory does not provide a clear rationale for the direction of relationships between various aspects of the board and managerial decisions about competitive complexity (Ingley and Van der Walt, 2001). Rather than developing hypotheses about board influence, we control for it and devote special attention to interpreting the controls and creating a road map for future research on the topic.

governance mechanisms to create better alignment between their interests and executives' interests (Jensen and Meckling, 1976). We hypothesize about how two of the most commonly studied mechanisms of corporate governance—ownership concentration and executive compensation—affect executives' propensity to undertake complex competitive repertoires.

Although most small owners do not have the means to influence a firm's actions, powerful principals can motivate executives to engage in specific types of competitive behavior (David, Hitt, and Gimeno, 2001). Research examining shareholder influence on managerial decision-making focuses largely on institutional investors with their concentrated shares. An institutional investor is an organization, such as a mutual fund, pension fund, or endowment, that manages more than $100 million in equity (David, Bloom, and Hillman, 2007). Such investors are required to file 13-F Securities and Exchange Commission (SEC) reports listing all holdings greater than 10,000 shares or $200,000 in market value. These prominent shareholders own over 70 percent of U.S. equities and maintain an outsized influence on firm behavior (Gillan and Starks, 2007; Kochhar and David, 1996).

Research has seen two types of institutional investors come to the fore. Dedicated investors maintain concentrated shareholdings in a small number of firms for a long time and do not trade based on short-term earnings (Bushee, 2001). Dedicated institutional investors are sometimes called "relational investors" because they engage with their agents and are active in establishing competitive strategies (Bhagat, Black, and Blair, 2004). Transient institutional investors are the opposite. They hold shares in a diverse range of firms, frequently trade in and out of stocks, and are keenly aware of earnings reports. We develop theory about how these characteristics make dedicated and transient investors particularly consequential to managerial decisions about competitive complexity.

A significant presence of dedicated investors may allow executives an extra measure of freedom to experiment with a diverse set of competitive actions. One reason has to do with these investors not trading based on current earnings reports (Bushee, 2001). As we argued above, complex competitive repertoires can adversely affect a firm's short-term performance. Managers may be unlikely to undertake a complex repertoire if they believe doing so will result in owner exit. Dedicated investors do not sell their holdings when faced with

short-term losses, so they provide a level of assurance to managers, who may undertake new and diverse competitive moves without fear of stock market repercussions. Stated differently, dedicated investors help reduce managerial myopia because managers do not feel external pressure from shareholders for immediate returns at the potential expense of long-term gains (Edmans, 2009).

Another reason arises because, in contrast to transient investors who hold a diversified portfolio of equities to mitigate risk, dedicated investors hold a small number of firms over time. Dedicated investors, therefore, may consider action repertoire complexity as a key mechanism to mitigate risk. Relatedly, because dedicated investors own only a few firms, they can comprehend and be sympathetic of the rationales that underlie a diversity of competitive actions. Given their concentrated holdings, dedicated investors can devote sufficient attention to understanding managerial intentions for competitive market gains, and thus, engage in strategic evaluation of competitive repertoires rather than relying solely on short-term financial measures. Complex competitive repertoires can take time to understand, and the institutional investor that holds its shares only briefly may not readily grasp the potential of such repertoires. By understanding and appreciating the strategic consequences of complex competitive repertoires, dedicated investors enable their agents to consider engaging in diverse competitive moves that yield advantages over time. Therefore, we hypothesize the following:

> *Hypothesis 2: Level of dedicated institutional ownership is positively associated with competitive complexity.*

Transient institutional investors are short-term investors who hold broad portfolios of shares in many firms. This is a fundamentally different set of principals that are not necessarily interested in understanding the long-term performance implications of firm actions (Koh, 2007). The short-term focus of their trading behavior does not motivate managers to execute complex competitive repertoires. In fact, they could contribute to managerial myopia as these investors impose external pressure to focus on near-term objectives (Bushee, 1998). Indeed, to keep transient investors on board, executives may need to compete with relatively simple competitive repertoires with a view toward short-term gains. Compared to dedicated investors who are

likely to devote more effort to understanding complex business models and competitive repertoires, transient investors may be keyed in to rudimentary signals of a firm's business model facilitated by a set of familiar competitive actions, again forcing managers to be myopic (Rindova *et al.,* 2010). Transient investors are averse to the short-term performance declines associated with competitive complexity because these investors tend to trade out from firms that experience even temporary downturns (Abarbanell, Bushee, and Raedy, 2003), so they are likely to discourage managers from making decisions that engender complex repertoires. Thus, we propose the following:

> *Hypothesis 3: Level of transient institutional ownership is negatively associated with competitive complexity.*

Tournament theory antecedent

Top executives design and implement competitive actions, and they may use those actions with a view toward gaining promotion and power. Therefore, firms often use compensation as a governance mechanism to incentivize the right kind of executive behavior. Tournament theory suggests that the pay gap between the CEO and TMT is a particularly potent motivator of executive action (Lazear and Rosen, 1981). Like agency theory, tournament theory is an economic theory that explains how firms can use governance (i.e., compensation structures) to elicit desired behavior from agents (Ehrenberg and Bognanno, 1990). Tournament theorists propose that executives compete against one another for high-level positions, with the main prediction being that employee effort increases mainly with *differences* in pay between levels, rather than the absolute levels of pay (Devaro, 2006). The strongest incentives lay at the highest level of the organization, wherein exorbitantly high CEO pay inspires the TMT to take actions that maximize their chances of attaining the CEO spot for themselves (Henderson and Fredrickson, 2001). As a result, tournament theory would suggest that a wide CEO-TMT pay gap should increase the volume of a firm's competitive activity (Gnyawali, Offstein, and Lau, 2008).

In addition, we argue that the CEO-TMT pay gap (hereinafter simply "pay gap") is also likely to be consequential to a firm's competitive

complexity because wide pay gaps compel top managers to make choices that increase their potential for promotion (Narayanan, 1985). The skills-based model of leadership (Mumford *et al.,* 2000b; Yammarino, 2000) helps explain why. The model consists of six elements: (1) individual attributes (such as motivation and personality), (2) knowledge and skills, (3) career experiences, (4) environmental influences, (5) problem solving, and (6) leader performance (Mumford *et al.,* 2000b: 23). According to Mumford *et al.* (2000a: 155), a series of relevant studies offers "compelling support" for this model.

Within the skills-based model of leadership, career experiences are crucial because "the experience leaders acquire in the course of their careers should influence whether requisite knowledge and skills are available for problem solving" (Mumford *et al.,* 2000b: 24). Career experiences also have an indirect effect on knowledge and skills in that a leader's career experiences shape his or her individual attributes, which are themselves important antecedents to knowledge and skills. In turn, a leader's knowledge and skills determine his or her ability to solve complex problems and perform as a leader.

Applying these notions to the tournament among top managers for the CEO position, we note that as one rises in the organization, solving complex problems becomes more and more important; this importance reaches its zenith within the executive suite. To win the promotion tournament, which becomes increasingly attractive as the pay gap widens, a potential CEO needs to convince others that he or she can proficiently solve complex problems and that he or she will perform well as the leader of a company. We posit that top managers who engage in a broad and changing mix of competitive action types (and hence, more complex repertoires) gain a more diverse set of relevant career experiences than those who implement simple repertoires, thus putting themselves in a position to win the promotion tournament. Top managers with complex competitive repertoires to their credit exhibit wider versatility and thereby demonstrate they are more promotion-worthy than their less versatile counterparts, all else being equal. Top managers vying for an enviable CEO position (i.e., one that involves a big jump in pay) want to demonstrate that they are broadly knowledgeable and skilled leaders who are proficient at overseeing a wide range of competitive moves. As a result, wide pay gaps not only result in high levels of competitive activity, but also highly complex competitive repertoires (controlling for volume).

Thus, we predict that:

> *Hypothesis 4: The CEO-TMT pay gap is positively associated with competitive complexity.*

Tournament-agency interaction

Agency theory and tournament theory both offer principals the practical directive that their interests and those of their agents need to be aligned (Dalton *et al.,* 2007). Our agency-based hypotheses described the direct influence of different types of principals who pressure agents to obtain the kind of behavior they desire (Hoskisson *et al.,* 2002). Meanwhile, our tournament theory hypothesis described how executive compensation might shape top managers' behavior, but this does not involve external pressure from principals. Scholars suggest that executive compensation tournaments can amplify or substitute for pressure from principals (Henderson and Fredrickson, 2001; Rosen, 1986), so consideration of their potential interaction offers an opportunity to advance understanding of agents' behavior.

Conceptually, there are several possible scenarios that could manifest themselves when executive compensation tournaments and pressure from institutional investors occur simultaneously. These two governance mechanisms could operate independently. This might occur if managers are motivated in different ways by external pressure and internal compensation structures so that the two forces are additive (i.e., no interaction). Another possibility is that one governance mechanism substitutes for the other. Compensation tournaments might dominate managerial motivations so much that they make shareholder pressure unimportant, or perhaps shareholder pressure is such an overarching concern that it renders compensation tournaments ineffective. In either case, there would be a negative interaction between our agency and tournament theory antecedents.

In contrast to these perspectives, we suggest that the presence and influence of dedicated institutional investors will positively interact with the effect of large CEO-TMT pay gaps on executives' propensity to develop complex competitive repertoires. High pay gaps already motivate managers to do so (Gnyawali *et al.,* 2008), thus making the presence of dedicated investors welcome. If managers are already

motivated to engage in complex competitive repertoires to advance their own interests, having acceptance from this key set of principals reinforces and confirms the preferred behavior. Instead of having a principal-agent problem (Dalton *et al.,* 2007), dedicated institutional investors serve as confederates for managerial agents who desire to engage in more complex repertoires with a view toward promotion. The combination of high levels of dedicated ownership and high pay gaps pulls managers toward complex repertoires more than they would be in the presence of only one of these governance mechanisms. This suggests a positive interaction between CEO-TMT pay gap and the firm's level of dedicated ownership. Stated formally,

> *Hypothesis 5: CEO-TMT pay gap (at the end of year t – 1) complements the influence of dedicated institutional ownership (at the end of year t – 1) on the complexity of a firm's competitive action repertoire over a given year (year t). Specifically, there is a positive interactive effect between CEO-TMT pay gap and dedicated institutional ownership on competitive complexity.*

We do not develop a hypothesis about the interaction between CEO-TMT pay gap and level of transient institutional ownership. Unlike the case of dedicated owners, there is no theoretical reason to propose an amplified effect in one direction or the other, especially since we hypothesize opposite effects for these predictors. We examine and discuss this further in a supplementary *post-hoc* analysis.

Methodology

Sample

Our sample included all publicly traded firms listed in the Standard & Poor's (S&P) 1,500 composite index from 2001 to 2010, plus actively traded firms that were once a part of the S&P 1,500 but have since been removed. Ending in 2010 allowed us to calculate the performance trend over several years following the final year of analysis. The S&P 1,500 index includes firms in the S&P 500 large-cap, S&P 400 mid-cap, and S&P 600 small cap. The Institutional Shareholder Services

(ISS) database adds a few other large publically traded firms, which we included as well. ISS is the owner and maintainer of the database of directors formerly held by the Investor Responsibility Research Center (IRRC). This database is housed by the University of Pennsylvania's Wharton Research Data Services (WRDS). After eliminating firms without complete data, we had a sample of 1,168 firms in 204 industries (i.e., four-digit NAICS industries).

We drew data from five main archival sources. We collected firm action data from the RavenPack News Analytics database, which aggregates press releases and news articles. The Thomson Reuter database and ExecuComp provided data on ownership structure and compensation, respectively. We collected board data from ISS and firm and industry level characteristics from Compustat.

Measures

Competitive repertoire complexity

Following previous competitive dynamics literature, we defined competitive actions as externally directed, specific, and observable moves initiated by a firm to enhance its competitive position (Ferrier *et al.,* 1999; Smith *et al.,* 1991). RavenPack scans for action-level data in the *Dow Jones Financial Wires*, *Wall Street Journal*, *Barron's*, and *MarketWatch*, plus all the daily press releases and regulatory disclosures from 22 different newswires (Twedt, 2016). The database records an entry any time one of these sources reports on a company.

RavenPack covers over 36,000 companies, including all of the companies in our sample. The database identifies the first mention of any given competitive action in order to eliminate duplication (Drake, Guest, and Twedt, 2014). RavenPack uses a patented algorithm to classify articles into categories (Lin, Massa, and Zhang, 2014). Rather than manually extracting news items, the program uses textual analysis, parts-of-speech tagging, adjacent word relationships, and language tokens (i.e., markers, such as dates) to identify and classify news articles. Though researchers have been manually coding business news events for decades (e.g., Chen, 2009; Chen, Smith, and Grimm, 1992), the steadily increasing volume of news sources and analyses calls for more automated approaches. To deal with the tens of thousands of business news stories published each day, RavenPack uses taxonomic

recognition algorithms to (1) identify entities mentioned in a story, (2) extract the story theme, (3) determine the role the entity played in the story, and (4) categorize the story as an event. For each story, RavenPack identifies a topic (which is a theme of events), group (collection of related events), type (class of events that share similar characteristics), and properties (such as the named entity and role), which allow for precise categorization of each story (cf. http://www.ravenpack.com/products/ravenpack-news-analytics/).

For our study, we examined eight major types of competitive actions that align with prior research on competitive dynamics (Derfus *et al.,* 2008; Ferrier, 2001; Upson *et al.,* 2012). These are as follows: new product actions, capacity-related actions, pricing actions, marketing actions, acquisitions, strategic alliances, market expansion, and legal actions. **Table 1** shows examples of each type. Our data collection uncovered 87,941 total competitive actions. This is an average of 10.76 actions per firm per year (firms may be in the data for less than 10 years, for example if they are acquired), which is consistent with prior research (Derfus *et al.,* 2008; Rindova *et al.,* 2010).

Based on the RavenPack identification of competitive actions, we created a composite measure of competitive repertoire complexity annually for each firm in our sample. Competitive dynamics scholars nearly always measure competitive complexity using some form of weighted diversity index, such as a Herfindahl-Hirschman index (HHI) (Basdeo *et al.,* 2006; Ferrier, 2001; Yu *et al.,* 2009) or Blau's index (Andrevski, Brass, and Ferrier, 2013; Chi *et al.,* 2010; Gnyawali *et al.,* 2006). Such an approach simultaneously reflects both how many different types of actions there are in a repertoire and how (un)evenly firms use different actions. Consistent with this approach, the first component of our composite measure is a diversity index.

To measure this component, we use the Shannon index. This index is a natural fit for the competitive dynamics literature. Claude Shannon (1948), who is widely known for having founded the field of information theory, developed an entropy index in the context of cryptography, wherein cryptographers faced a string of letters and were trying to determine what could be future letters in the string. Shannon's index is a mathematical representation of the string that shows the more different letters there are in the string, and equal their proportions, the more difficult it is to predict future letters. Similarly, a focal firm's competitors face a set of actions that the firm selects from

Table 1. Action categories and example headlines

Action category	*RavenPack classification*	*Company*	*Example headline*
New product actions [a]	Product Release	Barnes & Noble Inc.	*Barnes & Nobel Studio Debuts New Series: Mr. Literary*
	Product Release	Novellus Systems Inc.	*Novellus Systems Launches SOLA® xT UVTP System for Sub-45nm High Volume Manufacturing*
Capacity related actions	Facility Close	FootLocker Inc.	*Foot Locker Expects to Shutter 117 Stores*
	Facility Upgrade	Cintas Corp.	*Cintas Expands Document Management Operations in China*
Pricing actions	Product Price Cut	Atmel Corp.	*Atmel Reduces System Cost in Industrial Applications with High-Quality Video Decoding ARM926-based Microprocessor*
	Product Price Raise	Carnival Corp/PLC	*Carnival to Raise Cruise Prices*
Marketing actions	Campaign Ad	Office Depot Inc.	*Office Depot and National Association of Professional Organizers (NAPO) Launch Campaign to Help Business Professionals Get Organized in the New Year*
	Campaign Ad	United Parcel Service Inc.	*UPS Racing Unveils Commercials and Online Sweepstakes to Launch 2010 NASCAR Season*
Acquisitions	Acquisition - Acquirer	Bio-Rad Laboratories Inc.	*Bio-Rad Complete the Purchase of Certain Diagnostics Businesses of Biotest AG*
	Acquisition - Acquirer	SPX Corp.	*SPX Complete Acquisition of Gerstenberg Schroder*
Strategic alliances	Joint Venture	Scientific Games Corp.	*Playtech Signs Joint Venture with Scientific Games*
	Partnership	McAfee Inc.	*Brocade and McAfee Enter Strategic Partnership to Deliver Comprehensive Network Security Solutions*
Market expansion	Market Entry	Texas Instruments Inc.	*Texas Instruments to Enter E-Reader Market*
	Market Entry	Synaptics Inc.	*Synaptics Enters Home Appliance Market*
Legal actions	Legal Issue - Plaintiff	Microsoft Corp.	*Microsoft Sues TiVo, Claiming Patent Infringement*
	Legal Issue - Plaintiff	DirecTV Group Inc.	*DirecTV Sues Dish Network Over 'Why Pay More' Commercials*

a. "New product actions" describe product releases within a market in which the firm already competes. "Market expansion" describes new product or geographic markets where the firm does not yet compete.

a number of categories. These constitute a competitive repertoire, much like a string of text. Competitors would be interested in knowing what likely future actions a firm will take, as a cryptanalyst wants to know what are likely to be future letters in a string (strings are not letters embedded in words because they are encoded).

The Shannon index "is comparable to the Hirschman-Herfindahl index (HHI)" (Straathof, 2007: 298), but it offers a slightly more apropos measure of diversity for the context of competition between firms because it encompasses the notion of quantifying the ability to predict future letters/moves. By this we mean the difficulty a competitor would have predicting what future competitive actions might be, based solely on examining prior actions (Jost, 2006). Statistically, the two indices yield similar results, but the Herfindahl index fails to capture variance among the most concentrated and the most diverse types of profiles. As an illustration of the indices' differences, consider their values for the case of five actions in five different categories and ten actions in ten categories. Using the Herfindahl index, both of these repertoires return a score of one. However, the Shannon index for five actions in five categories is 1.61 and for ten actions in ten categories it is 2.30. Thus, the Shannon index recognizes the latter choice as being a more sophisticated repertoire of competitive actions, whereas the HHI does not.
The Shannon index is calculated as follows:

$$S = -\sum_{i=1}^{R} p_i \ln p_i$$

where *pi* is the proportion of competitive actions belonging to the *i*th competitive action category of R total categories. This index ranges from a high of ln(R) when all types of competitive actions are equally common and approaches zero as actions become more concentrated.

The second component of our composite measure of competitive complexity incorporates the notion of change, which we captured with a measure of the difference between the firms' competitive action repertoire in the prior year and the focal year of analysis. We operationalized this as the Euclidean Distance, D(t-1)t, between the two action repertoires, as follows:

$$D_{(t-1)t} = \text{SQRT}\left[\left(A1_{(t-1)} - A1_t\right)^2 + \left(A2_{(t-1)} - A2_t\right)^2 \ldots \left(A8_{(t-1)} - A8_t\right)^2\right]$$

where A1 through A8 are the number of actions taken in action categories 1 through 8 by the focal firm in the indicated year. We chose the Euclidean Distance measure because we are interested in how a firm changes its competitive action repertoire from one year to the next. Others, such as Ferrier (2001), and Ferrier and Lee (2002), have used INDEL costs, which are calculated from the Levenshtein Distance between competitive repertoires, to calculate what they call strategic unpredictability. The two measures are similar, but the Levenshtein Distance assigns penalties for every insertion, deletion, or substitution associated with conversion from one repertoire to the next because it is concerned with the order of events. Our data, however, are annualized, so we do not wish to distinguish, for example, between a pricing action followed (however long within the year) by an acquisition versus an acquisition followed by a pricing action. Thus, Euclidean Distance, rather than INDEL costs, is the appropriate measure for annual competitive repertoire comparisons.

Euclidean Distance describes action repertoire change, or how much the firm's competitive repertoire has repeated itself from time $t - 1$ to time t (Upson *et al.,* 2012), but it does not capture the degree to which firms are engaging in new action types. A firm could, for instance, increase or decrease the number of competitive actions of types in which they were already engaged. For example, in 2007 one prominent retailer, the Gap, changed its competitive repertoire considerably from what it did in 2006, but it did so without introducing any new types of competitive actions. To account for this, we counted the number of types of actions in which a firm engaged at time t but in which it did not engage at time $t - 1$. Although they both address aspects of change from the prior year to the focal year, the Euclidean Distance and the new action type count measure different things and are not strongly correlated (r=0.12).

We created z-scores from the three assessments—the Shannon index, Euclidean Distance, and new action count—and summed these scores to create a composite measure of *competitive complexity*. Our use of this composite score helped ensure that our measure captured the dimensions of competitive complexity noted in our conceptual development—diversity, change, and newness.

To illustrate why including change and newness improves our ability to capture competitive repertoire complexity, consider again two prominent retailers in 2007. Using a diversity index alone, Kohl's had

a higher score than did Finish Line. Unlike that index, however, our composite measure accounts for the fact that Kohl's scored low on change and added only one new action type in 2007, while Finish Line had a high change score and added five new action types in 2007. As a result, Finish Line scored higher on our competitive complexity measure than did Kohl's.

Performance

We operationalized *short-term performance* as return on assets (ROA) expressed as a percentage at the end of the focal year under investigation (Ndofor *et al.,* 2011). We operationalized firms' *performance trend over time* as the slope of the regression of ROA over three years, beginning with the focal year of analysis (Connelly *et al.*, 2016). Individual firm growth trends allowed us to observe the trajectory of firm performance, providing more detail about firm-level changes than simple averages or snapshots of performance. We selected a three-year period because it provides enough information (i.e., four data points, *t, t+1, t+2,* and *t+3*) to calculate a relatively long-term trend without getting too temporally removed from the competitive action repertoires under investigation.

Independent variables

The *dedicated* and *transient ownership* variables focus on the level of institutional ownership, accounting for shareholders with at least one percent equity in a focal firm during our sampling window. This restriction removes owners with marginal equity positions. We categorized each institutional owner in accordance with Bushee's (1998) classification system as being either dedicated, transient, or neither, for each year of the analysis. Dedicated and transient ownership are thus the percentage of a firm's total shares held by dedicated or transient institutional investors, respectively. On average, dedicated owners held 4.13 percent of firm shares and transient investors held 11.50 percent.

To arrive at these figures, we categorized each institutional investor according to their past trading behavior as described by portfolio diversification, portfolio turnover, and trading sensitivity. Portfolio diversification is a composite measure of the average percentage

of the institution's holdings invested in each firm, the average size of the institution's ownership position in its portfolio, the percentage of holdings that are greater than five percent, and a concentration index of the institution's holdings. Portfolio turnover is a combination of the annual change in ownership in the previous two years and the percentage of firms that the institution has held continuously over the previous two years. Trading sensitivity combines a ratio of changes in ownership position to firms' earning announcements with the average earnings change in firms bought minus firms sold. Dedicated institutional investors have low portfolio diversification, low portfolio turnover, and low trading sensitivity; in contrast, transient institutional investors have high portfolio diversification, high turnover, and high trading sensitivity.

CEO-TMT *pay gap* measures tournament incentives among top managers. We measured pay gap as the difference between the CEO's total compensation and the average total compensation of the TMT's four highest-paid members other than the CEO (Henderson and Fredrickson, 2001; Shi, Connelly, and Sanders, in press). Because CEO-TMT pay gap is not normally distributed, we monotonically transformed it by taking the natural logarithm of the difference, plus a constant that made all observations positive (Shi, Connelly, and Sanders, 2016).We centered all independent variables before adding them into our models.

Control variables

Prior research has suggested that large and high-performing firms can have complex competitive repertoires (Ndofor *et al.,* 2011), so we controlled for *firm size* as the natural logarithm of sales and *prior performance* as ROA at time $t - 1$. Firms whose resources are liquid may be able to engage in complex repertoires, so we control for the *current ratio* as (current assets)/(current liabilities). Old firms may be more resistant to change, so we control for *firm age*. CEOs that also chair the board of directors could be less creative in their competitive endeavors (Hambrick, Cho, and Chen, 1996) so we control for *CEO duality* with a dummy variable. Because near-term options that executives can exercise could motivate their self-interest in specific competitive moves, we control for the TMT's *in-the-money, exercisable options*. We

are interested in competitive complexity as opposed to the volume of competitive activity, so we control for *volume of competitive activity* as the number of actions taken.

We also control for potential influence of the board of directors, given our emphasis on corporate governance constraints. *Board size* is a count of the number of directors. *Board tenure* is the average number of years a firm's directors have served on the board (Hillman *et al.,* 2011). *Board age* is the average age of all a firm's directors.

In addition, we control for industry characteristics that might influence competitive repertoires. *Industry munificence* refers to the resources available to all firms in an industry, which we measure as the regression of sales over time divided by mean industry sales (Boyd, 1995). *Industry dynamism* refers to the level of instability in an environment; we calculated this as the standard error of munificence (Boyd, 1995). *Industry concentration* captures whether a small number of firms dominate an industry; we measured this using a standard Herfindahl index of industry sales (Boyd, 1995). Because we have panel data, we include year dummies to account for contemporaneous correlation (Certo and Semadeni, 2006).

Analytical technique

Our dataset is a hierarchical panel with firms nested within industries. We managed the annual panel settings using Stata's *xtset* function. Because competitive norms vary by industry (Ferrier, 2001), we needed to account for potential unobserved heterogeneity across multiple industries. We defined industry groups as all firms within a four-digit NAICS classification because our large sample size afforded the opportunity for a fine level of differentiation between groups. We used hierarchical linear modeling (HLM) to analyze the data because it allows for investigation of relationships across levels by recognizing the partial interdependency of observations and explicitly modeling both firm- and industry-level residuals. Panelized HLM controls for potential autocorrelation and heteroscedasticity by accounting for the panel structure of the data and both within- and between-industry variance (Hofmann, 1997).

Results

Table 2 reports descriptive statistics and correlations for all study variables. All variance inflation scores are well below a conservative threshold of five, so multicollinearity does not appear to be a concern.

Hypothesis tests

We first examined the effects of competitive complexity on short-term performance, as described in Hypotheses 1a. We measured both competitive complexity and ROA at the end of the focal year (time *t*) because competitive complexity constitutes a set of actions that occur throughout the year, but ROA is measured on the last day of the year. Conceptually, we intended to capture the actions' immediate impact, and the traditional lag structure could result in an appreciable gap between when the actions occurred and when we measure ROA. Consistent with this approach, we also measured the *volume of competitive activity* at time *t* because this control variable also represents competitive actions taken throughout the year. We measure all other control variables with a one-year lag, at time $t - 1$.

Table 3 reports the results for the influence of competitive complexity on short-term performance. Model 1 reveals that the control variables of firm size, prior performance, in-the-money options, volume of competitive activity, and board size and tenure are all predictors of short-term performance. In Model 2, the coefficient for competitive complexity is negative and strongly predictive of short-term performance ($\beta = -0.280$, $p < 0.001$), providing support for Hypothesis 1a.

We also tested our hypothesis about the firms' performance trends. Here again, we used competitive complexity and volume of competitive actions at the focal year of analysis (time *t*) and all other variables at the end of the prior year (time $t - 1$). Model 3 in **Table 4** shows that several controls (firm size, prior performance, current ratio, in-the-money options, board size, transient ownership, and pay gap) are key predictors.[6] Model 4 shows that competitive complexity is positively

6. Three of our controls showed different effects for short-term performance and performance trend. Large firms, firms with good past performance, and firms with smaller boards are more likely to perform better in the short term (Table 3). The first two of these appear straightforward as large firms often enjoy economies of scale, and past performance is an indicator of future performance. The link between small

Table 2. Descriptive statistics and correlations

Variables	*Mean*	*S.D.*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*
1 Firm size	7.65	1.51	1.00																	
2 Current ratio	2.37	2.23	−0.44	1.00																
3 Firm age	43.29	15.81	0.42	−0.27	1.00															
4 CEO duality	0.57	0.49	0.13	−0.05	0.15	1.00														
5 TMT in-the-money, exercisable options	0.02	0.06	0.24	−0.05	−0.01	0.04	1.00													
6 Volume of competitive activity	10.76	25.24	0.38	−0.07	0.06	0.01	0.15	1.00												
7 Board size	9.27	2.30	0.56	−0.30	0.39	0.04	0.11	0.19	1.00											
8 Board tenure	6.61	3.62	−0.03	0.07	0.08	−0.08	−0.02	−0.05	0.02	1.00										
9 Board age	60.81	3.84	0.09	−0.01	0.15	0.04	0.02	−0.01	0.08	0.30	1.00									
10 Industry munificence	0.05	0.07	0.07	−0.02	−0.02	0.00	0.07	0.05	0.05	−0.05	−0.04	1.00								
11 Industry dynamism	0.02	0.02	−0.06	−0.01	0.04	0.04	−0.06	−0.07	−0.01	−0.01	0.03	−0.18	1.00							
12 Industry concentration	0.16	0.14	0.12	−0.10	−0.03	−0.02	−0.03	−0.04	0.04	0.03	0.01	−0.05	0.07	1.00						
13 Dedicated ownership	0.04	0.07	−0.01	0.00	0.01	0.05	0.01	−0.03	0.00	−0.03	−0.19	0.01	0.03	−0.01	1.00					
14 Transient ownership	0.11	0.10	−0.29	0.11	−0.19	−0.05	−0.11	−0.18	−0.22	−0.08	−0.08	−0.09	0.11	0.01	0.06	1.00				
15 Pay gap	4.27	0.12	0.25	−0.10	0.12	0.08	0.08	0.10	0.14	−0.05	0.01	0.03	0.00	0.01	0.02	−0.05	1.00			
16 Competitive complexity	0.95	2.26	0.42	−0.12	0.12	0.05	0.16	0.57	0.26	−0.10	−0.05	0.07	−0.08	−0.03	0.02	−0.18	0.16	1.00		
17 Short-term performance[a]	4.90	11.70	0.10	−0.01	0.03	0.02	0.10	0.05	0.02	0.06	0.04	0.05	−0.08	0.07	−0.05	−0.09	0.02	−0.01	1.00	
18 Performance trend	−5.24	13.49	−0.08	0.05	−0.02	0.00	−0.05	−0.03	−0.02	−0.02	0.01	0.01	0.00	−0.03	−0.02	0.00	−0.03	0.00	−0.04	1.00

a. Expressed as a percentage.

N=7,888, All correlations greater than |0.02| are significant at $p<0.05$.

(β =0.183, p=0.032) associated with the performance trend. Model 5 then tests the hypothesized curvilinear relationship, suggesting that the squared term of competitive complexity is negatively associated with the firms' performance trend (β =−0.017, p=0.064). The results in Models 4 and 5 yield a pattern that is seemingly consistent with an inverted-U shaped relationship, as predicted in Hypothesis 1b.

Table 5 reports the results for our agency theory predictions about antecedents of competitive complexity. As shown in Model 6, firm size, prior performance, in-the-money options, volume of competitive activity, industry concentration, and all our board variables are strong predictors of performance trend. In Model 7, as predicted in Hypothesis 2, firms' level of dedicated institutional ownership is positively associated with competitive complexity (β =0.670, p=0.033). The level of transient institutional ownership, however, is not associated with competitive complexity (β =0.132, p=0.625), so Hypothesis 3 is not supported.

We test our hypothesis about tournament theory in Model 7 together with the other direct effects. As predicted in Hypothesis 4, this model shows that the direct effect of a firm's pay gap between the CEO and TMT is positively associated with competitive complexity (β =0.384, p=0.016). The final hypothesis examines the interaction between our agency theory prediction about dedicated institutional ownership and our tournament theory predication about CEO-TMT pay gap. In Model 8, this interaction is positive (β =10.559, p=0.002), as predicted in Hypothesis 5.

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boards and better short-term performance may be reflective of small boards being able to make fast decisions, allowing them to be nimble and responsive to the environment. For the performance trend (Table 4), small firms often grow quickly, so although the level of their short-term performance (i.e., ROA) may not match that of their large competitors, they are likely to see growth over time (i.e., large year-over-year percentage increases are common for small firms). The negative relationship between past performance and performance trend could be due to firms that experience appreciable short-term declines, but then climb back to where they were before the decline. Last, large boards appear to improve performance over time. One possibility is that large boards may make slow decisions, but they also make good decisions. They may be less nimble than their small-board counterparts, but they are also less likely to make big mistakes. We appreciate an anonymous reviewer encouraging us to note these differences and discuss possible reasons for their occurrence.

Table 3. Results of hierarchical linear modeling

Variables	*Model 1*		*Model 2*	
Constant	−0.619	*0.782*	−1.038	*0.643*
	(2.240)		(2.239)	
Firm size	0.455	*0.000*	0.554	*0.000*
	(0.122)		(0.124)	
Prior performance	0.402	*0.000*	0.400	*0.000*
	(0.009)		(0.009)	
Current ratio	−0.088	*0.122*	−0.084	*0.139*
	(0.057)		(0.057)	
Firm age	−0.001	*0.896*	−0.001	*0.919*
	(0.009)		(0.009)	
CEO duality	0.291	*0.227*	0.312	*0.195*
	(0.241)		(0.241)	
TMT in-the-money, exercisable options	−9.844	*0.000*	−9.576	*0.000*
	(1.929)		(1.928)	
Volume of competitive activity	0.011	*0.049*	0.022	*0.000*
	(0.005)		(0.006)	
Board size	−0.162	*0.011*	−0.149	*0.018*
	(0.063)		(0.063)	
Board tenure	0.122	*0.001*	0.114	*0.001*
	(0.035)		(0.035)	
Board age	0.039	*0.257*	0.034	*0.319*
	(0.034)		(0.034)	
Industry munificence	−0.691	*0.703*	−0.597	*0.742*
	(1.813)		(1.810)	
Industry dynamism	2.888	*0.671*	2.615	*0.700*
	(6.796)		(6.787)	
Industry concentration	1.531	*0.165*	1.397	*0.205*
	(1.103)		(1.102)	
Dedicated ownership	−0.451	*0.805*	−0.268	*0.884*
	(1.831)		(1.829)	
Transient ownership	2.374	*0.132*	2.402	*0.127*
	(1.576)		(1.574)	
Pay gap	0.708	*0.453*	0.829	*0.379*
	(0.943)		(0.943)	
Competitive complexity			−0.280	*0.000*
			(0.065)	
Year dummy variables	Included		Included	
N	8,173		8,173	
Chi-sq	2365.2	*0.000*	2389.7	*0.000*
df	25		26	

Standard errors in parentheses, *P*-values in italics.
DV: Short-term performance.

Table 4. Results of hierarchical linear modeling

Variables	*Model 3*		*Model 4*		*Model 5*	
Constant	−2.119	*0.470*	−1.834	*0.532*	−1.605	*0.585*
	(2.935)		(2.937)		(2.939)	
Firm size	−0.620	*0.000*	−0.686	*0.000*	−0.735	*0.000*
	(0.160)		(0.162)		(0.165)	
Prior performance	−0.097	*0.000*	−0.097	*0.000*	−0.096	*0.000*
	(0.012)		(0.012)		(0.012)	
Current ratio	0.367	*0.000*	0.364	*0.000*	0.360	*0.000*
	(0.074)		(0.074)		(0.074)	
Firm age	0.011	*0.363*	0.011	*0.369*	0.012	*0.345*
	(0.012)		(0.012)		(0.012)	
CEO duality	0.042	*0.894*	0.026	*0.933*	0.037	*0.906*
	(0.315)		(0.315)		(0.315)	
TMT in-the-money, exercisable options	−12.552	*0.000*	−12.725	*0.000*	−12.790	*0.000*
	(2.461)		(2.462)		(2.461)	
Volume of competitive activity	−0.005	*0.473*	−0.012	*0.114*	−0.007	*0.406*
	(0.007)		(0.008)		(0.008)	
Board size	0.179	*0.030*	0.171	*0.038*	0.167	*0.042*
	(0.082)		(0.082)		(0.082)	
Board tenure	−0.054	*0.238*	−0.048	*0.288*	−0.047	*0.302*
	(0.046)		(0.046)		(0.046)	
Board age	−0.002	*0.965*	0.001	*0.978*	0.003	*0.950*
	(0.045)		(0.045)		(0.045)	
Industry munificence	0.960	*0.685*	0.879	*0.711*	0.826	*0.727*
	(2.371)		(2.370)		(2.370)	
Industry dynamism	−0.742	*0.933*	−0.533	*0.952*	−0.469	*0.958*
	(8.885)		(8.882)		(8.881)	
Industry concentration	−2.242	*0.119*	−2.162	*0.133*	−2.104	*0.144*
	(1.440)		(1.439)		(1.440)	
Dedicated ownership	3.303	*0.165*	3.197	*0.179*	3.305	*0.164*
	(2.376)		(2.376)		(2.376)	
Transient ownership	4.244	*0.039*	4.235	*0.040*	4.300	*0.037*
	(2.060)		(2.060)		(2.060)	
Pay gap	2.375	*0.049*	2.298	*0.057*	2.293	*0.057*
	(1.205)		(1.206)		(1.205)	
Competitive complexity			0.183	*0.032*	0.263	*0.006*
			(0.085)		(0.096)	
Competitive complexity2					−0.017	*0.064*
					(0.009)	
Year dummy variables	Included		Included		Included	
N	7,702		7,702		7,702	
Chi-sq	574.2	*0.000*	579.1	*0.000*	582.8	*0.000*
df	25		26		27	

Standard errors in parentheses, *P*-values in italics.
DV: Performance trend.

Table 5. Results of hierarchical linear modeling

Variables	*Model 6*		*Model 7*		*Model 8*	
Constant	−1.771	*0.000*	−1.769	*0.000*	−1.725	*0.000*
	(0.381)		(0.392)		(0.392)	
Firm size	0.372	*0.000*	0.365	*0.000*	0.361	*0.000*
	(0.021)		(0.022)		(0.022)	
Prior performance	−0.005	*0.002*	−0.005	*0.003*	−0.005	*0.003*
	(0.002)		(0.002)		(0.002)	
Current ratio	0.013	*0.174*	0.013	*0.175*	0.012	*0.206*
	(0.010)		(0.010)		(0.010)	
Firm age	0.001	*0.528*	0.001	*0.548*	0.001	*0.499*
	(0.002)		(0.002)		(0.002)	
CEO duality	0.071	*0.083*	0.066	*0.112*	0.063	*0.125*
	(0.041)		(0.041)		(0.041)	
TMT in-the-money, exercisable options	0.861	*0.009*	0.859	*0.009*	0.825	*0.012*
	(0.328)		(0.328)		(0.328)	
Volume of competitive activity	0.038	*0.000*	0.039	*0.000*	0.039	*0.000*
	(0.001)		(0.001)		(0.001)	
Board size	0.042	*0.000*	0.042	*0.000*	0.042	*0.000*
	(0.011)		(0.011)		(0.011)	
Board tenure	−0.027	*0.000*	−0.026	*0.000*	−0.025	*0.000*
	(0.006)		(0.006)		(0.006)	
Board age	−0.015	*0.011*	−0.015	*0.014*	−0.015	*0.013*
	(0.006)		(0.006)		(0.006)	
Industry munificence	0.215	*0.508*	0.232	*0.474*	0.220	*0.497*
	(0.325)		(0.325)		(0.325)	
Industry dynamism	−0.405	*0.743*	−0.316	*0.798*	−0.323	*0.794*
	(1.235)		(1.234)		(1.233)	
Industry concentration	−0.464	*0.049*	−0.462	*0.050*	−0.460	*0.050*
	(0.236)		(0.235)		(0.235)	
Dedicated ownership			0.670	*0.033*	0.728	*0.020*
			(0.314)		(0.314)	
Transient ownership			0.132	*0.625*	0.141	*0.600*
			(0.269)		(0.269)	
Pay gap			0.384	*0.016*	0.491	*0.003*
			(0.159)		(0.163)	
Ded. ownership × Pay gap					10.559	*0.002*
					(3.490)	
Year dummy variables	Included		Included		Included	
N	8,173		8,173		8,173	
Chi-sq	4287.8	*0.000*	4305.2	*0.000*	4320.1	*0.000*
df	22		25		26	

Standard errors in parentheses, *P*-values in italics.
DV: Competitive complexity.

Supplementary analyses

As mentioned, we did not develop a formal hypothesis about the interactive effect between firms' CEO-TMT pay gap and their level of transient institutional investment because we expected these forces to cancel each other out. This interaction (not reported) is not a good predictor of competitive complexity.

We derived our control variables for board influence on strategic outcomes from Golden and Zajac (2001), but these authors actually suggest that our board control variables (board size, average tenure, and average age) have curvilinear relationships with firm outcomes. To test whether this possibility would affect our findings, we added squared terms for these control variables to our models and found that two of them (size and tenure) did, in fact, have curvilinear effects, but the results of our models with these additional squared controls were substantively the same.

Given the large number of control variables in our models, we also checked for the possibility of over-fitting by looking at the Akaike Information Criterion (AIC) (Akaike, 1987). The AIC resolves the potential problem of model over-fitting by introducing a penalty for the number of parameters in the model. Models with low values of AIC offer the best balance between model fit and specificity. The AIC for Model 6 with control variables is 32,278, and for Model 8 with all predictors the AIC is 32,266. This suggests that the full model, which accounts for all hypothesized variables and control variables together, provide a better fit to the data than the model with our control variables only.

Last, we tested for endogeneity in our performance models. Considering that capability is a key antecedent to competitive actions (Chen, 1996), it is possible that firms with high performance in the short term, or increasing performance trends leading up to the focal year of analysis, are better able to engage in complex competitive repertoires. Thus, there is some potential for reverse causality. To address this issue, we conducted instrument variable regressions using *xtivreg2* in Stata to help determine if competitive repertoire complexity is exogenous.

We identified competitive action richness and the firm's net plant, property, and equipment (PPE) as exogenous and relevant instrumental variables (Kennedy, 2008). Richness of a firm's competitive repertoire is a count of the number of different action types a firm undertakes in a given year, but does not account for the total number of actions, the concentration of those actions, or repetitiveness of actions

between years. As a result, richness should be related to competitive repertoire complexity, without necessarily having a strong relation to short-term performance (r=-0.02) or the firms' performance over time (r=-0.01). Similarly, a firm's net PPE represents the cost of all buildings included in its PPE account, minus accumulated depreciation. A larger net PPE can reflect more valuable assets and represent a firm's ability to engage in competitive actions (Chen, 1996), but holding these resources alone should not necessarily influence short-term performance (r=0.02) or the performance trend (r=−0.01).

Using these two instrumental variables (richness and net PPE), we examined the strength of our instruments for complexity using *xtivreg2* in both the short-term performance and performance trend models. In both cases, a high Chi-2 statistic for the under-identification test (p<0.001), and a much lower Chi-2 for the over-identification test (p=0.149 and p=0.830) suggest that our instruments predict competitive repertoire complexity, but are not correlated with the DV beyond their indirect relationship to the DV via complexity. Further, in testing for weak instruments, or instruments that have a weak relationship with competitive complexity, we find F-statistics far greater than the recommended threshold of 10. Collectively, these findings suggest that richness and net PPE are relevant and strong instruments in both of our models. Using these two instrumental variables, we conducted endogeneity tests in both the short-term performance and performance trend models. The endog() option in *xtivreg2* presents an endogeneity test that examines if a potentially endogenous regressor can be treated as exogenous, allowing for a more efficient estimator to be used than the instrument variables approach. In both the short-term performance and performance trend models, we failed to reject the null hypothesis that competitive complexity can be treated as exogenous, indicating that endogeneity is unlikely to be problematic to our models.

Discussion

Antecedents to competitive repertoire complexity

Relying on agency theory, we theorized and found that the presence of dedicated institutional investors encourages firms to engage in complex competitive repertoires. Using tournament theory, we

hypothesized and found that the CEO-TMT pay gap was an important predictor of the extent to which a firm engages in complex competitive repertoires. Last, we also found that the dedicated investors of our agency theory arguments and the CEO-TMT pay gap of our tournament theory arguments complemented each other with respect to their influence on firms' competitive repertoire complexity. Little past work has examined how shareholders and compensation structures jointly affect firm outcomes, but our results make progress toward integrating governance research with work on competitive dynamics. One implication is that scholars should account for these potential drivers in future competitive dynamics studies, or such studies will risk underspecifying the antecedents of a firm's choice of competitive moves.

Contrary to our prediction (i.e., Hypothesis 3), ownership by transient investors was not associated negatively with competitive complexity. Perhaps there are different kinds of transient institutional investors that we did not capture with our operationalization, which is based on trading behavior. Some transient institutional investors may be more knowledgeable than others, and as such, for certain firms the former occasionally act more like dedicated investors. Knowledgeable transient investors could wash out the influence of other transient investors that happen to be less knowledgeable, and consequently, less aware of the strategic benefits of complex repertoires. Given this potential explanation, viewing transient investors as a monolithic group could mask a source of variance. We thus recommend that future scholars gather primary data (as opposed to our use of secondary data) on owner types because this might help tease out important differences that are not obvious from using empirical categorizations.

Future competitive dynamics research might also expand to explore other forms of ownership. Many large public firms, such as Walmart and Samsung, have dominant family shareholders in place, and these owners often have strong opinions about the activities in which the firm should engage. Other types of principals are becoming more prominent, such as sovereign wealth funds, which are entities affiliated with national governments. We can imagine the sovereign wealth fund of Dubai, for example, perhaps pressuring a firm that it partially owns to compete in the Middle East (or facilitating its ability to compete there). Scholars might also consider the evolving ways in which principals interact with one another. For instance, given the rise of proxy access proposals (Campbell *et al.,* 2012), different

institutional investors could find themselves sitting together on boards of directors, which could radically influence the extent to which they coordinate and impose joint pressure on executives.

Another important extension of agency theory might investigate board influences on competitive complexity, which was outside the scope of our study. All of our board-related controls were meaningful predictors of firms' mix of competitive actions. For instance, large boards are associated with complex repertoires, and somewhat curiously, young, short-tenured directors are associated with low competitive complexity. Thus, there may be some competing influences among board characteristics. We expect some boards may be better than others at monitoring competitive activity, and some may be better able to receive and process information about firms' competitive actions, which could help explain the causal mechanisms behind these relationships. Future scholars might examine how boards exhibit complex or simple properties, *ex ante* to competitive behavior, arising from their culture, experience, or information processing, and how these characteristics affect the strategic guidance boards offer with respect to competitive complexity. There may also be a need to further explore how the board's composition, interactions, processes, and social network structure gives rise to a collective-cognitive framework that, in turn, shapes the firm's competitive action repertoire.

Our study is also likely to be of interest to those doing work on tournament theory. Whereas tournament theory's emphasis in the management literature has been on pay gaps encouraging employees to work harder (Devaro, 2006), our study adds that they also work more broadly in an effort to distinguish themselves, and hopefully, increase their chances of becoming the next CEO. Specifically, we theorize and find that tournaments increase the breadth of activity in which people engage as they try to prove themselves worthy of promotion. This is a seemingly novel twist on tournament theory that expands its reach from being mainly a theory of efficiency (Lazear and Rosen, 1981) to being useful for predicting different kinds of outcomes, such as the variety of competitive actions.

Scholars might build on our application of tournament theory to competitive complexity by exploring the relationship in more depth. For example, we can envision important boundary conditions to our findings. Tournament theory offers its greatest explanatory power when tournament participants (i.e., top managers) compete relatively independent of one another (Shi *et al.*, 2016). When managers

coordinate or are dependent on one another for success, it reduces competition among them (Main, O'Reilly, and Wade, 1993). As a result, tournament theory's predictions about competitive complexity might be more accurate in settings wherein top managers operate autonomously. For instance, our tournament theory arguments could hold for firms with unrelated diversification, but have less potency when firms have highly related business units that require cooperation and information sharing. Similarly, tournament theory also incorporates a stochastic component that allows for an element of randomness to tournament outcomes (Ehrenberg and Bognanno, 1990). In scenarios wherein luck, noise, or other random factors make important contributions to managerial output (e.g., in uncertain environments), the CEO-TMT pay gap may not be a good predictor of managerial behavior (Lazear and Rosen, 1981).

Our study also contributes to research on the concept of competitive complexity (Miller, 1993) in part by introducing the notion of time to the construct. Prior work has described complexity mainly as the diversity of a firm's competitive action repertoire (Ferrier *et al.,* 1999; Rindova *et al.,* 2010; Yu *et al.,* 2009), but we leverage theory and research to add that it also involves change and the newness of competitive action types. Returning to our prior illustration of Kohl's and Finish Line highlights why including these two elements improves our ability to capture competitive repertoire complexity. In 2007, Kohl's appeared to be more competitively complex than Finish Line when applying a narrow measure (e.g., a diversity index), but Finish Line scored higher in terms of our composite measure.

The performance effects of competitive repertoire complexity

In terms of explaining firm performance—a goal that is central to strategic management research (Nag, Hambrick, and Chen, 2007)—previous inquiry has hinted at the possibility of differential short- and long-term consequences of competitive complexity, but not tested it empirically (Ferrier and Lyon, 2004; Miller and Chen, 1996a). As we predicted, competitive complexity was found to adversely affect short-term performance but improve firms' performance over time, controlling for competitive aggressiveness (i.e., the number of competitive actions). Our findings about the implications of competitive complexity for short-term performance and the performance trend suggest that firms can benefit from aiming for a careful balance between simplicity

and complexity that will allow them to gain the advantages of complex competitive repertoires, but without confusing stakeholders or overburdening their executive team.

Future research into the competitive complexity—performance relationship might benefit from examining transient investors more closely. As shown in Table 4, our results suggest that transient ownership has a positive impact on a firm's long-term performance trend. This indicates that the presence of transient institutional investors might benefit firms, even though many executives—and strategic management theorists—view them as detrimental. One potential explanation is that transient institutional investors could prod executives to answer a different set of challenging questions about their decisions and performance compared to the questions dedicated investors are asking, and dealing with a broader set of questions leads companies to improve.

Our results regarding the competitive complexity—performance link also offer potentially important practical implications. Some firms may be reluctant to pull the trigger on building more complex competitive repertoires, knowing that doing so could hurt their bottom line in the short term, but we find that doing so can provide rewards if they stick with it. Armed with this knowledge, executives may want to woo particular types of shareholders (e.g., dedicated institutional investors) who provide managers with an extra measure of freedom to take on complex competitive repertoires (Bushee, 2004). For example, General Electric has stopped providing quarterly earnings guidance (Chen, Matsumoto, and Rajgopal, 2011) with a view toward deterring investors who are looking to make a "quick buck." Not providing quarterly earnings guidance might be entirely acceptable to the kind of shareholders who are concerned with the strategic gains that complex repertoires confer.

To the extent that future studies confirm our results, the link we found between competitive complexity and performance suggests that firms could benefit from building consideration of the competitive complexity concept into their strategy making process. Any potential competitive move needs to be judged on its own merits, but also assessing how a potential move shapes the complexity of a competitive repertoire can add an extra and valuable dimension to a firm's self-assessment efforts. To ensure that complexity is incorporated into the strategy making process, a firm might benefit from designating a senior executive to actively monitor the complexity of its competitive

repertoire. This point person would work to ensure that complexity lies in the sweet spot between being too low and too high.

Limitations

We were not able to capture the magnitude of competitive actions; a dimension that relates to the amount of resources necessary to implement an action, its irreversibility, time horizon, and difficulty of implementation. Connelly *et al.* (2010), for example, hand coded competitive actions taken by 72 firms based on these four dimensions using independent raters to arrive at a magnitude score. Adopting such a measure would be unwieldy for our study of 1,168 firms and 87,941 actions.

A related caveat to our study is that researchers using RavenPack cannot provide the same level of fine-grained scrutiny that they can within the typical competitive dynamics study. However, our data allowed us to account for intra-industry behavioral norms while establishing the validity of the relationships across industry boundaries. In this way, our study complements extant studies that provide more in-depth examinations of actions within a particular industry. Relatedly, because the nature of our data did not lend itself well to structural equation modeling (SEM), scholars might provide further complementarity to extant work by using SEM to assess the causal web of relationships involving governance, competitive repertoire complexity, and firm performance.

Conclusion

Using data from 1,168 firms that competed in 204 different industries over a 10-year period, we devoted our attention to unpacking the drivers and consequences of competitive complexity. As top managers look to engage rivals, they are likely to consider not only their own firm's abilities and rival actions, but also the controlling forces acting on them. After all, top managers generally act in ways in which they are incentivized, so we should expect them to undertake competitive moves for which they will be rewarded and for which they will receive the most support. For these reasons, we theorize and find that a firm's ownership structure and relative executive compensation are consequential to the nature of its portfolio of competitive actions. Building

competitive complexity might be painful initially but it eventually pays off, as long as managers do not go overboard. We hope our study spurs more research on competitive complexity and further investigation at the intersection of governance and competitive dynamics.

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