From a certain point of view: Executive attention to competitors and effects on firm innovation

Sruthi Monica Thatchenkery
University College London
School of Management
s.thatchenkery@ucl.ac.uk

Riitta Katila
Stanford University
Management Science and Engineering
rkatila@stanford.edu

Abstract
This study examines how executives’ attention to competitors influences firm innovation. We argue that the specific competitors that executives attend to can activate threat-based or opportunity-based views of competition. Attention to threats lead to restricted information processing, which is likely to decrease innovation, while attention to opportunities encourages more flexible thinking, which is likely to increase innovation. We test this idea using hand-collected data on a full population of public infrastructure software firms in the U.S. Controlling for direct competitors and using the Microsoft antitrust case to instrument for attention to competitors, we find that firms are more innovative when executives pay attention to more competitors, peripheral competitors, and dissimilar competitors. Our findings suggest that competition is not simply an obstacle that executives must try to overcome or understand. Rather, executives may be able to activate innovation-enhancing modes of thinking by being strategic in which competitors they pay attention to.
Abstract
This study examines how executives’ attention to competitors influences firm innovation. We argue that the specific competitors that executives attend to can activate threat-based or opportunity-based views of competition. Attention to threats lead to restricted information processing, which is likely to decrease innovation, while attention to opportunities encourages more flexible thinking, which is likely to increase innovation. We test this idea using hand-collected data on a full population of public infrastructure software firms in the U.S. Controlling for direct competitors and using the Microsoft antitrust case to instrument for attention to competitors, we find that firms are more innovative when executives pay attention to more competitors, peripheral competitors, and dissimilar competitors. Our findings suggest that competition is not simply an obstacle that executives must try to overcome or understand. Rather, executives may be able to activate innovation-enhancing modes of thinking by being strategic in which competitors they pay attention to.
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Innovation is one of the primary ways in which established firms adapt and change, especially in high-technology industries. Yet innovation is difficult, even for firms with substantial resources (Henderson, 1993). Strategy research has therefore investigated several “levers” that executives can use to increase innovation. For example, research on organizational design finds that ambidextrous orientations balance structure and flexibility in ways that enhance innovation (Taylor & Helfat, 2009; Tushman & O’Reilly, 1996). Research on human capital finds that “star” employees and employees with diverse backgrounds increase innovation (Rothaermel & Hess, 2007; Smith, Collins, & Clark, 2005). Finally, alliance research shows that firms can acquire new knowledge for innovation by creating ties to diverse partners (Ahuja, 2000). However, a major influence on firm innovation that has received less attention as a possible strategic “lever” is attention to competitors. Similar to how executives can strategically shape the firm’s structure, talent, and partnerships, the competitors that executives attend to can also increase the firm’s potential to innovate.

Specifically, the competitors that executives pay attention to may prime them to view competition as a threat or as an opportunity, with implications for innovation. Competition represents a threat because competitors block access to critical resources (Barnett & McKendrick, 2004; Pfeffer & Salancik, 1978). Yet competitors also represent opportunity because they can help guide search and learning (Greve & Taylor, 2000). Accordingly, prior work finds that executives associate the concept of “competition” with both threat and opportunity, with additional context needed for executives to classify competition as one or the other (Jackson & Dutton, 1988). The competitors that executives focus their attention on may provide this context by “priming” executives to interpret competition in a manner consistent with threats or consistent with opportunities. Prior work finds that framing an issue – such as competition – as a threat or an opportunity can then have implications for innovation. When executives believe they are facing a threat, they restrict search breadth and favor familiar, existing solutions (Gilbert, 2005; Staw, Sandelands, & Dutton, 1984). In contrast, when executives believe they are facing an opportunity, they become more flexible and open to novel solutions (Chattopadhyay, Glick, & Huber, 2001). Because innovation depends on the recombination of knowledge in novel ways, the greater flexibility and exploration associated with
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attention to opportunities may in turn foster increased firm innovation.

There are two open issues in our understanding of attention to competitors. First, prior work on
the effects of attention to competitors on performance outcomes has focused on shared beliefs and the
benefits to aligning with how others think about competition (Baum & Lant, 2003; Tsai, Su, & Chen,
2011). Yet we understand less about how managers differ in their attention to competition and how that
affects firm outcomes, such as innovation. Second, prior work has focused on attention to the firm’s
direct competitors (Chen, Su, & Tsai, 2007; Ng, Westgren, & Sonka, 2009; Porac, Thomas, Wilson,
Paton, & Kanfer, 1995). However, firms often face competitive threats from more distant or indirect
sources, such as potential entrants (Porter, 1980) or complementors (Brandenburger & Stuart, 1996). We
therefore do not yet understand how executives attend to more distant competitive threats and what that
means for firm performance. To address these gaps, we ask: How do the competitors that executives pay
attention to influence firm innovation?

We investigate this research question in the context of enterprise infrastructure software.
Infrastructure software is used to manage and maintain IT assets and encompasses a wide range of
functions, such as data backup, code testing, virus protection, and system performance monitoring. We
build a novel dataset on competition and product innovation among 121 public U.S. infrastructure
software firms over an eighteen year period from 1995 to 2012. We analyze the effects of attention to
competitors on new product introductions while controlling for direct competitors and firm fixed effects.
An interaction between the timing of the U.S. v. Microsoft antitrust ruling and membership in a large-,
mid-, or small-cap S&P index allows us to instrument for attention to specific types of competitors. We
supplement the quantitative data with fieldwork to sharpen the theoretical arguments and better interpret
the results.

There are two core insights. First, the competitors that executives pay attention to influence
product innovation, even when controlling for the firm’s direct competitors. For a given level of direct
competition, firms whose executives attend to higher numbers of competitors are more innovative.
Broadening their focus of attention to include more competitors can therefore be another “lever” by which
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executives enhance innovation. Second, we find that paying attention to competitors that are likely to activate opportunity-based views of competition are innovation-enhancing. Specifically, we find that firms introduce more new products when their executives pay attention to higher numbers of competitors, peripheral competitors, and competitors in dissimilar markets. Attending to competitors in this pattern discourages social comparison and increases executives’ feelings of autonomy and capability in dealing with competitor, thereby activating an opportunity-based interpretation of competition that encourages innovation.

THEORETICAL BACKGROUND

Attention to Competitors

The attention-based view conceptualizes strategy as “patterns of attention” that manifest through executives focusing on a “particular set of issues, problems, opportunities, and threats” (Ocasio, 1997: 188). Executives must focus their attention on a particular set of issues because they do not have the cognitive capacity to process every piece of information that might be relevant to their firm (March & Simon, 1958; Ocasio, 1997). Accordingly, empirical work has found that executives vary in their attention to environmental change (Barreto & Patient, 2013; Eggers & Kaplan, 2009), industry participants (Piezunka & Dahlander, 2014; Vuori & Huy, 2016), and strategic priorities (such as efficiency) (Cho & Hambrick, 2006).

Scholars have taken a particular interest in attention to competitors. Because executives do not have the cognitive resources to monitor every possible competitor, they must focus attention on some competitors at the expense of ignoring others (Porac et al., 1995; Reger & Palmer, 1996). Studies across a range of industries find that executives focus their attention on a limited number of competitors - typically on the order of four to seven – regardless of how many competitors exist in the immediate environment (Clark & Montgomery, 1999; Porac et al., 1995)\(^1\). This suggests a distinction between the “potential set”

\(^1\) Prior work has focused on how executives attend to competitors within their industry, i.e. “close competitors.” We create a broader measure of attention to competitors that includes “distant competitors” such as substitutes or possible entrants (Bergen & Peteraf, 2002).
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(or network) of all possible competitors in the environment and the “activated set” of competitors that executives actually bring to mind when making decisions (Smith, Menon, & Thompson, 2012). Thus, even when executives face the same competitive environment, variance in attention to specific competitors may lead to variance in decision-making and performance.

Yet research on the consequences of attention to competitors is still emergent and has focused primarily on shared beliefs among industry participants. Tsai and colleagues (2011) find that airlines gain market share when executives can more accurately predict which competitors other airlines are focusing on. The authors argue that understanding how competitors think makes it easier for executives to respond to and pre-empt competitors. Similarly, it can also be important to understand how customers think about competition. Baum and Lant (2003) survey managers at Manhattan hotels and compare the competitors that capture their attention to the competitors that are likely to have the strongest negative effect on the focal hotel’s survival – i.e. the hotel’s closest competition for customers. They find that hotels have higher survival rates when the set of competitors that managers pay attention to matches the set of competitors that are likely to have the strongest negative effects on hotel survival. Taken together, research on attention to competitors suggests that firms benefit when executives have a more accurate understanding of how other industry participants think about competition.

While these initial results on shared beliefs are intriguing, the specific competitors that executives attend to are also likely to influence the way they interpret competition more broadly, with implications for firm outcomes. In particular, research on threats and opportunities suggest that the manner in which executives interpret competition may affect firm innovation. Empirical research finds that opportunities and threats activate different modes of information-processing at the firm (Chattopadhyay et al., 2001). Executives tend to react to threats with increased rigidity and narrowed search, which is likely to decrease innovation, while they react to opportunities with greater flexibility and exploration, which is likely to increase innovation.

Paying attention to competitors as threats is likely to be innovation-decreasing. Empirical results suggest that executives respond to “threats” by restricting information-processing, narrowing search, and
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focusing on familiar solutions (Chattopadhyay et al., 2001; Gilbert, 2005; Staw et al., 1984). For example, Gilbert (2005) finds that executives at print newspapers responded differently to the rise of online publishing based on whether they interpreted it as a threat or opportunity. Specifically, executives who focused on online publishing as a threat engaged in less experimentation and focused on preserving existing products rather than exploring new options presented by online technologies (Gilbert, 2005). Voss and colleagues (2008) find that resource-constrained theatres engage in less product exploration (e.g. the development of new plays) when facing environmental threat. Thus, if competition is interpreted primarily as a threat, executives may be more rigid and focus on a limited number of familiar solutions, which is likely to reduce firm innovation.

In contrast, paying attention to competitors as opportunities is likely to be innovation-enhancing. Empirical work finds that executives respond to “opportunities” with expanded information processing and the exploration of novel solutions (Sharma, 2000; Thomas, Clark, & Gioia, 1993). Sharma (1993) finds that executives in oil and gas firms are more likely to explore the use of new technologies to respond to environmental regulation when environmental issues are interpreted as opportunities. Similarly, Thomas and colleagues (1993) find that hospital executives are more likely to add new product-service offerings when they interpret changes in the environment as opportunities rather than threats. Thus, paying attention to competition as an opportunity may then foster innovation by encouraging greater exploration of new ideas and the use of competitors as sources of knowledge.

Overall, prior work suggests that interpreting competition as an opportunity may have a positive effect on innovation by encouraging exploration and openness to new ideas while threat-based interpretations lead to increased rigidity and consideration of fewer alternatives.

**Competition as a Threat versus Opportunity**

Jackson and Dutton (1988) find that executives associate the concept of “direct competition” with both threats and opportunities rather than exclusively one or the other. In the same vein, strategy scholars have also framed competition as both a threat and opportunity for firms. Threat-based views of competition emphasize resource scarcity and constraint, in which competitors pursue the same finite pool of resources
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as the focal firm. Using a threat-based logic, the acquisition of a resource by a competitor often prevents the focal firm from using that same resource (Pfeffer & Salancik, 1978; Thompson, 1967). As a result, competitors can block the focal firm’s access to the resources needed to grow and innovate, thereby constraining the focal firm’s activities. Over time, as firms race to find more favorable positions to acquire resources, advantages that accrue to competitors often come at the expense of the focal firm – in other words, a competitor’s “solution” becomes the focal firm’s “problem” (Barnett, 2008; D’Aveni, 1994). Accordingly, a wide range of empirical work demonstrates that competition has a negative effect on firm survival (e.g. Barnett & McKendrick, 2004) and financial performance (e.g. Chen & MacMillan, 1992). Thus, because competitors can block the focal firm’s access to valuable resources, executives may primarily attend to competition as a threat to the focal firm.

Opportunity-based views of competition emphasize learning, in which competitors often serve as key reference points for the focal firm. Competitors serve as sources of new knowledge or signals of new search opportunities for the focal firm (Greve & Taylor, 2000; Srinivasan, Haunschild, & Grewal, 2007). For example, Srinivasan and colleagues (2007) find that digital camera firms develop more new products after competitors introduce “high technology frontier” (HTF) cameras that represent significant technical advances. These HTF products demonstrate the feasibility of new technological possibilities which executive can then choose to pursue. Similarly, Greve and Taylor (2000) show that competitor innovations prompts radio stations to introduce nonmimetic (i.e. differentiated) innovative responses. Simulation studies also highlight the benefits of competition. For example, Csaszar and Siggelkow (2010) show that observing competitors can “dislodge” a firm from current practices and direct it to explore new strategies. Thus, because competitors can serve as useful reference points, executives may primarily attend to competition as an opportunity for learning.

Prior work on attention to threats and opportunities has identified two primary mechanisms that may lead executives to attend to competition as one over the other. First, executives may be more likely to attend to competition as a threat when it is easy to engage in social comparison between the focal firm and a particular competitor. Social comparison theory suggests that individuals or organizations may
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evaluate their own performance by comparing it to the performance of others (Festinger, 1954). The
easier or more “valid” a comparison to another firm, the more likely that firm’s success relative to the
focal firm might be seen as coming at the focal firm’s expense (Festinger, 1954; Garcia, Tor, & Schiff,
2013). For example, Garcia and Tor (2009) find that individuals report more intense feelings of
competitiveness when facing a lower number of potential competitors because limiting the pool of potential
competitors makes it easier for the individual to directly compare themselves to each competitor.
Increased social comparison between the focal firm and competitors may therefore increase the likelihood
that those competitors are primarily attended to as threats rather than as opportunities.

Second, executives may be more likely to attend to competition as a threat when they feel they
have little control over their interaction with competitors. Dutton and Jackson (1988) find that managers
are more likely to interpret a strategic issue as a threat rather than an opportunity when they feel they have
little autonomy in deciding whether and how to respond to that issue. Similarly, Chattopadhyay and
colleagues (2001) find that executives are likely to engage in threat-consistent behavior when facing the
possibility of reduced autonomy in decision-making. Finally, Barreto and Patient (2013) find that
executives in an energy company were more likely to view deregulation as a threat when they were
uncertain of the firm’s capability to deal with deregulation. Overall then, prior work suggests that
managers may be more likely to view competition as a threat when they believe they have little choice in
whether to engage with competitors and when they frequently compare their firm to competitors. In
contrast, executives may view competition as an opportunity when they believe they have some autonomy
in whether to respond to competitors and when they avoid social comparison to competitors.

The extent to which executives engage in social comparison or believe they have control over
their interaction with competitors is likely to depend on exactly which competitors they pay attention to.
Research in cognition finds that concepts or ideas that remain in the focus of executives’ attention can
serve as “primes” that influence their subsequent thinking and behavior (Higgins, 1996; Smith et al.,
2012). Because executives focus their attention on a select set of competitors, those specific competitors
may function as primes that keep certain attributes of competition at the forefront of executives’ minds.
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Different competitors are likely to elicit different levels of social comparison as well as different beliefs about autonomy and capability. Consequently, the set of competitors that executives attend to may activate different modes of thinking about competition and prompt executives to primarily attend to competition as a threats or as an opportunity.

HYPOTHESES

Number of Competitors

We propose three hypotheses organized around typical patterns of attention to competitors.

The first hypothesis examines the effects of paying attention to higher numbers of competitors. We expect that paying attention to a higher number of competitors will activate an opportunity- rather than threat-based view of competition that enhance innovation, for two reasons.

First, paying attention to more competitors discourages threat-based framing by making it more difficult to engage in one-to-one social comparison to each competitor. When paying attention to a limited number of competitors, executives may find it easy to carry out in-depth comparisons between their own firm and each competitor. These social comparisons intensify feelings of competitiveness and perceived threat posed by competitors (Festinger, 1954). In contrast, when faced with higher numbers of competitors, it becomes much more difficult to meaningfully compare the focal firm to every single competitor (Garcia & Tor, 2009). The volume of information required to compare the focal firm to every competitor increases and each one-to-one comparison becomes less informative. As a result of this reduced tendency towards social comparison, the negative competitive feelings harbored toward competitors may become weaker, discouraging a threat-based view of competition. Thus, identifying more competitors may push executives away from a threat-based interpretation of competition by making one-to-one social comparisons against competitors more difficult and less meaningful.

Second, when executives pay attention to more competitors, they may feel like they have more autonomy in deciding when to respond to competitors. Paying attention to higher number of competitors effectively “diffuses” executives’ attention and makes each individual competitor relatively less important (Blettner, He, Hu, & Bettis, 2015; Ocasio, 1997). The “strategic importance” assigned to a competitor
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determines whether executives will think it is critical to respond to actions taken by that competitor (Marcel, Barr, & Duhaime, 2010). The reduced importance assigned to each individual competitor in a larger overall set of competitors may therefore reduce the likelihood that executives would see any one competitor’s actions as absolutely necessitating a response. If executives do not feel obligated to respond to specific competitors, they are likely to feel like they have more autonomy over the way they respond to competition, which discourages a threat-based framing.

Overall, we expect that attending to higher numbers of competitors discourages social comparison and increases perceived autonomy when deciding how to respond to competitors, thereby discouraging threat-based interpretations of competition in favor of an opportunity-based framing. Framing competition as an opportunity rather than threat encourages more open and flexible thinking that facilitates innovation. We hypothesize:

H1: Firms are more innovative when executives pay attention to higher numbers of competitors.

Peripheral Competitors

The second hypothesis examines the effects of attending to peripheral competitors. We expect that paying attention to peripheral competitors will activate an opportunity-based view of competition that increases innovation, for three reasons.

First, the relative lack of information available about peripheral competitors makes it harder to engage in social comparison. Prominent competitors, such as large firms, market leaders, or high status firms, tend to garner high levels of attention from customers, analysts, and other external audiences (Chen & Hambrick, 1995; Pollock, Rindova, & Maggitti, 2008). As such, there is often a great deal of information about prominent competitors, their actions, and their resources available for executives to use as the basis for social comparison. In contrast, peripheral competitors garner less attention from external audiences and are consequently less likely to have as much information about them available (Chen & Hambrick, 1995; Yoffie & Kwak, 2003). Reduced information availability is likely to make it more difficult for executives to carry out detailed social comparisons between their own firm and peripheral competitors and thereby reduce feelings of perceived competitive threat. Thus, attending to peripheral
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rather than prominent competitors may activate opportunity- rather than threat-based interpretations of competition by giving executives less information to fuel social comparisons.

Second, executives may feel less obligated to respond to peripheral rather than prominent competitors, increasing their perceived autonomy in dealing with competition. Because they are more likely to garner attention from customers and other external stakeholders, prominent firms often set benchmarks or baseline expectations in product features and performance (Posen, Lee, & Yi, 2013). Executives who identify prominent firms as competitors may therefore feel obligated to respond to or otherwise keep pace with the offerings of prominent firms so as to not “fall behind” in their customers’ eyes (Más-Ruiz, Nicolau-Gonzálbez, & Ruiz-Moreno, 2005). This perceived obligation to respond to prominent competitors is likely to reduce the level of autonomy executives have in choosing how to deal with competition. In contrast, peripheral competitors are unlikely to be widely known by customers and other stakeholders and so are less likely to create expectations that the focal firm must match. Reduced pressure to keep pace with peripheral competitors would likely increase executives’ autonomy in choosing when and how to interact with those competitors. Increased autonomy in responding to competitors may push executives from framing competitors as threats to instead framing them as opportunities. Thus, attending to peripheral competitors may encourage more flexible, opportunity-based views of competition relative to identifying prominent competitors.

Overall, we propose that paying attention to peripheral competitors activates an opportunity-based rather than threat-based view of competition. Executives will have less information available for social comparison and will be less likely to feel obligated to respond to peripheral competitors. Attending to competition as an opportunity rather than threat may in turn foster innovation by encouraging exploration of novel ideas and more flexible information processing. We hypothesize:

H2: Firms will be more innovative when executives pay attention to peripheral competitors.

Dissimilar Competitors

The third hypothesis examines the effects of identifying dissimilar competitors. We examine dissimilarity in market terms, in which dissimilar markets serve different customer needs or use different underlying
technologies (Porter, 1980). We expect that paying attention to peripheral competitors will activate an opportunity-based view of competition that increases innovation, for two reasons.

First, differences in technology or customer needs make dissimilar competitors less viable targets for social comparison. Meaningful social comparison often targets “similar others” because their performance can be compared to that of the focal actor by a common standard (Festinger, 1954: 121). The dimensions of similarity that matter are often those viewed as relevant to performance in the eyes of the focal actor (Feldman & Ruble, 1981). By using the same technology and serving the same customer needs, similar competitors offer a potent baseline for social comparison, increasing the likelihood that executives at the focal firm will view competition as a threat. In contrast, firms that use different technologies and serve different customer will face differing environmental influences on firm performance. In order to compare their own firm’s performance to that of a dissimilar competitor, executives will first need to disentangle the effects of serving different markets. It is therefore more difficult for executives to engage in meaningful social comparison to dissimilar competitors, increasing the likelihood that they interpret competition as an opportunity. Thus, attending to dissimilar competitors makes it more difficult to evaluate the focal firm and dissimilar competitors by an identical standard during social comparison, thus activating an opportunity-based rather than threat-based interpretation of competition.

Second, executives may feel less obligated to respond to dissimilar competitors because they do not compete in the focal firm’s immediate markets. Competitors that serve the same customer needs with the same technology are likely to be the focal firm’s most potent competition for customers and resources (Pfeffer & Salancik, 1978; Porter, 1980). Furthermore, competition against other firms in the same market may be viewed as zero-sum, in which a similar competitor’s gains necessarily come at the focal firm’s loss (Lavie, Stettner, & Tushman, 2010). Executives may therefore feel more pressure to keep pace with and respond to the actions of similar competitors, increasing the likelihood that they interpret competition as a threat. In contrast, dissimilar competitors are likely to pursue differentiated customers or resources, which reduces direct or zero-sum competition between dissimilar competitors and the focal firm.
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Dissimilarity may thus function as a “buffer” that gives executives greater autonomy in choosing whether and how to respond to dissimilar competitors, which encourages executives to interpret competition as an opportunity. Thus, the lack of direct competition for resources between dissimilar competitors and the focal firm gives executives more flexibility in responding to dissimilar competitors, thereby activating an opportunity-based rather than threat-based interpretation of competition.

Overall, we propose that paying attention to dissimilar competitors activates an opportunity-based rather than threat-based interpretation of competition. There will be less of a common basis for social comparison and the lack of direct competition may give executives greater discretion over how to interact with dissimilar competitors. Viewing competition as an opportunity rather than threat may in turn foster innovation by making executives more open to distant rather than familiar ideas. We hypothesize:

H3: Firms will be more innovative when executives pay attention to dissimilar competitors.

METHODS

Empirical setting

We test our hypotheses on 121 public U.S. firms in the enterprise infrastructure software industry from 1995 to 2012. Infrastructure software is used to manage and maintain complex IT systems, encompassing a wide range of functions such as data backup, code testing, virus protection, and system performance.

We begin our sample time period in 1995 to coincide with the transition from centralized computing to networked (aka “distributed”) computing, which marked a fundamental shift in the technical architecture of enterprise IT and created the need for more sophisticated infrastructure tools. We end the sample around another major technological shift, i.e. the advent of cloud computing in 2012. The core strength of our data is its comprehensive coverage of the entire population of public U.S. firms that developed infrastructure software during the sample timeframe. Firms are classified into five markets: application development, integration and middleware, database management, network and system management, and security. Examples of firms in our data include Forte Software (application development), Computer Associates (network and system management), and Symantec (security).

Infrastructure software is an ideal context in which to analyze the effects of competitors on
product innovation, for two reasons. First, product innovation is a high strategic priority for executives in infrastructure software. Financial performance and survival for software firms depends on continued innovation through new product introductions (Ndofor, Vanevenhoven, & Barker, 2013). The importance of constantly developing new products is further heightened for public firms such as those in our sample. One infrastructure software executive notes: “If you’re a public company you need to keep growing and the way to do that is to…create new products.” Indeed, during analyst calls and in letters to shareholders, executives consistently highlight advances in product functionality and share plans for future development. Thus, in infrastructure software, product innovation is of critical strategic importance.

Second, competitors’ products are highly influential in the product development process at infrastructure software firms, due to traditionally low rates of formal intellectual property protection and audience expectations to “keep up” with competitors. Software firms engage in low rates of patenting and software patents tend to be difficult to enforce (Hunt & Bessen, 2004). As a result, executives at infrastructure software firms are very explicit about using competitor products to guide their own product development through a process they call “benchmarking.” A security software executive described benchmarking as “a ground-to-build product-by-product comparison” used to “continuously challenge our [product team] leads.” In addition, keeping up with competitor products is central to meeting the expectations of external stakeholders. One executive noted that after his firm went public and became subject to greater external scrutiny, there was “…lots of pressure to define products more broadly and add features that other companies had.” Competitor products are therefore one of the central drivers of product innovation in infrastructure software. Overall, then, infrastructure software is an appropriate empirical setting to study competitor identification and product innovation because 1) product innovation is a high strategic priority for executives and 2) executives incorporate competitors’ products into their own product search.

Sample construction

We triangulated between multiple sources to create a comprehensive sample of public infrastructure software firms. Infrastructure software is classified into five core markets: application development,
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integration and middleware, database management, network and system management, and security.

Consistent with prior studies of the U.S. software industry, we first identified all public firms with either a primary or secondary\(^2\) classification under SIC code 7372 “prepackaged software” (Lavie, Kang, & Rosenkopf, 2010; Ndofor et al., 2013). Between 1995 and 2012, there were 1,206 such firms. These firms developed software that was intended to be sold to a broad audience rather than custom-developed for a specific client. However, because SIC codes for software firms do not distinguish among markets served, consumer, educational, and enterprise software are all classified together. We therefore used Gartner Research’s IT Glossary, which defines common enterprise software terminology, to develop a list of keywords to identify infrastructure software firms. We noted all terms associated with the five core infrastructure software markets. Examples include “authentication” (security) and “fault monitoring” (network and system management. For each firm in our sampling frame, we compared business and product descriptions from archival sources (such as press releases and cached websites) to the list of keywords in order to identify firms that developed infrastructure software. We cross-checked the resulting list of infrastructure software firms against those found in market research on infrastructure software and The Software Catalog (an annual listing of software products) and did not find any public firms missing from our sample. Some of the smallest (revenues less than $10 million) firms in our sample did not appear in market research or product catalogs but were still confirmed as infrastructure software firms through analyst reports. Our final sample consists of 121 firms and 821 firm-year observations and covers the full population of public U.S. infrastructure software firms from 1995-2012.

To supplement the quantitative data, we interviewed former and current executives, board members, and investors in infrastructure software, including CEOs. These interviews informed our data collection and measures and helped interpret the results. We conducted ten senior executive interviews covering 12 infrastructure software firms.

Data sources

\(^2\) The most common primary classifications for infrastructure software firms with 7372 as a secondary classification were 7371 (programming services), 7373 (integrated computer systems), and 3577 (other computer peripherals).
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We used several data sources. We collected data on product innovation using company press releases. Press releases are often used as a source for product data and are appropriate for this study because they are the most common way in which enterprise software firms announce new products (Li, Maggitti, Smith, Tesluk, & Katila, 2013; Pontikes, 2012). For each firm, we searched for relevant press using broad keywords (e.g. “launch,” “announce,” “new product,” “upgrade,” “version”). Pairs of coders then examined the press releases to identify product announcements, with very high inter-rater reliability (Cohen’s $\kappa= .92$). We excluded any product releases outside infrastructure software (e.g. enterprise applications). Content analysis of over 118,000 press releases yielded data on 8,502 unique infrastructure software products. We recorded each product’s launch date, name, version number, and a brief description.

We gathered data on attention to competitors from 10-Ks, which are reports that all public U.S. firms must file with the Securities and Exchange Commission (SEC) annually. 10-Ks are used to update shareholders on the company’s strategy, structure, and performance. Prior work has used investor relations documents to create attention-based measures for executives in public firms (e.g. Nadkarni & Barr, 2008). We examined the mandatory competition section of the 10-Ks, in which infrastructure software firms describe their competitive environment and list the competitors they view as most relevant. Lists of competitors in software firms’ 10-Ks are typically sourced from “competitive intelligence” units that work with top executives to analyze competition. Competitive intelligence units identify and monitor the firm’s competition and work with product executives to set competitive benchmarks and shape product development strategy. Competitive intelligence units also receive feedback from the CEO and other senior executives that ensures that they are in line with the perceptions and the intended strategic direction of the executive team. Thus, within infrastructure software, the competitors identified by the competitive intelligence group are likely to match those listed in 10-Ks and are influential in shaping product development.

We further investigated the validity of using the listed competitors in our sample firms’ 10-Ks as a measure of attention to competitors by interviewing current and former executives in infrastructure
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software, including ten CEO or senior executives covering twelve firms in our sample. During interviews with executives in our sample, we asked them to rate a list of competitors listed in their 10-Ks on a scale of 1 (not a competitor) to 10 (intense competitor) and also asked if there were any major competitors we did not mention. Our results indicated that executives viewed the competitors listed in 10-Ks as competitive threats and that no major competitors were missing from the 10-Ks. Thus, our interviews further support our sample firms’ 10-Ks as a valid data source for attention to competitors.

Finally, we collected data on firm and competitor financial indicators from COMPUSTAT, Thomson ONE, CapitalIQ, and LexisNexis. Our sample firms are all public, making financial information readily accessible from the listed sources. We also focused on public competitors to ensure a baseline level of visibility, so that variation in competitor identification reflects differing beliefs about which particular competitors are most relevant (Chen et al., 2007). Focusing on public competitors also ensures more accurate data collection on asymmetry and competitor attributes. As a robustness check, we calculate an alternative measure for the number of competitors using all listed competitors (public and private). Correlation between the measures based on all competitors versus only public competitors is high ($\rho=0.88$) and original results are consistently supported.

**Measures**

**Dependent variable.** We measured product innovation as the number of new infrastructure software products introduced by the focal firm in a year. We specifically examine the number of brand-new products (e.g. Version 1.0) introduced by the firm. This is an appropriate measure of product innovation for two reasons. First, counts of new products are a direct measure of innovation that has been widely used in prior studies (Li et al., 2013; Srinivasan et al., 2007). Second, the frequency of new product introductions is closely associated with software firm profitability and survival (Ndofor et al., 2013). As a robustness check, we also run models predicting the number of new product versions (e.g. Version 2.0, 2.5), with consistent results.

**Independent variables.** We used the lists of competitors in each firm’s 10-K to create yearly measures of attention to competitors. We measured number of competitors as a count of public
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competitors listed in the 10-K. We noted the specific business unit or product line associated with a competitor if the firm included that information (e.g. “Product X competes with offerings from Competitors A, B, and C”). If a firm offered products or services outside infrastructure software (such as enterprise applications or software consulting), we only included competitors that were listed in the section on infrastructure software.

We measured peripheral competitors as a count of competitors listed in the focal firm’s 10-K that had two or fewer inward ties. We first created a network in which each node represented a sample firm or a competitor and directed ties between nodes indicate that the ego (i.e. focal firm) viewed the alter as a competitor. Each inward tie thus represents a sample firm that paid attention to competitor j in year t. Competitor j is peripheral when it is only identified by the focal firm (one inward tie) or only attended to by the focal firm and one other sample firm (two inward ties). Competitors that are not attended to by more than one other firm can be considered “peripheral” because they are not attracting attention from the vast majority of firms in the industry. As a robustness check, we also tested measures that allowed for no inward ties other than the focal firm, or that allowed for two inward ties other than the focal firm. Results are broadly similar. We also tested an alternative measure in which peripherality is operationalized through firm size, such that small and mid-size competitors are “peripheral.” Results for this alternative size-based measure as also consistent.

We measured dissimilar competitors as a count of competitors listed in the firm’s 10-K that either a) developed infrastructure software but did not compete in any of the firm’s markets or b) developed platforms, i.e. enterprise server operating systems (“enterprise servers”). Platforms and software in other infrastructure markets serve distinct customer needs from the products of the focal firm and consequently differ substantially in terms of product features and functionality. Thus, there is a meaningful level of dissimilarity between the focal firm and firms in complementary markets.

Controls. We included several controls. Because prior work has demonstrated a relationship between numbers of direct competitors and firm innovation, we control for number of direct competitors, measured as the number of public firms that develop products in any of the focal firm’s markets. This
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measure, which defines competitors based on market overlap, matches the conventional operationalization of direct competitors as firms that serve the same customers with the same technology (Porter, 1980; Scherer & Ross, 1990). Competitors that overlap with the firm in more than one market were only counted once.

Because prior work suggests that firm size affects innovation (Cohen & Klepper, 1996), we controlled for firm size, measured as the firm’s annual revenues. We adjusted for inflation using the Computer Products Producer Price Index and logged the measure to correct for skew. As a robustness check, we also tested number of employees as an alternate measure of size, with consistent results.

Because firms that invest more resources in innovation may have higher innovation performance (Li et al., 2013), we controlled for R&D intensity, measured as R&D expenditures divided by revenue in year t. As a robustness check, we also tested a logged measure of R&D expenditures (inflation-adjusted), with consistent results.

Because going public may reduce innovation by shifting the firm’s focus to short-term rather than long-term performance (Aggarwal & Hsu, 2014; Bernstein, 2015), we controlled for the firm’s tenure as a public firm (years public), measured as the number of years since the firm’s IPO. Because we expect that firms that develop products in multiple markets will introduce more new products overall, we controlled for the number of markets (among the five major infrastructure software markets) in which the firm introduced at least one product in year t.

Because markets may differ in innovation performance, we controlled for baseline (i.e. time-invariant) differences in innovation across markets with fixed effects for each of the five markets major infrastructure software markets: application development, integration and middleware, database management, security, and network and system management. Each market fixed effect is measured as a binary variable set to one if the firm had at least one active product line in that market in year t and zero otherwise.

Because there may also be yearly fluctuations in the firm’s markets that affect firm innovation (Kaul, 2012), we controlled for the innovation intensity of each of the firm’s markets (market innovation
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activity), calculated as: $A_t = \sum_{i=1}^{5} (n_{it} m_{it})$ where $i = \{1,2,3,4,5\}$ indicates each of the five major infrastructure software markets, $n_i$ is the number of products introduced by all firms in market $i$, and $m_i$ is a binary variable set to one if the focal firm had at least one active product line in market $i$ in year $t$.

Because knowledge spillovers from co-located firms can increase innovation (Almeida & Kogut, 1997), we controlled for geographic fixed effects. Specifically, we included fixed effects for firms headquartered in California, Texas, and Massachusetts, which were the three most common states in our data. Finally, because macroeconomic variation may affect innovation, we controlled for year effects.

**Statistical Method**

Because our dependent variable is a count of new products and exhibits possible over-dispersion (i.e. its variance is much greater than its mean), we ran negative binomial regressions. As a robustness check, we also ran Poisson regressions, with consistent results. We selected a fixed effects model to control for time-invariant unobserved heterogeneity and lagged all independent variables and controls by one year to facilitate causal inference.

While we controlled for as many relevant factors as possible, there may be unobservable variables, such as firm quality, that also affect innovation. Correlation between our measures of competitor identification and these unobserved variables would bias our results. We addressed this bias with 1) firm fixed effects and 2) instrumental variables.

**Firm fixed effects.** We controlled for unobserved time-invariant firm heterogeneity with firm fixed effects. Fixed effects account for any constant (i.e. time-invariant) firm-level influences on our outcome variable that are not captured by other variables in the analysis. Firm fixed effects can therefore be thought of as a control for baseline differences in quality. We included firm fixed effects in all reported analyses and in all robustness checks.

**Instrumental variables.** We ran two-stage instrumental variables analyses for the hypothesis on the effects of the number of competitors (H1). The first stage uses exogenous instruments to predict the endogenous explanatory variable i.e. the number of competitors. The second stage tests effects of those predicted values on the dependent variable i.e. innovation. We used a Generalized Method of Moments
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(GMM) estimator and the same controls found in the main analysis, including firm fixed effects.

Our instrument is an interaction between a major regulatory event and firm visibility. The regulatory event is the landmark United States v. Microsoft Corp antitrust case, in which Microsoft was found to have obstructed competition in software. U.S. v. Microsoft was the first major regulatory action taken against a software firm, which led to concern over future enforcement (Liebeler, 2002). In particular, several of the “anticompetitive” practices employed by Microsoft, such as bundling, were common practice in software.

The Microsoft antitrust case likely sparked an increase in numbers of competitors software firms pay attention to. To avoid antitrust scrutiny, software markets needed to appear more competitive. As a very simplified rule of thumb, markets populated by more firms – particularly smaller firms - appear more competitive (Scherer & Ross, 1990). Given limited control over their firm’s direct competition, software firm executives appeared to increase the number and types of competitors they attended to in order to make their markets appear more populated. At the same time, there was no evidence of a systematic effect of the antitrust case on software firm innovation (Pitofsky, 2001). The Microsoft antitrust case can therefore function as an exogenous shock that affected attention to competitors but not innovation.

However, the effects of the Microsoft case were not equal among all software firms; rather, more visible firms were likely to feel more vulnerable to increased antitrust enforcement. We measured visibility with membership in one of the three major Standard & Poors stock indices: the S&P LargeCap 500, S&P MidCap 400, or the S&P SmallCap 600. S&P index membership is unlikely to affect innovation performance because inclusion is not based on expectations of strong future performance, but rather the extent to which a stock contributes to a balanced representation of the overall economy (Standard & Poor’s, 2013).

Because we expect S&P index membership (i.e. visibility) to affect attention to competitors only

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3 Inclusion in an S&P index draws increased attention from investors and other stakeholders (Aghion, Van Reenen, & Zingales, 2009). Greater attention to a firm’s stock draws greater attention to the firm itself, increasing visibility.
4 Given this emphasis on representativeness, prior work has used S&P index membership as an instrumental variable for innovation outcomes (Aghion et al., 2009; Clay, 2002).
after the Microsoft antitrust ruling, we instrumented for our explanatory variables (number of competitors, peripheral competitors, and dissimilar competitors) with an interaction between the timing of the initial Microsoft ruling in June 2000 and S&P index membership. We measured Post-US v Microsoft as a binary variable set to 1 if the year is after 2000. We measured S&P Index Membership as a binary variable set to 1 if the firm is a member of the S&P 500, 400, or 600. The interaction which serves as the instrument is Post-US v Microsoft x S&P Index Membership, which takes a value of 1 only when the year is after 2000 and the firm is a member of an S&P index.

RESULTS
Table 1 reports descriptive statistics and correlations. The average firm develops products in one or two markets and releases two to three new products per year. Firm size ranges from under $100,000 to $6.9 billion in annual revenues (not adjusted for inflation). 45% of the sample firms are headquartered in California. Among explanatory variables that are included in regression models simultaneously, correlations are mostly low. The exceptions are high correlations between variables that depend heavily on the number of markets the firm develops products for (i.e. number of markets, number of direct competitors, and market innovation activity). Each correlated variable is tested without the others in partial models with results that are consistent with the reported models.

Descriptive analysis
To better understand the phenomenon of interest, we conducted a descriptive analysis to explore the differences between the direct competitors typically examined in strategy research and the competitors that executives actually pay attention to. First, we examined the number of competitors. The average firm in our sample has roughly 36 direct competitors but pays attention to 6 competitors. Our data is thus highly consistent with prior work that shows that executives pay attention to a limited number of competitors, and specifically about six to seven competitors on average (Clark & Montgomery, 1999).

Our data indicates that executives did not limit their attention to only direct competitors, but also included more distant competitors. Out of the six competitors executives attend to on average, only three are direct competitors. The other three competitors are found outside the
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firm’s immediate markets and include platform owners, application software, hardware, and other infrastructure software markets (see Table 2). Firms were more likely to view hardware and application software firms as competitive threats rather than other infrastructure software firms, despite the fact that infrastructure software firms use the same technology (compared to hardware firms) and serve markets with closely related customer needs (compared to application software).

Intriguingly, executives also paid attention to threats to partner firms. BEA Systems, an application integration firm, named Microsoft as a competitor because it posed a threat to Java development environments. As stated in its 2003 10-K:

“[Microsoft’s .NET initiative] competes with the Java-based environment of our products. A widespread acceptance of Microsoft’s .NET initiative…could curtail the use of Java and therefore adversely impact the sales of our products.”

Executives therefore do not only narrow attention to a select group of direct competitors in the immediate environment but can also more broadly pay attention to potential competitors.

**Regression analysis**

**Instrumental variables analysis.** To help control for time-varying heterogeneity, we ran a two-stage instrumental variables analysis to test the effects of attention to competitors on innovation. Table 3 shows first and second stage results for all three hypotheses. Models 1-3 report results from a first-stage OLS regression. We instrumented for the number of competitors, peripheral competitors, and dissimilar competitors with an interaction between the timing of the Microsoft ruling and S&P index membership. As expected, the coefficient on the interaction term is positive and significant for number of competitors and peripheral competitors. The Microsoft case thus led to a broadening of attention to competitors for the visible firms that were more likely to be targets for regulators. However, our instrument does not significantly predict attention to dissimilar competitors, and thus second stage results for hypothesis 3 must be interpreted with caution. We also run fixed effects panel regressions with the observed values of our explanatory variables to mitigate the concern that a weak instrument could bias our results, particularly for hypothesis 3.
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Models 4-6 report second stage results predicting the number of new product introductions (see Nichols, 2008 for a discussion of instrumental regression with count models). Because we only have one instrument, we cannot include all three endogenous variables in our instrumental variables analysis simultaneously, and so report models with each variable entered separately. Results for control variables are in line with expectations. Firm R&D intensity and number of markets served increase product innovation, while firms that have been public for more years introduce fewer new products.

Model 4 adds instrumented values for number of competitors. Hypothesis 1 predicted that, controlling for the number of direct competitors, attention to more competitors increases innovation. The coefficient on the number of competitors is positive and significant supporting hypothesis 1.

Model 5 adds instrumented values for peripheral competitors. Hypothesis 2 predicted that attention to peripheral competitors increases innovation. The coefficient on peripheral competitors is positive and significant, supporting hypothesis 2.

Model 6 adds instrumented values for dissimilar competitors. Hypothesis 3 predicted that attention to dissimilar competitors increases innovation. The coefficient on dissimilar competitors is positive and significant. However, it should be noted that the first stage results for dissimilar competitors were not significant, indicating that our instrument is weak. Hypothesis 3 is therefore tentatively supported but requires further testing.

Models 7-9 report second stage results using Poisson rather than negative binomial regressions. Results mirror those from the negative binomial models, with positive and significant coefficients on all three explanatory variables. Overall, we find strong support for hypothesis 1 and 2 and tentative support for hypothesis 3.

**Sensitivity analyses.** Because our instrument only weakly predicted attention to dissimilar competitors (hypothesis 3), we also run fixed effects panel negative binomial regressions in which we use the observed values of our three hypothesized variables to predict new product introductions. Our fixed effects panel regressions do still partially address bias from unobserved heterogeneity by including firm fixed effects. Using the observed values of dissimilar competitors retains the positive and significant
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effect found in the instrumental variables analysis. Combined, our instrumental variables analysis and fixed effects panel regressions support hypothesis 3. We also find support for hypotheses 1 and 2 using observed rather than instrumented values (results available from authors).

We also test alternate versions of our dependent variable. First, we test a measure of new product versions, which counts the number of new software generations (e.g. Version 2.0) or upgrades (e.g. Version 2.5) released by the firm. Results are consistent with our main results for new product introductions for number of competitors and peripheral competitors, but the coefficient on dissimilar competitors is not significant when predicting new product versions. Research on product portfolios suggests that firms may enter new product niches in order to flood the market and reduce opportunities for new entrants (Giachetti & Dagnino, 2014). Given that dissimilar perceived competitors are not currently competing in the firm’s markets, the emphasis on new product introductions may indicate that firms are specifically responding to perceived entry threats. Second, we test of combined measure of new product introductions and versions. Results are consistent with our main results using only new product introductions. Overall, our results are robust to multiple measures of product innovation.

Because the effects of direct competitors on firm innovation can vary based on size, we created alternate controls that subset direct competitors based on relative size. Firms that are similar in size may exert stronger competitive pressures on each other (Mas-Ruiz, Ruiz-Moreno, & Ladron De Guevara Martinez, 2014). We measured number of similarly-sized direct competitors as the number of direct competitors with annual revenues in the same quartile as the focal firm. In addition, large firms exert intense competitive pressure on small and mid-size firms (Barnett & McKendrick, 2004; Mas-Ruiz et al., 2014). We measured number of large direct competitors as the number of direct competitors with annual revenues over $1 billion. The control for large direct competitors can also function as a control for the “expected” number of asymmetric competitors, because large firms are the most common targets of asymmetric competition (Porac et al., 1995). Results using the alternate controls are consistent with the results reported in our main analysis. Results are also robust to other revenue-based thresholds for similarity and large firms (e.g. deciles, quintiles, manual cutoffs).
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We tested an alternative measure for peripheral competitors, based on competitor size. We measured small and mid-size competitors as the proportion of competitors listed in the firm’s 10-K with annual revenues less than $1 billion, based on financial data gathered from Compustat. This captures the proportion of competitors that are not prominent (and therefore are peripheral). We operationalized peripheral competitors using revenue because firms, customers, and analysts generally consider software firms with revenues in excess of $1 billion to be prominent and use those firms as exemplars for the industry as a whole. As a further robustness check, we test other cutoffs informed by the sample’s revenue distribution: the top 5% ($2.2 billion), exact top 10% ($1.3 billion), and top 25% ($485 million). Results are broadly consistent with our main analysis, as we find that paying attention to higher proportions of small and mid-size competitors increases product introductions.

We checked the robustness of our market designations by running alternate analyses with markets defined at higher or lower levels of aggregation. For example, “application development” and “integration and middleware” can be combined into a single “application development and integration” market. Results do not substantively vary at different levels of aggregation and we reported results using categories commonly referenced by industry analysts within our sample timeframe. Because these broad market categories reflect substantial differences in product functionality, their use constituted a conservative test of how the competitors that managers pay attention to can differ from direct competitors.

We tested the robustness of our results to dropping years prior to firm entry into new markets. Paying attention to competitors in other markets could simply indicate that the firm plans to soon enter those markets. We re-ran our results excluding one year or two years prior to the release of a product in a new market. Results are broadly consistent, indicating that the observed effects are not simply driven by attention to future competitors in markets the firm plans to enter.

DISCUSSION

In this paper, we built on research in managerial cognition to examine how attention to competitors influences product innovation. An analysis of competition and innovation among 121 infrastructure software firms from 1995 to 2012 yielded two key findings. The first key finding is that the way
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executives think about competition influences innovation, even when controlling for direct competitors in the firm’s immediate environment. Attention to competitors therefore has tangible effects on firm innovation, above and beyond the effects of the direct competitors that have been the focus of prior work. The second key finding is that there is a specific pattern in which executives should attend to competitors in order to enhance innovation. Specifically, firms are more innovative when executives pay attention to higher numbers of competitors, peripheral competitors, and competitors that are dissimilar from the focal firm. Executives can therefore be strategic in how they think about competition in order to enhance innovation. These findings have implications for research at the intersection of attention and competition.

Contributions

We contribute to research on attention to competitors. We first show that attention to competitors can influence tangible firm outcomes such as innovation, even after controlling for the direct competitors in the firm’s environment. Prior work on attention to competitors has focused on the firm’s “closest” competitors in the immediate environment, e.g. within the same industry or the same strategic groups (Baum & Lant, 2003; Chen et al., 2007; Porac et al., 1995). In contrast, we show that, even among firms facing the same competitive environment, differences in attention to competitors can lead to differences in firm outcomes such as innovation. We argue that these differences come about by activating different modes of thinking about competition – specifically, by prompting executives to think of competition primarily as an opportunity or primarily as a threat. Opportunity-based views are in turn likely to yield broader search and more flexible information processing, in contrast to threat-based views which lead to narrower and more restricted information processing (Chattopadhyay et al., 2001; Staw et al., 1984). Thus, even among executives facing the same direct competitors, different patterns of attention to competitors may prompt modes of thinking that are more conducive to innovation.

We also highlight the benefits to variance rather than conformity. Prior work has focused on adhering to dominant shared beliefs among industry participants (Ng et al., 2009; Reger & Huff, 1993; Tsai et al., 2011). In contrast, we show that firms benefit from more novel ways of looking at competition, particularly by paying attention to peripheral competitors that most other firms ignore and to
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competitors in dissimilar markets. Breaking away from conventional thinking about competition – in which executives focus their attention on highly similar competitors in the immediate environment – reduces two key drivers of threat-based interpretations of competition. Namely, executives may be less inclined to engage in social comparison to peripheral and dissimilar competitors and executives may feel less obligated to respond to their actions, thereby prompting opportunity-based views of competition that are more conducive to innovation. Overall, we highlight the benefits to engaging in more novel framings of competition that may lead executives to be open to seeing competition as an opportunity rather than purely as a threat.

Finally, we contribute more broadly to research on attention by linking two key theoretical constructs: attention focus and causal logics. Attention focus refers to the information that captures executives’ attention, while causal logics reflect why executives believe that information matters (Fiske & Taylor, 1991; Ocasio, 1997). Prior work has generally examined attention focus and causal logics as two distinct facets of executive attention that have separate effects on decision-making and firm performance (Nadkarni & Barr, 2008). In contrast, we argue that attention focus can in fact shape causal logics. Specifically, the types of competitors in executives’ attention focus may activate opportunity-driven rather than threat-driven causal logics about competition, by discouraging social comparison and increasing feelings of autonomy when interacting with competitors. For example, executives may be less inclined to engage in social comparison when focusing attention on higher numbers of competitors. Activating an opportunity-driven rather than threat-driven logic of competition, then, may broaden information processing and encourage exploration in ways that foster innovation. Thus, attention focus and causal logics may not only act as distinct influences on decision-making and performance, but may also be actively shaped by each other to determine how interpret and utilize information about the environment.

Implications for practice

Our analysis suggests that executives can be strategic in how they think about competition by attempting to think about competitors in a less conventional manner. Specifically, executives should pay attention to
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a higher number of competitors that include peripheral firms and firms in dissimilar markets. The fundamental question of “Who are my firm’s competitors?” may therefore be answered in a manner that is strategic rather than descriptive. That is to say, instead of accepting competition as a structural feature of the environment, executives can more flexibly define which firms pose the greatest competitive threats, regardless of market overlap.

Suggestions for future research

Our sample consisted of public firms that almost all had over $1 million in annual revenue. Yet perceptions of competition may have different effects on innovation among small or young firms. For example, paying attention to prominent rather than peripheral competitors may create positive aspiration-related benefits for small or young firms (Greve, 1998). Investigating whether our results hold for small and young firms could therefore be informative.

This paper also focused on the consequences of attention to competitors rather than its antecedents. In our data, similar firms often had divergent perceptions of competition and every firm had at least one identified competitor that was not shared by any others in its markets. Prior work has identified firm attributes that influence competitor identification but has not closely examined managerial characteristics, such as TMT demographics. Examining how managerial characteristics affect competitor identification could thus be another fruitful area of inquiry.

CONCLUSION

In this study, we show that attention to competitors influences product innovation, above and beyond the effects of direct competitors in the firm’s environment. Specifically, we find that firms are more innovative when executives pay attention to more competitors, peripheral competitors, and competitors in dissimilar markets. We argue that these patterns of attention are likely to activate opportunity-based rather than typical threat-based interpretations of competition, which in turn broaden information processing and encourage novel thinking. Competition is thus not merely an obstacle in the environment that executives must overcome but rather can be used to create strategic advantage. As one CEO put it, “Celebrate competition…It’s good to have a bad guy.”
REFERENCES
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Table 1. Descriptive statistics and correlations

| Variable                               | Mean  | S.D.  | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13   | 14   | 15   | 16   |
|----------------------------------------|-------|-------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 1 Number of new products              | 2.73  | 3.29  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 2 Number of competitors (H1)          | 6.71  | 3.46  | 0.20 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 3 Peripheral competitors (H2)         | 1.03  | 1.38  | 0.02 | 0.54 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 4 Dissimilar competitors (H3)         | 1.59  | 1.16  | 0.17 | 0.54 | 0.21 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 5 Number of direct competitors        | 36.63 | 17.47 | 0.26 | 0.02 | -0.05| -0.11|      |      |      |      |      |      |      |      |      |      |      |      |      |
| 6 Firm size                            | 0.84  | 0.97  | 0.42 | 0.19 | -0.03| 0.14 | 0.08 |      |      |      |      |      |      |      |      |      |      |      |      |
| 7 Firm R&D intensity                   | 0.42  | 3.28  | -0.02| -0.06| -0.03| -0.03| 0.03 | -0.06|      |      |      |      |      |      |      |      |      |      |      |
| 8 Years public                         | 7.76  | 5.98  | 0.16 | 0.06 | -0.08| 0.12 | -0.08| 0.59 | -0.06|      |      |      |      |      |      |      |      |      |      |
| 9 Number of markets                    | 1.62  | 0.81  | 0.27 | 0.06 | -0.08| -0.01| 0.52 | 0.46 | -0.04| 0.38 |      |      |      |      |      |      |      |      |      |
| 10 Market innovation activity          | 5.40  | 0.55  | 0.19 | 0.02 | -0.07| -0.09| 0.83 | 0.00 | 0.05 | -0.15| 0.29 |      |      |      |      |      |      |      |      |
| 11 Developer tools                     | 0.28  | 0.45  | 0.04 | -0.07| -0.04| -0.04| 0.13 | 0.05 | -0.02| 0.08 | 0.45 | 0.03 |      |      |      |      |      |      |      |
| 12 Integration and middleware          | 0.32  | 0.47  | -0.07| -0.08| -0.12| -0.05| 0.23 | 0.06 | -0.03| -0.01| 0.43 | 0.06 | 0.27 |      |      |      |      |      |      |
| 13 Databases                           | 0.25  | 0.43  | 0.15 | 0.03 | -0.01| -0.07| 0.12 | 0.21 | -0.03| 0.30 | 0.50 | 0.05 | 0.20 | 0.08 |      |      |      |      |      |
| 14 Security                            | 0.25  | 0.43  | 0.16 | 0.25 | 0.08 | 0.17 | -0.20| 0.19 | -0.03| 0.14 | 0.01 | -0.17| -0.32| -0.36| -0.17|      |      |      |      |
| 15 California                          | 0.45  | 0.50  | 0.00 | 0.10 | 0.11 | -0.04| 0.03 | 0.04 | -0.04| -0.03| 0.00 | -0.02| 0.06 | 0.01 | -0.03|      |      |      |      |
| 16 Texas                               | 0.14  | 0.34  | 0.02 | 0.05 | 0.01 | 0.02 | -0.04| -0.06| -0.01| 0.07 | 0.01 | -0.04| -0.04| 0.00 | 0.10 | 0.11 | -0.36| -0.33| -0.15|
| 17 Massachusetts                       | 0.12  | 0.32  | -0.09| -0.12| -0.03| -0.11| 0.08 | -0.10| -0.02| -0.05| 0.00 | 0.04 | 0.10 | -0.03| 0.03 | -0.15| -0.33| -0.15|      |

Table 2. Distribution of competitors listed in 10-Ks among 121 infrastructure software firms, 1995-2012

<table>
<thead>
<tr>
<th>Competitor's market</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct competitors (same market)</td>
<td>52%</td>
</tr>
<tr>
<td>Operating systems</td>
<td>17%</td>
</tr>
<tr>
<td>Hardware</td>
<td>12%</td>
</tr>
<tr>
<td>Application software</td>
<td>10%</td>
</tr>
<tr>
<td>Other infrastructure software</td>
<td>8%</td>
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<tr>
<td>Other IT</td>
<td>1%</td>
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### Table 3. Two-stage instrumental variables models with firm fixed effects predicting number of new products (N=821)

<table>
<thead>
<tr>
<th></th>
<th>H1: Number of competitors</th>
<th>H2: Peripheral competitors</th>
<th>H3: Dissimilar competitors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st Stage OLS</td>
<td>2nd Stage Neg Bin</td>
<td>2nd Stage Poisson</td>
</tr>
<tr>
<td>Instruments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-Microsoft ruling</td>
<td>-0.48</td>
<td>-0.35 **</td>
<td>-0.03</td>
</tr>
<tr>
<td>(0.34)</td>
<td>(0.34)</td>
<td>(0.16)</td>
<td>(0.12)</td>
</tr>
<tr>
<td>Member of S&amp;P 1500</td>
<td>-0.13</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>(0.45)</td>
<td>(0.45)</td>
<td>(0.20)</td>
<td></td>
</tr>
<tr>
<td>Post-Microsoft ruling x Member of S&amp;P 1500</td>
<td>0.41</td>
<td>0.31 **</td>
<td></td>
</tr>
<tr>
<td>(0.10)</td>
<td>(0.18)</td>
<td>(0.14)</td>
<td></td>
</tr>
<tr>
<td>Instrumented explanatory variable</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Number of competitors (H1)</td>
<td>0.22 *</td>
<td>0.17 *</td>
<td>0.41 *</td>
</tr>
<tr>
<td>(0.10)</td>
<td>(0.08)</td>
<td>(0.18)</td>
<td>(0.14)</td>
</tr>
<tr>
<td>Peripheral competitors (H2)</td>
<td>0.06 ***</td>
<td>-0.01</td>
<td>-0.01</td>
</tr>
<tr>
<td>(0.02)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Dissimilar competitors (H3)</td>
<td>0.91 **</td>
<td>0.18</td>
<td>0.24 *</td>
</tr>
<tr>
<td>(0.34)</td>
<td>(0.15)</td>
<td>(0.11)</td>
<td>(0.16)</td>
</tr>
<tr>
<td>Firm size</td>
<td>-0.02</td>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td>(0.03)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Firm R&amp;D intensity</td>
<td>-0.04</td>
<td>-0.09 ***</td>
<td>-0.09 ***</td>
</tr>
<tr>
<td>(0.05)</td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
</tr>
<tr>
<td>Years public</td>
<td>-0.13</td>
<td>0.59 **</td>
<td>0.71 ***</td>
</tr>
<tr>
<td>(0.61)</td>
<td>(0.20)</td>
<td>(0.15)</td>
<td>(0.28)</td>
</tr>
<tr>
<td>Number of markets</td>
<td>-0.83 *</td>
<td>0.06</td>
<td>0.11</td>
</tr>
<tr>
<td>(0.33)</td>
<td>(0.14)</td>
<td>(0.10)</td>
<td>(0.15)</td>
</tr>
<tr>
<td>Market innovation activity</td>
<td>0.64</td>
<td>564.0</td>
<td>1323.0</td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chi-Squared</td>
<td>564.0</td>
<td>1323.0</td>
<td>564.6</td>
</tr>
</tbody>
</table>

Two-tailed significance tests: † p < .10   * p < .05   ** p < .1   *** p < .001
All models include firm, market, geographic and year effects