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Managerial attention to exploitation versus exploration: toward a dynamic perspective on ambidexterity

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Abstract

Managerial attention to exploitation and exploration has a strong influence on organizational performance. However, there is hardly any knowledge about whether senior managers need to adjust their distribution of attention to exploitation and exploration in response to major changes in demand patterns in their industry. Drawing on the analysis of a panel data set of 86 firms in the information technology industry exposed to an economic recession and recovery, we find that successfully navigating an economic downturn demands more managerial attention to exploration, while leveraging the subsequent upswing requires more attention to exploitation. As such, this study contributes to the literature by providing a dynamic perspective on ambidexterity: that is, senior managers need to redistribute their attention to exploration and exploitation to effectively meet the changing environmental demands over time.

JEL classification: C01 L1 L2 L86.

1. Introduction

To adapt and survive in the complex and dynamic business environments of today, corporate strategies need to enable the exploitation of existing knowledge and simultaneously facilitate the exploration of new knowledge domains (March, 1991; Levinthal and March, 1993; Laureiro-Martínez *et al.*, 2015). This type of strategy originates, ultimately, from the company's senior managers (Smith and Tushman, 2005; Eisenhardt *et al.*, 2010). In this respect, a key determinant of organizational performance is the ability of senior managers "to pursue cognitively distant opportunities [. . .] without losing [. . .] the ability to attend to cognitively closer tasks" (Laureiro-Martínez *et al.*, 2015: 320). Here, we assume that managerial ambidexterity involves the relative distribution of managerial attention to exploitation and exploration. Corporate leaders such as Steve Jobs and Andy Grove exemplify such "ambidextrous" behavior in their organizations by simultaneously enabling exploitation for short-term performance *and* exploration that enhances long-term performance.

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Thus far, considerable progress has been made in understanding the performance implications of exploitation and exploration. Whereas several studies suggest a positive link between the simultaneous pursuit of exploitation–exploration (EE) and firm performance (He and Wong, 2004), other scholars have observed that industry characteristics like competitiveness, dynamism, and R&D intensity affect the most profitable EE distribution (Auh and Menguc, 2005; Jansen *et al.*, 2006; Uotila *et al.*, 2009; Derbyshire, 2014). However, earlier work in this area has not addressed whether senior managers in charge of a given firm need to redirect their attention to EE over time. More specifically, there is little empirical evidence that suggests that senior managers need to adjust their balance of attention to exploitation and exploration to effectively deal with major changes *within* their company's industry context. This article addresses this gap in the literature.

The recent economic recession and subsequent recovery provide the opportunity for a natural experiment, as these different episodes are likely to impose different attentional demands on senior managers. System Generalized Method of Moments (GMM) estimation on a panel data set, including 86 firms in the information technology (IT) industry, indeed indicates that different levels of managerial attention to EE are required to effectively deal with a recession versus a recovery. As such, our study contributes to the literature on EE and ambidexterity, by providing a dynamic perspective on ambidexterity (Raisch *et al.*, 2009; Lugar *et al.*, 2013). Moreover, our study has important implications for managers facing recessions and recoveries in the IT sector. More specifically, we find that an economic downturn requires more managerial attention to exploration, while leveraging the subsequent economic upswing demands more attention to exploitation.

2. Managerial attention and EE at the firm level

The attention-based view seeks to understand firm behavior and organizational adaptation by studying "how organizations and their structures channel and distribute the attention of their decision-makers" (Ocasio, 1997: 203). Following Ocasio (1997: 189), we define attention as "the noticing, encoding, interpreting, and focusing of time and effort by organizational decision-makers on both issues [. . .] and answers [. . .]." Within this line of research, managerial attention has been shown to significantly affect different output variables such as technological responsiveness to competitors (Eggers and Kaplan, 2009), technological innovations (Kaplan, 2008), and firm response speed to sector and task changes (Nadkarni and Barr, 2008).

More specifically, senior managers' attention to particular aspects serves to focus their organization toward specific areas of activity by influencing what information others in the firm attend to and how this information is interpreted (Simons 1991; Lefebvre *et al.*, 1997; Yadav *et al.*, 2007). In this respect, senior managers are in a position to affect the behavior of their firm, due to their highly influential position, through their choices and the matters they pay attention to. That is, managerial attention helps drive organizational activities within the firm by focusing the attention of other firm members through communication and symbolic actions as well as development and adjustment of organizational forms and resources allocated to alternative operations (Gifford, 1998; Yadav *et al.*, 2007). This enhances the level of awareness, anticipation, and action with respect to managerial focal matters. Through this organizational mechanism, senior managers are able to guide and direct the firm (Hambrick and Mason, 1984). Therefore, managerial attention is an important determinant of firm behavior and its consequences (Hambrick and Mason, 1984; Jansen *et al.*, 2008; Gavetti *et al.*, 2012).

In particular, senior managers interpret environmental challenges on an ongoing basis in terms of problems, opportunities, and threats, and subsequently respond by focusing the attention of their firm (Ocasio, 1997; Yadav *et al.*, 2007). Such responses manifest themselves, generally speaking, in exploitative and/or explorative behaviors. More specifically, managerial attention to exploitation helps the firm reduce its knowledge variety, increase its efficiency, and therefore, generate profits in the short run (March, 1991; Andriopoulos and Lewis, 2009). In contrast, managerial attention to exploration serves to develop or obtain new knowledge different from the current knowledge base (Lavie *et al.*, 2010), and thereby enhance the firm's adaptability (March, 1991; Andriopoulos and Lewis, 2009).

3. Toward a dynamic perspective on managerial ambidexterity

Managerial attention is a limited resource, and management teams are exposed to much more information than they can possibly process (Simon, 1947; Ocasio, 1997, 2011; Yadav *et al.*, 2007; Shepherd *et al.*, 2016). Indeed, information processing capacity, rather than information itself, is the scarcer resource for many senior managers (Yadav

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et al., 2007). Thus, managerial attention to EE constitutes a zero-sum game: "Increases in the allocation of attention to [exploitation] are likely to come at some expense to the allocation to [exploration] and the radical opportunities to which it often leads" (Shepherd *et al.*, 2016: 3). As a result, senior management needs to be selective regarding what exploitative and/or explorative matters they attend to, and those to ignore. Here, the so-called *EE ratio* refers to the relative distribution of managerial attention over exploitation and exploration.

Several studies suggest that firm performance is positively influenced by a strategic distribution of exploitation and exploration (He and Wong, 2004; Jansen *et al.*, 2006; Uotila *et al.*, 2009). Specifically, Uotila *et al.* (2009) show that the relationship between the EE ratio and firm performance is characterized by an inverted U-shape. On the one hand, excessive attention to exploration can be extremely costly because its outcomes are highly uncertain. Moreover, it tends to drive out economies of scale and/or disciplined problem-solving (He and Wong, 2004; Smith and Tushman, 2005). This one-sided managerial focus tends to result in the so-called "failure trap" (Levinthal and March, 1993; Andriopoulos and Lewis, 2009). On the other hand, a strong focus on exploitation might result in relatively certain returns but also discourages more radical learning, and is therefore likely to undermine the firm's adaptability (Teece *et al.*, 1997; Benner and Tushman, 2003; Walrave *et al.*, 2011). This phenomenon has been called the "success trap" (Levinthal and March, 1993).

As some scholars suggest, the most effective EE ratio is likely to vary significantly across different environmental contexts (Jansen *et al.*, 2006; O'Reilly and Tushman, 2008, 2013). Drawing on empirical findings, several scholars indeed recommend managers to provide specific levels of attention to exploitation and exploration in view of, for instance, the level of competitiveness or dynamism of their company's industrial context (Jansen *et al.*, 2006; Uotila *et al.*, 2009). For instance, more attention to exploitation is beneficial in highly competitive settings, while more attention to exploration is needed in very dynamic industrial contexts. These studies, therefore, present a *static* perspective on ambidexterity: that is, senior managers (are recommended to) adopt a fixed distribution of attention to EE that aligns with their company's environmental characteristics (Raisch *et al.*, 2009).

Yet, several key environmental characteristics are likely to change significantly *within* a given industry over time. A clear example is the change in customer preferences and needs observed when an economic recession moves into a recovery (O'Malley *et al.*, 2011). As a result of this economic transition, management very likely needs to readjust their balance of attention to exploitation and exploration to effectively deal with such changing environmental demands (Webb and Pettigrew, 1999; Siggelkow, 2002). In this respect, Raisch et al. (2009: 688) argue that it is "unlikely that [static] organizational configurations (not even ambidextrous ones) could provide the exhaustive steady-state functionality required to deal with the entire range of boundary conditions that an organization faces over time." Consequently, managerial attention to EE needs to involve a *dynamic balance*: while the attentional emphasis sometimes is on exploration, at other times, it is on exploitation to be able to manage the changing demands within a given industry over time. This constitutes our main thesis: the need for a dynamic perspective on ambidexterity.

To develop and test a dynamic perspective on EE, an empirical setting that includes a strong environmental change is required. This environmental change moderates the relationship between managerial attention to EE and firm performance by altering "how the subsystems of the environment (e.g., technology and markets) and the organization (e.g., knowledge and goals) are linked" (Shepherd *et al.*, 2016: 9). In other words, we expect that major environmental changes are likely to transform the EE attentional requirements over time.

In the next section, we explore how the transition from an economic recession to a recovery presents senior managers with significantly different EE challenges (cf. Lamey *et al.*, 2007; Steenkamp and Fang, 2011). Notably, we assume that managerial attention to *both* exploitation and exploration is required for sustained organizational performance. Following Uotila *et al.* (2009), we assume an inverted-U relationship, but also argue that exploitation and exploration must be dynamically balanced; that is, *more* attention needs to be given to either exploration or exploitation, depending on the recessionary or recovery context.

4. Hypotheses

The National Bureau of Economic Research (Hall *et al.*, 2010: 1) defines an economic recession as a "period of falling economic activity spread across the economy, lasting more than a few months, normally visible in real gross domestic product, real income, employment, industrial production, and wholesale–retail sales." Conversely, an economic recovery can be defined as a period of rising economic activity spread across the economy, lasting more than six months, normally visible in real gross domestic product, real income, employment, industrial production,

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and wholesale–retail sales (Hall *et al.* 2010). A recession is characterized by an industry-wide contraction, which strongly reduces the amount of business opportunities that can be pursued (Deleersnyder *et al.*, 2004; Lamey *et al.*, 2007; Srinivasan *et al.*, 2011; Steenkamp and Fang, 2011; Archibugi *et al.*, 2013). In contrast, a recovery triggers a general rise in economic conditions, resulting in a growing number of business opportunities to be pursued (Deleersnyder *et al.*, 2004; Lamey *et al.*, 2007). In this respect, recession and recovery periods differ in terms of their *environmental munificence* (i.e., lower for the former, higher for the latter), that is, "the extent to which the environment can support sustained [firm] growth" (Dess and Beard, 1984: 55). Furthermore, a recessionary context is likely to alter customer preferences and needs, as the associated economic uncertainty undermines the confidence of consumers, making them more price conscious and reduce their spending (O'Malley *et al.*, 2011).

In this respect, a recession can rather suddenly alter an organization's environmental context (Pearson and Clair, 1998; O'Malley *et al.* 2011), rendering organizational capabilities, including products and services, obsolete (Schmitt *et al.*, 2010). Senior managers attending more to exploration direct their company to learn about the new environmental demands (March, 1991), making it more likely that the company discovers and develops new products, services, or business models which better align to the recessionary context (O'Malley *et al.*, 2011). The alternative strategy involves a sustained or even increasing amount of attention to exploiting the current business, which essentially implies a focus on a declining business. In this respect, Yang *et al.* (2011) observe that sales prices can, in general, decline by up to 1% per week in a recessionary context. Together these arguments suggest that in recessions, the *attentional emphasis* should be on exploration. Indeed, the latter appears to stimulate investments in product development and innovation, which are critical in any attempt to survive a recession (Pearce and Michael, 1997; O'Malley *et al.*, 2011).

Moreover, threat-rigidity theory predicts that managers facing organizational decline, a likely scenario during a recession, will direct their attentional emphasis to exploitation (Staw *et al.*, 1981). Such a retrenchment strategy may be a natural response to a recession by conserving resources until the economic recovery sets in (Srinivasan *et al.*, 2011; Paunov, 2012). Indeed, any managerial interventions that reflect a more exploratory focus, such as R&D investments, are believed to be "a perennially attractive target for corporate belt-tightening rituals, since it doesn't produce cash directly" (Barrett *et al.*, 2009: 92). Interestingly, as many senior managers are likely to reduce their attention to exploration, it becomes relatively easy for those few managers focusing more on exploration to (have their firm) uncover business opportunities that better fit the changing environmental situation. This also implies that senior managers who, in a recession, direct their attentional emphasis to exploration are likely to position their firm better for the subsequent economic recovery (Amore, 2015).

Any subsequent period of economic recovery brings about an increase in munificence, with business opportunities becoming increasingly dense (Deleersnyder *et al.*, 2004; Lamey *et al.*, 2007) and, therefore, easier to pursue. In this setting, managerial attention to exploration becomes less important. Indeed, senior managers need to take advantage of this situation by redirecting their attention toward exploitation to enable the generation and restoration of short-term profits. As such, different EE ratios appear to be required to effectively deal with a recession versus recovery context: while the attentional emphasis should be more on exploration in a recession, it has to shift more toward exploitation during a recovery. Therefore:

H1: To enhance firm performance, (i) more managerial attention to exploration is required during a recession than during a recovery and (ii) more managerial attention to exploitation is required during a recovery than during a recession.

More managerial attention to exploration in a recession is extremely critical because business opportunities are becoming scarcer in times of economic decline (Grewal and Tansuhaj, 2001). That is, the lower level of munificence in a recession makes for a more severe selection regime of business opportunities (Steenkamp and Fang, 2011). As a consequence, recessions provide few opportunities for accelerated firm growth. If these opportunities are not explored, a recession is likely to reinforce organizational decline (Walrave *et al.*, 2011). Marketing scholars have long maintained that contractions, compared to expansions, present managers with the rare opportunity to boost their firms' market share and long-term profitability (O'Malley *et al.*, 2011; Steenkamp and Fang, 2011). This observation also resonates with the organizational decline literature (Porter and Harrigan, 1983; Rosenblatt *et al.*, 1993) and implies that senior managers' attention to the "right" amount of EE is *more critical* in a recession than in a recovery.

Moreover, the lack of managerial attention to exploration and the subsequent failure to pursue (the shrinking volume of) business opportunities in a recession, in combination with the general decline in output levels, cause a rapid decrease in firm performance. This decrease can give rise to a vicious feedback loop, in which the negative

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performance trend further deteriorates the alignment between environmental demands and the balance of attention to EE, which in turn accelerates organizational decline (Leonard-Barton, 1992; Levinthal and March, 1993). In responding to economic recessions and other external threats, senior managers frequently let their firms slip into such a trap (Schmitt *et al.*, 2010; Walrave *et al.*, 2011). In contrast, a vicious feedback loop is (far) less likely to develop in a recovery because of the general rise in output levels (Deleersnyder *et al.*, 2004). We thus expect the relative importance, or the differential performance effect, of the EE ratio to be greater in an economic recession:

H2: The differential performance effect of the most effective managerial attention to EE (see H1) is greater in a recession than in a recovery.

H1 and *H2* imply that managerial attention to EE needs to be dynamically balanced, within a given industry over time, because of the fundamentally different challenges arising from environmental changes.

5. Method, measures, and analysis

As argued earlier, we assume that the EE ratio has an inverted U-shaped relationship with firm performance (Uotila *et al.*, 2009). Accordingly, we assume *two* inverted U-shaped relationships (see Figure 1), one for the recession and the other one for the recovery, following our main thesis that the attentional requirements differ over time. More specifically, the two inverted U-shaped curves anticipated in Figure 1 differ in their position on the horizontal axis: this shift in the vertex reflects the need for more attention to exploration during a recession (*H1*). Furthermore, the two inverted U-shaped relationships also differ in the steepness of their slopes, which reflects a difference in the relative importance of the EE ratio (*H2*). Moreover, the inverted U-shaped relationships also differ in their position along the vertical axis. That is, during a recession, the firm is less likely to accomplish the financial results achievable during a recovery due to the decreased level of environmental munificence. As such, the difference in munificence implies that (on average) a certain EE ratio, sustained throughout both the recession and recovery, is expected to be more profitable during the recovery than in the recession. This expectation implies a difference in the absolute performance implications of a given EE ratio, that is, a difference along the *y*-axis.

5.1 Data collection

Although economic recessions and recoveries affect the entire economy, not all industries are equally affected (Deleersnyder *et al.*, 2004; Steenkamp and Fang, 2011). For example, senior managers of companies in the high-tech sector tend to allocate more resources to exploration than their counterparts in other sectors (Grewal and Tansuhaj, 2001). The IT industry is an exemplar of a high-tech sector characterized by continuous product innovation, high growth rates, and high product differentiation (Mendelson, 2000). As such, senior managers of IT firms need to be more responsive to environmental fluctuations, and returns on (explorative) investments are generated faster

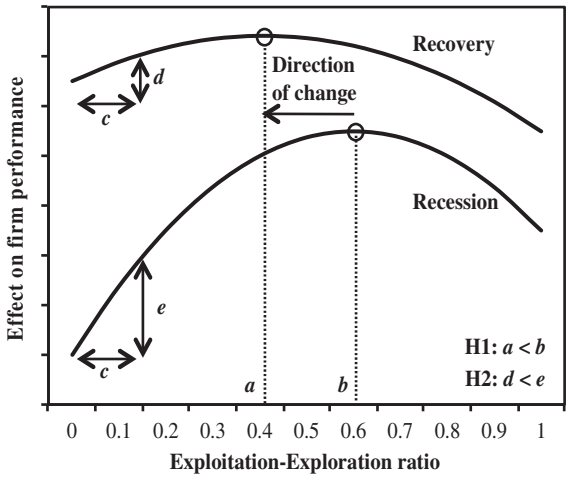

Figure 1. Graphical representation of *H1* and *H2*.

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compared to many other (e.g., gas or food) industries (Mendelson, 2000). Consequently, the performance implications arising from any given EE ratio are likely to be observed faster in the IT industry than in most other industries (Uotila *et al.*, 2009; Vagnani, 2012). We therefore selected the IT industry as the context for our empirical study.

To test the hypotheses, longitudinal data involving both a recession and a recovery are required. As such, we collected data covering the years 2006–2010 for companies active in the IT sector (20 quarters in total). The Global Industry Classification Standard (GICS) lists these firms under codes 4510–4530. In view of the global character of the recession and recovery under investigation, we collected data on both US-based and Europe-based companies. Moreover, we focused on publicly owned corporations because they generate a regular flow of documents such as annual reports and letters to shareholders (Yadav *et al.*, 2007; Uotila *et al.*, 2009; Walrave *et al.*, 2011). Finally, to make the sample consistent in terms of firm size, a net income in excess of US$75 million (in 2006) was required to be included in the final data set. In summary, our sample includes firms that (i) were listed in GICS codes 4510–4530, (ii) were based in the United States or Europe, (iii) were publicly owned, (iv) traded at the beginning of 2006, and (v) had a net income in excess of US$75 million in 2006.

With these criteria, we first selected 89 firms in the United States from Standard and Poor's (S&P) 500 index and 11 European–based firms from the S&P 350 EURO index. To improve the geographical balance in the sample, we then supplemented the data with all European-based IT firms (not listed in the S&P indexes) that had a net income of at least US$75 million in 2006 (from Thomson ONE Banker). These 21 firms were too small to be listed in the S&P EURO index, but did meet the sample selection criteria outlined earlier. This process resulted in an initial sample of 121 firms.

We collected the firm-level data from two main sources: Thomson ONE Banker and annual letters to shareholders, commonly found in annual reports. We omitted 35 firms from the analysis because the panel for these firms was incomplete (i.e., missing letters to shareholders or missing financial data)—which would cause a misfit with our longitudinal research design. This resulted in a final sample of 86 companies (66 in the United States and 20 in Europe) and 1720 valid observations over 20 quarters. The geographical distribution of the firms in the sample is reported in the Appendix that is available upon request from the authors.

5.2 Recession and recovery

We analyzed the economic recession that occurred over the course of 2006–2008. The recovery that unfolded during 2009–2010 was of such strength and length that any later recession—for example, arising from the European sovereign debt crisis—is considered a new one (Hall *et al.*, 2010). In this respect, the 2006–2008 and 2009–2010 periods represent distinct phases with opposing macroeconomic characteristics. Furthermore, global economic upheavals tend to be synchronized at large (Claessens *et al.*, 2009), and we therefore assumed there is no delay between the responses of American and European firms. This assumption is reinforced by the fact that all firms in our sample are global players that are simultaneously affected by any global economic crisis.

To be able to allocate the observations to either the recession or the recovery period, we applied the Zivot and Andrews unit root test to the sample; this test treats the breakpoint endogenously (Zivot and Andrews, 2002). More specifically, we tested the averaged values (per quarter) of net income across the sample. We found that the breakpoint (i.e., the minimum t-statistic) was significant at quarter 12 (-7.079, $P < 0.01$), that is the fourth quarter of 2008. Therefore, we split the data into a recession and a recovery phase as follows: for Quarters 1 through 12 (i.e., years 2006–2008), we coded the "Recovery dummy" variable as 0 to indicate a recession, and for Quarters 13 through 20 (i.e., years 2009–2010), it was coded as 1 to indicate a recovery.

5.3 Dependent variable: profit margin

The EE literature employs various performance measures. Some studies draw on self-reported measures (Gibson and Birkinshaw, 2004; Lubatkin *et al.*, 2006) or accounting-based measures (He and Wong, 2004), whereas others rely on market value-based measures (Uotila *et al.*, 2009). In view of their subjective and retrospective bias, self-reported measures are not appropriate when historical data are collected within a longitudinal research design (Golden, 1992). Market value-based measures, such as Tobin's Q, may adequately capture both the short-term (book value) performance and the long-term (market value) prospects of managerial decision-making (Lubatkin and Shrieves, 1986; Lee and Makhija, 2009). Yet, during periods of economic upheaval, market value-based performance indicators are likely to be biased due to severely increased levels of volatility on the stock market. As such, we use an

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accounting-based measure, the profit margin, as the performance indicator in this study. The model was also tested with return on assets (ROA) as dependent variable, resulting in findings consistent with the ones reported later.

5.4 Independent variable: EE ratio

Prior research has operationalized exploitation and exploration in many different ways. For example, Katila and Ahuja (2002) use the depth and breadth of technological search activity as a proxy. Other studies have relied on questionnaires that target key personnel (He and Wong, 2004; Jansen *et al.*, 2006; Sidhu *et al.*, 2007). These operationalizations tend to be highly specific and therefore lack generalizability and applicability outside their particular contexts (Uotila *et al.*, 2009). Moreover, it is unclear whether and how they resonate with the original definitions of exploitation and exploration (Uotila *et al.*, 2009; Lavie *et al.*, 2010). Furthermore, questionnaire data on managerial attention to EE are difficult to obtain, especially for extended periods of time (Vagnani, 2012).

As previously argued, the exploitative and explorative capability of firms inherently manifests itself in the attentional focus of senior managers. Therefore, we documented senior management's attentional focus, in terms of the EE ratio, by analyzing the content of letters to shareholders (Nadkarni and Barr, 2008; Vagnani, 2012). Content analysis of linguistic media is useful for reconstructing the beliefs and perceptions of their authors (D'Aveni and MacMillan, 1990). As such, letters to shareholders are a relatively homogeneous communication channel that is carefully controlled by senior managers (D'Aveni and MacMillan, 1990; Ocasio, 2011). These letters embody the "corporate speak" of senior management more than any other form of communication. The managerial attention reflected in these letters has been found to affect the company's response to competitors (Eggers and Kaplan, 2009), technological innovation (Kaplan, 2008), speed of response to sector and task changes (Nadkarni and Barr, 2008), orientation toward exploration (Vagnani, 2012), and how the firm detects, develops, and deploys new technologies (Yadav *et al.*, 2007). In this respect, previous work has demonstrated that the strategic direction set by senior management can be effectively uncovered by means of content analysis of letters to shareholders (D'Aveni and MacMillan, 1990; Yadav *et al.*, 2007; Walrave *et al.*, 2011; Vagnani, 2012).

The operationalization of exploitation and exploration in our content analysis is based on March's (1991) original work, also in line with earlier work (Uotila *et al.*, 2009; Vagnani, 2012). This ensures that the operationalization of the EE ratio aligns well with the conceptual definitions adopted. Moreover, Uotila *et al.* (2009) demonstrate that March's definitions statistically and accurately differentiate between exploitation and exploration. Thus, we captured managerial attention to exploitation by (the roots of) the keywords "refinement," "choice," "production," "efficiency," "selection," "implementation," and "execution." We captured managerial attention to exploration by (the roots of) the keywords "search," "variation," "risk," "experimentation," "play," "flexibility," "discovery," and "innovation." Moreover, manual inspection of a randomly chosen selection of letters to shareholders, comprising 5% of all letters, revealed that the keywords "new" and "technology" reflect attention to exploration, and "cost" and "reduction" represent a focus on exploitation. Therefore, we also included (the roots of) these four words in the analysis. A preliminary analysis of the letters indicated that contractions of the keywords selected are rarely used in the context of other meanings, except in the case of "executive," which was therefore excluded from the analysis.

Given our zero-sum approach, we assume that managerial attention to exploitation and managerial attention to exploration are two ends of the same continuum (March, 1991; Greve, 2007; Lavie *et al.*, 2010; Walrave *et al.*, 2011). We therefore operationalized the EE ratio as the total number of matched keywords for exploration divided by the sum of matched keywords for exploitation and exploration (Uotila *et al.*, 2009). Thus, an EE ratio exclusively directed toward exploitation receives a score of 0, and the EE ratio is 1 when it is exclusively directed to exploration. In total, we matched the keywords to 16,340 instances, of which 66% involve exploration. We checked whether the EE ratio is sufficiently reflected in exploration and exploitation as operational activities (Vagnani, 2012) by correlating the EE ratio with the amount of resources dedicated to R&D over sales (0.26, $P < 0.001$). We also found our measure to be temporally stable (0.91, $P < 0.000$), in line with what can be expected (Vagnani, 2012).

5.5 Control variables

We added several other variables to control for possible confounding effects. We used the autoregressive component y_{t-1} to control for past firm performance and included time dummies (for every quarter) to prevent contemporaneous correlation, the most likely form of cross-individual correlation (Roodman, 2009b). R&D spending is likely to influence firm performance positively in times of economic upheaval (Srinivasan *et al.*, 2011; Steenkamp and Fang,

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2011). As such, we used the standardized value of R&D spending as a percentage of sales ("R&D-Sales ratio"). However, not all companies reported their R&D spending; therefore, we coded the firms that do not report R&D expenses as 0 (effectively replacing the missing value with the sample's mean) and coded the dummy variable "R&D missing dummy" as 1 (Cohen *et al.*, 2003; Uotila *et al.*, 2009). Furthermore, larger firms may be better able to mitigate the effects of economic recessions and recoveries (Lee and Makhija, 2009; Steenkamp and Fang, 2011). Therefore, we controlled for effects arising from size, measured by the number of employees ("Firm size") and the standardized value of "Total assets." Older firms are also likely to be more inert and thus less able to adapt to changing environmental circumstances (Steenkamp and Fang, 2011). Therefore, we included "Firm age" (Balasubramanian and Lee, 2008; Aschhoff and Sofka, 2009) in terms of the standardized value of the number of days since the initial public offering. Furthermore, Walrave *et al.* (2011) observe that in case of unsatisfactory performance, shareholders are likely to direct senior management's attention to exploitation (at the cost of attention to exploration). To account for this effect, we included "Net Income" in the model. Finally, we incorporated geographic location by coding and including a dummy variable for US-based versus Europe-based firms ("US location dummy") and also controlled for industry subsector by coding and including two dummy variables ("GICS 4510 dummy" and "GICS 4520 dummy").

5.6 Analysis

Several econometric methods serve to control for endogeneity and unobserved heterogeneity in studies that draw on panel data (Blundell and Bond, 1998; Roodman, 2009b; Uotila *et al.*, 2009). In this respect, simple dynamic panel models estimated with standard GMM estimators have often produced unsatisfactory results due to, among others, a weak instrument problem (Blundell and Bond, 1998, 2000). *System* GMM estimation has become increasingly popular in the field of strategic management (Keil *et al.*, 2008; Uotila *et al.*, 2009; Vagnani, 2012) because of its ability to allow for a short panel, a lack of good external instruments, fixed effects, and a first-order autoregressive error term (Arellano and Bover, 1995; Blundell and Bond, 2000; Roodman, 2009a, b). By employing multiple instrumental variables, the system GMM estimator controls for firm-specific effects as well as for possible sources of simultaneity between dependent and independent variables, without biasing the estimates (Vagnani, 2012). We therefore adopted system GMM estimation in testing our hypotheses.

Roodman (2009a) recommends putting all regressors and their lags into the instrument matrix. Therefore, we treated almost all variables as predetermined (Uotila *et al.*, 2009); exceptions were the time dummies, the recovery dummy, the industry dummies, and the US dummy, which were all treated as exogenous variables. This approach, combined with the number of variables included, resulted in a large number of instruments and therefore in overidentification. Although overidentification does not compromise the coefficient estimates, it does weaken the Sargan/Hansen test and as such raises the need for robustness tests (Roodman, 2009a). Consequently, we also tested the models by varying the number of instruments. These robustness tests demonstrated that the key coefficients, in terms of their sign, effect size, and significance level, are consistent with those of the model used for testing the hypotheses. The details and results of these and other robustness tests are available upon request from the authors.

6. Results

Table 1 presents the descriptive statistics and correlations for all variables. The EE ratio significantly correlates with R&D expenditure (0.26, $P < 0.001$), which suggests that senior managers giving more attention to exploration also accomplish higher R&D investment levels in their firms. This finding suggests that managerial attention to EE indeed influences firm-level indicators of EE.

Table 2 presents the results of the system GMM regression analyses. Notably, the effect of the EE ratio on the profit margin is assumed to be delayed by four quarters (Wang and Li, 2008). Three models were estimated. Model 1 is the base model that includes the EE ratio, as a linear effect, and the control variables. Subsequently, to test for the inverted U-shaped relationship, we included the squared term of the independent variable in Model 2 (Aiken and West, 1991). As such, this model serves to explain variation in the dependent variable over the course of a recession and recovery, assuming *static ambidexterity*. In other words, Model 2 tests the theory that a certain fixed distribution of managerial attention to exploitation and exploration is needed to optimize performance. Finally, Model 3 includes the moderating effect of environmental change (recovery dummy) on the relationship between the EE ratio and firm

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Table 1. Means, SDs, and correlations* (t_1–t_{20})

		M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Profit margin	0.09	0.33	1.00													
2	Profit margin $_{t-1}$	0.08	0.33	0.34*	1.00												
3	EE ratio $_{t-4}$**	0.70	0.17	0.09*	0.09*	1.00											
4	(EE ratio)^2 $_{t-4}$	0.52	0.23	0.09*	0.09*	0.99*	1.00										
5	Recovery dummy	0.40	0.49	−0.06*	−0.10*	−0.13*	−0.14*	1.00									
6	Net income	240	741	0.37*	0.18*	0.17*	0.19*	0.03	1.00								
7	Total assets	11132	19058	0.04	0.04	0.11*	0.13*	0.04	0.70*	1.00							
8	R&D–sales ratio	0.14	0.14	−0.10*	−0.10*	0.26*	0.28*	0.03	−0.09*	0.00	1.00						
9	Firm size	29281	56352	−0.00	0.00	0.00	0.02	0.00	0.56*	0.86*	−0.09*	1.00					
10	Firm age	32573	4002	−0.01	−0.01	0.09*	0.09*	0.00	−0.16*	−0.28*	−0.03	−0.30*	1.00				
11	R&D missing dummy	0.14	0.34	0.04	0.05	0.04	0.03	−0.01	−0.07*	−0.13*		−0.04	0.04	1.00			
12	GICS 4510 dummy	0.44	0.50	0.09*	0.10*	0.18*	0.19*	0.00	0.09*	−0.00	−0.08*	0.03	0.23*	0.35*	1.00		
13	GICS 4520 dummy	0.29	0.45	−0.05*	−0.05	−0.10*	−0.09*	0.00	−0.00	0.15*	−0.03	0.15*	−0.25*	−0.18*	−0.57*	1.00	
14	US location dummy	0.77	0.42	0.07*	0.07*	0.03	0.03	0.00	0.17*	0.12*	−0.05*	0.09*	−0.19*	−0.07*	0.16*	−0.01	1.00

Note: *Correlations are significant at the 0.05 level. Significance levels reported are two-tailed. **The average EE ratio during the recession was 0.73 (SD 0.17; min 0.23; max. 1.00). The average EE ratio during the recovery was 0.68 (SD 0.17; min. 0.19; max. 1.00).

performance by incorporating the interaction terms (Aiken and West, 1991). As such, this model serves to test for two inverted U-shaped relations, that is, the thesis of *dynamic ambidexterity*.

As Table 2 illustrates, Model 3 has a significantly better model fit compared to the other two models ($P < 0.001$). This key finding supports our main thesis that senior managers need to adjust their distribution of attention to exploitation and exploration over time to effectively deal with major changes in their company's environment. The remainder of this section elaborates the key findings for Model 3.

The autoregressive component appears to be persistent ($b_6 = 0.20$, $P < 0.05$). Furthermore, net income positively influences the dependent variable ($b_7 = 0.62$, $P < 0.01$), while total assets has a negative effect ($b_8 = -0.40$, $P < 0.05$). As expected, firm age ($b_{12} = -0.14$, $P < 0.05$) has a significant influence on the dependent variable. Moreover, the recovery dummy ($b_3 = 1.56$, $P < 0.01$) implies that overall performance is lower during a recession. Model 3 also points at a curvilinear relationship between the EE ratio and firm performance in both a recession and recovery context. That is, the required coefficients are statistically significant: EE ratio ($b_1 = 3.39$, $P < 0.01$), EE ratio squared ($b_2 = -2.35$, $P < 0.01$), EE ratio × recovery dummy interaction ($b_4 = -3.93$, $P < 0.05$), and EE ratio squared × recovery dummy interaction ($b_5 = 2.72$, $P < 0.05$), which confirms *H1*. Interestingly, this implies an inverted U-shaped relationship in recessions, but a U-shaped relationship in a recovery setting. Figure 2 depicts this finding. This unexpected result further reinforces the idea that changes within an industry require different, in this case, even opposite, EE ratios. Indeed, to enhance firm performance, a recession requires more managerial attention to exploration, while a recovery calls for more managerial attention to exploitation.

Figure 2 also suggests that the differential performance effects of the EE ratio are greater in a recession than in a recovery. That is, in absolute terms, the graph for the recession is steeper than the graph for the recovery. In this respect, Figure 2 shows a visual image of the interaction effect, which may provide face validity for *H2*. However, this visual interpretation in itself does not demonstrate that the two graphs in Figure 2 are significantly different. We already observed that the transition from recession to recovery constitutes a structural break. From this result, the results for *H2* can be assessed. More specifically, we use the following equation to estimate Model 3 (X denotes the EE ratio and Z the recovery dummy):

$$\hat{Y} = b_1X + b_2X^2 + b_3Z + b_4XZ + b_5X^2Z + b_0 + [b_6 \ldots b_{36}].$$

Because Z is either 0 or 1, it follows that:

$$\hat{Y}_{recession} = b_1X + b_2X^2 + b_0 + [b_6 \ldots b_{36}](as\ Z = 0),\ \text{and}$$

$$\hat{Y}_{recovery} = (b_1 + b_4)X + (b_2 + b_5)X^2 + b_3 + b_0 + [b_6 \ldots b_{36}]\ \ (as\ Z = 1).$$

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Table 2. Results of the system GMM regression analysis (8 of 20 lags used)

Dependent variable: profit margin	Model 1: base model		Model 2: static ambidexterity		Model 3: dynamic ambidexterity	
	Coefficient	(SE)[b]	Coefficient	(SE)[b]	Coefficient	(SE)[b]
b_1—EE ratio $_{t-4}$	0.07	(0.22)	0.89	(1.00)	3.39	(1.33)**
b_2—(EE ratio)^2 $_{t-4}$			−0.64	(0.76)	−2.35	(0.95)**
b_3—Recovery dummy					1.56	(0.61)**
b_4—EE ratio $_{t-4}$ × recovery dummy					−3.93	(1.82)*
b_5—(EE ratio)^2 $_{t-4}$ × recovery dummy					2.72	(1.41)*
b_6—Profit margin $_{t-1}$[a]	0.20	(0.09)*	0.20	(0.09)*	0.20	(0.09)*
b_7—Net income[a]	0.62	(0.20)**	0.62	(0.20)**	0.62	(0.20)**
b_8—Total assets[a]	−0.40	(0.22)*	−0.39	(0.22)*	−0.40	(0.22)*
b_9—R&D–sales ratio[a]	−0.01	(0.07)	−0.00	(0.07)	−0.00	(0.07)
b_{10}—R&D missing dummy	0.17	(0.16)	0.15	(0.16)	0.17	(0.17)
b_{11}—Firm size[a]	−0.04	(0.17)	−0.04	(0.17)	−0.04	(0.16)
b_{12}—Firm age[a]	−0.13	(0.07)*	−0.12	(0.07)*	−0.14	(0.07)*
b_{13}—GICS 4510 dummy	0.13	(0.13)	0.14	(0.13)	0.15	(0.13)
b_{14}—GICS 4520 dummy	0.11	(0.12)	0.11	(0.12)	0.12	(0.12)
b_{15}—US location dummy	−0.07	(0.11)	−0.07	(0.11)	−0.09	(0.11)
b_{16}—Constant	−0.06	(0.15)	−0.31	(0.34)	−1.39	(0.49)**
Hansen test of overidentification	1.00		1.00		1.00	
Arellano–Bond test for AR(1)[c]	−2.89	**	−3.03	**	−3.03	**
Arellano–Bond test for AR(2)[c]	0.45		0.17		−0.18	
Wald χ^2 (df in parentheses)	142.90	(31)	144.10	(32)	172.00	(35)

Note: [a]Standardized value. [b]The standard errors are robust to heteroskedasticity and arbitrary patterns of autocorrelation within agents (Roodman, 2009a). [c]*z*-values reported. $*P < 0.05$; $**P < 0.01$; $***P < 0.001$; time dummy variables were included in all models but are omitted from these results. One-tailed significance levels are reported. SE = standard error.

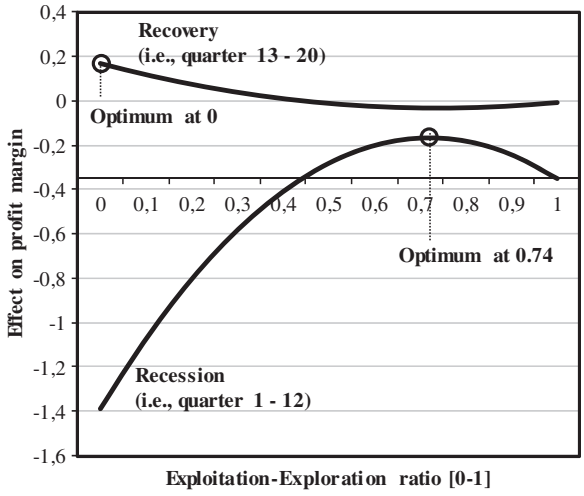

Figure 2. The relationship between EE ratio and performance in recession and recovery.

As such, the difference between the recession and the recovery equals:

$$\hat{Y}_{recovery} - \hat{Y}_{recession} = b_5X^2 + b_4X + b_3.$$

Equation 4 involves a quadratic relationship, a parabola. This implies that b_5 determines the difference in steepness of the parabola between the recession and the recovery. The significant and positive b_5 coefficient ($b_5 = 2.72$,

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$P < 0.05$) therefore provides support for *H2*: the differential performance effects of the EE ratio are greater in a recession than in a recovery.

7. Discussion and conclusion

The performance implications of EE are becoming increasingly understood (Auh and Menguc, 2005; Jansen *et al.*, 2006; Uotila *et al.*, 2009). For example, different levels of environmental dynamics appear to demand different distributions of managerial attention to exploitation and exploration (Wang and Li, 2008). However, this body of literature assumes that these environmental characteristics are not likely to change significantly over time. Earlier in this article, we have criticized this assumption to subsequently explore how senior managers adapt their attention to exploitation and exploration to effectively deal with changing environmental demands (Raisch *et al.*, 2009). There is little empirical evidence for a dynamic perspective on ambidexterity (Lugar *et al.*, 2013), which constitutes the *reason d'être* for conducting this study.

Overall, our results confirm that, in times of strong economic upheaval, senior managers need to adjust their distribution of attention to exploitation and exploration. More specifically, we observe that an economic downturn requires more attention to exploration, while leveraging the subsequent economic recovery demands more attention to exploitation. The observed difference in attentional requirements appears to be even stronger than expected, as the nature of the relationship also differs between recession and recovery settings (i.e., an inverted U-shape versus U-shape). In this respect, our study suggests that a static perspective on managerial ambidexterity might not be valid during more turbulent economic times, that is, "managing for ambidexterity is a task of dynamic rather than static alignment" (Raisch *et al.*, 2009: 689).

Our findings thus provide evidence for an inverted U-shaped relationship between the EE ratio and firm performance in a recession, and a U-shaped relationship between these variables in a recovery. The former finding replicates earlier work (Uotila *et al.*, 2009), whereas the latter one demonstrates that the curvilinear relationship inferred by Uotila *et al.* (2009) from a cross-sectional sample consisting of both traditional manufacturing and IT firms cannot be readily generalized to other populations and contexts. In this respect, this article serves to extend the "ambidexterity hypothesis" arising from March's (1991) original argument, but also suggests that more work is needed to better understand under which conditions a static or dynamic perspective on ambidexterity can be applied (Raisch *et al.*, 2009).

Moreover, our findings suggest that the attentional balance between exploitation and exploration is even more difficult to manage than originally anticipated. Our study shows that the attentional balance needs to be adapted over time, as the nature of the balance itself evolves. As such, the simultaneous pursuit of exploitation and exploration may imply a dynamic rather than static alignment challenge, which calls for structures and systems that facilitate such a dynamic balancing act (O'Reilly and Tushman, 2013). The organizational vacillation literature (Boumgarden *et al.*, 2012) may provide some guidance in how such a dynamic balance can be achieved at the organizational level.

This study also has interesting implications for managerial practice, most notably for how to effectively handle recessions. Economic downturns are inevitable (Berends and Romme, 2001; O'Malley *et al.*, 2011), and the aftermath of any past period of economic upheaval illustrates that some firms are affected considerably more than others. For instance, Apple saw only little downfall during the most recent global recession and achieved a tremendous "recovery" afterward. In this respect, we find that senior managers of (IT) firms should shift their attention to exploration to successfully navigate recessions and outperform competitors. This advice resonates with other studies on recessions, which recommend firms to maintain a more explorative strategy during a recession (Archibugi *et al.*, 2013). In economic recessions, therefore, the benefits from extra managerial attention to exploration appear to outweigh the (short-term) benefits arising from extra attention to exploitation—also because the extra attention to exploration is likely to enhance organizational growth in the subsequent recovery period (Amore, 2015). In the latter period, characterized by increasing levels of munificence, management needs to redirect some of its attention back to exploiting the (newly uncovered) business opportunities.

Moreover, we observed significant differential performance effects of the EE ratio between a recession and recovery context. Misdirected attention to exploitation–exploration appears to have far greater negative performance implications in a recession than in a recovery. This finding resonates with the observation that adverse times provide extraordinary opportunities for firm revitalization and progress (Rosenblatt *et al.*, 1993; O'Malley *et al.*, 2011;

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Steenkamp and Fang, 2011), or alternatively, provoke and reinforce firm decline (Walrave *et al.*, 2011, 2015). In this respect, we argued that decreasing levels of munificence make for a more severe external selection regime. Post-analysis of the data (i.e., mean-comparison test) shows that senior managers, who deviate on average more than 15% from the vertex identified in a recession, realize a profit margin that is more than 14% lower ($P < 0.001$) during the recession and more than 33% lower during the subsequent recovery ($P < 0.001$). This simple test again points at the need for the EE ratio to shift over time, dependent on the environmental context.

The fact that many senior managers tend to shift their attention toward exploitation in a recession (Archibugi *et al.*, 2013) suggests it is counterintuitive for most managers to proactively initiate more exploration activity in this context (Filippetti and Archibugi, 2011). In times of decline, senior managers are inclined to adopt a retrenchment approach in an attempt to maintain liquidity (Robbins and Pearce, 1992; Berends and Romme, 2001; Srinivasan *et al.*, 2011; Steenkamp and Fang, 2011), especially if they can get away with downsizing, while blaming the economic conditions (Schmitt *et al.*, 2010). In doing so, senior managers frequently ignore the long-term challenges and problems of their organization (Staw *et al.*, 1981; D'Aveni and MacMillan, 1990; Levinthal and March, 1993). Our findings, however, suggest that such a strategy might be highly counterproductive in times of major economic upheaval.

Furthermore, the managerial failure to orchestrate EE during environmental disruptions can cause the firm to get trapped in a process of *suppressing* exploration (Walrave *et al.*, 2011, 2015), a self-reinforcing process in which a decline in performance gives rise to more attention toward exploitation in an attempt to preserve shareholder value. Attentional mismanagement fuels this self-reinforcing retrenchment process. The suppression of exploration can also be reinforced by the firm's shareholders, especially when they press senior management to focus on exploitation in an effort to compensate for declining performance (Wiersema, 2002; Walrave *et al.*, 2011). Our study suggests that management teams adopting this strategy are likely to make their firms very vulnerable in adapting to and exploiting the subsequent economic upswing, relative to competitors that have proactively invested in exploration during the recession.

7.1 Limitations, future work, and conclusion

A key limitation of this study arises from the nature of the sample, composed of large firms in the IT industry in the United States and Europe. This focus helped uncover the implications of managerial attention to EE in a recession and recovery context. Therefore, our findings may only apply to (large companies in) the IT industry and the North American and European capital market regimes. Future work would need to test whether our findings can be generalized to other industries and/or smaller firms.

We found that managerial attention to exploitation and exploration needs to shift over time, but the limits to such shifts are unknown. While our theoretical arguments and empirical findings provide some indications of the most effective direction of change in attention (relatively more exploration versus more exploitation), the precise boundaries of such changes are unclear—for example, with regard to whether and how firm-level structures and processes should change accordingly. These challenges can also be addressed in future work.

We selected the IT industry because the performance implications arising from managerial attention to EE are likely to be observed more clearly and within a shorter time span than in many other industries (Vagnani, 2012). That is, the actual exploitation and exploration activities in an IT firm are likely to be quickly adapted to changes in managerial attention. The lead times of major exploration efforts are extremely long in several other industries; for example, firms in the consumer electronics or pharmaceutical industries engage in explorative projects that may take 10–15 years (or longer) from first idea to market introduction. The management teams of these firms therefore tend to craft strategies that have a rather long time horizon and are less likely to be adapted along the way, even in a global economic recession. Future work in this area will serve to establish the extent to which our findings can(not) be generalized.

This study draws on letters to shareholders to capture managerial attention to exploitation and exploration. Some researchers have criticized the use of letters to shareholders because they are, to some extent, written for "impression management" purposes (Yadav *et al.*, 2007). That is, letters to shareholders are sometimes considered to be deliberately crafted to manipulate the perceptions of external audiences, rather than being a governance and procedural channel that adequately reflects managerial attention inside the company. If this would be the case, then the metrics of cognition derived from letters to shareholders would not predict the actions and performance of the firm in the

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future. However, a substantial body of research has confirmed that the content of these letters has a systematic effect on firm actions and performance (D'Aveni and MacMillan, 1990; Noble *et al.*, 2002; Yadav *et al.*, 2007; Tetlock *et al.*, 2008; Vagnani, 2012), thereby demonstrating that these letters do adequately reflect managerial attention.

Our main finding is that, in times of strong economic upheaval, the distribution of managerial attention to exploitation and exploration needs to be adjusted to effectively deal with environmental changes. Navigating an economic downturn demands more managerial attention to exploration, while leveraging the subsequent upswing requires more attention to exploitation. As such, this study provides a dynamic perspective on ambidexterity.

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