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Consistently Capricious: Simultaneous and Sequential Exploration and Exploitation

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Abstract

Recent research has identified several mechanisms to overcome the inherent tensions between exploration and exploitation within organizations (Raisch & Birkinshaw, 2008; Lavie, Stettner & Tushman, 2010). In this paper, we focus upon the method of temporal separation in which corporations alternate between periods focused on discovery and experimentation and times concentrating upon refinement and efficiency. We argue that most organizations actually combine simultaneous and sequential balancing. This is confirmed by our observations. Since both methods have their obvious benefits, we hypothesize that the performance effects are contingent upon firm-specific factors: its environmental velocity, its resource endowment and its business strategy. By testing our theory on observations of innovation ambidexterity for a subset of Fortune 500 firms over a ten-year period, we find partial support for our hypotheses. Particularly corporations rich in financial and technological resources can benefit from a more radical implement of dynamic sequential ambidexterity compared to a static simultaneous approach.

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Consistently Capricious

The Performance Effects of Simultaneous and Sequential Exploration and Exploitation

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Abstract

Recent research has identified several mechanisms to overcome the inherent tensions between exploration and exploitation within organizations (Raisch & Birkinshaw, 2008; Lavie, Stettner & Tushman, 2010). In this paper, we focus upon the method of temporal separation in which corporations alternate between periods focused on discovery and experimentation and times concentrating upon refinement and efficiency. We argue that most organizations actually combine simultaneous and sequential balancing. This is confirmed by our observations. Since both methods have their obvious benefits, we hypothesize that the performance effects are contingent upon firm-specific factors: its environmental velocity, its resource endowment and its business strategy. By testing our theory on observations of innovation ambidexterity for a subset of Fortune 500 firms over a ten-year period, we find partial support for our hypotheses. Particularly corporations rich in financial and technological resources can benefit from a more radical implement of dynamic sequential ambidexterity compared to a static simultaneous approach.

Introduction

The majority of publications on innovative ambidexterity have consistently argued that maintaining a tight balance between exploration and exploitation improves the financial and operational performance of organizations. In reality, however, we observe a large variation over time in the levels of exploration and exploitation of a substantial group of firms. These firms seem to maintain a balance not only simultaneously, but also concurrently. We therefore ask ourselves the questions what the performance effects of temporal balancing are? And under what circumstances it is more beneficial than a concurrent implementation? We find that both periods of simultaneous and concurrent exploration and exploitation increase firm financial results, but also that internal and external differences moderate their performance.

Ambidexterity, as a unique managerial capability of maintaining equilibrium between optimizing short-term performance and preparing long-term survival, has therefore rapidly gained attention in managerial theory and practice (Raisch, Birkinshaw, Probst & Tushman, 2009). According to this view, corporations should efficiently capitalize on their existing skills and competences while maintaining their flexibility to effectively adapt to or lead in changes in the industrial environment. Most existing publications on ambidexterity have focused on the organizational hurdles to perform exploration and exploitation simultaneously (Raisch & Birkinshaw, 2008). As such, they have proposed several potential solutions for the inherent frictions between them. However, relatively little research (Piao, 2010; Sasson & Minoja, 2010) has been done concerning performing exploration and exploitation activities sequentially.

We address the gap in the empirical literature by asking whether and under what conditions sequential balancing is preferred over simultaneous balancing. The former allows an organization to focus on one particular type of activities with all benefits of specialization accordingly, but involves the risks of overexploration and overexploitation, while the latter eliminates this risk but poses the challenge of reconciling the opposing types of activities (Chen & Katila, 2008).

Our initial analysis, similar to Rosenkopf and Nerkar (2001), immediately shows that most firms apply a dynamic approach mixing concurrent and consecutive balancing. Therefore it seems hard to predict that one strategy might be superior to another. Instead, we focus upon the conditions under which more specialized periods of exploration or exploitation are preferred over a static simultaneous balance. In high-velocity industries firms should be very reactive to changes because of high uncertainty levels (Davis, Eisenhardt & Bingham, 2009; McCarthy, Lawrence, Wixted & Gordon, 2010). As such, simultaneous balancing should be preferred over consecutive periods of experimentation and refinement. Nevertheless, firms with more resources can take more risks since they are less influenced by industry conditions (Cao, Gedajlovic & Zhang, 2009; Greve, 2007). These

firms can therefore obtain the benefits of separating exploration from exploitation over time. Finally, the ambidexterity approach should be aligned with the corporate strategy (Auh & Menguc, 2005).

When testing our theoretical arguments, we find no direct effect of simultaneous or sequential balancing on firm performance. Instead, all effects are conditional upon the moderating factors. Firms with higher resources endowments are most likely to benefit from temporal separation whereas the effects of industry volatility remain unconfirmed.

This investigation contributes to the existing stream of research on ambidexterity by further conceptualizing temporal balancing. First, we develop sequential balancing as a viable alternative for simultaneous balancing of exploration and exploitation. Just like simultaneous balancing can be implemented in various ways (Lavie et al., 2010), there are also several options to execute temporal separation. We identified two axes among which firms can vary while using a successive approach. Future research should therefore no longer use annual observations, but see corporations' exploration patterns over a longer period of time to identify which ambidexterity strategy they use.

Second, we have shown that neither sequential nor concurrent ambidexterity is beneficial for large corporations. Instead, the increase in firm valuation is conditional upon environmental velocity and the organization's technological and financial resources. The robustness checks show that these effects are consistent independent of time windows or exploration-exploitation measurements used. So the results of balancing the opposing activities are likely to be contingent upon alternative factors. As a practical implication, managers should use a more holistic approach and align their ambidexterity practices with the firm resources and business strategy.

The remainder of this paper is organized as follows. To start with, we theoretically develop the concept of temporal balancing after quickly reviewing the ambidexterity paradox and simultaneous balancing mechanisms. Second, we predict if and under what conditions more temporal and less simultaneous balancing is preferred. Hereafter, the data collection method and measurement systems are described. Fourth, we test our ideas with the data and show the results of our analysis. Finally, the findings are discussed and avenues for further research are identified.

Ambidexterity theory

The ambidexterity paradox

The concepts of exploration and exploitation are currently burgeoning in the fields of organizational learning, technological innovation, and interorganizational cooperation. Despite their different interpretations and operationalizations, most studies refer directly to the ground-breaking work by March (1991) who introduced the opposing concepts of exploration and exploitation. Exploitation is related to refinement, efficiency and implementation (March 1991:71), which all have a clear focus on temporary solutions and interim results. Contrary, exploration is related to experimentation, variation

and discovery (March 1991: 71), implying a more costly search for a more durable competitive advantage. Ambidexterity is then the capability to reconcile conflicting short-range and long-standing organizational objectives (Gupta, Smith & Shalley, 2006). Combining both types of activities is required for corporation to prosper in the short term and survive in the long term (O'Reilly & Tushman, 2008).

At first sight, exploration and exploitation seems perfectly complementary activities (Lavie et al., 2010). Present-day exploration provides an organization with the new skills and competences it can capitalize upon in future periods whereas current exploitation provides the firm with rents necessary to finance next period's exploratory operations. A corporation's long-term strategic plan should assure that both types of activities are performed by the company in a well-adjusted and even-handed manner.

Unfortunately implementing an ambidextrous strategy is an almost bipolar process since exploration and exploitation are very different processes and put opposing demands upon an organization. Their mutually reinforcing nature is subject to a strong trade-off resulting from resource constraints, their different characters, limited managerial capabilities, and their self-reinforcing characteristics. To start with, both exploration and exploitation compete for the same limited organizational resources (Gupta et al., 2006; March, 1991). Since the available set of resources is fixed for a given point in time, dedicating more resources to experimentation will directly reduce the amount available for refinement at that moment. Second, exploration and exploitation require different styles of management, adapted organizational structures and distinctive sets of routines (Lawrence & Lorsch, 1967; Stettner & Lavie, 2011). An exploitation strategy is supported by a mechanistic setting with high levels of specialization, standard operating procedures and environmental stability (Burns & Stalker, 1961). Exploratory policies require a dynamic setting characterized by flexibility, informality and interaction. Moreover, even when corporations decide to structurally or temporally separate the rivaling processes, organizational discord will continue at a managerial level (Lavie et al., 2010; March, 1996). Limited managerial resources cause managers to devote an insufficient amount of time to create a precise equilibrium and limited cognitive abilities may cause non-consideration of a balance at all. Finally, both exploration and exploitation have the tendency to be self-reinforcing, meaning that firms can easily slip into modes of overexploration and overexploitation (Wang & Li, 2008). Overexploration results in underperformance because firms do not use their new skills and competences to their full degree. Overexploiting organizations become inert and irresponsive to environmental changes, which reduces their prospects for long-term continued existence.

Balancing mechanisms

Existing literature has offered roughly four methods to deal with the opposing demands for successful exploration and exploitation: contextual ambidexterity, structural separation, domain separation, and temporal separation (Lavie et al., 2010).

Contextual ambidexterity refers to facilitating, via supportive organizational structures and accommodating managerial practices, the simultaneous performance of exploratory and exploitative activities in all organizational units (Gibson & Birkinshaw, 2004; Kauppila, 2010). Creating a culture characterized by mutual support, pro-active behavior and strong goal alignment resolves the tensions caused by the conflicting nature of exploratory and exploitative maneuvers (Gibson & Birkinshaw, 2004). When modeled as a continuum in empirical studies, there is an optimal ratio of exploration-exploitation activities (Belderbos, Faems, Leten & Van Looy, 2010; Jansen, Van den Bosch & Volberda, 2006; Lin, Yang & Demirkan, 2007). In an orthogonal view, both exploration and exploitation efforts have shown to improve financial performance (Auh & Menguc, 2005; He & Wong, 2004), particularly when combined (Gibson & Birkinshaw, 2004) or balanced (Cao et al., 2009; He & Wong, 2004).

Structural separation means practicing exploration and exploitation concurrently in different organizational units (Raisch & Birkinshaw, 2008; Raisch et al., 2009). In this solution, certain departments will have an organic setting facilitating exploration while other units are more mechanic to concentrate upon exploitative activities. Managers are then responsible for creating mechanisms that integrate the outcomes of both activities (Lawrence & Lorsch, 1967). Schulze, Heinemann and Abedin (2008) found strong support for the benefits of structural separation: partitioning resource experimentation and utilization over different units combined with strong integration mechanisms improves operational and strategic performance.

Domain separation is the simultaneous execution of exploration and exploitation in different organizational domains (e.g. alliances, innovation, production) (Lavie & Rosenkopf, 2006). Contrary to structural separation, domains are not linked to particular organizational units and thus support simultaneous exploration and exploitation in the same location. It resolves the trade-offs between the two activities by employing them in different domains. Lavie and Rosenkopf (2006) found significant negative interdependencies among exploration rates in different domains. Moreover, Stettner and Lavie (2011) have shown how market value increases when firms do not combine but specialize in four different organizational domains. At the same time, financial valuation further increases when corporations gain ambidexterity over these domains.

Finally, temporal separation implies that an organization alternates between periods of exploitation and periods of exploration (Gupta et al., 2006; Raisch et al., 2009). Overcoming the difficulties of a simultaneous trade-off, rotating efficiency and renewal focused periods provides benefits of specialization and coherence, but might also result in high costs of mode switching. Experiential

evidence of performance effects of temporal balancing is scarce, though it has been shown that companies interchanging stages of exploration and exploitation reduce their hazard rate (Piao, 2010) but also reduce their financial performance (Sasson & Minoja, 2010).

Sequential ambidexterity

Compared to other balancing mechanisms, temporal separation has received limited theoretical and empirical attention in the literature (with the notable exceptions of Chen & Katila (2008), Piao (2010) and Sasson & Minoja (2010)). So the questions that arise are: do firms actually balance exploration and exploitation over time? And if so, why? The answer to the first question seems to be affirmative: Rosenkopf and Nerkar (2001) show that there is significant variation in exploration rates over time within the same company. Similarly, we observe substantial temporal variance in patent new citations rates (a one-dimensional measure for exploration-exploitation balance) for some large companies, as revealed in Figure 1. Long-term averages on the other hand, also shown in Figure 1, are far less whimsical and show more stable trends over time.

INSERT FIGURE 1 HERE

Temporal balancing is achieving organizational ambidexterity by alternating between periods of exploration and exploitation (O'Reilly & Tushman, 2008). Since it can create ambidextrous organizations in the longer term, temporal separation is a viable alternative for the other methods separating exploration and exploitation over domains or business units (O'Reilly & Tushman, 2008). Organizations using this strategy pass through periods of (over)exploration and (over)exploitation while assuring that they are in equilibrium in the long run (Chen & Katila, 2008). Contrary to the other balancing strategies, the levels of exploration and exploitation are not (supposed to be) stable at each particular moment of time.

Whereas simultaneous balancing is often related to the theory of paradox (Andriopoulos & Lewis, 2009; Smith & Lewis, 2011), the sequential approach to ambidexterity is closer to organizational ecology punctuated equilibrium theories (Chen & Katila, 2008; Gupta et al., 2006). Organizational ecology explains how organizations in a particular environment go through loops of variation-selection-retention (Hannan & Freeman, 1977). Variation is the equivalent of a period of exploration where selection and retention are similar to an exploitative era (Chen & Katila, 2008). Insufficient or ineffective exploration will strongly reduce a corporation's survival prospects, particularly in periods of exploitation when competition for resources increases. Punctuated equilibrium is a particular branch of evolutionary theory and describes how long runs of stability are followed by relatively short

sprints of radical change (Gersick, 1991; Tushman & Anderson, 1986). Similarly, temporal cycling can be implemented as going through long periods of alignment focused on efficiency and short periods of adaptation via experimentation (Gupta et al., 2006). Both organizational ecology and punctuated equilibrium assume exploration and exploitation to be driven by the external environment, but ambidexterity theory argues otherwise and supposes that corporate executives will actively pursue an optimal balance irrespective of the environment.

Firms will apply sequential ambidexterity because it provides risks and benefits different from simultaneous ambidexterity strategies. Compared to other mechanisms, temporal separation excels in creating consistency, dealing with bounded rationality, and improving flexibility. First, by concentrating on either exploration or exploitation at each period in time, the organization is able to overcome the incompatibilities between the types of activities. In any form of simultaneous balancing, firms are faced with the opposing demands of each type (March, 1991). Their opposing demands for flexibility, efficiency, agility and rigidity require specific organizational cultures, procedures and configurations. Cycling through periods of exploration and exploitation overcomes these issues because an organization can reform itself to garner the full benefits of mode specialization (Chen & Katila, 2008). Second, temporal ambidexterity is easier to combine with the limited cognitive abilities of employees (March, 1991). All the alternative balancing strategies assume simultaneous exploration and exploitation somewhere in the organization (employees or managers). But sequential ambidexterity on the other hand does not demand employees or managers to be ambidextrous. Instead, it permits them to specialize in either type of activities. Finally, temporal balancing provides a firm with more flexibility because it can easily change the duration of a particular period if changed circumstances require doing so (Chen & Katila, 2008). Contextual ambidexterity and structural separation keep the balance between exploration and exploitation stable over time because they assume there is a static optimum. But rotating periods of exploration and exploitation permits organizations to remain in or quickly switch to a particular mode if the environment demands to (O'Reilly & Tushman, 2008).

Still, balancing over time is not without risks and organizations can easily fall into the traps of overexploration and overexploitation (Chen & Katila, 2008; Wang & Li, 2008). The activities have a strong positive feedback loop, meaning that once an organization is in a particular mode, the cost of changing mode will almost certainly outweigh the expected benefits. This causes organizational inertia that eventually will become a huge liability for the corporation. Therefore temporal balancing requires particular managerial insight and strong firm capabilities.

Implementing sequential ambidexterity

Sequential and simultaneous ambidexterity are not mutually exclusive. Actually, all organizations usually apply both of these methods but to different extents. In fact, Laplume and Dass (2009)

developed a typology describing four modes based whether a firm applied concurrent and/or consecutive ambidexterity. Perfect simultaneous balancing ('static ambidexterity') means that executives decide upon an optimal exploration-exploitation ratio and will pursue this level over time. Initially this leads to stable levels of experimentation and refinement over time, but it is questionable if such a stable balance remains beneficial in future times. In perfect temporal balancing ('cyclical ambidexterity'), an organization switches from a mode of complete (over)exploitation to complete (over)exploration and vice versa each new period. When applied, this puts great pressure on the organization to switch completely after a particular period of time. Whereas the perfect concurrent approach might be too static, the perfect consecutive method might be too extreme to implement. In reality, therefore, most organizations apply 'dynamic ambidexterity': a combination of concurrent and serial strategies whereby firms perform exploration and exploitation simultaneously, but at different levels in each period of time with an equilibrium in the long run.

When conceptualizing temporal balancing, we identified two dimensions additional to the average ratio (see Figure 2): magnitude and frequency. The extent to which an organization ranks higher on either one or both of these dimensions implies moving away from static ambidexterity towards cyclical or dynamic ambidexterity. Nevertheless, the average ratio of exploration-exploitation remains highly important. Because of their complementary nature, both activities need to be performed at equal levels to maximize performance (Wang & Li). But contrary to simultaneous balancing, sequential balancing argues that an equilibrium should be observed over a longer period of time and not constantly.

Magnitude refers to the extent an organization deviates from its average exploration-exploitation ratio at a particular point in time. The magnitude is simply the imbalance in exploration-exploitation activities at a specific moment. Organizations using a simultaneous balancing strategy try to minimize this magnitude to assure stable levels of exploration and exploitation over time. But organizations applying more dynamic balancing strategies allow for or go after certain degrees of magnitude. Perfect concurrent balancing actually maximizes the magnitude by alternating periods of full exploration and full exploitation. While such deviations have been related to underperformance (Wang & Li), the evidence remains inconclusive since we need to relate organizational results to both the long-term average and the temporal deviations to see its effects.

Frequency refers to the pace of switching between modes emphasizing exploration and emphasizing exploration. Firms that apply dynamic balancing methods will switch between exploration and exploitation at various points in time, but the rate at which they do this may vary. The frequency dimension of temporal balancing is hardly investigated in ambidexterity theory, but the alternative theories give some guidance. Organizational ecology predicts that firms will alternate at the pace of the environment: resource munificence and miserliness will permit or require mode switches. Punctuated equilibrium also predicts that the length of an exploration-exploitation cycle is led by the external environment. Moreover, it specifies that organizations spend most of the time in an

efficiency-focused mode and only a limited time in an experimentation-aimed mode. Changing between exploration and exploitation can involve significant firm resources and managerial attention. Therefore a high frequency and short cycles can hurt firm performance. Contrariwise, a low frequency might result in firms being misaligned with their environment and thus have lower results.

INSERT FIGURE 2 HERE

Hypotheses development

Compared to simultaneous balancing methods, the performance effects of sequential ambidexterity are ambiguous. Whereas there are clear benefits like reduced trade-offs, there are also some risks and extra costs involved, such as the efforts to switch from one mode to another. Similarly to the contradictory evidence on concurrent balancing (e.g. Doganova, Colombo, Piva & D'Adda (2011) vs. Stettner & Lavie (2011)), we argue that there are no clear performance effects for temporal ambidexterity. Instead, the results are more likely to be dependent on moderating variables. Past research has often identified that the outcomes of exploration and exploitation are strengthened by, altered by, or conditional upon related factors. We will therefore make predictions about the effects in combination with the environment, resources, and firm strategy.

Environmental velocity

The role of environmental uncertainty and dynamism on exploration and exploitation rates is undeniable (Lavie et al., 2010; Raisch & Birkinshaw, 2008). More volatile industries demand higher levels of exploration for organizations to survive. With an uncertain future, flexibility and diversity are vital competences (Davis et al., 2009). In environments with high levels of competition, rapid technological innovations and a fluctuating market demand, the speed of adaptability to new circumstances is an essential capability. Exploration not only facilitates rapid adjustment, but also allows the firm to remain at the competitive edge and cause these environmental changes (Sidhu, Commandeur & Volberda, 2007). At the same time, these firms are also in need of strong exploitation competences since their time to exploit the outcomes of experimentation and variation is shorter and competitive advantages fade quickly (McCarthy, Lawrence, Wixted & Gordon, 2010).

In simultaneous balancing strategies, the impact of environmental velocity alters the optimal level of exploration-exploitation ratios (Davis et al., 2009; Uotila, Maula, Keil & Zahra, 2009). In sequential balancing strategies, firms have alternative means to adapt their ambidexterity strategy to the environment. However, the optimal exploration exploitation ratio will still affect the performance

differently in high-velocity industries. Therefore we argue that the initial effects of ambidexterity are more pronounced in such environments.

Hypothesis 1: Environmental velocity strengthens the relationship between the average rate of exploration and exploitation over time and organizational performance.

When organizations apply sequential ambidexterity, they have to optimize the opposing effects of rate magnitude. First, being more exploratory or more exploitative brings the benefits of specialization and more internal consistency (Lin et al., 2007). However, it also brings larger risks and changing costs (O'Reilly & Tushman, 2008). Moreover, firms might have to forego opportunities to explore or exploit when they appear quickly and last shortly. Particularly this last negative effect will be more important in volatile industries where changes occur very often and opportunities generally last shortly. In these environments, corporations should actually limit their temporal variation and tend more towards simultaneous ambidexterity. Especially the magnitude of temporal ambidexterity, the extent to which firms become fully exploratory or exploitative, will hurt organizational performance when using sequential balancing in uncertain industries.

Hypothesis 2: Environmental velocity negatively moderates the relationship between the magnitude of balancing exploration and exploitation over time and organizational performance.

Besides the potential negative effects of magnitude, the pace at which an organization goes through periods of exploitation and exploration might also have an impact on firm performance. Being too slow in alternating exploratory and exploitative cycles results in periods of undercapitalizing on new innovations (too long in exploration) or being temporally misaligned with the environment (Wang & Li, 2008). Being too fast means firms will not fully employ their innovations (too short in exploitation) and take insufficient time to properly experiment with new methods. As such, the frequency of changing from an exploitative to an exploratory mode and vice versa will depend on the dynamism of the industry. In low-volatile environments, companies can remain longer in a particular mode: the competitive advantage created by extensive exploration will endure longer and as such allow a larger pay-back period (Cao et al., 2009; Garcia, Catalone & Levine, 2003). For that reason we propose that the optimal length of periods of exploration and exploitation activities depends on the environmental dynamics.

Hypothesis 3: Environmental velocity positively moderates the relationship between the frequency of alternating exploration and exploitation over time and organizational performance.

Firm resources

The organization's resource endowment has been identified as a second contingency factor for both the performance effects as well as ambidexterity itself (Lavie et al., 2010). Resource-munificent corporations are less restricted by the competition for resources between exploration and exploitation (Raisch & Birkinshaw, 2008) but face less market pressure. So it should be easier for them to attain an optimal ambidextrous position, but there is less incentive to do so. Whereas Cao et al. (2009) shows that large organizations benefit more from exploration and exploitation (independent of balancing), alternative studies reveal that more slack resources strengthen particular the outcomes of exploratory activities (Greve, 2007; Kyriakopoulos & Moorman, 2004; Sidhu et al., 2007). Similarly, resource-scarce firms might become exploitation-focused since it requires smaller investments and better predictable returns. Instead, resource-deprived organizations should face more pressure to explore since the absence of firm slack does not allow them to miss out on new opportunities. Both arguments agree that resource-poor firms will face most difficulties when they attempt to balance, which is empirically supported by Lin et al. (2007). Besides simple financial assets and technological skills, absorptive capacity is another organizational skill related to ambidexterity. More absorptive capacity might reduce the costs for exploration since firms can easily acquire new knowledge from their environment (Cohen & Levinthal, 1990; Lavie et al., 2010) and it also strengthens the performance effects of exploitation (Rothaermel and Alexandre, 2009).

We argue that the organization's resource endowment moderates the relationship between its long-term exploration-exploitation ratio and its performance. Increasing exploration rates is usually risky since firms invest too much in projects with unpredictable outcomes (March, 1991). However, more exploration also increases the probabilities of more successful innovation. Resource-rich firms can afford such a strategy since they have the necessary means for exploration present internally and have sufficient slack to continue exploitation concurrently or at later points in time (Lavie et al., 2010).

Hypothesis 4: Firm resources positively moderate the relationship between the average rate of exploration and exploitation over time and organizational performance.

Firm's resources will positively influence the effects of exploration rate magnitude on firm performance. As stated before, larger magnitudes provide the benefits of task specialization at the costs of larger efforts to switch modes and risks of overexploration and -exploitation (Piao, 2010). It is likely that excess resources will mitigate the drawbacks of larger magnitudes. First, more financial, technological and human assets permit a firm to increase the magnitude (Greve, 2007). Implementing and changing from entirely exploratory to a purely exploitative mode (perfect sequential balancing) requires significant time and effort. Second, a larger degree of specialization increases the effectiveness of a firm's operations, but also involves forgoing some opportunities (O'Reilly &

Tushman, 2008). Firms with less slack are unlikely to sustain such a strategy. Strong exploration means postponing the immediate gains of exploitation and strong exploitation implies increased risk of going out of business. The benefits of larger deviations from the mean exploration rate are therefore smaller or non-existent for resource-deprived companies, but obtainable for resource-rich firms.

Hypothesis 5: Firm resources positively moderate the relationship between the magnitude of balancing exploration and exploitation over time and organizational performance.

More firm resources in combination with a (higher) frequency of alternating exploration and exploitation will improve performance. Higher frequencies means shorter cycles of exploration-exploitation within a firm (Laplume & Dass, 2009). Whereas it increases the resources spent on changing modes, it allows for faster utilization of newly explored opportunities. Corporations using simultaneous ambidexterity approaches will not face these switching costs of frequency, but face other obstacles by explore and exploit continuously. We argue that a higher frequency is (more) beneficial in combination with adequate organizational resources. More financial resources allow the management to spend more time and effort on switching. Besides, firms that have built up internal and external absorptive capacity will face less difficulty in changing mode. Moreover, technological knowledge also facilitates an easy transition since having more organizational knowledge makes it easier to exploit existing resources (Rothaermel & Alexandre, 2009) or increase the current knowledge base (Cohen & Levinthal, 1990) quickly. All in all, more organizational resources facilitate an easier transition between the different modes of ambidexterity and as such improve their combined financial performance.

Hypothesis 6: Firm resources positively moderate the relationship between the frequency of alternating exploration and exploitation over time and organizational performance.

Business strategy

Besides environmental volatility and organizational resource endowment, we identified market positioning as a third related factor. Again, business strategy has been recognized as both determinant of the exploration-exploitation ratio as well as moderating factor for its relation to performance (Raisch & Birkinshaw, 2008). We link temporal balancing to firm strategy by via the aggressiveness strategy continuum introduced by Miles and Snow (1978). Firms with a prospector strategy are constantly searching for new product and market opportunities to exploit (Miles & Snow, 1978; Miles, Snow, Meyer & Coleman, 1978). A larger part of their resources are dedicated to searching incremental and radical improvement to retain their innovator status. Built-in flexibility provides the

abilities to move and use new opportunities quickly. A defender strategy, at the other extreme of the continuum, involves constant optimization of the organizational resources to obtain current market dominance (Miles & Snow, 1978). By constantly improving production and distribution efficiency, firms with a defender strategy gain larger market shares and are able to influence and restrain intra-industry competition. Therefore they adopt a mechanistic structure with tough control and supervision.

Traditionally prospector strategies have been linked to exploration while defender strategies are related to exploitation (Auh & Menguc, 2005). Prospectors apply more aggressive business strategies and create dynamic organizations to identify new opportunities faster and experiment more effectively. Kyriakopoulos and Moorman (2004) show that firms with a stronger market orientation receive larger returns on their exploratory activities.

Hypothesis 7: The business strategy aggressiveness positively moderates the relationship between the average rate of exploration and exploitation over time and organizational performance.

The relationship between exploration rates and firm strategy seems intuitive, but it is less clear how strategy is related to simultaneous or consecutive balancing. In simultaneous balancing, the performance of prospectors is closely aligned with exploration activities but they only benefit limitedly from creating a balance (Auh & Menguc, 2005; Kyriakopoulos & Moorman, 2004). This intrinsic tension indicates that prospectors can benefit from sequential balancing. Compared to companies with more conservative strategies, prospectors will gain benefits by adopting more extreme swings. By using larger degrees of exploration and exploitation at different points in time, prospectors can extensively create and examine new opportunities followed by a period of intense exploitation afterwards. Such an aggressive approach mitigates the risk of underperformance, the primary peril of this strategy (Miles et al., 1978). It is not immediately clear if or how defenders can benefit from temporal ambidexterity compared to concurrent methods because their mechanistic strategy is based on stability and reliability.

Hypothesis 8: The business strategy aggressiveness positively moderates the relationship between the magnitude of balancing exploration and exploitation over time and organizational performance.

When organizations apply temporal separation of their exploration and exploitation activities, the length of a full cycle will be part of the ambidexterity strategy decided upon by the executives. Top management has to make sure that its ambidexterity approach matches with the business strategy (Operti, Carnabuci & Kovacs, 2011; O'Reilly & Tushman, 2008). Prospectors actively pursue all opportunities, meaning intensive exploration and rigorous exploitation, so their cycles should be relatively short when they apply temporal separation to prevent foregoing opportunities. A contrary

argument is related for defenders. When a company with a less aggressive approach uses sequential balancing tactics, it should maintain long cycles of exploration and exploitation. A high frequency of switching its attitude undermines the dependability and steadiness its business strategy is based upon. So as to align business strategy with the implementation of consecutive ambidexterity, organizations with prospector strategies perform better when mode changing frequency is higher and enterprises with defender strategies achieve better results with longer exploration-exploitation cycles.

Hypothesis 9: The business strategy aggressiveness positively moderates the relationship between the frequency of alternating exploration and exploitation over time and organizational performance.

Methodology

Contrary to previous empirical studies that focused on organizational ambidexterity within a particular industry or within a particular organization, we analyze the exploration and exploitation activities of large corporations in several industries to test our hypotheses. We have collected a ten-year long panel dataset of the firm financial performance and contemporary innovative ambidexterity for a large set of Fortune 500 companies.

Setting & data collection

The sampling frame of this study are all corporations part of the 1990 Fortune 500 index. The Fortune 500 is an annual index of the five hundred largest U.S. corporations ranked by their revenues. This sampling frame was used to improve the generalizability and validity of our findings. It also enhances the data collection since performance and operations accounts of Fortune 500 companies are normally publicly available. Finally, we overcome one limitation by not restricting the sample to a single corporation or industry. We collected financial and operational data about these companies over the period 1990-2000. A substantial number of corporations disappeared over time because of mergers, acquisitions, or firm failures. After excluding financial intermediaries and removing incomplete records as well, the final sample consists of 241 corporations with 1,797 firm-year observations.

Regarding ambidexterity, the empirical investigation concentrates upon the domain of innovation with a one-dimensional interpretation of exploration-exploitation. Corresponding to March (1991) who focused on ambidexterity in organizational learning, we look at the knowledge acquisition and utilization domain. The clear relation between learning types and innovation helps to improve the construct validity. Also in line with March (1991), we assume that exploration and exploitation are both extremes of the same continuum. In the literature, however, it remains debatable if both activities

are continuous or orthogonal (Gupta et al., 2006; Lavie, Stettner & Tushman, 2010; Raisch et al., 2009).

Solely archival data was used to circumvent sampling and perception biases. The primary data sources are Standard & Poor's CompuStat, providing the majority of the financial and operational data in the dependent, moderating, and control variables, and the National Bureau of Economic Research (NBER) Patent Data Project (Hall, Jaffe & Trajtenberg, 2001) for primary data on innovation ambidexterity. From each source, longitudinal data has been collected for a period of at least a decade to observe the short-term and long-term effects of ambidexterity.

Measurement

Dependent variable

Organizational performance is measured by the firm's Tobin's Q. We have chosen Tobin's Q over alternative accounting-based measures for two reasons. First, it is a forward-looking measure, whereas different return-based performance indicators (ROA, ROE, ROI) only consider the current results (Belderbos et al., 2010). Second, Tobin's Q captures both short-term and long-term effects of exploration and exploitation. The numerator, the market capitalization of the company, comprises all expected future cash flows (Uotila et al., 2009).

Independent variables

Ambidexterity is based on a single, continuous variable of exploration-exploitation. To measure organizational learning (exploration), we use the patent new citations rate with a five-year look back window. Patent citations are required links to existing similar work and are a commonly used measure for knowledge flow and learning (Jaffe, Trajtenberg & Henderson, 1993). The cited patents are often consulted by inventors to get detailed information about the functioning of a technology (Trajtenberg, 1990). When citations are repeated, it is considered exploitation because a company is re-using its knowledge. New citations, however, reveal learning by the organization and are therefore exploration. For each corporation the annual exploration rate (#new citations ÷ #total citations) as a ratio between 0 (pure exploitation) and 1 (pure exploration) has been calculated. Subsequently temporal ambidexterity measures have been calculated by looking at a ten-year time window.

Average exploration rate is the average patent new citations rate over a ten-year moving time window. As seen in Figure 1, the exploration rate varies significant per year, but the ten-year average seems quite stable over time.

Magnitude of temporal balancing is measured as volatility (standard deviation) in the exploration rate over a similar ten-year moving window. Firms applying simultaneous ambidexterity should ultimately show no volatility in their exploration rate whereas organizations using sequential

balancing should at least show a moderate variance. Since the exploration rate is a limited variable (ranging between 0 and 1), we divide the standard deviation by the potential maximum given its average rate to create a commensurable measure.

Frequency of alternating is measured via the sum of absolute changes in the exploration rate of a corporation over the same ten-year moving window. The sum of absolute changes in exploration rates captures the speed of change. Since the sum of absolute changes depend both on frequency as well as volatility, the sum is divided by the standard deviation of the exploration rate to correct for this.

The measures for magnitude and frequency are quite robust in capturing their constructs. For instance, when calculated for the patterns shown in Figure 2, similar magnitudes are found for each column and equal frequencies among the two rows. Data for patent citations was obtained from the NBER Patent Data Project (Hall et al., 2001).

Moderating variables

Environmental velocity is a composite score of industry concentration, R&D intensity, advertising intensity, and growth. Each variable captures a separate element of uncertainty. Industry concentration and growth captures the competitive uncertainty (McCarthy et al., 2010): the concentration indicates current intensity of competition while industry growth indicates the changes in competitive intensity. Technological uncertainty is measured via the industry R&D intensity, the fraction of total industry sales spent on R&D. Higher expenditures on R&D implies faster rates of innovations in the sector (Uotila et al., 2009; Vaaler & McNamara, 2010). Advertising intensity, the fraction of total industry sales spent on advertising, measures the market's competitive intensity. A one-dimensional composite score was created by obtaining the rotated principal-component factor. As expected, concentration is negatively related to velocity while the other three factors contributed positively. Data for industry concentration and growth stems from the Annual Survey of Manufactures database by the U.S. Census Bureau and data for R&D and advertising intensity from the R&D Ratios and Budgets dataset and the Advertising Ratios and Budgets dataset published by Schonfeld & Associates.

Firm resources is a composite score of patent stock, net income, and R&D expenditure. Patent stock (the number of patents granted during the past five years) is a simple measure of the firm's technological resources (Silverman, 1999). Companies can exploit their patents in new products and processes or use them for further exploration by recombination. Net income is used as an indicator of financial resources within the corporation. Past studies (e.g. Greve, 2007; Lin et al., 2007) have sometimes used alternative measures like firm size, quick ratio or current assets. But they do not always capture the exact size of the financial resources since some measures are too generic and ratios ignore the exact size. Net income on the other hand is an absolute measure of profits. Firm R&D expenditure proxies the absorptive capacity the organization develops over time (Cohen and Levinthal, 1989; 1990). A one-dimensional composite score was created by obtaining the rotated principal-

component factor. As expected, each factor contributed positively. Financial data was obtained from Compustat and patent data from the NBER Patent Data Project.

Business strategy is operationalized by combining corporate R&D and advertising intensity (Miles et al., 1978). Prospectors will aggressively pursue new opportunities. In the innovation domain, this implies larger R&D expenses relative to its sales. Additionally, these companies also advertise more intensively to exploit their resources better. Defenders on the other hand, with their conservative cost-focused strategies, will try to refrain from these costs. Again, we calculated a composite score with principal-component factor analysis. Compustat was used to obtain firm-level data on R&D expenditures, advertising costs and firm sales.

Control variables

We added a number of control variables that are known to influence the market-to-book value of the corporation. First, we controlled for *firm age* and *firm size*. Older companies have more experience and should therefore have higher valuations (Cyert & March, 1963), so the age in years is included. Firm size, its annual sales in millions, affects market valuation in a similar way.

Second, we control for firm diversity and slack. More diverse firms might explore more because of their different resources and opportunities, but they tend to be undervalued on the market by the diversification discount (Campa & Kedia, 2002). Therefore we include *diversity* as a count measure of the number of industry segments at the two-digit SIC level that the corporation operated in. *Slack* is known to influence overall levels of innovation (Nohria and Gulati, 1996) and measured via the organization's quick ratio. Data stem from Compustat Fundamentals and Compustat Business Segment.

Finally, we controlled for several interorganizational activities: acquisitions, alliances, and corporate venture capital investments. Interorganizational cooperation is known to influence the organizational exploration rates and even its levels of ambidexterity (Rothaermel & Alexandre, 2009), but may also have a direct of upon firm valuation. Therefore we include the number of *acquisitions*, new *alliances* and new *CVC investments* executed in a particular year. The Securities Data Company (SDC) M&A database, its joint venture and alliance database, and Thomson's VentureXpert database were consulted for these measures.

Estimation method

We employ ordinary least square regression analysis with time and firm fixed effects to test all hypotheses. Since Tobin's Q is a continuous and normally distributed variable, OLS is an appropriate method. Time fixed effects were included to control for the strong contemporary trends in market valuation. Firm fixed effects were applied to capture the impact of unobserved corporate-specific heterogeneity on the dependent variable. Fixed effects was preferred over random effects as the

Hausman test indicated (X^2=58.55; p<0.01). The independent variables are lagged by one period to improve internal validity and reduce potential reverse causality issues. Several variables, including the dependent variable, were skewed to the right and so log-transformations were performed. The various predicted interaction effects can easily lead to multicollinearity, so we normalized all independent and moderating variables before entering them in the regression.

Results

Table 1 displays the descriptive statistics and Pearson correlation coefficients of the independent, dependent and control variables. The descriptive statistics are the variables before any transformation has been performed, while the correlation coefficients are calculated after their transformations. The correlation table gives limited indications for multicollinearity: despite almost all variables being significantly correlated, none of the correlations exceeds 0.7 though firm resources are strongly related to several control variables.

INSERT TABLE 1 HERE

Table 2 provides the results of the fixed effects OLS regression. Model 1 shows the effects of the control variables upon firm valuation. Firm age has a significant positive effect: one additional year increases Tobin's Q on average with 4%. Remarkably, firm size has a strong consistent negatively impact on firm performance whereas diversification has a marginally positive effect. This was contrary to our expectations. Interorganizational activities matter as well: alliances are negatively related to the firm's valuation whereas CVC investments increase its value. Year fixed effects (not shown in the table) show significant variation, in accordance with the cyclical nature of financial markets. The control variables combined with time and firm fixed effects explain almost 22% of all variation in market-to-book values.

INSERT TABLE 2 HERE

Of the moderating variables (model 2), only firm resources seems to have a direct effect upon the corporation's value (p<0.01). Industry velocity has a consistent negative coefficient, but does not reach significance. Business strategy seems unrelated to the firm's Tobin's Q.

In our theory on temporal separation, we did not predict any direct effects of its implementation. As we argued, temporal separation might only be beneficial under particular circumstances. This is confirmed in model 3 showing that none of the elements has a significant effect upon market-to-book value. Long-term exploration rates, magnitudes, and frequencies are seemingly unrelated to investors' assessments of its future returns.

Since the correlation table showed potential multicollinearity, we entered the interaction effects independently in models 4-6 whereas model 7 combines all factors. Model 4 tests the first three hypotheses. Hypothesis 1 predicted that industry volatility would amplify the effect of exploration on performance. The direct effect of average exploration is negative, but not significant. In combination with higher environmental velocity, higher levels of exploration actually hurt performance. So hypothesis 1 is only partially supported. We find no significant support for hypothesis 2 forecasting a negative effect of magnitude in highly uncertain industries. Hypothesis 3 predicted positive effects of mode switching frequency within high-velocity industries, but we find no support for that. Actually, model 7 shows a marginally significant opposite effect ($p<0.07$).

Firm resources do not only have a direct impact on Tobin's Q, but also change the dependent variable in combination with temporal balancing. Model 5 shows how firms with more resources should focus on exploitation to augment their valuation. Though the result is not significant ($p<0.08$), it strongly reject hypothesis 4 predicting the opposite. Hypothesis 5 and 6 predicted that resource-rich firms can benefit from temporal separation by specializing more in one particular mode and switching modes more frequently over time. This is strongly supported by the analysis.

The combination of an aggressive business strategy with sequential ambidexterity provides no additional benefits (model 6). First, the intuitive relation between a prospector strategy and exploration does not exist. Instead, the analysis shows that it is more desirable for pro-active corporations to focus on exploitation. Hypothesis 8 predicted that firms with a more aggressive strategy boost their market-to-book value if they implement temporal balancing with a larger magnitude. Though marginally significant ($p<0.06$), there is insufficient support to proof this. Hypothesis 9, predicting a positive combined effect of strategy and short exploration-exploitation cycles, also lack empirical support.

Robustness checks

We performed several additional checks to see if our analysis are influenced by measurement or estimation biases. A subset of the outcomes of these robustness checks is included in Table 3 and 4. First, multicollinearity potentially biased our results by decreasing the significance of the explanatory variables. The VIF statistics actually confirmed our suspicion by showing inflation factors over the value of 10 for firm size (17.3) and firm resources (16.0). So we re-analyzed the data with the same

estimation method while using robust standard errors. The results of this analysis are qualitatively the same (model 1 in Table 3).

INSERT TABLES 3 AND 4 HERE

Second, we checked if time windows influence our analysis. The patent new citations rate is now based on a five-year look back period. Whereas not uncommon, some papers have used longer time windows. So we recomputed the patent new exploration rate for time windows of 7 years and performed the same regression analysis (Table 3 model 2). Though the significance level of our predicting measures changed, they all indicate effects in the same direction.

Third, the ten-year window we use to measure temporal balancing is arbitrary chosen. We think that ten years is quite similar to the length of an economic cycle and if temporal balancing is related to the environmental circumstance, our ten-year window should capture the complete cycle. Nevertheless, we also tried shorter time windows of five years (model 3) and seven year (model 4) and find similar effects.

Fourth, patent new citation rates has sometimes argued to be an overly precise measure for learning: when an organizations cites a patent for the first time, it might already have been familiar with the knowledge that specific patent is based upon. So we also measured exploration via the patent new classes rate: the number of patents cited from patent classes the firm has not used before. This measure is more restrictive (e.g. exploration rates are much lower). This provides slightly different results, but the main effects are confirmed (see model 5 in Table 3).

Fifth, while some studies have found direct linear effects of exploration and/or exploitation, other studies have found that there is a non-linear effect with an optimal balance. In our linear conceptualization of temporal separation this was not present. So we included the quadratic terms of average exploration rate, its magnitude, and frequency. After recalculating the interaction effects, the results show no additional interesting effects (see Table 4 models 1-4).

Discussion

The outset of this paper was driven by a lack of conceptual and empirical research regarding temporal balancing. As a viable alternative to simultaneous balancing, temporal ambidexterity can provide significant benefits in dealing with the exploration-exploitation trade-off (O'Reilly & Tushman, 2008). However, a sequential approach towards ambidexterity increases the risks of trapping into modes of

overexploration and overexploitation. Limited empirical support for this strategy was potentially driven by measurement problems (for instance Piao (2010); Venkatraman et al., 2007).

Existing literature also described sequential balancing as an alternative for several simultaneous approaches. Instead, the data has shown that most of the corporations in our sample vary their exploration rates over time but not to the extremes, revealing that most organizations apply a dynamic strategy which combines both concurrent and cyclical elements (Laplume & Dass, 2009).

Most existing studies have insufficiently recognized the potential for dynamic ambidexterity by solely looking at the firm's exploratory and exploitative activities at particular points in time. Instead, by observing a corporation's operations over a longer time window, we reveal that executives balance both simultaneously and over time. However, like simultaneous balancing can be implemented via contextual ambidexterity or structural/domain separation, sequential balancing can also be executed in different ways. Each method is likely to influence firm performance in particular directions.

We have attempted to resolve this issue by developing a two-dimensional conceptualization of sequential ambidexterity. Whereas some authors already discussed the relevance of a single measure (e.g. Sasson & Minoja, 2010), this article introduced two factors that are mutually independent but combined exhaustive to describe the different options for consecutive balancing. Besides the average, we argue, exploration-exploitation research should also include magnitude and frequency to capture the organizations positions on the static-dynamic continuum of ambidexterity.

Whether firms should apply simultaneous or sequential balancing is hard to say. Both strategies provide their unique benefits and involve different risks, so their performance consequences are initially not clear. Nevertheless, under certain circumstances one approach might be superior to the other. Therefore we hypothesized no direct effects, but only effects that are combined or conditional upon other factors. Our first analysis confirms these expectations by showing no significant direct effects for dynamic or static ambidexterity. But most of the obtained results make us rethink the earlier posited hypotheses.

The attained effects of the average ambidexterity rate were all indirect. The exploration rate had no significant linear or curvilinear relation with the firm’s market-to-book value. This contradicts earlier studies that found either optimal exploration-exploitation ratios or a direct effect (e.g. Belderbos et al., 2010; Uotila et al., 2009). Our sample, large U.S. corporations, might explain why our results are different from the earlier findings. Also different from the previous studies, we used ten-year averages instead of a single year to capture the long-term effects. Nevertheless, the influence of average exploration rate in combination with industry velocity, firm resource endowment, and business strategy are significant. Higher exploration rates provide reduced benefits in uncertain industries. This finding is similar to Sidhu et al. (2007) who argued that the increased uncertainty of high-velocity industries undermines the benefits of explorations. Besides, the large firms in our sample might also lack the entrepreneurial capabilities of capitalizing on new inventions. Resource-rich corporations are also better off exploiting their assets and skills because the excess slack resources can easily result in

overexploration that leads to inefficiencies (Wang & Li, 2008). Companies that actively pursue new opportunities by investing heavily in R&D (for new products and technologies) and advertising (to attract new customers and increase market share) should be more focused in their innovation ambidexterity: they can increase their market capitalization by exploiting their current resources more and stressing exploration less. Auh and Menguc (2005) provide a more complex argument for that, combining competitive intensity, ambidexterity and business strategy, but our results seem to conform that prospectors do not per se benefit from more exploration and defenders not from more exploitation in itself.

While using a consecutive balancing method, managers need to decide upon the extent to specialize in exploration or exploitation. They can steer this via elements similar to simultaneous ambidexterity: the routines, structure and culture at the corporate, business unit and departmental level (Gibson & Birkinshaw, 2004). More intense specialization requires initially larger efforts, but it reduces the tensions between exploration and exploitation once in place (Stettner & Lavie, 2011). As we argued before, whether firms apply simultaneous or sequential balancing might not directly be related to performance. This is different from the results by Sasson and Minoja (2010) who observed direct negative effects from variance in market exploration and market exploitation by Norwegian banks. But in according with our predictions, magnitude only influences the corporation's Tobin's Q when combined with alternative factors. Here firm resources and business strategy provide positive effects. Firms that have more financial and technological resources and skills will, on average, increase their share price-to-book ratio substantially. More resources normally ease the competition between exploration and exploitation, but apparently also facilitate a more effective implementation of sequential ambidexterity. Potentially these companies are less subjected to external pressures and can therefore permit to deviate from a structure that carefully balances short-term and long-term returns (Chen & Katila, 2008; Raisch & Birkinshaw, 2008). Though not significant, results indicate that prospectors also benefit from a larger magnitude. These forward-looking companies might try to be more effective in exploration and exploitation by specializing in each mode over time. Such an approach is enabled by the dynamic and flexible organization created by following a prospector strategy. Defenders should actually face a penalty when using temporal separation since this strategy is incompatible with their focus on stability.

There is large variation in the cycle time of corporations. Some companies show substantial magnitudes over the ten-year period but limited annual changes though others show also large annual variation. A higher frequency of alternating between exploration and exploitation requires more managerial time and effort, but also allows for faster exploitation of new exploration. So the direct effect is ambiguous, as the analysis confirms. The conditional effects are also limited. Industrial velocity has often been related to more rewards for exploration (Davis et al., 2009; Jansen et al., 2006; Uotila et al., 2009; Vaaler & McNamara, 2010), but Sidhu et al. (2007) have shown that benefits of market exploration are actually lower in high-velocity industries because of the uncertainty. If

uncertainty is large, organizations should actually apply a simultaneous balancing mode or try to gain internally stable and predictable processes. A temporal approach to ambidexterity with frequent switching does not support this. The lack of results for frequency in combination with strategy implies that defenders and prospector equally benefit from frequent switching. This is remarkable since frequency seems detrimental to organizational stability and mechanistic efficiency of defenders (Auh & Menguc, 2005; Miles et al., 1978). As such, this finding should be investigated further. Organizations with higher levels of resources already receive higher market valuations and this effect is strengthened when combined with temporal separation. We interpret this as proof that sequential ambidexterity is more effective in maintaining, extending and exploiting the organization's resource base.

Managerial implications

Our findings have two major practical implications for managers. First, executives should develop a long-term strategy for innovation ambidexterity to improve their organizational performance. Whereas past studies have shown how exploratory and exploitative studies within a particular time period matter for organizational performance, we argue that these studies have missed the effects of temporal separation, which may provide alternative benefits to the organization. So if managers pursue the benefits of sequential ambidexterity, they should not try to optimize the short-term results, but focus on the long-term outcomes. This requires the careful development of and dedication to an ambidexterity strategy.

Second, managers should not consider innovation ambidexterity as an independent activity, but align it carefully with other factors. Several studies have already shown how the optimal execution of simultaneous balancing depends on alternative organizational characteristics. Comparably, the performance effects of sequential balancing also depend on other elements. This study has mainly shown that firms with plenty technological and financial skills and resources do not benefit from more exploration, but from larger and quicker variation in exploration rates. So directors should decide upon an ambidexterity approach in combination with other strategic decisions and plans.

Limitations and future research

This study on temporal separation of exploration and exploitation is a first attempt to rigorously investigate its performance consequences. Nevertheless, like every study, it is subject to some deficiencies and remaining questions that provide guidance for future research. Most of the operationalization biases have already been investigated in the robustness checks, but there are also some more serious weaknesses. First, we only focused on ambidexterity within the innovation domain. Whereas innovation is closely related to March's (1991) organizational learning, it is only one of the elements in which firms can develop. Actually, recent research has shown that firms do not only

balance over time, but also over domains like product innovation, geographical expansion, and market exploration (Stettner & Lavie, 2011). So future research should focus on the combination of balancing over time and domains.

Second, we operationalized exploration and exploitation as ends of an ambidexterity continuum. The debate on continuity vs. orthogonality is on-going and both methods have shown to be useful (Gupta et al., 2006; Raisch et al., 2009). Our current measures can easily be transformed into two independent measures of exploration and exploitation by using the method of search depth and scope of Katila and Ahuja (2002). Future research can then investigate whether the volatility in the ratio between these two activities or in both measures independent matters more for temporal ambidexterity.

Finally, as with most moderating variables, they might also be determinants of exploration and exploitation (Lavie et al., 2010). When executives recognize the importance of environmental and firm characteristics, they will align their approach towards ambidexterity with them. As such, what initially was a moderator now becomes a contingency factor and ambidexterity actually becomes a (partially) mediating variable. We have not checked for that in this study, but leave it up to future investigation.

Conclusion

Our empirical findings indicate under what conditions temporal balancing is preferred over simultaneous balancing. It also suggests how corporations should implement simultaneous balancing. Nevertheless, "the precise mix of exploitation and exploration that is optimal is hard to specify" (Levinthal and March, 1993). Contrary to earlier research (Hoang & Rothaermel, 2010; Lichtenthaler, 2009; Uotila et al., 2009), our study finds no direct benefits of exploration or exploitation for large companies. Instead, the performance implications of exploration depend on environmental velocity, firm resource endowment, and business strategy.

Our data have shown that all firms apply a dynamic balancing method by combining simultaneous and sequential ambidexterity. Like concurrent ambidexterity (Lavie et al., 2010), there are different ways to implement consecutive ambidexterity. We developed a two-dimensional scheme revealing how organizations deviate from perfect simultaneous balancing to more temporal balancing strategies. The optimal combination of temporal and simultaneous balancing depends on several firm and environmental characteristic. When executed correctly, temporal balancing can significantly increase the market valuation of the corporation.

As a result, corporate executives should carefully develop long-term plan for organizational ambidexterity (Gibson & Birkinshaw, 2004). Instead of continuously trying to maximize short-term results, better results can be obtained by looking at long-term effects. Similarly, since performance is influenced by the combination of current exploration with past exploration, a new form of path

dependency has been introduced. Future research should further specify how managers can optimize their market valuation by aligning their approach towards long-term ambidexterity with related factors.

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Tables & figures

Table 1 – Descriptive statistics and correlation coefficients

	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Tobin's Q	0.925	0.810	-3.317	4.116	1													
2. Expl. Rate	0.000	0.995	-3.317	2.146	-0.277	1												
3. Expl. Magnitude	-0.005	0.982	-1.647	4.084	-0.133	0.186	1											
4. Expl. Frequency	-0.014	1.005	-2.337	2.848	-0.122	0.165	0.018	1										
5. Industry velocity	0.313	1.027	-3.541	15.540	0.254	-0.126	-0.155	-0.125	1									
6. Firm resources	0.296	1.313	-0.693	12.333	0.212	-0.225	-0.353	-0.346	0.243	1								
7. Business strategy	0.167	0.954	-0.967	4.468	0.421	-0.166	-0.181	-0.126	0.491	0.233	1							
8. Firm age	78.381	32.020	9	229	0.044	-0.205	-0.097	0.085	-0.123	0.045	-0.118	1						
9. Firm sales	8.291	1.136	5.807	12.071	0.178	-0.182	-0.370	-0.251	0.036	0.677	0.082	0.150	1					
10. Diversification	2.993	1.759	1	13	-0.088	0.031	-0.135	-0.038	-0.149	0.157	-0.246	0.147	0.311	1				
11. Quick ratio	-0.115	0.493	-2.746	1.839	0.017	0.086	-0.029	-0.080	0.198	0.149	0.137	-0.204	-0.171	-0.088	1			
12. Acquisitions	2.027	3.831	0	55	0.187	-0.093	-0.129	-0.140	0.091	0.491	-0.026	0.071	0.414	0.310	0.065	1		
13. Alliances	4.412	11.152	0	174	0.065	-0.051	-0.254	-0.229	0.192	0.654	0.182	-0.072	0.473	0.100	0.061	0.364	1	
14. CVC investments	0.650	6.519	0	179	0.153	-0.056	-0.021	-0.107	0.220	0.327	0.075	-0.045	0.173	0.080	0.078	0.334	0.156	1

N=1,797. Note: Positive and negative correlations greater than 0.06 are significant at $p<0.01$ level

Table 2 – Fixed effect OLS regression models

	(1) Ln Tobin's Q	(2) Ln Tobin's Q	(3) Ln Tobin's Q	(4) Ln Tobin's Q	(5) Ln Tobin's Q	(6) Ln Tobin's Q	(7) Ln Tobin's Q
Firm age	0.043***	0.043***	0.041***	0.040***	0.039***	0.041***	0.040***
	(0.005)	(0.005)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Firm size	-0.158***	-0.195***	-0.199***	-0.197***	-0.273***	-0.202***	-0.255***
	(0.046)	(0.048)	(0.048)	(0.048)	(0.049)	(0.047)	(0.048)
Diversification	0.025*	0.025*	0.024*	0.024*	0.020	0.021	0.019
	(0.014)	(0.014)	(0.014)	(0.014)	(0.013)	(0.013)	(0.013)
Quick ratio	0.029	0.024	0.021	0.025	0.034	0.025	0.039
	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)
CVC investments	0.006***	0.004**	0.004**	0.003	-0.004*	0.003*	-0.004*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Alliances	-0.013***	-0.011***	-0.011***	-0.010***	-0.009***	-0.009***	-0.008***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Acquisitions	0.003	0.002	0.001	0.002	0.005	0.003	0.006
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Industry velocity		-0.018	-0.017	-0.028*	-0.016	-0.017	-0.023
		(0.014)	(0.014)	(0.015)	(0.014)	(0.014)	(0.015)
Firm resources		0.076***	0.074***	0.071***	0.323***	0.051**	0.263***
		(0.024)	(0.024)	(0.024)	(0.046)	(0.024)	(0.047)
Business strategy		0.002	0.002	-0.004	-0.032	-0.020	-0.043
		(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)
Expl Rate			-0.032	-0.028	-0.019	-0.031	-0.016
			(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
Expl Magn.			-0.022	-0.020	-0.023	-0.012	-0.010
			(0.027)	(0.027)	(0.027)	(0.027)	(0.027)
Expl Freq.			-0.015	-0.013	-0.028*	-0.008	-0.012
			(0.016)	(0.017)	(0.016)	(0.016)	(0.016)
Rate * Ind. Velocity				-0.038***			-0.012
				(0.013)			(0.013)
Magn. * Ind. Velocity				0.021			0.004
				(0.014)			(0.014)
Freq. * Ind. Velocity				-0.007			-0.024*
				(0.012)			(0.013)
Rate * Firm Resources					-0.033*		-0.016
					(0.018)		(0.019)
Magn. * Firm Resources					0.175***		0.146***
					(0.029)		(0.030)
Freq. * Firm Resources					0.057***		0.045***
					(0.011)		(0.012)
Rate * Business Strategy						-0.142***	-0.113***
						(0.019)	(0.020)
Magn. * Business Strategy						0.046*	0.015
						(0.024)	(0.024)
Freq. * Business Strategy						0.020	0.021
						(0.014)	(0.016)
Observations	1,797	1,797	1,797	1,797	1,797	1,797	1,797
R-squared	0.217	0.223	0.224	0.229	0.255	0.253	0.273
Number of corporations	241	241	241	241	241	241	241
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1							

Table 3 – Robustness checks

	Robust standard errors	Seven-year look back period	Five-year temporal balancing	Seven-year temporal balancing	Learning based on classes
	(1)	(2)	(3)	(4)	(5)
	Ln Tobin's Q	Ln Tobin's Q	Ln Tobin's Q	Ln Tobin's Q	Ln Tobin's Q
Firm age	0.040***	0.040***	0.027***	0.032***	0.043***
	(0.010)	(0.007)	(0.006)	(0.006)	(0.005)
Firm size	-0.255***	-0.254***	-0.100**	-0.128***	-0.272***
	(0.092)	(0.049)	(0.044)	(0.046)	(0.049)
Diversification broad	0.019	0.018	0.019	0.015	0.020
	(0.018)	(0.013)	(0.013)	(0.013)	(0.013)
Quick ratio (log)	0.039	0.032	0.033	0.044	0.024
	(0.060)	(0.037)	(0.035)	(0.036)	(0.037)
CVC new investments	-0.004*	-0.004*	-0.003	-0.005**	-0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Alliances	-0.008**	-0.009***	-0.008***	-0.007***	-0.014***
	(0.004)	(0.003)	(0.002)	(0.002)	(0.002)
Acquisitions	0.006	0.006	0.009**	0.009*	0.005
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Industry velocity	-0.023	-0.023	-0.024*	-0.023	-0.033**
	(0.017)	(0.015)	(0.015)	(0.015)	(0.016)
Firm resources	0.263***	0.256***	0.240***	0.273***	0.432***
	(0.062)	(0.047)	(0.045)	(0.047)	(0.056)
Business strategy	-0.043	-0.040	-0.059**	-0.066**	-0.019
	(0.039)	(0.030)	(0.029)	(0.029)	(0.031)
Expl Rate	-0.016	-0.013	-0.040*	-0.014	0.055**
	(0.044)	(0.032)	(0.021)	(0.025)	(0.028)
Expl Magn.	-0.010	-0.014	0.045**	0.038*	0.028
	(0.039)	(0.027)	(0.019)	(0.022)	(0.031)
Expl Freq.	-0.012	-0.005	0.019*	0.009	-0.010
	(0.025)	(0.016)	(0.011)	(0.013)	(0.016)
Rate * Ind. Velocity	-0.012	-0.012	-0.018	-0.020	-0.031*
	(0.017)	(0.013)	(0.012)	(0.013)	(0.016)
Rate * Firm Resources	-0.016	-0.019	-0.002	-0.006	0.152***
	(0.023)	(0.019)	(0.019)	(0.019)	(0.033)
Rate * Business Strategy	-0.113***	-0.116***	-0.090***	-0.090***	-0.105***
	(0.028)	(0.020)	(0.017)	(0.018)	(0.023)
Magn. * Ind. Velocity	0.004	0.002	0.013	0.015	0.010
	(0.014)	(0.015)	(0.014)	(0.015)	(0.017)
Magn. * Firm Resources	0.146***	0.143***	0.159***	0.156***	0.097**
	(0.039)	(0.032)	(0.030)	(0.031)	(0.043)
Magn. * Business Strategy	0.015	0.020	-0.016	-0.003	0.064**
	(0.034)	(0.024)	(0.021)	(0.023)	(0.026)
Freq. * Ind. Velocity	-0.024	-0.024*	-0.031**	-0.021	-0.007
	(0.016)	(0.013)	(0.012)	(0.013)	(0.011)
Freq. * Firm Resources	0.045**	0.042***	0.019*	0.038***	0.014*
	(0.018)	(0.012)	(0.010)	(0.012)	(0.008)
Freq. * Business Strategy	0.021	0.017	0.005	-0.020	0.011
	(0.020)	(0.016)	(0.012)	(0.014)	(0.016)
Observations	1,797	1,792	2,073	1,948	1,845
Number of corporations	241	241	286	262	244
R-squared	0.273	0.267	0.252	0.258	0.262

Table 4 – Quadratic checks (control variables not shown)

	(1)	(2)	(3)	(4)
	Ln Tobin's Q	Ln Tobin's Q	Ln Tobin's Q	Ln Tobin's Q
Firm age	0.039***	0.039***	0.042***	0.038***
	(0.007)	(0.007)	(0.007)	(0.007)
Firm size	-0.196***	-0.201***	-0.233***	-0.235***
	(0.048)	(0.048)	(0.049)	(0.049)
Diversification broad	0.024*	0.021	0.019	0.028**
	(0.014)	(0.013)	(0.014)	(0.014)
Quick ratio (log)	0.022	0.028	0.033	0.024
	(0.037)	(0.037)	(0.037)	(0.037)
CVC new investments	0.004**	0.001	-0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.002)
Alliances	-0.010***	-0.005**	-0.009***	-0.012***
	(0.002)	(0.003)	(0.002)	(0.002)
Acquisitions	0.001	0.002	0.002	0.004
	(0.004)	(0.004)	(0.004)	(0.004)
Industry velocity	-0.017	-0.036*	-0.012	-0.005
	(0.014)	(0.018)	(0.018)	(0.017)
Firm resources	0.071***	0.029	0.220***	0.167***
	(0.024)	(0.025)	(0.037)	(0.033)
Business strategy	-0.000	-0.018	-0.016	-0.041
	(0.030)	(0.032)	(0.031)	(0.032)
Expl Rate	-0.043	-0.057*	-0.017	-0.046
	(0.033)	(0.033)	(0.033)	(0.033)
Expl Rate Sq	-0.006	-0.025*	-0.008	-0.006
	(0.013)	(0.014)	(0.013)	(0.013)
Expl Magn.	0.003	-0.008	-0.008	-0.001
	(0.032)	(0.032)	(0.034)	(0.032)
Expl Magn. Sq	-0.020	-0.012	0.011	-0.020
	(0.013)	(0.012)	(0.014)	(0.013)
Expl Freq.	-0.011	-0.006	-0.013	-0.019
	(0.016)	(0.016)	(0.016)	(0.017)
Expl Freq. Sq	0.008	0.009	0.004	0.024**
	(0.010)	(0.010)	(0.010)	(0.011)
Rate * Ind. Velocity		-0.011		
		(0.015)		
Rate Sq * Ind. Velocity		0.011		
		(0.011)		
Magn. * Ind. Velocity			-0.005	
			(0.016)	
Magn. Sq * Ind. Velocity			0.003	
			(0.010)	
Freq. * Ind. Velocity				-0.012
				(0.013)
Freq. Sq * Ind. Velocity				-0.019*
				(0.010)
Rate * Business Strategy		-0.131***		
		(0.021)		
Rate Sq * Business Strategy		-0.004		
		(0.012)		
Magn. * Business Strategy			-0.004	
			(0.026)	
Magn. Sq * Business Strategy			0.010	

			(0.015)	
Freq. * Business Strategy				-0.005
				(0.015)
Freq. Sq * Business Strategy				0.023*
				(0.012)
Rate * Firm Resources		-0.073**		
		(0.032)		
Rate Sq * Firm Resources		-0.013		
		(0.014)		
Magn. * Firm Resources			0.195***	
			(0.039)	
Magn. Sq * Firm Resources			0.026	
			(0.024)	
Freq. * Firm Resources				0.059***
				(0.022)
Freq. Sq * Firm Resources				0.004
				(0.010)
Observations	1,797	1,797	1,797	1,797
R-squared	0.226	0.258	0.242	0.239
Number of corporations	241	241	241	241
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Figure 1 – Longitudinal view of firm exploration rates (patent new citations rates)

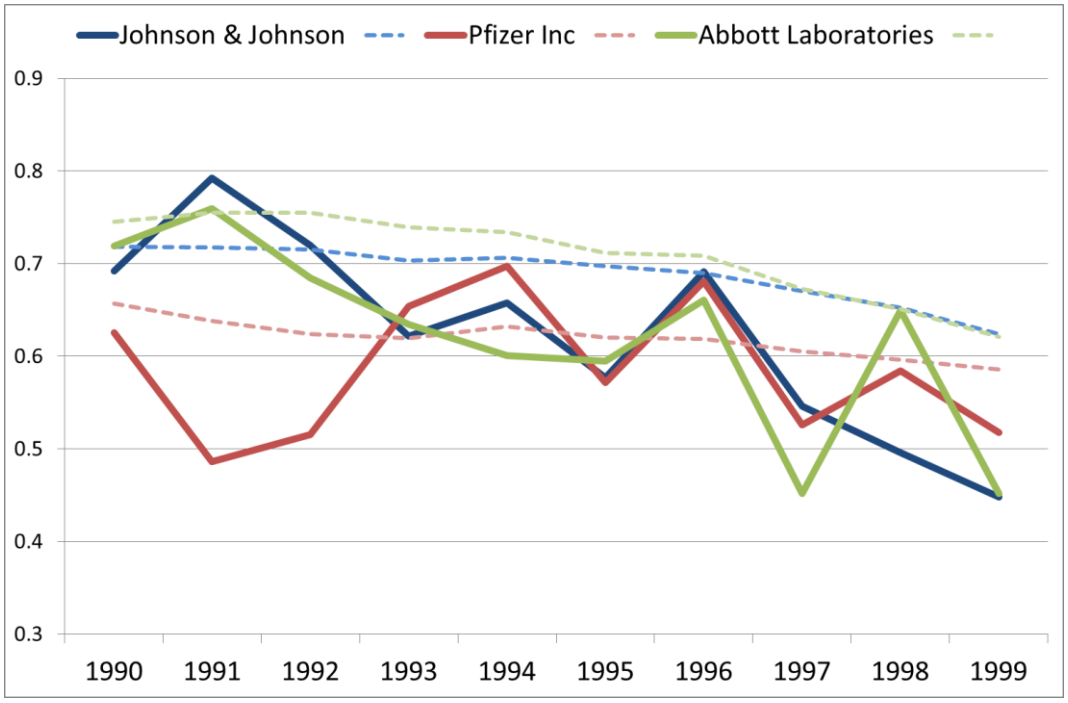

Figure 2 – Two-dimensional conceptualization of temporal ambidexterity