

The role of senior management in opportunity formation: Direct involvement or reactive selection?

Jay B. Barney¹ | Nicolai J. Foss² | Jacob Lyngsie³

¹Eccles School of Business, University of Utah,
Salt Lake City, Utah

²iCRIOS—Department of Management and
Technology, Bocconi University, Milan, Italy

³Strategic Organization Design, Department of
Management, Southern Denmark University,
Odense, Denmark

Correspondence

Nicolai Foss, Università Bocconi Dipartimento di
Management e Tecnologia, Milan, Italy.
Email: nicolai.foss@unibocconi.it

Research Summary: Much research suggests that entrepreneurial opportunities in established firms result from bottom-up initiative in a diverse workforce, senior management's main role in the entrepreneurial process is to select among opportunities generated in the bottom-up process, and it should refrain from directly getting involved in this process. We develop an alternative and more active view of the role of senior management in the opportunity formation process in which senior management intervenes in the entrepreneurial process to resolve coordination and collaboration problems across initiatives and decide on resource allocation. We proffer rival hypotheses concerning the effect of such senior management involvement in the entrepreneurial process. Specifically, we hypothesize that the positive relations between bottom-up initiative/employee diversity and opportunity formation are positively (negatively) moderated by such direct involvement by senior management. We examine these ideas using two matched data sources: a double-respondent survey of CEOs and HR managers and employer–employee register data. We find support for the view that senior management involvement positively moderates the relations between bottom-up processes/diversity and opportunity formation.

Managerial Summary: What are the processes through which entrepreneurial opportunities emerge in established companies? Research has pointed to diversity and bottom-up initiative, but our understanding is limited with respect to what senior managers should do to optimally promote entrepreneurship in such companies. In one view, senior management should keep a distance and limit their involvement to picking the best opportunities out of those they are presented with in the bottom-up process. In contrast, we argue that given bottom-up initiative

in the context of a diverse workforce, senior management should play a more direct role in the entrepreneurial process. The reason is that senior-management involvement at early stages of the opportunity formation process is required to handle the management challenges arising from diversity and bottom-up initiative. Overall, our study suggests that firms that wish to seize the potential benefits (in terms of entrepreneurial opportunities) of having a more diverse workforce and more bottom-up initiative need senior managers that directly engage in the entrepreneurial process.

KEY WORDS

bottom-up initiative, decision control, demographic diversity, entrepreneurship, opportunity formation

1 | INTRODUCTION

There is increasing interest in how entrepreneurial opportunities emerge in established companies (e.g., Foss & Lyngsie, 2014; Ireland, Covin, & Kuratko, 2009). Research points to two mechanisms within firms that have an impact on the emergence of entrepreneurial opportunities, namely intended, top-down planned processes and bottom-up autonomous processes (e.g., Burgelman, 1991, 2002). However, most scholars emphasize the autonomous, bottom-up process as the most important driver of such opportunities (e.g., Burgelman, 1991; Lovas & Ghoshal, 2000; Taylor, 2010)—especially when a firm has a diverse work force (Lyngsie & Foss, 2017; Østergaard, Timmermans, & Kristinsson, 2011). This view also stipulates that direct senior management involvement in this process is likely counterproductive. Thus, senior management should not directly engage with the process of opportunity formation, and mainly assume the role of approving or rejecting opportunities generated through the autonomous process (Burgelman, 1994; Foss, 2003; Lovas & Ghoshal, 2000).

While we acknowledge the importance of the autonomous process among a diverse workforce in generating entrepreneurial opportunities in established firms, we take issue with the view that senior management's role in the entrepreneurial process is mainly one of reacting to the opportunities that are generated in the bottom-up process (the “reactive selection view”). First, if senior managers are merely reactive, the autonomous process may generate initiatives that have little chance of ultimately being exploited, because they are too costly or inconsistent with a firm's strategy. The employees who developed such rejected projects may be discouraged and demotivated by this experience. Incentives to engage in bottom-up entrepreneurial activity are harmed as a result (Rotemberg & Saloner, 1994). Second, the reactive selection view fails to acknowledge organizational costs associated with generating opportunities through the autonomous process in the context of a diverse workforce. While earlier work suggests that such a context will generate many entrepreneurial opportunities, bottom-up initiative and diversity may both produce problems of cooperation and coordination that harm processes of opportunity formation. For example, demographic diversity can make it difficult for individuals within the firm to understand and coordinate their different entrepreneurial activities (Heath & Staudenmayer, 2000). Thus, bottom-up initiative in the context

of diversity presents distinct challenges in the entrepreneurial process that call for senior management involvement (the “direct involvement view”).

We proffer three hypotheses that we argue represent the “reactive selection view,” and we develop three rivalrous hypotheses that embody the “direct involvement view.” To test these, we analyze two matched data sets: a large scale, double-respondent survey of CEOs and HR managers, and a population-wide employer–employee register data. Our analysis suggests that both the positive relation of demographic diversity and “bottom-up” entrepreneurial initiative to opportunity formation are positively moderated by senior management involvement in the entrepreneurial process. These results are robust with respect to a variety of model specifications, and lend credence to the direct involvement view rather than the selective reaction view.

In sum, we contribute to the literature on, in particular, the relative roles of bottom-up initiative and top-down control in established firms (e.g., Burgelman, 1983a, 1983b, 1994). However, we frame this discussion in a novel manner by contrasting the established reactive selection view with our direct involvement view of senior management’s role in the entrepreneurial process. Empirically, we deploy a large-N research design that draws on unique data, and present several new findings relating to the combined influence of bottom-up initiative, employee diversity, and senior manager involvement in the entrepreneurial process.

2 | BACKGROUND

2.1 | Opportunity Formation

The entrepreneurial opportunity, a central construct in the entrepreneurship literature, may be defined as a potentially profitable but not yet exploited *project* (Casson & Wadeson, 2007).¹ Thus, it is more than simply any idea in the firm. At the same time, it is not so well articulated, tested, prototyped, etc., that it is ready for exploitation; thus, the formation of opportunities precedes the decision of whether to commit resources to the realization of the opportunity (i.e., formal evaluation of the opportunity). However, at the same time, opportunity formation is also upstream from initial loose idea generation. In general, opportunity formation denotes the process of forming a (likely loosely defined) idea into a workable project that can potentially be exploited. For example, a new product idea may undergo several iterations of refinement before a feasible project emerges that has enough content and structure to be more formally evaluated. The entrepreneurship literature mainly focuses on how opportunities relate to start-up firms. However, increasingly scholars, building on earlier contributions by Burgelman (1983a, 1983b, 1991) and others, seek to systematically understanding opportunity formation in established firms (cf. Foss & Lyngsie, 2014).

We here consider three sets of arguments and findings that are common in the literature on entrepreneurship in established firms: (a) a higher level of diversity among employees is associated with a higher level of formation of entrepreneurial opportunities; (b) opportunities in established firms are often formed deep within the hierarchy of a firm; and (d) senior managers are ineffective with respect to directly stimulating opportunity formation, and should keep a distance to the bottom-up entrepreneurial process, playing mainly a reactive role. The latter argument essentially amounts to the reactive selection view.

¹Much discussion in entrepreneurship has focused on whether these opportunities are “discovered” (Kirzner, 1973; Shane & Venkataaman, 2000; Shane, 2003), “created” (Alvarez & Barney, 2007), “imagined” (Foss & Klein, 2012), or result from “effectuation processes” (Sarasvathy, 2001). Our reasoning and findings are not dependent on any of these particular perspectives. Accordingly, we talk of the “formation of opportunities” which we consider to be terminology that is neutral to these debates.

We discuss each of these arguments in turn. As our empirical analysis is based on Danish register and survey data, we offer contextualization by drawing on illustrative Danish company examples.

2.2 | Employee diversity and opportunity formation in established firms

Research points to a number of reasons why employee diversity may be associated with the formation of opportunities in established firms. Research on creativity and problem-solving in groups suggests that, up to a point, increasing diversity in a group is often beneficial in terms of creative outcomes (Horwitz & Horwitz, 2007). For example, from a Schumpeterian perspective, innovative opportunities may emerge from knowledge combinations within a firm (Leiponen & Helfat, 2011). Such combinations are more likely to give rise to new innovative opportunities when employees are heterogeneous in terms of their education, age, gender, tenure, and experience, and thus are likely to have different perspectives on the technical and commercial problems (Galunic & Rodan, 1998; Nickerson & Zenger, 2004). Employee diversity may also positively influence the formation of opportunities when employees with different types of education, job histories, gender, etc., are positioned in different networks (e.g., communities of practice, academic associations, etc.). Some of these networks can cut across firm boundaries, giving the firm the potential to access external knowledge that can be leveraged in an innovation context (Chesbrough, 2003; Laursen & Salter, 2006; Leiponen & Helfat, 2011).

Finally, employee diversity matters for opportunity formation because different kinds of human capital lend themselves to different entrepreneurial tasks. In contrast to individual entrepreneurs, or small entrepreneurial teams, established firms often have access to large pools of heterogeneous human capital, which allow employees to specialize in different aspects of the entrepreneurial process (Foss & Lyngsie, 2014). Thus, firms can combine the efforts of employees who differ in terms of creative skills (creative processing skills, associational skills, and other traits) in a way that positively impacts the firm's entrepreneurial process (e.g., Hills, Shrader, & Lumpkin, 1999; Lumpkin & Lichtenstein, 2005).²

Increasingly, firms actively shape the composition of their workforces so as to support opportunity formation processes. For example, Danish facility services giant, ISS, has, after long being criticized for its lack of entrepreneurship, embarked on a series of diversity initiatives designed to improve productivity and innovation (ISS, 2017). The idea is to exploit that ISS is already highly diverse (in terms of gender, age, and country of origin) in a systematic manner in terms of team composition. While many of the resulting initiatives are quite incremental, the analytics carried out by the company indicates substantial productivity and earnings gains (ISS, 2017).

2.3 | Bottom-up initiative and opportunity formation in established firms

Empirical research, usually of the small-N variety, suggests that opportunity formation in established firms often starts deep within their organizational hierarchy (e.g., Brown & Eisenhardt, 1997; Burgelman, 1983a, 1983b; Foss, 2003; Taylor, 2010), and may only come to the attention of senior managers in a "bottom up" way (Burgelman, 1994). However, senior managers may design organizations to further opportunity formation from the bottom up (Lovas & Ghoshal, 2000).

²For example, drug-development processes in big pharmaceutical companies involve the application of an array of human-capital profiles, with micro-biologists, engineers, lawyers, economists, and business managers cooperating in the entrepreneurial process of creating new drug opportunities

A well-known example is the 1991 adoption by Danish hearing-aid producer, Oticon of the “Spaghetti Organization,” an extreme (for that time) example of radically decentralizing a company to stimulate bottom-up initiative in the service of innovation (Foss, 2003). This organizational form was based on delegating rights to employees that would motivate and enable them to come up with new project ideas, propose these to a board of senior managers who would evaluate projects based on simple financial criteria, hire project members, manage projects, make decisions on the pay of colleagues, etc. The design was instrumental in launching and developing numerous major innovation projects, saving the company from an impending bankruptcy and founding a trajectory of successful innovation that has continued to this day. However, the Spaghetti Organization was abandoned in 1996, partly because it resulted in too many uncoordinated initiatives (e.g., duplicative R&D and marketing efforts).

The thinking that informed the Oticon Spaghetti Organization was that employees at lower levels often possess superior knowledge of markets and technology (as compared to senior managers), and that delegation of decision rights is a means to motivate and enable employees to make use of this knowledge in an entrepreneurial manner (Jensen & Meckling, 1992). In addition to motivational issues, economizing on the costs of transmitting entrepreneurial knowledge inside a hierarchy offers a general rationale for delegation. Entrepreneurial initiatives often start from “hunches,” “flashes of insight,” and “judgment” that are costly to articulate, transmit, and receive (e.g., Alvarez & Barney, 2004; Foss & Klein, 2012), especially across multiple levels in a hierarchy (Galbraith, 1974). Delegating decision rights to engage in opportunity formation to lower levels helps economize on the costs of communicating such knowledge (Jensen & Meckling, 1992).³

2.4 | Opportunity formation and the role of senior management

Many scholars suggest that the role of senior management in the innovation and entrepreneurial process in established firms is inherently limited. Senior management may design an administrative framework that supports such processes (as in the case of the Oticon Spaghetti Organization). However, with respect to actual decision-making, senior managers should keep a distance to processes of idea generation and opportunity formation, and seek to restrict their involvement in the bottom-up process to approving or rejecting opportunities generated through this process (e.g., Burgelman, 1991; Foss, 2003; Lovas & Ghoshal, 2000). Thus, direct involvement by senior management in the process of opportunity formation is seen as counter-productive, particularly when this takes the form of “selective intervention,” that is, using fiat authority to directly influence resource allocation in early stages of the entrepreneurial process (Foss, 2003). The typical arguments in favor of the reactive selection view are that senior managers will often be constrained by a firm’s current definitions of lines of business, operating procedures, and dominant logic (Prahalad & Bettis, 1986); do not have enough detailed knowledge about what goes on in the opportunity formation process to warrant direct intervention (Jensen & Meckling, 1992); will often have a difficult time communicating subtleties about entrepreneurial opportunities across internal organizational boundaries; may be risk averse in proposing new and highly innovative opportunities (Amit & Wernerfelt, 1990); and demotivate employees who feel overruled by managerial interventions in the entrepreneurial process (Foss, 2003).

³Additionally, less senior members of a firm’s hierarchy can “make a name for themselves” by developing entrepreneurial opportunities that, *ex post*, turn out to create great value for the firm (Brown & Eisenhardt, 1997). Thus, the up-side potential for these kinds of innovative efforts is very high for more junior or lower-level employees.

To sum up, the thrust of prior research is that both employee diversity and bottom-up initiative are important for fostering opportunity formation in established firms, and that senior management's proper role in the entrepreneurial process is to keep a distance from the process itself and only reactively select among opportunities surfacing from the bottom-up process. However, this view may be contested. As an empirical example that a reactive selection approach may not always be optimal, the world's currently leading toy producer, Danish Lego Group, was on the brink of bankruptcy around 2004. This was partly caused by too little senior-level decision control of Lego's internal process of initiative generation, resulting in too many unconnected lower-level entrepreneurial initiatives (Foss, Pedersen, Pyndt, & Schultz, 2012). Subsequent changes in the internal structure of Lego involved redesigning the allocation of decision rights across the hierarchy in an attempt to better control local entrepreneurial initiative, and expanding the size of the senior management team, partly to allow for more direct control of the entrepreneurial process as it plays out at lower levels in the firm.

In the following we develop theoretical arguments why the dominant reactive selection view of the role of senior management in the entrepreneurial process may underestimate the need for senior management involvement in this process. We specifically discuss and empirically examine interactions among employee diversity, bottom-up initiatives, and senior-level involvement in the entrepreneurial process. Our basic argument is that high levels of diversity and bottom-up initiative may create outcomes at lower levels that necessitate senior management involvement. Because our emphasis thus is on interactions, we do not directly test main effect relations (e.g., whether employee diversity is associated with more entrepreneurial opportunities). We explicitly proffer rival hypotheses to account for both the established reactive selection view and our alternative direct involvement view.

3 | THEORY AND HYPOTHESES

3.1 | Bottom-up initiative, senior-level decision control, and opportunity formation

The view that the role of senior management in the entrepreneurial process should be a reactive one is based on a variety of arguments that assert the efficiency of delegating decision rights to entrepreneurial initiative to lower levels. For example, when relevant knowledge underlying such initiative is located at lower hierarchical levels, efficiently exploiting this knowledge calls for delegation (Foss, 2003; Jensen & Meckling, 1992). Additionally, the uncertainty involved in opportunity formation may require coordination by mutual adjustment, which necessitates a high level of individual autonomy (Galbraith, 1974; Lovas & Ghoshal, 2000).

However, in actuality senior management often has superior information of how a given entrepreneurial initiative may fit with the firm's core activities in terms of, for example, the required complementary assets and activities, spillover effects on other projects, what are the next opportunities that should be pursued, etc. (Day, 1994). Such information may warrant different forms of involvement by senior management, ranging from discrete signaling to direct "top-down championing."⁴ For example, the formation of IBM's famous 360 series was notable for the substantial and

⁴Indeed, Kuratko, Covin and Garrett (2009, p. 464) report cases where "the more successful ventures tended to originate as planned initiatives. The relatively higher success levels achieved by such ventures may be attributable to the fact that they were 'strategically legitimate' at their inception; that is, they were explicitly and formally recognized as desirable initiatives within their corporations' business portfolios. Such early legitimacy could increase the likelihood that the ventures would receive needed financial resources and other forms of support from the corporate parent."

continuous involvement of the CEO, Thomas Watson (Day, 1994). In other words, senior managers can work with protagonists of entrepreneurial initiatives at lower levels, and, for example, help projects to pivot if they encounter critical resource constraints, or if certain aspects do not make commercial sense. Such senior management involvement is supportive, and based on senior management's positive judgment of the commercial implications of the initiative.

However, senior manager involvement in the entrepreneurial process may also be of a corrective kind. The Lego and Oticon cases illustrate that bottom-up entrepreneurial processes can become too untrammeled, leading to problems of duplicative efforts, lack of knowledge sharing, harmful competition between projects and teams, initiatives that do not fit core business areas, and failure to recognize linkages between initiatives. While the highly asymmetric information and high uncertainty conditions that often characterize entrepreneurial processes complicate senior management involvement in the process, such involvement can reduce the coordination and cooperation problems that can arise as result of entrepreneurial bottom-up initiative. For example, senior managers may identify and terminate inefficient projects before formal evaluation, economizing on organizational resources. Senior management can also ensure that entrepreneurial initiatives are in line with the firm's overall strategic orientation (Rotemberg & Saloner, 1994). Therefore, the direct involvement of senior management in the entrepreneurial process can be "amplifying" in the sense that it strengthens the positive outcomes of bottom-up initiative. This line of reasoning motivates the following hypothesis:

Hypothesis 1 (H1a) *The positive association between bottom-up entrepreneurial initiative and opportunity formation is positively moderated by senior-level involvement in the entrepreneurial process.*

The reactive selection view, in contrast, proffers the opposite hypothesis:

Hypothesis 1 (H1b) *The positive association between bottom-up entrepreneurial initiative and opportunity formation is negatively moderated by senior-level involvement in the entrepreneurial process.*

3.2 | Employee diversity, senior-level involvement, and opportunity formation

Employee diversity is conducive to opportunity formation when different perspectives, insights, etc., brought on by differences in gender, job experiences, skill levels, types of education, etc., reveal otherwise unnoticed opportunities and prompt new ways of framing and solving problems. However, a high level of employee diversity may also pose distinct managerial challenges that are rooted in problems of coordination and cooperation. The many different individual and group identities and different ways of framing events and situations (Ancona & Caldwell, 1992) associated with a more diverse workforce can make agreeing on shared interpretations of internal exchanges and activities difficult (van Dick, van Knippenberg, Hägele, Guillaume, & Brodbeck, 2008), and even to communicate sufficiently. When a shared interpretation or framing is difficult to negotiate (Kaplan, 2008), because of the highly diverse backgrounds of organizational members, there is a risk of coordination failure (i.e., activities are not carried out at the right level, in the right way, at the right time, etc., because actors do not agree; Heath & Staudenmayer, 2000).

A high level of diversity in the firm's workforce may also cause cooperation problems (Foss & Weber, 2016). Research suggests that more heterogeneous individuals are less likely to exhibit helping behaviors (Broschak & Davis-Blake, 2006), may feel less group commitment (Jehn,

Northcraft, & Neale, 1999), and may be less trusting of each other. Additionally, high levels of heterogeneity constrain peer monitoring, particularly in situations where clear performance standards are absent: More heterogeneous employees may have greater difficulties establishing if a colleague's effort is subpar (Kandel & Lazear, 1992). As a result, employee diversity is more likely to give rise to problems of moral hazard, such as withholding effort in the process of opportunity formation (e.g., knowledge sharing that is beneficial to opportunity formation may not take place) (Holmström, 1989).

Such problems of coordination and cooperation call for senior management involvement in the entrepreneurial process (Elenkov, Judge, & Wright, 2005). In particular as, even informed, lower level managers may lack sufficient decision authority to address problems that cut across the firm. In contrast, senior management can utilize its fiat powers to do this (Richard, Barnett, Dwyer, & Chadwick, 2004). Resolving coordination and cooperation problems in the entrepreneurial process results in more opportunity formation. Therefore, we hypothesize the following:

Hypothesis 2 (H2a) *The positive association between employee diversity and opportunity formation is positively moderated by senior-level involvement in the entrepreneurial process.*

Although we do not know of any research proffering the reactive selection view that explicitly takes employee diversity into account, per extension the following hypothesis may be associated with this view:

Hypothesis 2 (H2b) *The positive association between employee diversity and opportunity formation is negatively moderated by senior-level involvement in the entrepreneurial process.*

3.3 | Bottom-up initiative, employee diversity, and senior-level involvement in the process of opportunity formation

Employees often possess superior "private" knowledge about customers, suppliers, and emerging technologies that can drive opportunity formation if this knowledge can be leveraged through bottom-up initiative. A more diverse workforce means more of such private knowledge and a greater plurality of perspectives, which is conducive to opportunity formation. However, as argued above, both bottom-up initiative and employee heterogeneity may independently give rise to cooperation and coordination problems that call for senior management involvement in the entrepreneurial process. In fact, the need for such involvement becomes *increasingly* pressing given a combination of bottom-up initiative and employee heterogeneity. The coordination and cooperation problems (duplicative efforts, losing sight of the big picture, agency problems, etc.) that may arise when decisions are delegated to lower-level employees are exacerbated by employee diversity because such diversity makes it harder to communicate, negotiate shared frames, monitor the efforts of peers, and so on. In fact, uncontrolled cooperation and coordination problems may effectively mitigate the positive effect of bottom-up initiative in a setting of high employee diversity, hence ensuring that projects fit with the firm's overall strategic orientation becomes imperative. While the benefits in terms of opportunity formation of having *both* bottom-up processes *and* high employee diversity may seem particularly strong, this combination also poses stark management challenges. As coordination of bottom-up initiatives by lower-level management becomes increasingly difficult in a setting with bottom-up initiative and high employee diversity, direct involvement by senior management is

increasingly called for. Thus, to realize the benefits from combining bottom-up initiative and high employee diversity, considerable involvement in the entrepreneurial process on the part of senior managers is required. This reasoning leads to our third hypothesis:

Hypothesis 3 (H3a) *Bottom-up initiative, employee diversity, and senior-level involvement positively interact, such that the positive interaction between bottom-up processes and employee diversity in terms of opportunity formation is increased by senior-level involvement in the entrepreneurial process.*

In contrast, by extension of the previous reasoning, we associate the following hypothesis with the reactive selection view:

Hypothesis 3 (H3b) *Bottom-up initiative, employee diversity, and senior-level involvement interact in terms of opportunity formation, such that the positive interaction between bottom-up processes and employee diversity is reduced by senior-level involvement in the entrepreneurial process.*

4 | DATA AND METHODS

4.1 | Data and sampling frame

To test the hypothesized relations we relied on two data sources. The first data source was a paired-respondent questionnaire that was sent to all Danish companies with more than 40 employees in 2009. Specifically, each company received two questionnaires: one addressed to the executive manager (e.g., CEO or president) and the other addressed to the most senior HR manager. The CEO questionnaire contained questions regarding the firm's entrepreneurial activities (e.g., number of formed opportunities and whether opportunity formation typically took place at the senior-management level). The questionnaire mailed to the senior HR manager addressed the firm's organizational design (e.g., the level of centralization, hierarchical levels within the organization). The public Danish statistics agency (i.e., Statistics Denmark) handled all administrative tasks related to the survey. Statistics Denmark sent the questionnaires directly to the relevant respondents. Specifically, each potential respondent received an email containing a short introduction to the survey and a personal password to complete the questionnaire online. Non-respondents received two email reminders before being contacted personally and offered an opportunity to complete the questionnaire by telephone.

Of the 3,409 questionnaires sent out, 654 pairs in which surveys were completed by both the CEO and the HR manager in the same firm were returned. This resulted in a response rate of 19.2%. To test the representativeness of the sample, comparison tests were conducted on respondents and non-respondents. No generalizable differences were found in terms of firm age, size, or industry association. Furthermore, we analyzed whether non-responding firms differed significantly from responding firms in terms of their employees' education level, firm tenures, and salaries. We did not find any substantial differences. We employed listwise deletion in case of missing responses to questionnaire items.

We accessed the second data source—the Danish Integrated Database for Labor Market Research (IDA)—through Statistics Denmark. It contains detailed information on all members of the Danish labor force. Approximately 170,000 individual employees were matched with their employing firm in the final sample. However, a cutoff limit was imposed for missing observations. As the analysis is at the firm level, firms missing employee observations (e.g., educational background) for

more than 5% of their workforce were deleted from the final sample.⁵ Although the imposed cutoff level resulted in a substantial reduction in sample size, this decision helped mitigate systematic biases caused by omitted variation in firms' employees. In combination, the listwise deletion and the cutoff resulted in a final sample of 473 Danish firms.

We tailored our research design to mitigate common method variance concerns (Podsakoff, MacKenzie, & Podsakoff, 2003). Thus, information on each firm was collected from two independent respondents with different areas of expertise. While the CEO is likely to be well informed about ongoing entrepreneurial activities, the HR manager may have a superior understanding of how these activities are organized. The use of objective register data to construct our main independent variable also serve to reduce common method variance resulting from reliance on the same source for the construction of multiple independent variables.

4.2 | Measures

4.2.1 | Dependent variable

The dependent variable (opportunity formation) was measured as the CEO's self-reported counts of new opportunities, in terms of new products, services, and markets that the firm had identified during 2007–2009. To guard against misreporting, the questionnaire emphasized that exploitation was not a requirement for opportunities to be reported. We also highlighted that minor modifications to existing products and services should not be considered new opportunities. The dependent variable was constructed as the sum of opportunities (of all three types).

Although pretests did not indicate any comprehension problems regarding opportunity formation as something that is different from opportunity exploitation, we note two concerns. First, our reliance on the CEO's response presumes that the CEO is informed about opportunity formation activities throughout the firm. We fully acknowledge that the CEO, and senior management in general, are unlikely to be informed about idea generation. However, opportunity formation represents more structured projects and thus is likely to be observable to senior-management before formal evaluation. The CEO's awareness of opportunities that has yet to be exploited may, however, be imperfect, as knowledge of such opportunities are likely to reside at lower levels, as we have argued. Thus, if the CEO is unaware of (some) opportunities, our measure may underestimate the true level of opportunity formation. To address this potential bias, we used a 3-year opportunity-formation timespan (similar to the way key variables are measured in the Community Innovation Survey), which helps smooth out sudden spikes or drops in the firm's opportunity formation, and reduces the likelihood that the CEO is generally unaware of instances of opportunity formation in the firm. Second, we rely on the covariance between CEO awareness of opportunity formation, the firm's organizational setup and individual characteristics of the senior management to systematically control for underestimation of opportunity formation. Thus, we include control variables based on their association with "true" opportunity formation as well as their indirect influence on the CEOs awareness of such activities.

4.2.2 | Independent variables

We used the IDA database to construct our measure of employee diversity. Diversity is a multi-dimensional and highly complex construct. Thus, we decided to adopt *employee educational diversity* as the relevant proxy. Education has previously been linked to opportunity formation

⁵We imposed the 5% cutoff level to mitigate the potential biases of a few individual observations unduly influencing the firm average, we imposed the 5% cutoff level.

(e.g., Ucbasaran, Westhead, & Wright, 2007). The variable was based on the individual educational backgrounds of all non-management employees. Although managers make up a relatively small proportion of the firm's overall workforce, they may be very different from lower-level employees in terms of educational background and job experience. Therefore, our independent variable measures the influence of the "average" employee on the firm's level of opportunity formation.

In conformity with the International Standard Classification of Education (ISCED), education was first decomposed into eight categories based on length and the qualifications provided (e.g., high-school diploma, bachelor's degree, master's degree, PhD). Given that the complexity of an educational area varies substantially between educational levels (e.g., between a bachelor of science and a master of science), we calculated educational diversity based on the number of different areas of study (e.g., humanities, natural science, social science, etc.) within the same level of education.⁶ Specifically, the sum of unique educational backgrounds was recorded for each education level. To produce a firm-wide measure, and to account for the indirect influence of firm size, we then summed all unique educational backgrounds and divided by the number of employees. Thus, educational diversity ranges from 0 to 1.

Centralization refers to the distribution of entrepreneurial decision-making authority within the firm. Respondents were presented with four different entrepreneurial decisions and asked to indicate the hierarchical level at which the authority to make decisions in relation to the activity was vested. The four activities, which were chosen to closely reflect key decisions related to the entrepreneurial process, were: (a) developing new products or services, (b) introducing major changes in marketing activities, (c) making significant changes in products and services, and (d) discontinuing a major product or service. Based on Miller and Droege (1986), the lowest level of centralized decision making was coded 0 and denoted "lower-level management" (e.g., functional managers, plant managers, regional managers, division managers). Conversely, the highest level of centralization was coded 3 and denoted "senior management" (e.g., executive director, deputy director). *We interpret high values of the centralization measure to reflect a high level of senior manager involvement in the entrepreneurial process.* Based on the scoring, we constructed an average composite measure of the centralization of entrepreneurial decision-making ($\alpha = 0.7$).

Bottom-up initiative measures whether the firm approaches opportunity formation as a bottom-up process. Thus, respondents were asked whether "the identification of new business opportunities primarily happens at the senior-management/corporate level." The variable was coded 1 if respondents answered "no" and 0 otherwise. Posing the question in general terms (i.e., "primarily happens") and using binary reporting help guard against misreporting in situations where opportunities are rarely recognized at lower hierarchical levels. Thus, the variable captures the firm's general acceptance of opportunity formation as a bottom-up process.

4.2.3 | Control variables

To guard against confounding effects stemming from underlying systematical differences implied that all models included control variables based on characteristics at the management, employee and firm-level.

Industry controls were based on level-one ISIC codes. These included: (a) manufacturing (used as the baseline category), (b) transportation and storage, (c) information and communication, (d) financial and insurance activities, and (e) administrative and support activities. These controls

⁶We disregard differences in study areas on the primary education level, as such differences are essentially inconsequential given the legal requirements for primary education.

were included because industry differences may drive the type of opportunities formation. In addition, industry affiliation is likely to relate to the educational background of the firm's human capital.

Senior management size was measured as the number of senior managers in the firm. A large number of senior managers is likely to influence senior management's awareness of the level of opportunity formation within the firm. Moreover, having more senior managers is likely to translate into smaller, more specialized areas of responsibility. This, in turn, indicates greater awareness of lower-level initiatives. Senior managers were identified through the IDA database as those employees with the highest job classification (e.g., CEO, director, administrative managers, commercial managers).

Although we used generic wording to measure centralization, we included a control for the number of *hierarchical levels* in the firm. This control was operationalized based on the HR manager's indication of the number of hierarchical levels from the CEO to the lowest level in the firm. The maximum number of levels was restricted to 10.

R&D activities indicate the extent to which the opportunity-formation process is formalized within the firm. All models included a binary control variable coded 1 if the firm had formal R&D activities.

The firm's general level of *work-process formalization* was included as entrepreneurial activities are often intertwined with mundane work processes. Highly formalized work processes may diminish the effect of bottom-up initiative on opportunity formation, as individuals rather passively follow preset instructions. To account for such confounding influences, we included an average composite measure of the firm's level of formalization. The measure was based on four items targeting different aspects of the firm's organizational environment. The first two items measured the firm's emphasis on "getting personnel to follow the formal procedures" and "letting the final say rest with the formal leaders" (on a scale from 1 to 7). The third item measured the extent to which training activities focused on "compliance with rules, regulations, and procedures." The last item measured the firm's focus on "compliance with preset behaviors, procedures, and standards" through performance appraisals. Empirically, the formalization measure demonstrated adequate internal consistency in conceptualizing firm-wide formalization ($\alpha = 0.7$).

Individual age has previously been linked to the entrepreneurial process; specifically, age is generally negatively associated with entrepreneurial risk-taking (e.g., Lévesque & Minniti, 2006). Even though engaging in entrepreneurial activities within an established firm may shield an individual from some of the risk associated with external entrepreneurship, these activities can still carry considerable risk. Given the resource commitment typically associated with developing new products or services, individuals' careers may be at risk if a decision to pursue an opportunity does not result in a successful launch. Moreover, educational background may influence the activities of older employees less than the activities of new graduates. On average, older employees are also more likely to have acquired substantial practical experience since completing their education. Therefore, in combination with the extended time since graduation, a higher average age of a firm's workforce is likely to diminish the diversity resulting from different educational backgrounds. Thus, a control variable measuring the *average age of the firm's non-management employees* was included in the models.

In addition to the influences mentioned above, the age of senior managers may also affect the firm's allocation of entrepreneurial decision control. Older, more seasoned managers may be less inclined to delegate decision rights to younger, less experienced employees. On the other hand, age may indicate more limited attention spans and time among senior-level managers. Thus, we included a control for the *average age of senior managers*.

The *tenure* of the firm's employees may have a direct impact on opportunity formation. Longer tenure may weaken the relation between diversity and opportunity formation, as employees become

complacent and docile, and tend to fall victim to groupthink (e.g., Hambrick & Mason, 1984). Among senior management, longer tenures may be associated with less willingness to break with tried and true routines, leading to less openness to new opportunities. Therefore, all models included controls for the *average tenure of senior managers* and the *average tenure of non-managerial employees*, which were measured as the average of all relevant individuals' years of employment in the focal firm.

As our measure of employee diversity is based on different educational specializations, we included a control for the average *educational level* of the firm's employees. Including this control ensures that an association between the general level of education and opportunity formation does not confound our measure of educational diversity. Based on the same categorization of educational background as our diversity measure, education level ranged from one (primary school) to eight (higher research education). A more educated workforce may be more capable of addressing complex problems and, thus, increase the firm's overall opportunity formation. Based on similar reasoning, we also included a control variable for average *senior-management education level*.

Firm size was calculated as the natural logarithm of the firm's total number of employees. Larger firms create more opportunities than smaller firms, all else equal. However, greater firm size is also likely to be linked to increased formalization and rigidity. Moreover, smaller firms may be more innovative in general due to self-selection of less risk-adverse employees (Parker, 2009).

Firm age is often argued to be negatively associated with innovation (Zahra & Covin, 1995). Employees in younger firms may be less constrained by formalized work processes, institutionalized ways of rewarding organizational members, path-dependent organizational beliefs and culture, and other legacies of a longer history. The greater flexibility in terms of what is allowed in younger firms may translate into more opportunity formation. Thus, firm age was included as a control.

New hires are likely to be a significant confounding factor when examining the relation between employee diversity and opportunity formation. New hires may bring different knowledge, unconventional routines, and different ties to the external environment with them. Moreover, new senior-level managers may influence the way rights to make decisions are allocated inside the firm. To reduce such confounding effects, we controlled for the proportional recruitment at both the non-managerial and senior-level. Individuals who were not employed by the firm in the previous year were identified using the IDA database.

We include a binary control for whether the firm was located in a larger *metropolitan* area. Metropolitan areas may offer a more diverse and highly educated supply of potential employees. Thus, firms located in municipalities with more than 50,000 inhabitants were coded 1, while all others were coded 0.

The final control variables relate to the composition of the firm's workforce. First, a control was included to capture the number of employees categorized as *occupational specialists*. Firms with a large proportion of highly specialized employees may simultaneously be more likely to have lower levels of educational diversity and be more focused on opportunity formation. Thus, based on the ISCO classification, we measured the number of employees performing jobs that required specialist knowledge at the highest level.

As the measure of employee educational diversity is based on unique educational areas, we included a control capturing the proportion of employees that share the firm's *dominant educational background*. Firms may have a high degree of educational diversity and simultaneously have core educational requirements. Thus, including the control ensures that educational diversity is not confounded by the firm's general educational profile.

4.3 | Method

Descriptive statistics and pairwise correlations are presented in Table 1.⁷

Table 1 reveals various interesting characteristics. Twenty-nine percent of all firms rely on bottom-up opportunity-formation initiative. The low frequency of bottom-up initiatives is perhaps surprising given the long-standing arguments for the benefits of relying on bottom-up processes. The mean age of senior managers is 46.6 years, while the corresponding number for lower-level employees is 40.4 years. There is also a strong negative correlation between the proportional amount of new hires and the average tenure and age of the firm's human capital. In other words, new hires appear to predominantly replace seasoned employees. The highest correlation (-0.79) in Table 1 is found between firm size and educational diversity. However, based on the average variance inflation factor of the full model, which is less than 2, the relatively high correlation did not raise actionable concerns.

As Table 1 indicates clear over-dispersion of the dependent variable, we used a hierarchical negative binomial model with robust standard errors for the regression analysis. Model 1 contains the control variables. Model 2 includes the direct associations of educational diversity, centralization, and bottom-up opportunity formation. Model 3 includes all two-way interactions. Finally, Model 4 includes the three-way interaction.

5 | RESULTS

In Model 2, the negative coefficient for centralization lends general support to the reactive selection view. Specifically, that direct involvement by senior-management is counterproductive to opportunity formation. Although the confidence interval includes small positive values ($p = 0.10$), a higher level of centralization appears to be generally associated with less opportunity formation. Estimations based on the sampled firms indicate that increasing centralization to one standard deviation above the mean leads to 10.5% less opportunity formation, on average; see Table 2.

In addition, we find that educational diversity is strictly positively (95% CI = [1.49–6.41]) associated with opportunity formation. Educational diversity is also economically meaningful, as increasing diversity by one standard deviation from the mean is associated with, on average, a 51.3% increase in opportunity formation.

Given the positive coefficient for bottom-up initiative (95% CI = [0.11–0.64]) in Model 2, a firm in which opportunity formation is dominated by bottom-up initiative will, on average, create 65.6% more opportunities than a firm in which opportunity formation is vested with senior-management. However, Hypothesis 1a/b specifies that opportunity formation is higher when bottom-up initiative is combined with a high/low level of senior management involvement in the entrepreneurial process. In model 3, the interaction between bottom-up initiative and such involvement, which is strictly positive (95% CI = [0.18–1.07]), is suggestive of a positive association. Thus, in a setting with more direct involvement by senior management in the entrepreneurial process (i.e., a higher degree of centralization of rights to make decisions over entrepreneurial projects), bottom-up initiative is more strongly associated with more opportunity formation.

To ease interpretation, given the non-linearity of the model (Ai & Norton 2003; Norton et al., 2004; Buis, 2010), we graph the average marginal effect of bottom-up initiative conditional on centralization, with 90% confidence intervals, in Figure 1. Average marginal effect (AME) is a common way of expounding results based on non-linear models. The average marginal effect of bottom-up

⁷Average firm size and standard deviation are presented in original values. Correlations are based on log transformation.

TABLE 1 Descriptive statistics and pair-wise correlations

Variables	Mean	SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Opportunity formation	11.65	21.11	1.00						
(2) Centralization	2.13	0.57	-0.04 (0.43)	1.00					
(3) Educational diversity	0.18	0.10	-0.01 (0.82)	-0.01 (0.89)	1.00				
(4) Bottom-up initiative	0.71	0.46	0.15 (0.001)	-0.06 (0.19)	-0.08 (0.07)	1.00			
(5) Formalization	4.64	1.12	0.001 (0.99)	-0.04 (0.42)	-0.13 (0.003)	-0.03 (0.58)	1.00		
(6) Dominant educational background	0.46	0.12	0.06 (0.22)	-0.02 (0.60)	-0.07 (0.11)	0.04 (0.36)	0.05 (0.33)	1.00	
(7) Senior management size	16.48	127	0.24 (0.000)	-0.09 (0.04)	-0.13 (0.01)	0.08 (0.10)	0.07 (0.13)	0.02 (0.63)	1.00
(8) Occupational specialist	23.18	70.32	0.10 (0.04)	-0.07 (0.11)	-0.23 (0.000)	0.13 (0.005)	0.01 (0.76)	0.21 (0.000)	0.21 (0.000)
(9) Avg. educational level	3.81	0.88	-0.03 (0.52)	0.01 (0.84)	0.26 (0.000)	0.04 (0.34)	-0.05 (0.28)	0.33 (0.000)	-0.08 (0.09)
(10) Avg. TMT educational level	4.85	1.09	-0.01 (0.76)	0.09 (0.06)	0.09 (0.05)	-0.01 (0.90)	-0.04 (0.41)	0.2 (0.000)	-0.04 (0.39)
(11) Avg. age	40.40	5.03	-0.05 (0.28)	-0.06 (0.18)	0.06 (0.22)	-0.02 (0.70)	0.02 (0.71)	0.06 (0.22)	-0.15 (0.001)
(12) Avg. TMT age	46.64	6.37	-0.12 (0.01)	-0.04 (0.39)	0.03 (0.53)	-0.02 (0.71)	0.03 (0.55)	0.10 (0.03)	-0.12 (0.01)
(13) Avg. tenure	4.96	2.82	0.03 (0.53)	0.06 (0.21)	-0.04 (0.33)	-0.02 (0.64)	0.05 (0.28)	-0.003 (0.94)	-0.05 (0.27)
(14) Avg. TMT tenure	6.61	4.96	-0.02 (0.72)	-0.01 (0.76)	0.03 (0.54)	-0.01 (0.87)	0.02 (0.60)	0.04 (0.36)	-0.04 (0.42)
(15) Firm size	262.99	1345.4	0.18 (0.000)	-0.01 (0.75)	-0.79 (0.000)	0.10 (0.03)	0.09 (0.06)	0.11 (0.02)	0.34 (0.000)
(16) Firm age	24.46	21.67	0.08 (0.09)	0.04 (0.33)	-0.17 (0.000)	0.04 (0.43)	0.09 (0.06)	-0.01 (0.80)	0.08 (0.07)
(17) R&D activities	0.45	0.5	0.13 (0.005)	-0.01 (0.83)	-0.04 (0.36)	0.03 (0.51)	-0.05 (0.31)	0.17 (0.000)	-0.02 (0.62)
(18) Hierarchical levels	3.89	1.27	0.15 (0.001)	-0.06 (0.16)	-0.30 (0.000)	0.04 (0.36)	0.16 (0.000)	0.06 (0.17)	0.20 (0.000)
(19) Prop. new hires	0.15	0.12	0.05 (0.27)	-0.02 (0.72)	-0.004 (0.93)	-0.02 (0.72)	-0.01 (0.78)	-0.03 (0.58)	0.08 (0.09)
(20) Prop. TMT new hires	0.14	0.22	-0.07 (0.12)	-0.07 (0.15)	0.02 (0.67)	-0.11 (0.01)	0.02 (0.74)	-0.09 (0.04)	-0.02 (0.60)
(21) Metropolitan location	0.28	0.45	0.07 (0.14)	0.07 (0.14)	0.16 (0.001)	-0.05 (0.31)	-0.06 (0.17)	0.05 (0.33)	0.07 (0.14)
(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(8)	1.00								
(9)	0.35 (0.000)	1.00							
(10)	0.26 (0.000)	0.55 (0.000)	1.00						
(11)	0.03 (0.58)	0.05 (0.3)	0.14 (0.002)	1.00					
(12)	0.01 (0.90)	0.05 (0.24)	-0.03 (0.46)	0.46 (0.000)	1.00				
(18)	(19)	(20)	(21)						

TABLE 1 (Continued)

(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
(13) 0.01 (0.85)	-0.09 (0.04)	0.08 (0.09)	0.46 (0.000)	0.30 (0.000)	1.00								
(14) -0.02 (0.72)	-0.05 (0.32)	-0.09 (0.04)	0.20 (0.000)	0.35 (0.000)	0.55 (0.000)	1.00							
(15) 0.42 (0.000)	-0.03 (0.47)	0.08 (0.09)	-0.04 (0.36)	-0.07 (0.11)	-0.001 (0.99)	-0.08 (0.07)	1.00						
(16) 0.10 (0.03)	-0.06 (0.23)	0.05 (0.3)	0.17 (0.000)	0.08 (0.10)	0.25 (0.000)	0.16 (0.001)	0.19 (0.000)	1.00					
(17) 0.21 (0.000)	0.17 (0.000)	0.22 (0.000)	0.16 (0.001)	0.03 (0.53)	0.18 (0.000)	0.07 (0.15)	0.17 (0.000)	0.02 (0.76)	1.00				
(18) 0.21 (0.000)	-0.01 (0.75)	0.04 (0.37)	-0.09 (0.06)	-0.11 (0.02)	0.01 (0.85)	-0.1 (0.03)	0.49 (0.000)	0.14 (0.002)	0.15 (0.001)	1.00			
(19) -0.02 (0.69)	-0.07 (0.11)	-0.14 (0.002)	-0.48 (0.000)	-0.27 (0.000)	-0.55 (0.000)	-0.28 (0.000)	0.05 (0.30)	-0.11 (0.02)	-0.10 (0.02)	0.07 (0.12)	1.00		
(20) -0.03 (0.57)	0.01 (0.82)	0.05 (0.30)	-0.12 (0.01)	-0.19 (0.000)	-0.14 (0.003)	-0.36 (0.000)	-0.03 (0.51)	-0.11 (0.02)	-0.06 (0.23)	0.005 (0.92)	0.22 (0.000)	1.00	
(21) -0.01 (0.88)	0.05 (0.24)	-0.05 (0.26)	-0.08 (0.07)	0.03 (0.45)	-0.01 (0.84)	0.01 (0.80)	-0.10 (0.04)	-0.10 (0.02)	0.01 (0.84)	-0.05 (0.26)	0.04 (0.38)	0.01 (0.77)	1.00

n = 473; p-values in parentheses.

initiative is estimated by assigning firms with each level of centralization, between low (-1 SD) and high (+1 SD), while keeping all other variables at their original values. Thus, the average marginal effect represents the average change in the association between bottom-up initiative and opportunity formation associated with a given level of centralization, all else equal. Although average marginal effects lend themselves easily to interpretation, given the non-linearity of the model, marginal effects at the means⁸ (MEM) were also calculated. As the different estimation techniques produce similar results, we present average marginal effect to ease interpretation.

Figure 1 shows that bottom-up initiative only becomes positively associated with opportunity formation when centralization approaches the mean level. The interpretation is that firms where senior management is not directly involved in the entrepreneurial process do not benefit from relying on a bottom-up opportunity-formation process as coordination and cooperation problems may mitigate the positive influence of vesting opportunity formation with lower-level employees.

In Model 3, the positive coefficient ($p = 0.01$) for the interaction between educational diversity and centralization provides initial support for the benefit of direct involvement by senior-management (i.e., Hypothesis 2a).

Similar to Figure 1, we further probe the interaction effect by analyzing the average marginal effect of educational diversity conditional on centralization. Using values between high (+1 SD) and low (-1 SD) levels of centralization reveals that increasing centralization positively moderates educational diversity's association with opportunity formation. To aid interpretation, Figure 2 graphs the conditional association.

The figure illustrates that the positive relationship between educational diversity and opportunity formation is strengthened as the rights to make decision in the entrepreneurial process are increasingly centralized. Therefore, we find support for Hypothesis 2a.

⁸In contrast to AME, marginal effect at the means (MEM) holds all other variables constant at their mean. While this has an intuitive appeal, it also superimposes artificial values for the categorical and binary control variables in the model.

TABLE 2 Hierarchical negative binomial regression analysis for opportunity formation

DV: Opportunity formation	Model 1	Model 2	Model 3	Model 4
Centralization		-0.19 (0.10)	-0.43 (0.01)	-0.41 (0.01)
Educational diversity		3.95 (0.002)	3.48 (0.004)	3.68 (0.003)
Bottom-up initiative		0.37 (0.01)	0.36 (0.01)	0.36 (0.01)
Edu. diversity X Centralization			2.15 (0.01)	1.11 (0.28)
Centralization X Bottom-up			0.62 (0.01)	0.66 (0.002)
Edu. diversity X Bottom-up			2.17 (0.12)	2.02 (0.16)
Centralization X Edu. diversity X Bottom-up				4.51 (0.04)
Formalization	-0.04 (0.61)	-0.01 (0.88)	-0.001 (0.99)	0.003 (0.96)
Dominant educational background	0.15 (0.82)	0.53 (0.38)	0.34 (0.56)	0.46 (0.44)
Senior management size	0.0005 (0.23)	-0.0002 (0.38)	-0.0003 (0.34)	-0.001 (0.08)
Occupational specialist	-0.001 (0.13)	-0.001 (0.02)	-0.001 (0.02)	-0.002 (0.01)
Avg. educational level	0.32 (0.004)	0.18 (0.12)	0.18 (0.13)	0.22 (0.06)
Avg. TMT educational level	-0.05 (0.46)	-0.02 (0.77)	0.02 (0.77)	0.01 (0.86)
Avg. age	-0.0003 (0.99)	-0.01 (0.53)	-0.02 (0.33)	-0.02 (0.29)
Avg. TMT age	-0.03 (0.001)	-0.03 (0.004)	-0.02 (0.01)	-0.03 (0.01)
Avg. tenure	0.03 (0.42)	0.04 (0.19)	0.03 (0.28)	0.04 (0.18)
Avg. TMT tenure	0.01 (0.70)	0.001 (0.94)	0.003 (0.84)	0.002 (0.89)
Firm size	0.22 (0.01)	0.58 (0.000)	0.65 (0.000)	0.65 (0.000)
Firm age	0.01 (0.09)	0.004 (0.15)	0.003 (0.24)	0.004 (0.17)
R&D activities	0.50 (0.001)	0.41 (0.01)	0.38 (0.01)	0.36 (0.01)
Hierarchical levels	0.01 (0.83)	-0.02 (0.73)	-0.003 (0.96)	-0.001 (0.98)
Prop. new hires	1.40 (0.07)	0.90 (0.22)	0.85 (0.24)	0.87 (0.23)
Prop. TMT new hires	-0.60 (0.05)	-0.44 (0.15)	-0.48 (0.10)	-0.44 (0.13)
Metropolitan location	0.37 (0.02)	0.34 (0.04)	0.30 (0.07)	0.29 (0.07)
Intercept	2.14 (0.000)	2.03 (0.000)	2.07 (0.000)	2.08 (0.000)

n = 473; *p*-values in parentheses; all models include industry controls.

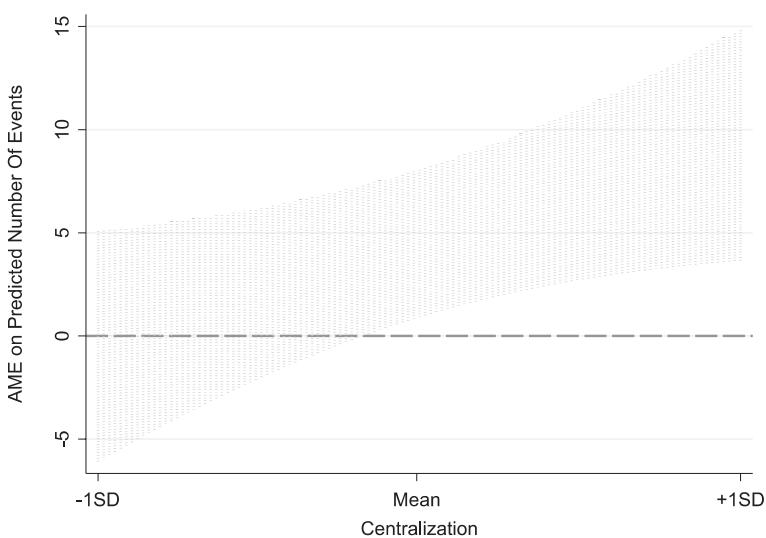


FIGURE 1 AME of bottom-up initiative given centralization

The support for both hypotheses raises questions regarding the influence of senior management involvement in the entrepreneurial process in settings characterized by both high educational diversity and bottom-up initiative (Hypothesis 3a and 3b). Intuitively, the two positive interaction terms suggest that some involvement is necessary to benefit from bottom-up initiative, given high levels of educational diversity. To examine this combined effect, Model 4 includes the three-way interaction. Although the strictly positive coefficient suggests support for Hypothesis 3a, given the complex nature of the interaction, we graph average adjusted predictions of opportunity formation associated with varying levels, between high (+1 SD) and low (-1 SD), of educational diversity, alternating between bottom-up/top-down initiative and fixing centralization at either high (+1 SD) or low (-1 SD). All other variables retain their original values.

Figure 3 illustrates that the combination of high educational diversity, bottom-up initiative, and centralization is associated with the highest level of opportunity formation. This finding supports

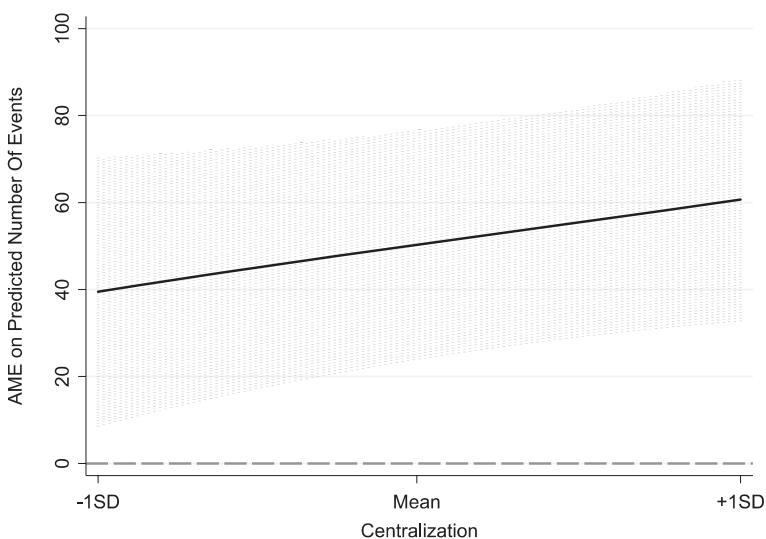


FIGURE 2 AME of educational diversity given centralization

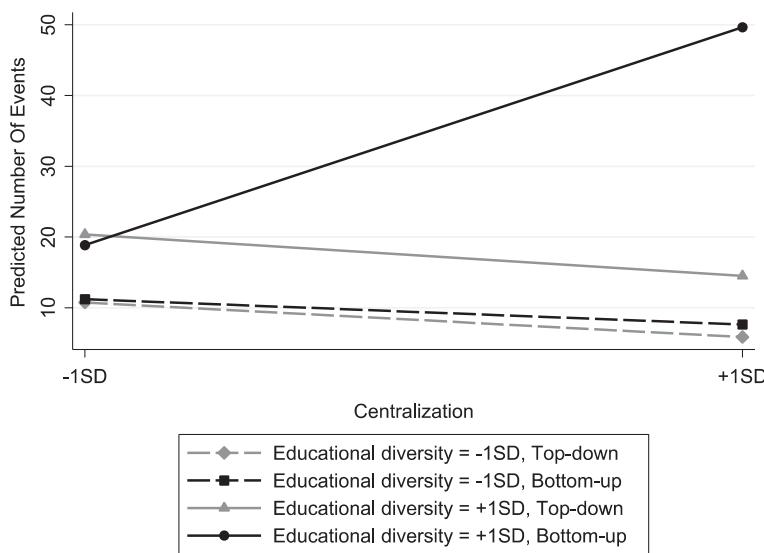


FIGURE 3 APP opportunity formation given educational diversity, centralization and bottom-up initiative

Hypothesis 3a and the direct involvement view of senior-management's role in the entrepreneurial process.

To further examine the contingent association between educational diversity, bottom-up initiative, and centralization, we estimated average marginal effects. The average marginal effect of educational diversity was estimated by assigning each value between high (+1 SD) and low (-1 SD) levels of centralization in combination with either bottom-up or top-down initiative. All other variables were kept at original values. Inspection of the average marginal effect reveals that senior-level involvement does not positively moderate educational diversity, given top-down initiative. On the other hand, when relying on bottom-up initiative in the entrepreneurial process, we find an increased positive association for educational diversity as centralization increases. In combination, this suggests that educational diversity benefits from senior management involvement only when firms simultaneously rely on bottom-up initiative.

However, the association between bottom-up initiative and opportunity formation must follow a similar pattern, to support the hypothesized relationship of interactions. Thus, we estimated the average marginal effect of bottom-up initiative given increasing levels, between -1 SD and +1 SD, of centralization in the presence of either high (+1 SD) or low (-1 SD) levels of educational diversity. All other variables retained their original values. At low (-1 SD) educational diversity, bottom-up initiative is negligible in terms of opportunity formation regardless of the level of centralization. In contrast, given high (+1 SD) educational diversity, senior-level involvement is a precondition for bottom-up processes to be positively associated with opportunity formation. Specifically, at levels of centralization below the mean, bottom-up initiative is not associated with increased opportunity formation, on average. Thus, firms need to combine high diversity with above-mean levels of centralization to benefit from vesting opportunity formation at lower levels.

In sum, the empirical results generally support a positive contingent relevance of senior management direct involvement in the entrepreneurial process in terms of both bottom-up initiative and employee diversity (i.e., the direct involvement view). In addition, we find support for a configurational association among the use of bottom-up initiative, employee diversity, and centralization. Thus, to fully benefit from a diverse workforce, firms may rely on bottom-up initiative while controlling the entrepreneurial process through more direct involvement by senior management.

5.1 | Robustness

A key concern relates to the causal direction between educational diversity and opportunity formation. Some opportunities represent new and innovative breaks with the firm's existing activities, and may require recruitment of employees with different skills and educational backgrounds. Thus, increased opportunity formation may drive increased employee diversity. To mitigate this concern, we employed different techniques based on the semi-longitudinal nature of our data. First, educational diversity in 2010 was regressed on all independent and control variables from the original model. No generalizable association was found to exist between opportunity formation and educational diversity in the following year. Thus, reverse causality does not appear to severely confound our results. To further mitigate concerns, the non-linear transformation of opportunity formation was included without any stable associations emerging. We also tested whether the association between opportunity formation and future educational diversity was conditional on the firm's employee turnover. As indicated in Table 1, new hires appear to predominately replace seasoned employees. Thus, increasing educational diversity as a result of opportunity formation may require a higher turnover rate to facilitate the intake of new skills and educational backgrounds. However, as the interaction term did not have a strictly positive or negative interpretation ($95\% \text{ CI} = [-0.001-0.002]$), this alternative explanation was not supported.

Finally, we examined whether firms with more opportunity formation had less stable core educational requirements. A variable measuring the firms' dominant educational background in 2010 was regressed on all variables, including opportunity formation. We did not find a generalizable association between opportunity formation and the firm's dominant educational background. In combination, the robustness analysis helps to refute alternative explanations based on reverse causal claims.

A second concern relates to our measure of opportunity formation. Self-reported opportunity formation may potentially underestimate the true intensity of firms' opportunity formation, in particular because respondents were CEOs. We employ several controls variables to account for potential systematical covariance between firms' organizational characteristics, including its human capital, and the likelihood that the CEO is aware of opportunity formation. Yet, unobserved mechanisms may still indirectly influence the purported association between opportunity formation and centralization, educational diversity, and bottom-up initiative. The most intuitive and direct organizational characteristic influencing the CEO's awareness of opportunity formation is the size of the firm. Firm size positively relates to actual opportunities formation, for which we control. However, increased firms size may also reduce the CEO's awareness of opportunity formation resulting from bottom-up initiative. In addition, CEOs in large firms may be less directly involved in decisions at lower levels, and thus receive less information about opportunity formation. To test the extent to which these potential indirect influences confound our findings, a respecified model included interaction effects between our three focal independent variables and firm size. The model did not indicate that firm size systematically moderates the associations between centralization, educational diversity, bottom-up initiative and opportunity formation. Thus, it appears that inclusion of control variables is sufficient to guard against our findings being confounded by size effects.

The complexity of testing the interactions between bottom-up initiative, educational diversity and centralization, especially given the non-linear nature of the model, may raise concerns of overfitting. To ensure that our findings were not primarily driven by complex model specification, we reran Model 1, 2, and 3 on two subsamples. Even though sample splitting is not necessary to test even higher-order interactions, and adversely effects the precision of coefficient estimates, given the binary nature of the variable measuring bottom-up initiative, the sample could be split without any loss of generalizability.

Corroborating the findings of the original models, the subsample with top-down initiative indicated a generalizable negative association between centralization and opportunity formation. On the other hand, the subsample with bottom-up initiative did not support a stable negative association between centralization and opportunity formation. Thus, it appears that the negative influence of centralization is mitigated under conditions of bottom-up opportunity formation. The positive relationship between increased educational diversity and opportunity formation existed in both subsamples. However, similar to the full sample results, we were only able to detect a positive moderating effect of centralization in the subsample based on firms with bottom-up initiative. In combination, the results of the split-sample analysis alleviate concerns about the findings being driven by the complexity of the model.

The last robustness test focused on the boundary conditions of our theory development, specifically, whether increased opportunity formation is always beneficial to the firm. Our measure of opportunity formation does not speak directly to the benefits of opportunity formation. It is conceivable that increased opportunity formation may negatively impact the firm by overloading the decision-making process (cf. Foss, 2003), or if the higher frequency of new opportunities is driven by a decrease in the average quality of opportunities. On the other hand, more opportunities may also make employees impose informal quality control. Specifically, lower level employees may engage in pre-evaluation of opportunities to maximize the likelihood that their opportunity will be accepted for exploitation. Such pre-evaluation effectively narrows the amount of opportunities up through the hierarchy. To address the impact on opportunity formation we regressed *perceived opportunity quality* on the entire set of independent variables and controls, using ordered logistic regression with robust standard errors.⁹ Perceived opportunity quality was proxied by the percentage of evaluated opportunities that were ultimately realized. To reduce complexity, respondents were presented with an ordinal scale (0%, 1–20%, 21–40%, 41–60%, 61–80%, 81–100%). The choices of percentile groupings enable characterization of increased opportunity quality in a parsimonious way. The model reveals that increased opportunity formation is associated with higher levels of realization. This finding is at odds with alternative explanations based on increased opportunity formation triggering decision overload and/or decreased quality. Indeed, if increased opportunity formation was associated with lower average perceived quality of new opportunities, we would expect the percentage exploited to be stable or even to decline. We cautiously interpret this as lending support to our measure of opportunity formation. Moreover, if our measure predominantly captures CEOs' inability to accurately report opportunity formation, we would not expect opportunity formation to be positively associated with the *percentage* of opportunities being exploited. We did not find any generalizable associations between realization percentage and the three focal independent variables. Thus, vesting entrepreneurial decision-making lower in the hierarchy does not raise the likelihood of opportunities being exploited, as the narrowing effect of pre-evaluations would suggest. Although the last robustness test sheds light on the link between opportunity formation and exploitation, we emphasize the explorative nature of the model. The path from opportunity exploitation to ultimate firm performance involves many other variables, none of which are addressed in the robustness test.

6 | CONCLUDING DISCUSSION

6.1 | Contribution to theory

In spite of increasing interest in the entrepreneurial activities of established firms (e.g., Ahuja & Lampert, 2001; Ireland et al., 2009), significant research gaps remain (Foss & Lyngsie, 2014). Much

⁹Ordinary least square regression, with robust standard errors, produced similar results

established thinking posits that senior management should take a hands-off approach to the bottom-up entrepreneurial process, and that their main role is to select among the opportunities that emerge from this process. In this research, we have contrasted this established view with an alternative view that puts more emphasis on senior management direct involvement in the entrepreneurial process.

Starting from the established findings that opportunity formation is related to employee diversity and bottom-up initiative, we find that the strength of these associations is each reinforced when senior managers increase their involvement in the entrepreneurial process (i.e., Hypotheses 1a and 2a), but that the strongest association is produced when bottom-up initiative, employee diversity and senior management involvement are all high (i.e., Hypothesis 3a). These findings lend some cautious support to the view that senior management has a role in the entrepreneurial process that goes beyond defining the administrative framework for the process and then selecting among opportunities generated in the bottom-up process.

More broadly our study calls attention to how exactly decision-making is distributed across the hierarchy in the context of the entrepreneurial process (cf. Day, 1994; Foss & Lyngsie, 2014). Much research emphasizes the informal aspects of organization in the context of entrepreneurship (e.g., Burgelman & Sayles, 1986; Ireland et al., 2009). However, there is evidence that firms often take considerable care when it comes to the (formal) organizational design aspects of entrepreneurial projects, notably the allocation of decision rights within and across hierarchical layers (Kuratko et al., 2009). More research is required to cast light over how firms combine top-down decision-making with bottom-up initiative in the context of the entrepreneurial process.

6.2 | Limitations and future research

Our study also calls attention to the various mechanisms that are at play in established companies, influencing the formation of opportunities, namely bottom-up initiative, employee diversity and senior manager involvement—and the interactions of these. Our measures of all these have limitations. For example, employee diversity is a multifaceted construct and it may be that the positive association we find do not hold to the same extent for all aspects of diversity. Although the diversity measure we use, namely educational background, is a commonly used measure of employee diversity, several other aspects of diversity may be associated with opportunity formation (e.g., diversity of work experience). Thus, the reported results should exclusively be interpreted in terms of employees' formal education. Also, senior management involvement is measured in terms of the hierarchical allocation of formal decision rights across different types of entrepreneurial initiatives. But, senior managers can involve themselves in other ways than formal decision-making, such as lending informal support, giving encouragement, and so on.

Another concern relates to our measure of opportunity formation. As we asked respondents to recall the number of identified opportunities over a 3-years timespan, our data may be affected by measurement error. In general, we acknowledge that our measure may not perfectly capture the formation of entrepreneurial opportunities. For example, respondents may disproportionately underestimate the true number of opportunities when opportunity formation is based on bottom-up initiative. However, the split-sample robustness test indirectly mitigates concerns about unobserved associations between the measure of opportunity formation and firms' reliance on bottom-up initiative. We find support for the benefits of direct involvement by senior management in the subsample of firms with bottom-up initiative, which suggests that such concerns are not the primary driver of the findings. Moreover, as the direct influence of bottom-up initiative and educational diversity are both positive and the direct association of centralization is negative, underestimation of opportunity formation runs in the opposite direction of all main mechanisms. Thus, our findings may be interpreted

as conservative estimates. Nonetheless, given the possibility of measurement error, the results, and in particular effect sizes, should be interpreted with caution.

Our findings should also be viewed in light of the basic limitation that all our models are cross-sectional, which means that we are unable to satisfactorily include a time perspectives and that we can only examine between-firm differences. This means, for example, that while we make use of the longitudinal nature of the IDA data set to partly mitigate concerns about employee turnover and associated changes in employee diversity, firms' hiring policies remain unobserved. Therefore, we cannot conclusively rule out the possibility that more entrepreneurial firms differ in terms of recruitment practices, and that this may confound the positive association between employee diversity and opportunity formation. While we perform several indirect tests of this reverse relationship, including a test of hiring patterns, the inability to establish causation remains a limitation. Finally, we have not established a link between opportunity formation and firm performance, but focused on correlates of the "intermediate" variable of opportunity formation. However, the link from more opportunity formation to increased firm performance is far from trivial. Linking opportunity formation to performance requires addressing firms' evaluation mechanisms and exploitation process. While we include a robustness test based on the percentage of opportunities ultimately being exploited, we have focused on opportunity formation, as a goal in itself; however, linking it to firm performance is a warranted next step.

7 | CONCLUSION

The understanding of the processes and structures that drive the formation of entrepreneurial opportunities in established companies is still in its infancy (Ireland et al., 2009). Research has often suggested that the proper role of senior management is to reactively select opportunities that have been formed in a bottom-up process. In contrast, our findings indicate that senior management may have a more direct role to play than is commonly held in the research literature. We hope our study will stimulate more research on the challenges that established firms face in managing bottom-up initiative and employee diversity for firm-level entrepreneurship.

ACKNOWLEDGMENTS

We thank, without implicating, Michael Mol, three anonymous reviewers of this journal, and seminar audiences at the London Business School and the Warwick Business School for comments on earlier versions.

REFERENCES

- Ahuja, G., & Lampert, C. M. (2001). Entrepreneurship in the large corporation: A longitudinal study of how established firms create breakthrough inventions. *Strategic Management Journal*, 22, 521–543.
- Ai, C., & Norton, E. C. (2003). Interaction terms in logit and probit models. *Economics Letters*, 80, 123–129.
- Alvarez, S. A., & Barney, J. B. (2004). Organizing rent generation and appropriation: Toward a theory of the entrepreneurial firm. *Journal of Business Venturing*, 19, 621–635.
- Alvarez, S. A., & Barney, J. B. (2007). Creation and discovery: Alternative theories of entrepreneurial action. *Strategic Entrepreneurship Journal*, 1, 11–26.
- Amit, R., & Wernerfelt, B. (1990). Why do firms reduce business risk? *Academy of Management Journal*, 33, 520–533.
- Ancona, D. G., & Caldwell, D. F. (1992). Demography and design: Predictors of new product team performance. *Organization Science*, 3, 321–341.
- Broschak, J. P., & Davis-Blake, A. (2006). Mixing standard work and nonstandard deals: The consequences of heterogeneity in employment arrangements. *Academy of Management Journal*, 49, 371–396.

- Brown, S. L., & Eisenhardt, K. M. (1997). The art of continuous change: Linking complexity theory and time-paced evolution in relentlessly shifting organizations. *Administrative Science Quarterly*, 42, 1–34.
- Buis, M. L. (2010). Interpretation of interactions in nonlinear models. *The Stata Journal*, 10, 305–308.
- Burgelman, R. A. (1983a). A process model of internal corporate venturing in the diversified major firm. *Administrative Science Quarterly*, 28, 223–244.
- Burgelman, R. A. (1983b). Corporate entrepreneurship and strategic management: Insights from a process study. *Management Science*, 29, 1349–1364.
- Burgelman, R. A. (1991). Intraorganizational ecology of strategy making and organizational adaptation: Theory and field research. *Organization Science*, 2, 239–262.
- Burgelman, R. A. (1994). Fading memories: A process theory of strategic business exit in dynamic environments. *Administrative Science Quarterly*, 39, 24–56.
- Burgelman, R. A. (2002). *Strategy is destiny: How strategy-making shapes a company's future*. New York, NY: The Free Press.
- Burgelman, R. A., & Sayles, L. R. (1986). *Inside corporate innovation: Strategy, structure, and managerial skills*. New York, NY: The Free Press.
- Casson, M. C., & Wadeson, N. (2007). The discovery of opportunities. *Small Business Economics*, 28, 285–300.
- Chesbrough, H. (2003). *Open innovation*. Boston, MA: Harvard Business School Press.
- Day, D. L. (1994). Raising radicals: Different processes for championing innovative corporate ventures. *Organization Science*, 5, 148–172.
- Elenkov, D. T., Judge, W., & Wright, P. (2005). Strategic leadership and executive innovation influence: An international multi-cluster comparative study. *Strategic Management Journal*, 26, 665–682.
- Foss, N., Pedersen, T., Pyndt, J., & Schultz, M. (2012). *Management Innovation*. Cambridge: Cambridge University Press.
- Foss, N. J. (2003). Selective intervention and internal hybrids: Interpreting and learning from the rise and decline of the Oticon Spaghetti Organization. *Organization Science*, 14, 331–349.
- Foss, N. J., & Klein, P. G. (2012). *Entrepreneurial judgment and the theory of the firm*. Cambridge: Cambridge University Press.
- Foss, N. J., & Lyngsie, J. (2014). The strategic organization of the entrepreneurial established firm. *Strategic Organization*, 12, 208–215.
- Foss, N. J., & Weber, L. (2016). Putting opportunism in the back seat: Bounded rationality, costly conflict and hierarchical forms. *Academy of Management Review*, 41, 41–79.
- Galbraith, J. R. (1974). Organization design: An information processing view. *Interfaces*, 4, 28–36.
- Galunic, D. C., & Rodan, S. (1998). Resource recombinations in the firm: Knowledge structures and the potential for schumpeterian innovation. *Strategic Management Journal*, 19, 1193–1201.
- Hambrick, D. C., & Mason, P. A. (1984). Upper echelons: The organization as a reflection of its top managers. *Academy of Management Review*, 9, 193–206.
- Heath, C., & Staudenmayer, N. (2000). Coordination neglect: How lay theories of organizing complicate coordination in organizations. *Research in Organizational Behavior*, 22, 155–193.
- Hills, G. E., Shrader, R. C., & Lumpkin, G. T. (1999). Opportunity recognition as a creative process. In *Frontiers of entrepreneurship research* (pp. 216–227). Wellesley, MA: Babson College.
- Holmström, B. (1989). Agency costs and innovation. *Journal of Economic Behavior and Organization*, 12, 305–327.
- Horwitz, S. K., & Horwitz, I. B. (2007). The effects of team diversity on team outcomes: A meta-analytic review of team demography. *Journal of Management*, 33, 987–1015.
- Ireland, R. D., Covin, J. G., & Kuratko, D. (2009). Conceptualizing corporate entrepreneurship strategy. *Entrepreneurship Theory and Practice*, 33, 19–46.
- ISS. 2017. Diversity adds millions to ISS bottom line. Retrieved from <http://bit.ly/2lExEQa>
- Jehn, K. A., Northcraft, G. B., & Neale, M. A. (1999). Why differences make a difference: A field study of diversity, conflict and performance in workgroups. *Administrative Science Quarterly*, 44, 741–763.
- Jensen, M. C., & Meckling, W. H. (1992). Specific and general knowledge and organizational structure. In L. Werin & H. Wijkander (Eds.), *Contract Economics* (pp. 251–274). Oxford: Blackwell.
- Kandel, E., & Lazear, E. P. (1992). Peer pressure and partnerships. *Journal of Political Economy*, 100, 801–817.
- Kaplan, S. (2008). Framing contests: Strategy making under uncertainty. *Organization Science*, 19, 729–752.
- Kirzner, I. M. (1973). *Competition and entrepreneurship*. Chicago, IL: University of Chicago Press.
- Kuratko, D. F., Covin, J. G., & Garrett, R. P. (2009). Corporate venturing: Insights from actual performance. *Business Horizons*, 52, 459–467.
- Laursen, K., & Salter, A. (2006). Open for innovation: The role of openness in explaining innovation performance among U.K. manufacturing firms. *Strategic Management Journal*, 27, 131–150.
- Leiponen, A., & Helfat, C. (2011). Location, decentralization, and knowledge sources for innovation. *Organization Science*, 22, 641–658.
- Lévesque, M., & Minniti, M. (2006). The effect of aging on entrepreneurial behavior. *Journal of Business Venturing*, 21, 177–194.
- Lovas, B., & Ghoshal, S. (2000). Strategy as guided evolution. *Strategic Management Journal*, 21, 875–896.
- Lumpkin, G. T., & Lichtenstein, B. B. (2005). The role of organizational learning in the opportunity-recognition process. *Entrepreneurship Theory and Practice*, 29, 451–472.

- Lyngsie, J., & Foss, N. J. (2017). The more, the merrier? The role of gender in explaining entrepreneurial outcomes in established firms. *Strategic Management Journal*, 38, 487–505.
- Miller, D., & Droege, C. (1986). Psychological and traditional determinants of structure. *Administrative Science Quarterly*, 31, 539–560.
- Nickerson, J. A., & Zenger, T. R. (2004). A knowledge-based theory of the firm--the problem-solving perspective. *Organization Science*, 15, 617–632.
- Norton, E. C., Wang, H., & Ai, C. (2004). Computing interaction effects and standard errors in logit and probit models. *Stata Journal*, 4, 154–167.
- Østergaard, C. R., Timmermans, B., & Kristinsson, K. (2011). Does a different view create something new? The effect of employee diversity on innovation. *Research Policy*, 40, 500–509.
- Parker, S. C. (2009). *The economics of entrepreneurship*. Cambridge: Cambridge University Press.
- Podsakoff, P. M., MacKenzie, S. B. L., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88, 879–903.
- Prahalad, C. K., & Bettis, R. (1986). The dominant logic: A new linkage between diversity and performance. *Strategic Management Journal*, 7, 485–501.
- Richard, O. C., Barnett, T., Dwyer, S., & Chadwick, K. (2004). Cultural diversity in management, firm performance, and the moderating role of entrepreneurial orientation dimensions. *Academy of Management Journal*, 47, 255–266.
- Rotemberg, J. J., & Saloner, G. (1994). Benefits of narrow business strategies. *American Economic Review*, 84, 1330–1349.
- Sarasvathy, S. (2001). Causation and effectuation: Toward a theoretical shift from economic inevitability to entrepreneurial contingency. *Academy of Management Review*, 26, 243–263.
- Shane, S. (2003). *A general theory of entrepreneurship: The individual-opportunity nexus*. Cheltenham: Edward Elgar Publishing Limited.
- Shane, S., & Venkataraman, S. (2000). The promise of entrepreneurship as a field of research. *Academy of Management Review*, 25, 217–226.
- Taylor, A. (2010). The next generation: Technology adoption and integration through internal competition in new product formation. *Organization Science*, 21, 23–41.
- Ucbasaran, D., Westhead, P., & Wright, M. (2007). Opportunity identification and pursuit: Does an Entrepreneur's human capital matter? *Small Business Economics*, 30, 153–173.
- van Dick, R., van Knippenberg, D., Hägele, S., Guillaume, Y. R. F., & Brodbeck, F. C. (2008). Group diversity and group identification: The moderating role of diversity beliefs. *Human Relations*, 61, 1463–1492.
- Zahra, S. A., & Covin, J. G. (1995). Contextual influences on the corporate entrepreneurship-performance relationship: A longitudinal analysis. *Journal of Business Venturing*, 10, 43–58.

How to cite this article: Barney JB, Foss NJ, Lyngsie J. The role of senior management in opportunity formation: Direct involvement or reactive selection?. *Strat Mgmt J*. 2018;39: 1325–1349. <https://doi.org/10.1002/smj.2768>