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Entrepreneurial Human Capital and Firm Innovation

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Abstract

We use a human capital lens to study how firm innovation benefits from the presence of employees with entrepreneurial experience. We argue that former entrepreneurs' execution skills ? a generalist ability to discover and exploit new opportunities by acquiring and mobilizing resources ? spur entrepreneurship inside established firms. Using Danish matched administrative and Community Innovation Survey data, we find that a more entrepreneurial workforce is associated with higher sales from innovation. Organizations make better use of entrepreneurial human capital when they are less bureaucratic and when former entrepreneurs occupy managerial positions. While entrepreneurial human capital is not associated with patents, it is positively related to knowledge breadth, in line with our theory.

Entrepreneurial Human Capital and Firm Innovation*

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Abstract

Using a human capital lens, we argue that former entrepreneurs are endowed with execution skills: a generalist ability to create and exploit new market opportunities by acquiring and mobilizing resources. We propose that entrepreneurial human capital enhances innovation inside established firms by developing new uses for existing, but possibly underused knowledge. Combining Community Innovation Survey and register data from Denmark, we find that entrepreneurial hires are associated with higher sales from innovation, with stronger effects for incremental rather than radical innovation. Hiring entrepreneurs in middle management is particularly important for firm innovation, consistent with execution skills' higher effectiveness when paired with broader decision rights and resource access. Together, our findings suggest that entrepreneurial hires provide a way for firms to potentially appropriate a larger share of the value their knowledge generates.

JEL Classification: J24, L23, M12, M21, M51.

Keywords: Entrepreneurship, execution skills, human capital, innovation, learning by hiring, middle management.

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1 Introduction

Human capital contributes to firms' competitive advantage by allowing organizations to exploit knowledge and develop new capabilities (Coff, 1997; Campbell et al., 2012a). In particular, firms recruit highly-skilled human capital to acquire insights into new technological domains and improve their invention outcomes (Song et al., 2003; Singh and Agrawal, 2011; Kaiser et al., 2018). However, for innovation to translate into profits, established organizations must exploit inventions by discovering and developing new business opportunities (Covin and Miles, 1999; Hitt et al., 2001; Teece, 2016). In this paper, we argue that firms gain such capabilities by hiring individuals with entrepreneurial human capital or *execution skills*; these employees provide an additional path for incumbents to exploit their technical knowledge internally, appropriating a larger share of the value that knowledge generates.

Beyond preexisting differences in preferences, skills, and judgment relative to employees that make entrepreneurs well-equipped for the pursuit of opportunities and new venture development, start-ups expose individuals to an uncertain, dynamic environment. As founders, entrepreneurs deepen their generalist expertise in social and material resource acquisition and mobilization across functional domains and audiences, such as customers, competitors, or suppliers (Alvarez and Busenitz, 2001; Elfenbein et al., 2010; Foss and Klein, 2012; Distel et al., 2019; Faleye et al., 2020). Entrepreneurs thus develop 'execution skills': a human capital profile uniquely suited to building new ventures. We propose that execution skills transcend the start-up context and can be deployed by established firms seeking to bring new products and services to market. This process requires connecting an organization's possibly under-exploited knowledge with market opportunities by assembling the requisite internal and external resources, such that firms with a larger share of new entrepreneurial hires obtain a higher share of sales from innovation.

The nature of execution skills, in contrast to scientists' technical skills, holds additional implications for the link between entrepreneurial human capital and firm innovation. As superior

market knowledge helps former entrepreneurs select more profitable projects, central positions of authority facilitate the exercise of decision rights over which resources to acquire and mobilize (Burgelman, 1991; Wooldridge et al., 2008). We therefore posit that new entrepreneurial hires in middle management roles have stronger effects on innovation. Moreover, radical innovation depends heavily on specialized technical human capital and investments, whereas incremental innovation benefits from broader search strategies emphasizing customers and competitors (Gatignon et al., 2002; Köhler et al., 2012). Former entrepreneurs' competitive landscape insight favors the pursuit of otherwise difficult to spot marginal improvements, so we propose that new entrepreneurial hires are more tightly linked to incremental, rather than radical innovation.

To test our theory, we combine matched employer-employee administrative and Community Innovation Survey data for Denmark for the years 2007-2016, allowing us to analyze a host of firm-level innovation outcomes, while capturing employees' career history in detail. Empirically, we focus on the effect of new entrepreneurial hires on firms' share of sales from innovation. To alleviate worker-firm matching concerns, we use firm fixed effects models netting out time-invariant traits and control for (lagged) sales growth and investment intensity to address time-variant demand for execution skills. We find that entrepreneurial hires are positively associated with sales from innovation; this relationship is stronger when these hires occur in middle management positions, as well as for incremental, relative to radical innovation. In addition, we rule out alternative explanations based on technical or managerial skills and find evidence that entrepreneurial human capital is subject to depreciation, implying that regular inflows of former founder hires may be required for sustained innovation.

This paper makes two key contributions to strategic management. We bridge entrepreneurship and organizational hiring research to explain how firms can gain capabilities for boosting revenue from new products and services (Alvarez and Busenitz, 2001; Teece, 2016). Beyond acquiring human capital directly involved in producing inventions (Song et al., 2003; Tzabbar, 2009; Singh and Agrawal, 2011; Kaiser et al., 2018), firms must develop complementary com-

petences in commercializing innovation; that is, hiring for innovation must account for both execution and technical skills. Hiring entrepreneurs for their ability to marshal resources to exploit existing knowledge offers a path for developing these competences, allowing firms to retain a larger share of value created, rather than concede it, for example to employee entrepreneurship (Agarwal et al., 2004; Campbell et al., 2012b; Gambardella et al., 2015). Moreover, organizations hiring former entrepreneurs in middle management roles may be especially well positioned for developing sustained competitive advantage, as entrepreneurial human capital reaches its productive potential when accompanied by decision rights over resource allocation (Teece, 1996; Foss et al., 2015). The contribution of execution skills to firms' innovation activities and its interaction with organizational design and other types of human capital can serve as an avenue for further studies of learning by hiring, strategic entrepreneurship, and innovation.

We also add to the growing literature on returns to entrepreneurial experience (Campbell, 2013; Manso, 2016). Building on studies of selection (Lazear, 2005; Roach and Sauermann, 2015; Vladasel et al., 2021) and learning (Elfenbein et al., 2010; Eesley and Roberts, 2012; Parker, 2013), we propose that entrepreneurs are distinctly endowed with execution skills. These skills cover the entire business development process, centering on finding new market opportunities for exploiting firms' underutilized knowledge through resource assembly. Closely related to the resource reallocation ability of entrepreneurial top managers and directors (Distel et al., 2019; Faleye et al., 2020) and entrepreneurial judgment generally (Foss and Klein, 2012), execution skills span all stages of venture creation, are transferable across contexts, and have clear testable implications. Established firms' innovation benefits from such skills, providing an explanation for recent studies finding positive earnings effects for entrepreneurs returning to paid employment, especially in knowledge intensive sectors (Campbell, 2013; Luzzi and Sason, 2016; Manso, 2016). By making precise wherein the portability of entrepreneurial human capital lies, our study offers a starting point for investigations of how former entrepreneurs are integrated into established firms and how their skills are deployed and rewarded in different

domains. Our work further highlights that monetary returns to entrepreneurship also accrue to established firms: building on a large body of work assessing the individual consequences of entrepreneurship, we add to a burgeoning literature on the consequences for the firms that hire them (Distel et al., 2019; Faleye et al., 2020), finding positive effects on innovation.

2 Theory and Hypotheses

We develop a theoretical reasoning predicting how firms benefit from hiring entrepreneurs. We outline how founders' human capital is distinct from that of employees, positing that they are endowed with execution skills. We then propose that new entrepreneurial hires help firms gain capabilities in bringing new products and services to market. Finally, we reason that execution skills are most effective when entrepreneurs are hired in middle management ranks and that they are particularly valuable for incremental innovation.

2.1 Entrepreneurial Human Capital and Execution Skills

Entrepreneurs differ from other workers in both their pre-entry traits and the skills acquired in their business (Elfenbein et al., 2010; Eesley and Roberts, 2012).¹ On average, individuals who become entrepreneurs have higher (non)cognitive ability, higher social skills, generalist skills, higher risk and loss tolerance, higher (over)confidence, as well as preferences for autonomy, commercialization, and managerial activities.² These traits make entrepreneurs better predisposed to take on new venture development projects, from the initial step of spotting opportunities to the final step of bringing new ideas to market, relative to other employees.

Importantly, founding a firm is an intense learning experience in terms of developing and executing a business idea. Entrepreneurs perform varied functions inside new ventures, allowing them to learn and develop their skills regardless of their ultimate success (Minniti and Bygrave, 2001). In highly uncertain environments, founders exercise judgment over how to deploy hetero-

¹ Entrepreneurs are theoretically and empirically distinct from the self-employed, given the different organizational forms pursued and tasks performed, consistent with entrepreneurial selection from the tails of the ability distribution (Åstebro et al., 2011; Levine and Rubinstein, 2017; Vladasel et al., 2021).

² See, among others, Busenitz and Barney (1997), Lazear (2005), Hartog et al. (2010), Åstebro et al. (2011), Roach and Sauermaun (2015), Koudstaal et al. (2016), Levine and Rubinstein (2017), Vladasel et al. (2021).

geneous resources to achieve various outcomes (Foss and Klein, 2012): they identify and pursue novel opportunities (Shane and Venkataraman, 2000; Klein, 2008); plan, experiment with, and execute strategy (Camuffo et al., 2019; Ching et al., 2019); acquire and mobilize the required human, social, and financial capital resources (Davidsson and Honig, 2003; Baker and Nelson, 2005; Hsu, 2007; Zott and Huy, 2007; Zhang, 2011); and lead and manage the start-up (Lounsbury and Glynn, 2001; Hmieleski and Ensley, 2007; Eesley and Roberts, 2012). Entrepreneurs thus gain expertise in many functional areas and strengthen their generalist profile, helping them develop unique venture development and commercialization skills (Elfenbein et al., 2010; Campbell, 2013). Moreover, beyond an *ex ante* higher alertness, practical experience and contact with clients or competitors improve founders' ability to spot, time, and exploit market opportunities (Baron and Ensley, 2006; Ucbasaran et al., 2009; Faleye et al., 2020).

Innate or acquired, entrepreneurs' human capital is distinct from that of employees, especially in their higher ability to recognize and create strategic opportunities, assemble and configure heterogeneous resources, as well as craft and execute strategy (Alvarez and Busenitz, 2001; Foss and Klein, 2012). That is, entrepreneurs possess superior *execution skills*, enjoying advantages over non-entrepreneurs at all stages of new venture development. This knowledge-intensive occupational human capital (Mayer et al., 2012) facilitates successful future entrepreneurial endeavors, as shown by research on serial entrepreneurs' improved performance (Gompers et al., 2010; Eesley and Roberts, 2012; Parker, 2013).

New ventures are not alone in rewarding former entrepreneurs' execution skills. While earlier studies uncover negative returns to entrepreneurship experience in paid employment (Hamilton, 2000; Bruce and Schuetze, 2004; Baptista et al., 2012), recent methodological advances paint a positive picture. Entrepreneurs receive a premium upon returning to established firms (Campbell, 2013; Manso, 2016), especially in innovative sectors (Luzzi and Sasson, 2016) or when they have industry experience (Kaiser and Malchow-Møller, 2011), are more likely to reach managerial positions (Baptista et al., 2012; Mérida and Rocha, 2021), and earn higher executive pay

(Mériada, 2019).³ That incumbent firms reward entrepreneurial human capital provides initial evidence that former founders' skills are valuable across contexts. We now turn to a theoretical analysis of how new hires' execution skills affect firm innovation.

2.2 Entrepreneurial Hires and Firm Innovation

Entrepreneurial action inside established organizations has been proposed as a complement to traditional inventive activities, allowing for the economic exploitation of technical and scientific advances (Schumpeter, 1934; Arrow, 1962; Nelson and Winter, 1982; Covin and Miles, 1999; Hitt et al., 2001). But while scholars have paid substantial attention to the effect of knowledge worker hires on firms' development of inventive capabilities, i.e. patenting activities, we know far less about how organizations recruit human capital for transforming inventions into innovations that can be successfully commercialized, i.e. revenue from innovation.

The idea that organizations build, broaden, or deepen capabilities by hiring workers with different knowledge, perspectives, or skills is hardly novel (March, 1991; Rao and Drazin, 2002; Song et al., 2003; Hatch and Dyer, 2004; Lacetera et al., 2004; Jain, 2016; Wang and Zatzick, 2019). Notably, new scientist hires affect the quantity, quality, and direction of hiring firms' inventive activities. The knowledge new hires bring over from previous contexts such as universities or other innovative firms is reflected in the patents obtained by the hiring firm (Song et al., 2003; Tzabbar, 2009; Palomeras and Melero, 2010; Singh and Agrawal, 2011; Herstad et al., 2015; Kaiser et al., 2015, 2018).⁴ Nonetheless, while recruiting scientists spurs the production of inventions, it does not guarantee commercial success.

What human capital do established firms need to acquire or build in order to commercialize inventions? Bringing new products to market requires firms to undertake entrepreneurial action, characterized by the creation of market opportunities and resource orchestration (Covin and Miles, 1999; Hitt et al., 2001; Kuratko et al., 2001; Sirmon et al., 2011). Entrepreneurial action,

³ Firms may initially offer former entrepreneurs lower wages due to uncertainty about their ability (Mahieu et al., 2019), but these wages recover and surpass those of workers in the long-run (Mériada and Rocha, 2021).

⁴ Firms also strategically hire workers with advocacy or export experience in order to develop stakeholder or, respectively, foreign market knowledge (Grimpe et al., 2019; Guri et al., 2019).

as a counterpart to inventive production, requires employees to tolerate uncertainty and apply their knowledge to commercial ends as they craft and execute strategy for the purpose of placing the firm on a path to competitive advantage (Stevenson and Jarillo, 1990; Covin and Miles, 1999; Antoncic and Hisrich, 2001; Butler, 2017). These requirements match the execution skills we describe, implying that former founders have an advantage over other workers in marshaling the requisite resources for bringing new products and services to market. For instance, multinational companies exhibit larger host country sales when subsidiary managers have entrepreneurial experience, due to their resource allocation skills and enhanced local market knowledge (Distel et al., 2019), while entrepreneurs on the board are positively associated with R&D investments and firm market value (Faleye et al., 2020).

We thus conceptualize execution skills as a unique bundle of characteristics, abilities, and experiences that allows former founders to successfully pursue internal ventures conducive to innovation. Due to superior competitive landscape insight, entrepreneurs are on average better than other employees at recognizing the commercial potential of existing firm knowledge and devising the appropriate market strategy for realizing opportunities. In addition, introducing new products and services is an uncertain endeavor, which former founders are better equipped to navigate. Entrepreneurs' higher social skills are useful for assembling the internal and external resources needed for project completion, including financial support and buy-in from employees, leadership, and other stakeholders. Entrepreneurs accomplish this broad array of tasks more easily than employees due to their generalist skills and varied functional expertise. Overall, we propose that firms hiring entrepreneurs derive a larger share of revenue from new offerings:

Hypothesis 1 *The share of new entrepreneurial hires is positively associated with the share of sales from innovation in established firms.*

2.3 Execution Skills in Middle Management

Firms' ability to generate commercial innovations depends not only on employee human capital, but also on organizational design (Miller, 1983; Teece, 1996; Dess et al., 1999; Foss et al., 2015).

By influencing the flow of information and collaboration across the firm through coordination and motivation mechanisms, organizational design may facilitate or hinder workers' ability to exercise their skills. Thus, an important decision firms face is not just whether to hire former founders, but what level of authority and responsibility to entrust them with (Foss and Klein, 2012). Distel et al. (2019) and Faleye et al. (2020), for example, show that entrepreneurs in a top management team or on the board of directors can direct a firm's strategy and investments, with positive effects on performance. By contrast, the nature of execution skills and the innovation process suggest that entrepreneurial hires are particularly important for innovation when paired with the decision rights afforded to middle managers.

Whereas top managers outline the broad contours of strategy, implementation and execution are usually delegated to middle managers (Kanter, 1982; Burgelman, 1983b; Wooldridge et al., 2008), whose involvement and engagement are positively linked to firm performance (Wooldridge and Floyd, 1990; Huy, 2001; Mollick, 2012). Middle managers constitute a critical organizational design element, performing an information processing function (Garicano, 2000; Colombo and Grilli, 2013; Wooldridge et al., 2008). Put differently, they represent agents of selection inside the firm, picking ideas worth championing and acquiring the requisite resources for their execution (Burgelman, 1983a, 1991; Mollick, 2012). Middle managers' capacity to command upwards and downwards influence is driven by their ability to span boundaries across firm layers, manage emotions and navigate organizational culture, and clearly communicate organizational purpose (Floyd and Wooldridge, 1997; Huy, 2002, 2011; Rouleau and Balogun, 2011; Guo et al., 2017; Gartenberg et al., 2019). Unsurprisingly, middle managers are seen to play a key role in firms' entrepreneurial behavior (Burgelman, 1983a).

Due to their central position in the flow of information, configuration of resources, and exercise of authority, middle managers' involvement in all stages of venture development connects naturally with execution skills. New entrepreneurial hires generally link firms' existing technical knowledge with unaddressed market needs, but non-managerial roles rarely confer the authority

required to assemble the requisite resources for pursuing innovation; conversely, top managers dispose of stronger decision rights and guide strategy, but may not command full knowledge of firms' technical assets and may be unable to connect them with market gaps (Stevenson and Jarillo, 1990). Middle management roles offer a practical compromise between these extremes, allowing former founders to provide valuable inputs across all stages of internal ventures, not just in limited phases of new business development (Burgelman, 1983a).

To begin with, superior market insight and easier access to firms' technical knowledge help new entrepreneurial hires in middle management act as effective agents of selection; that is, they discern the value of different ideas, authorize subsequent development, and champion the projects they deem most profitable.⁵ Central positions in information and resource flows then facilitate the acquisition of financial support and buy-in for selected ideas by allowing their access to gatekeepers and decision makers at both lower and higher levels of hierarchy, as well as external stakeholders; at this stage, execution skills' social dimension likely plays a vital role. Moreover, middle managers' support for entrepreneurial action is strongly associated with firms' implementation of innovative ideas (Kuratko et al., 2005; Hornsby et al., 2009), so hiring former founders in such positions may disseminate and foster a broader entrepreneurial culture throughout the organization. These arguments therefore imply that:

Hypothesis 2 *The positive relationship between new entrepreneurial hires and sales from innovation is stronger for entrepreneurial hires in middle management positions.*

2.4 Execution Skills and Incremental Innovation

The nature of entrepreneurial human capital holds implications for the type of innovation firms can introduce and appropriate value from. Researchers and practitioners commonly distinguish two broad categories: incremental innovation 'involves refining, improving, and exploiting an existing technical trajectory', whereas radical innovation 'disrupts an existing technological trajectory' (Gatignon et al., 2002). Given these categories' distinct determinants, we argue new

⁵ This applies to both selecting *in* valuable opportunities and selecting *out* poor projects (Lerner and Mendier, 2013), improving firms' overall innovation portfolio (Klingebiel and Rammer, 2014).

entrepreneurial hires help discover marginal improvements to firms' under-utilized knowledge and have a larger effect on incremental, rather than radical innovation.

Several factors drive heterogeneity in innovative outputs. Radical innovation represents a recombination of relatively distant, often external, knowledge that generates truly novel ideas; this type of innovation is associated with high uncertainty, but promises to generate substantial returns for the innovative firm, albeit materializing over a long time horizon (Dewar and Dutton, 1986). Radical innovation is strongly dependent on highly specialized, technical human capital and R&D investments (Dewar and Dutton, 1986; Subramaniam and Youndt, 2005), science-driven search practices emphasizing university ties, patents, and knowledge acquisition (Köhler et al., 2012; Zhou and Li, 2012), systematic knowledge management practices (Cantner et al., 2011), and a history of engaging with novel technologies or previous breakthroughs (Ahuja and Lampert, 2001; Dunlap-Hinkler et al., 2011). In sum, radical innovation is tightly connected to technical skills and the invention stage of product development: that is, researchers are more important than entrepreneurs for this type of innovation.

Alternatively, incremental innovation generates commercial success by exploiting firms' existing knowledge assets in new ways (Dewar and Dutton, 1986; Gatignon et al., 2002); so while technical human capital and R&D investments retain some importance (Laursen and Salter, 2006; Cantner et al., 2011; Leiponen and Helfat, 2011), this form of innovation exhibits closer ties with insight into the firm's competitive landscape.⁶ For example, firms engaging in search strategies with a market orientation – focusing on customers and competitors – are more likely to generate successful incremental innovation (Köhler et al., 2012), as are firms drawing broadly from external sources (Laursen and Salter, 2006; Leiponen and Helfat, 2011). Additionally, the ability to share knowledge internally and externally among employees, customers, suppliers, and partners favors incremental innovation (Subramaniam and Youndt, 2005).

While execution skills do not exclude a technical component – evaluating knowledge assets

⁶ Incremental innovation is sometimes associated with imitation (partly due to its common measurement as products and services new to the firm, but not the market), which highlights the importance of market knowledge.

may even require a certain technical competence, they emphasize the ability to create market opportunities and resource configurations less visible to non-entrepreneurs (Foss and Klein, 2012); entrepreneurial human capital should thus lend itself more to incremental than to radical innovation. Former founders' stronger previous contact with customers, competitors, suppliers, and other complementors allows for broader insight into the competitive landscape, enhancing firms' market-oriented search. The generalist dimension of execution skills further allows entrepreneurial hires to more effectively acquire information and resources across domains, aiding internal knowledge sharing. Former founders' value added thus lies to a larger extent in bringing to market more marginal improvements in firms' product and service offerings than in developing the technical areas that favor radical innovation, so we posit that:

Hypothesis 3 *The positive relationship between new entrepreneurial hires and sales from innovation is stronger for incremental relative to radical innovation.*

3 Data

3.1 Empirical Setting

We test our hypotheses empirically in Denmark, a context that features several key properties. First, the richness of data made available by the national statistics bureau, Statistics Denmark, allows us to analyze a host of innovation outcomes while tracking individual career histories in detail. Second, Denmark enjoys a thriving entrepreneurial ecosystem, ensuring that the supply of entrepreneurs available for firms to hire is relatively large; moreover, the Danish labor market is highly flexible, so we observe dynamic career trajectories with substantial moves to and from entrepreneurship. Finally, there is an abundance of innovative firms at the global frontier, affording us with variation in our outcomes of interest.

3.2 Community Innovation Survey Data

To measure firm innovation, we rely on the Danish version of the Community Innovation Survey (CIS). This survey is based on the Oslo Manual designed to collect self-reported data on R&D activities and innovation of European firms and is a major source of information for in-

novation research (see, for instance, [Cassiman and Veugelers, 2006](#); [Laursen and Salter, 2006](#); [Leiponen and Helfat, 2010](#); [Klingebiel and Rammer, 2014](#)). Statistics Denmark took over the administration of the CIS in 2007, when the data collection approach also changed; therefore, we construct our sample starting in 2007 to ensure consistency in our dependent variables. The data is collected yearly through an online survey at the central webpage for tax reporting by firms registered in Denmark and participation is mandatory for selected firms, such that we avoid non-response or attrition problems. The CIS relies on stratified random sampling to ensure coverage across industries subject to international competition and excludes state-owned companies; sampling intensity is higher for industries with high R&D levels, as well as for larger firms, with around 4,500 firms participating in the survey annually. Our final panel dataset for the years 2007-2016 is unbalanced, although most firms complete the CIS multiple times. We then link the CIS data to the general firm register – including *all* firms in Denmark – to obtain additional information on employment and investments; we also link our dataset to patent data to obtain measures of technical output.

3.3 Linked Employer-Employee Data

Our main data source for identifying entrepreneurs is the Integrated Database for Labor Market Research (IDA) containing linked employer-employee information on the full Danish workforce from 1980 onward. The IDA database is recognized for its ability to reliably track both firms and workers over time and is often used in entrepreneurship and innovation research (see, e.g., [Sørensen, 2007](#); [Dahl and Sorenson, 2012](#); [Kaiser et al., 2018](#); [Rocha and van Praag, 2020](#)). However, due to a change in the key that uniquely identifies firms, we track individual career histories from 1999 onward; the IDA data includes all firms in Denmark associated with at least one individual, thus excluding holding or shell companies. We match these firms with the general firm register to obtain the year of establishment, which we use to identify new firms. We also match the individual level observations with two other registers containing information on worker occupation (International Standard Classification of Occupations or ISCO codes)

and education. We aggregate individual observations to the firm level by computing counts of individuals (such as new entrepreneurial hires) before merging with the CIS data. Since we are interested in established firms' innovation, we restrict our sample to firms more than five years old and with more than 25 employees, counting only individuals' main occupation.

3.4 Dependent Variables

Given our theoretical focus on the commercial success of innovation, our main dependent variable in testing Hypotheses 1 and 2 is the share of *Sales from innovation*. This variable captures the share of revenue derived from new and improved products and services, and ranges from zero to a hundred percent in a given year. Alternatively, we use a binary version of this variable, *Any sales from innovation*, which equals one if a firm reports any such sales in a given year and zero otherwise. To test Hypothesis 3, we disaggregate our dependent variable into the share of sales from products and services new to the firm, *Sales from incremental innovation*, or to the market/world, *Sales from radical innovation*. Often used as proxies for innovation activities in previous research (Cassiman and Veugelers, 2006; Laursen and Salter, 2006; Leiponen and Helfat, 2010), these measures are especially well-suited to our study as the fraction of revenue obtained from new offerings speaks directly to the function we posit former entrepreneurs perform inside established organizations: unlocking the economic significance of innovation.⁷ Our sales-based variables also allows us to capture innovation more broadly than more technical, traditional measures, as only a small fraction of firms exhibit regular patenting activities. Nonetheless, we use *Any patents*, *Number of patents* and *Citation-weighted patents* as dependent variables to assess whether entrepreneurial hires generate new technical knowledge.

3.5 Independent Variables

Correctly identifying entrepreneurs is a key challenge for our study. Since the execution skills we theorize founders bring to the hiring firm come from running a start-up with growth potential, we

⁷ Grimpe and Kaiser (2010) note that our measure of sales from innovation provides 'direct information on the success of commercializing the firm's inventions and can thus be regarded as a success measure superior to patents, since these constitute an intermediary output of R&D activities'.

define entrepreneurs as founders of an incorporated start-up with employees. We use Statistics Denmark’s general firm registry to identify new firms, using their date of registration as a legal entity. We define a new firm as one registered in the current or previous year (age zero or one) and with at most 25 employees including the founder, in order to avoid counting spin-offs from existing companies. Identifying incorporated firms’ founders is not straightforward. Following [Sørensen \(2007\)](#), we identify founders as individuals working at a new firm with at most three employees; if the new firm consists of more than three employees, we identify founders as employees in managerial roles; and absent managerial roles, we count the top three earners as founders. We exclude founders who do not hold their main occupation with the firm until year three of its existence, as well as solo ventures within this time frame. This approach, capturing engagement in a meaningful start-up’s early life, allows us to measure founding experience in a way that reflects our theoretical interest in entrepreneurial human capital.

For our analysis, we consider founding experience within the five years prior to the hiring event, focusing on observations where the focal firm provides the individual’s main occupation. To assess different labor inputs’ impact on innovation (as explained in Section 4 and detailed in Appendix A), we split the workforce into three distinct groups: *Hires with founder experience*, *Hires without founder experience*, and *Stayers*.⁸ We also disaggregate founder hires into those occupying *Top management*, *Middle management*, and *Non-management* roles: we use one-digit ISCO codes to identify managers and three-digit codes to identify top managers, then compute the shares of entrepreneurial hires at each level. Moreover, we use ISCO codes to assess individuals’ managerial experience and compute firms’ share of *Hires with managerial experience*: contrasting this group with entrepreneurial hires helps us examine the potential for managerial skills to confound our preferred execution skills channel. As current output depends on past inputs, we lag labor shares by one year (also alleviating reverse causality).

⁸ This categorization reflects our theoretical focus on different types of new hires’ relative contributions to innovation. In additional analyses, we disaggregated stayers into *Stayers with founding experience*, *Stayers without founding experience*, and *Original founding team*, with similar results. Interestingly, entrepreneurial stayers are not significantly related to innovation, which we attribute to human capital depreciation (see Section 5.2).

3.6 Control Variables

We control for several variables that may determine firms' innovation outcomes and hiring decisions. We include logged *Firm size* as the total number of workers (based on main occupations), *Firm age* as years since establishment, and the logged book value of *Physical capital*. Following [Kaiser et al. \(2015\)](#), we consider individuals holding a higher education degree in STEM-related areas of technical, natural, health, veterinary, and agricultural sciences and occupying job functions requiring high levels of knowledge as *R&D workers*. We also control for the logged number of *University graduates* and include dummies for whether the firm has an *R&D department*, has *Applied for patents*, or *Acquired patents*, as well as *R&D intensity* as R&D spending over revenue. All measures derived from IDA data are lagged in the estimation and we include two lags of *Sales growth* and *Investment intensity* (net investment over revenue) as time-varying proxies for the demand for execution skills. Finally, our main models include (two-digit NACE level) industry-year fixed effects, as well as firm fixed effects.

Table 1: **Descriptive statistics for the main variables**, $N = 20,236$

	Mean	St. dev.	Min.	Max.
<i>Innovation outcomes</i>				
Sales from innovation	0.115	0.277	0	1
Sales from incremental innovation	0.054	0.181	0	1
Sales from radical innovation	0.060	0.198	0	1
<i>Lagged labor shares</i>				
Hires with founder experience	0.00550	0.010	0	0.273
... in <i>top management</i>	0.00007	0.001	0	0.053
... in <i>middle management</i>	0.00023	0.002	0	0.041
... in <i>non-management</i>	0.00520	0.010	0	0.273
Hires without founder experience	0.213	0.146	0	1
Stayers	0.781	0.149	0	1
<i>Control variables</i>				
Firm size	274.335	1,008.521	26	>33,500
Firm age	27.109	18.417	6	>100
Physical capital (mil. DKK)	378.858	2,599.477	0	>9,800,000
R&D workers	24.854	138.147	0	>7,000
University graduates	66.162	258.172	0	>10,800
R&D department	0.225	0.418	0	1
R&D intensity	0.023	0.103	0	1
Applied for patent(s)	0.104	0.305	0	1
Acquired patent(s)	0.083	0.276	0	1
Sales growth	0.120	2.060	-0.996	>200
Investment intensity	0.041	0.095	0	1

3.7 Descriptive statistics

Our dataset, summarized in Table 1, comprises 20,236 observations for 3,842 firms. Firms' average share of sales from innovation is 11.5%, with slightly more than half coming from radical (6%), rather than incremental (5.4%) innovation. The share of new entrepreneurial hires in the workforce is 0.5%, reflecting the fact that many organizations do not hire entrepreneurs in any given year; most of these hires occur in non-managerial positions; instead, 78% of the workforce comprises non-entrepreneurial stayers.

4 Method

An ideal experiment to test our hypotheses would entail randomly assigning the *quantity* and *quality* of employees with and without entrepreneurial human capital to firms, whose innovative performance we could then track. In practice, the prohibitive cost of such an experiment renders our analysis vulnerable to several sources of endogeneity and bias, whose sign and magnitude are difficult to establish *ex ante*. Below, we explain the identification and interpretation challenges we face and our approach to limiting their impact on our estimates.

4.1 Identification Challenges

The first order concern for our identification strategy is the positive selection of more innovative firms into hiring entrepreneurs. If firms with a higher share of revenue from new products and services generally hire more entrepreneurs, firm innovativeness confounds our relationship of interest. Firm fixed effects alleviate this concern, but a dynamic effect may still arise if firms hire founders when they anticipate additional market opportunities and demand execution skills. In our empirical analysis, we mitigate this potential issue by controlling for a broad set of firm characteristics and including lagged sales growth and investment intensity as proxies for time-varying demand for execution skills (Bloom et al., 2007; Michaely and Roberts, 2012).

A second order concern with interpreting our results is returning entrepreneurs' ability: if only the worst performers become employees, can we expect them to impact firms' innovation

outcomes? Moves in and out of paid employment are a common component of entrepreneurial careers and entrepreneurs returning to paid employment are not necessarily negatively selected (Burton et al., 2016; Dillon and Stanton, 2017; Failla et al., 2017), with exits determined by diverse (non-)business motives (Wennberg et al., 2010; DeTienne et al., 2015). Moreover, negative selection would run counter to our assertion that former founders increase firms' innovation sales, making our estimates lower bounds. Potential assortative matches between more innovative firms and better founders pose a subtler challenge; in this case, our results should be interpreted as upper bounds for entrepreneurial hires' effect on average firms' innovation.

4.2 Econometric Model

As Appendix A describes in detail, we adopt an innovation production function allowing us to back out the relative impact of new entrepreneurial hires relative to other labor inputs under a set of weak assumptions (Kaiser et al., 2015, 2018). In practice, we estimate ordinary least squares models with fixed effects, regressing innovation outcomes on lagged labor shares (alleviating reverse causality), firm characteristics, firm fixed effects (addressing time-invariant unobservables), lagged sales growth and investment intensity (addressing time-variant demand for execution skills), and industry-year fixed effects (addressing common shocks).⁹ Although they cannot be interpreted directly, positive labor share coefficients indicate higher returns in terms of sales from innovation compared to stayers. More importantly, we test our hypotheses by comparing coefficients for *Hires with founder experience* and *Hires without founder experience*, which also helps us evaluate the magnitude of our effects of interest.¹⁰ We perform similar calculations when comparing entrepreneurial hires at different managerial levels and contrast coefficients across models when evaluating incremental and radical innovation. We cluster standard errors at the firm level throughout the analysis.

⁹ Pooled ordinary least squares or tobit models produce economically and statistically larger results. However, potential unobserved firm-level confounders justify the use of fixed effects models.

¹⁰ As Kaiser et al. (2018) note, the estimated coefficients do not translate directly into elasticities due to the differentiated nature of labor inputs (and the many associated zero values), as well as our reliance on a composite labor index (see Appendix A). Moreover, the negative coefficient we obtain for *Firm size* effectively precludes us from calculating meaningful effect sizes relative to the baseline category.

Table 2: **The effect of hiring entrepreneurs on firms' sales from innovation**

	Model I: Sales from innovation			Model II: Sales from innovation			Model III: Sales from incremental innovation			Model IV: Sales from radical innovation		
	β	p	s.e.	β	p	s.e.	β	p	s.e.	β	p	s.e.
<i>Lagged labor shares</i>												
(1) Hires with founder experience	0.510	0.006	0.185				0.264	0.033	0.123	0.246	0.056	0.129
(2) ... in <i>top management</i>				-2.077	0.125	1.354						
(3) ... in <i>middle management</i>				2.562	0.059	1.355						
(4) ... in <i>non-management</i>				0.266	0.180	0.199						
(5) Hires without founder experience	-0.004	0.856	0.020	0.001	0.945	0.020	0.000	0.648	0.014	-0.010	0.472	0.014
<i>Control variables</i>												
Log firm size	-0.015	0.107	0.020	-0.013	0.145	0.009	-0.009	0.144	0.006	-0.005	0.401	0.006
Log physical capital	-0.002	0.303	0.002	-0.002	0.300	0.002	-0.003	0.054	0.001	0.000	0.916	0.002
Firm age	0.002	0.000	0.001	0.002	0.000	0.001	0.002	0.000	0.000	0.001	0.085	0.000
Log R&D workers	0.009	0.145	0.006	0.009	0.142	0.006	0.010	0.021	0.004	-0.001	0.788	0.004
Log university graduates	-0.003	0.645	0.007	-0.002	0.745	0.007	0.002	0.639	0.005	-0.005	0.259	0.005
R&D department	0.138	0.000	0.014	0.138	0.000	0.014	0.073	0.000	0.010	0.064	0.000	0.010
R&D intensity	0.058	0.374	0.066	0.077	0.217	0.061	-0.005	0.669	0.011	0.064	0.319	0.064
Applied for patent(s)	0.024	0.123	0.016	0.024	0.136	0.016	-0.005	0.669	0.011	0.029	0.009	0.011
Acquired patent(s)	0.037	0.002	0.012	0.037	0.002	0.012	0.013	0.122	0.008	0.024	0.006	0.009
Sales growth/investment intensity	Yes			Yes			Yes			Yes		
Industry-year fixed effects	Yes			Yes			Yes			Yes		
Firm fixed effects	Yes			Yes			Yes			Yes		
Number of observations/firms	20,236/3,842			20,236/3,842			20,236/3,842			20,236/3,842		
<i>F-tests</i>												
Hypothesis 1: (1)=(5)	7.57	0.006					4.31	0.038		3.88	0.049	
Hypothesis 2: (3)=(2)				5.74	0.016							
Hypothesis 2: (3)=(4)				2.82	0.093							
Hypothesis 2: (3)=(2) or (4)				5.07	0.024							

Robust standard errors clustered by firm. Sample restricted to firms older than 5 years and with more than 25 employees, for years 2007-2016; stayers represent the baseline category. All models estimated by ordinary least squares with firm fixed effects.

5 Results

5.1 Main Results

Table 2 presents our main estimation results. Model I tests Hypothesis 1, which predicts that a higher share of new entrepreneurial hires is positively associated with firms' share of sales from innovation. In row (1), hires with founder experience are positively and significantly associated with sales from innovation relative to the baseline stayer category ($\beta = 0.510, p = 0.006$), but hires without founder experience in row (5) return a small and insignificant negative coefficient ($\beta = -0.004, p = 0.856$). Comparing these two estimates provides strong support for Hypothesis 1 ($p = 0.006$) and implies that an additional hire with founding experience contributes 26 times more (in absolute terms) to the hiring firm's sales from innovation relative to an additional hire without founding experience.

Hypothesis 2 proposes that new entrepreneurial hires are more tightly linked to innovation when they occur in middle management positions, as opposed to top management or outside of managerial roles. To test this hypothesis, Model II substitutes labor shares corresponding to the different managerial levels for our main measure of entrepreneurial human capital.¹¹ Within entrepreneurial hires, those in middle management are the most strongly and positively correlated with innovation ($\beta = 2.562, p = 0.059$), followed by non-managers ($\beta = 0.266, p = 0.180$). These estimates are weakly statistically different from each other ($p = 0.093$) and imply that entrepreneurial hires in middle management contribute 10.1 times more to firm innovation relative to those in non-managerial roles. Entrepreneurial hires in top management are, instead, negatively correlated with firm innovation, although this result is not statistically significant ($\beta = -2.077, p = 0.125$).¹² Comparing estimates for hires with founding experience across managerial layers returns a significant difference ($p = 0.046$) and implies that entrepreneurial

¹¹ The small fractions of entrepreneurial hires in managerial positions (see Table 1) produce large standard errors for these categories, which may inflate p -values for the hypothesis tests at the bottom of Table 2.

¹² One concern with this set of estimates lies in the potential selection of better entrepreneurs into higher managerial positions; however, our finding that new entrepreneurial hires in top management do not affect the share of sales from innovation speaks against this explanation.

hires in middle management contribute 1.2 times more (in absolute terms) to the hiring firm's innovation relative to those in top management. A joint test of hires in middle management relative to those in other positions provides further support for Hypothesis 2 ($p = 0.024$) and highlights the importance of matching entrepreneurial human capital with the relevant decision rights and access to resources.

We test Hypothesis 3 by estimating models separately for incremental and radical innovation. In Model III, we find that hires with founder experience are positively and significantly associated with sales from incremental innovation relative to stayers ($\beta = 0.264, 0.033$), whereas hires without founder experience return an insignificant coefficient ($\beta = -0.000, p = 0.648$). These estimates are significantly different ($p = 0.038$) and imply that an additional hire with founding experience contributes 25.3 times more (in absolute terms) to the hiring firm's sales from incremental innovation relative to an additional hire without founding experience. In Model IV, the equivalent coefficients for radical innovation are 0.246 ($p = 0.056$) for hires with founding experience and -0.010 ($p = 0.472$) for hires without founding experience. This significant difference ($p = 0.049$) entails a 16.1 times larger contribution (in absolute terms) to firms' radical innovation for an additional entrepreneurial hire compared to a non-entrepreneurial hire. The relative contribution of hires with founder experience is therefore larger for incremental innovation, an economically important difference. Comparing the results in Models III and IV, we conclude that new entrepreneurial hires have a stronger effect on more marginal improvements to firms' offerings, as predicted by Hypothesis 3.

5.2 Alternative Explanations and Robustness Checks

In this section we investigate the robustness of our results to alternative dependent variable, independent variable, and sampling choices. We pay particular attention to competing explanations of entrepreneurial hires' effect on firm innovation based on technical or managerial skills, which we attempt to rule out.

Table 3: Alternatives to execution skills: technical and managerial skills

	Model V: Any patents			Model VI: Number of patents			Model VII: Citation-weighted patents			Model VIII: Sales from innovation		
	β	p	s.e.	β	p	s.e.	β	p	s.e.	β	p	s.e.
<i>Lagged labor shares</i>												
(1) Hires with founder experience	0.011	0.917	0.107	0.261	0.667	0.606	-0.164	0.906	1.387	0.509	0.006	0.185
(2) Hires without founder experience	-0.034	0.029	0.016	0.027	0.897	0.207	-0.092	0.882	0.622			
(3) Hires with managerial experience										0.185	0.211	0.148
(4) Hires without either experience										-0.013	0.529	0.021
Control variables	Yes			Yes			Yes			Yes		
Sales growth/investment intensity	Yes			Yes			Yes			Yes		
Industry-year fixed effects	Yes			Yes			Yes			Yes		
Firm fixed effects	Yes			Yes			Yes			Yes		
Number of observations/firms	10,782/2,819			10,782/2,819			10,782/2,819			20,236/3,842		
<i>F-tests</i>												
Technical skills: (1)=(2)	0.18	0.672		0.14	0.710		0.00	0.966				
Managerial skills: (1)=(3)										2.00	0.157	

Robust standard errors clustered by firm. Sample restricted to firms older than 5 years and with more than 25 employees, for years 2007-2012, when patent data is available; stayers represent the baseline category. All models estimated by ordinary least squares with firm fixed effects. In Models V-VII, the means of the dependent variables are 2.7% (*Any patents*), 0.172 (*Number of patents*), and 0.196 (*Citation-weighted patents*); in Model VIII, the mean share of hires with managerial experience is 0.9%, with a standard deviation of 0.015.

We argue that former founders improve firm innovation through their execution skills, but a similar outcome may arise if they help established organizations gain access to new technical knowledge. To test this channel, we use firms’ possession of *Any patents*, *Number of patents*, and *Citation-weighted patents* as alternative dependent variables that better reflect invention outcomes in Table 3. We do not find an effect of new entrepreneurial hires on these measures, suggesting that former founders’ technical skills cannot explain our results.¹³ We obtain similarly insignificant results with *Any sales from innovation* as a dependent variable, implying that new entrepreneurial hires improve firm innovation along the *intensive*, but not *extensive* margin. In other words, they are more valuable to firms already engaged in innovation activities and that possess potentially underused technical knowledge, shoring up our theoretical focus on innovative firms. Moreover, while we follow previous work that treats products and services new to the market or world as ‘radical innovation’, we can analyze these types separately. Hires with founding experience have a positive and marginally significant association with offerings new to the market ($\beta = 0.163, p = 0.133$) and a positive, but insignificant one with offerings new to the world ($\beta = 0.084, p = 0.252$), a result that reinforces our view that entrepreneurial human capital favors incremental over radical improvements.

As entrepreneurs perform a variety of managerial functions in their start-ups, an alternative explanation for why entrepreneurial hires aid firms’ innovation outcomes may be that they acquire managerial, rather than execution skills. In other words, their advantage relative to hires without founding experience may stem not from the ability to discern new business opportunities based on existing knowledge, but from deploying more general skills in goal-setting, operational, monitoring, or personnel practices (Bloom and van Reenen, 2007). We evaluate this potential confounding channel by measuring individuals’ managerial experience – whether they occupied a management position in the five years prior to hiring. We then regress *Sales from innovation* on

¹³ New entrepreneurial hires may also occur as a result of ‘acqui hires’, which may bring in both entrepreneurial human capital and innovative projects; however, this is rather new phenomenon and quite rare in Denmark, so it is unlikely to affect our results.

three distinct labor shares: *Hires with founding experience*, *Hires with managerial experience*, and *Hires without founding or managerial experience*. Model VIII in Table 3 suggests that new entrepreneurial hires remain positively and significantly correlated with firm innovation ($\beta = 0.509, p = 0.006$), whereas new managerial hires exhibit a weaker, insignificant association ($\beta = 0.185, p = 0.211$). While these coefficients are not statistically different ($p = 0.157$), they are economically distinct and the effect of entrepreneurial hires is virtually unchanged from that in Table 2. We thus conclude that while entrepreneurial human capital likely encompasses managerial skills, an important role remains for execution skills connecting existing knowledge with market insight to generate new business opportunities.

We subject our independent variables to additional sensitivity analyses. First, whereas our main analysis identifies founders only in years zero and one of their start-up, we consider an alternative definition where we allow founders to be recorded as such for up to three additional years, provided they remain with the firm. This expands the number of individuals for whom we record entrepreneurial experience within the past five years, but implies that start-up experience (i.e. in the venture's first two years) is somewhat more distant from the hiring event. The results are qualitatively similar with those in Table 2, although their magnitude decreases slightly: for example, in Model I, the coefficient is now 0.399 ($p = 0.021$) as opposed to 0.510 ($p = 0.006$). The depreciation of entrepreneurial human capital provides one potential explanation for this pattern, with more recent experience having larger effects on innovation. To further probe this explanation, we re-estimate our models computing the shares of hires with and without founding experience based solely on the year prior to the hiring event: if entrepreneurial human capital depreciates quickly, more recent founding experience should produce larger effects on innovation. This is indeed what we find, with a Model I coefficient of 0.621 ($p = 0.031$), implying that hiring firms benefit more from hiring individuals with more recent entrepreneurial experience.

Second, one year of start-up experience (i.e. a new venture's years zero and one) is enough to identify a founder in our main analysis, reflecting our interest in start-ups' early life, when

execution skills are developed. However, this raises the question of whether brief spells in entrepreneurship – potentially reflecting failed projects – lead to enhanced execution skills or whether longer, sustained founding experience is needed. To evaluate this, we re-calculate our measures of entrepreneurial human capital requiring individuals to have been with the venture at least two consecutive years (i.e. years zero and one, or one and two). If short-term engagement does not build execution skills, the estimated coefficient for *Hires with founding experience* should increase; otherwise, it should remain essentially unchanged. Using these independent variables produces broadly similar effect sizes to those in Table 2 (Model I, $\beta = 0.401, p = 0.091$), implying that entrepreneurial human capital is developed even through brief engagement during a new venture’s early life; this may also suggest that both failure and success are linked with learning and entrepreneurial human capital development.

Third, we subject the possibility that more entrepreneurial firms hire more former founders to an alternative test, regressing our measures of innovation on *leads* of the labor shares: a positive and significant effect would imply that reverse causality can explain our results. We find that future entrepreneurial hires do not affect innovation outcomes: when analyzing *Sales from innovation*, this variable returns a coefficient of 0.052 ($p = 0.794$). The evidence therefore speaks against reverse causality as a driver for our findings.

Fourth, our theoretical framework guides our analysis of human capital *flows*, but we can also assess the effects of its accumulation as a *stock*. We compute the share of *Workers with founder experience* (mean of 1.2%) and use it as an independent variable in fixed effects models. The results point towards a significant positive effect of entrepreneurial human capital stocks on sales from innovation ($\beta = 0.372, p = 0.056$), albeit statistically weaker than the one for flows. Its positive association with incremental innovation is significant ($\beta = 0.257, p = 0.064$), but the one with radical innovation is not ($\beta = 0.115, p = 0.405$). So while entrepreneurial human capital accumulation is important, the inflow of execution skills and market insight may have a stronger correlation with firm innovation, in line with our depreciation argument.

Fifth, our analysis considers all employees who report a firm as provider of their main occupation, although some roles require no specific knowledge or qualifications and are unlikely to affect innovation. When we exclude such positions from firm size and labor shares measures, the results are qualitatively and quantitatively similar (Model I, $\beta = 0.495$, $p = 0.025$), as would be the case if most entrepreneurs are hired in positions above this level and the new variables were simply re-scaled versions of our main independent variables.

Finally, we assess the robustness of our results to sampling decisions. Our focus on *established* firms as recipients of entrepreneurial human capital guided our decision to analyze firms more than five years old and with more than 25 employees, but these cutoffs are arguably subjective. As a check, we use alternative age cutoffs from more than three to more than 100 years old, estimating our main specification (Model I) in each new sample. We find consistent results in terms of sign, magnitude, and significance for all cutoffs up to 20 years, where the effect begins to weaken, partly due to smaller sample size; the effect is halved for firms over 40 years old and becomes weakly negative for the oldest firms. We also use size cutoffs ranging from more than 10 to more than 500 employees, again estimating our main specification in each sample. We find consistent results in terms of sign, magnitude, and significance for all cutoffs from 15 to 200 employees, where the effect weakens economically and statistically. That larger and older firms benefit less from entrepreneurial hires is an important boundary condition for our work, with these firms' more deeply entrenched routines and business models making it more difficult to integrate and act upon entrepreneurial human capital.

6 Discussion

Theoretical Implications By showing that new entrepreneurial hires improve firms' ability to introduce new products and services or find new markets for existing goods, we show how entrepreneurship and innovation interface to generate growth opportunities, thus linking two distinct strands of literature. Our results highlight the importance of considering entrepreneurial

human capital – former founders’ execution skills – as a scarce and valuable resource for firms’ innovative performance (Alvarez and Busenitz, 2001; Foss and Klein, 2012). We provide novel evidence of organizations’ capacity to build entrepreneurial capabilities (Teece, 2016; Distel et al., 2019; Faleye et al., 2020), a function whose determinants have received limited attention despite a recognition that ‘entrepreneurial action is required to transform knowledge investments from possessing the potential to create value into a form that enables its appropriation’ (Agarwal et al., 2010). Entrepreneurial capabilities complement inventive potential, allowing firms to appropriate a larger share of the value they create (Teece, 1986).

Our emphasis on entrepreneurial action inside established firms appears at odds with studies of employee entrepreneurship, where the ‘abundance of under-exploited knowledge’ is used outside the organization that generated it when employees deploy their human capital through spin-offs (Agarwal et al., 2004, 2007; Klepper and Sleeper, 2005; Franco and Filson, 2006; Hellmann, 2007; Campbell et al., 2012b; Ganco, 2013; Gambardella et al., 2015). Yet, our argument is simply that firms *can* exploit the scientific and technical knowledge they produce by hiring the appropriate human capital. Former entrepreneurs’ execution skills allow firms to appropriate a larger share of the value they create, thereby improving firms’ incentives to generate knowledge in the first place and leaving them less liable to competition from ventures spawned otherwise.¹⁴ Disentangling entrepreneurial hires’ contribution to preventing spin-offs by exploiting technical knowledge in-house from their contribution to encouraging spin-offs by acting as role models for peers may represent a fruitful area for future research.

In theorizing and showing a stronger effect of new entrepreneurial hires in middle management on firm innovation, this paper highlights the importance of organizational design for human capital deployment (Teece, 1996; Garicano, 2000; Foss et al., 2015). Middle managers perform crucial information processing and resource allocation functions in organizations (Wooldridge

¹⁴ If new entrepreneurial hires are better selection agents, the knowledge exploited inside the firm is of higher quality and spin-offs are of lower quality, while fewer disagreements inside the firm prevent spin-offs (Klepper, 2007). The knowledge spillover view of strategic entrepreneurship suggests, however, that firms may also forgo spill-ins from the new ventures they could have spawned otherwise (Agarwal et al., 2007; Ioannou, 2014).

et al., 2008; Mollick, 2012). Former founders' advantage in linking market knowledge with firms' technical assets translate into improved performance as selection agents when they occupy middle management roles; moreover, entrepreneurial hires in such roles can better acquire and mobilize resources across dispersed gatekeepers than hires in other hierarchical positions. Matching entrepreneurial human capital and decision rights (Foss and Klein, 2012) is therefore vital for execution skills to reach their productivity potential in terms of firm innovation.

Our results suggest that new entrepreneurial hires in top management are not significantly related to firm innovation, in apparent contrast to Faleye et al. (2020). However, top managers' responsibilities lie mainly in outlining strategy and providing a vision for the firm (including increases in R&D spending, for instance), actions that may take longer to materialize as sales from innovation; the outcomes Faleye et al. (2020) study speak to external audiences' perception of firm value and are far more proximate to the hiring event. Understanding the dynamic effects of entrepreneurial human capital on firm innovation and performance presents an important dimension along which our work could be extended.

The core premise of our theoretical framework is that former founders possess a combination of innate and, especially, acquired entrepreneurial human capital (albeit subject to depreciation). In other words, we theorize that former entrepreneurs enjoy advantages over non-entrepreneurs with regards to the generality of their human capital, which enhances their effectiveness in searching for, acquiring, and subsequently mobilizing heterogeneous social, human, and financial capital resources to pursue newly identified market opportunities building on under-utilized knowledge. Consequently, we propose and find evidence that new entrepreneurial hires are more tightly linked to incremental innovation – which finds new uses for existing assets, than to radical innovation, which is more heavily dependent on technical human capital. In other words, execution skills are relatively more helpful in detecting and implementing more marginal (and potentially imitative) improvements to firms' product and service offerings.¹⁵ Nevertheless,

¹⁵ An alternative interpretation is that if radical innovation requires enacting business models distinct from those of the knowledge-originating firm, commercialization is more likely to occur outside the firm (via spin-offs);

substantial business R&D is directed towards imitative products and incremental innovation accounts for a fair share of firm revenues (Leiponen and Helfat, 2011), such that improvements along this dimension could still be efficiency-enhancing.

Our conceptualization of entrepreneurial human capital as a unique set of execution skills is closely related to entrepreneurial judgment under uncertainty, or ‘decisive action about the deployment of economic resources when outcomes cannot be predicted according to known probabilities’ (Foss and Klein, 2012). For these authors, entrepreneurial judgment is non-contractible and, consequently, non-tradable due to the fundamental uncertainty surrounding the assembly and configuration of heterogeneous resources. Our results suggest that entrepreneurial behavior can be traded, albeit imperfectly: previous founding experience acts as a valuable, but potentially noisy signal that individuals possess entrepreneurial judgment which could be fruitfully deployed inside established organizations.¹⁶ This study also provides a link between definitions of entrepreneurship as *outcome* (e.g. firm formation) and as *function*, namely that entrepreneurs create and exploit strategic opportunities. Defining entrepreneurship remains a fundamental and challenging task, but the substantial overlap between alternative interpretations offers a positive upshot for scholars in this area.

In showing how entrepreneurs’ execution skills are used in established organizations, we contribute to research on entrepreneurial careers and post-entrepreneurship wages (Hamilton, 2000; Burton et al., 2016; Failla et al., 2017; Manso, 2016). While a substantial share of (un)successful founders return to paid employment following their entrepreneurial spells, organizations may struggle to recognize their distinctive skill set, such that former founders initially experience an earnings penalty (Mahieu et al., 2019); however, as execution skills are revealed to employers conversely, the business models required for incremental innovation may fit more easily with existing structures and strategies (Chesbrough and Rosenbloom, 2002). Yet, entrepreneurial hires might be better able to integrate new business models within established firms (Burgelman, 1983a), explaining why we observe positive effects of entrepreneurial hires on radical innovation. Investigating the link between entrepreneurial human capital and business models with both qualitative and quantitative methods is worth future exploration.

¹⁶ A *Harvard Business Review* essay (Smith, 2013) takes a more radical view, arguing that hiring entrepreneurs is problematic for firms: “Too often employers hire entrepreneurs, not entrepreneurial spirit. Big mistake. (...) Far better for you to ferret out the entrepreneurs before they ever join, and spend your energies and resources nurturing true entrepreneurial spirit.” Our results offer evidence that entrepreneurs can benefit firm innovation, but the comparative efficacy of entrepreneurial inputs is an interesting question for future research.

through an innovation process that takes time to materialize, former entrepreneurs' wages rebound, displaying a long-run premium (Manso, 2016; Mérida and Rocha, 2021). Our study of entrepreneurial human capital helps explain former founders' wage dynamics, but also suggests that firms may capture substantial short run value by capitalizing on entrepreneurs' underrated skills. Consequently, future studies may inquire *how* the value former entrepreneurs generate is distributed between employee and firm. Nonetheless, studies of entrepreneurs' contribution to economic growth are possibly understated if limited to the value created by their start-ups, but not the firms they subsequently move to. This insight therefore relates to the finding that failed start-ups' patents spur substantial follow-on knowledge and value creation (Hoetker and Agarwal, 2007; Serrano and Ziedonis, 2018).

If hiring former entrepreneurs is associated with higher innovation sales, then why do some firms hire only a small share of such individuals? If in equilibrium firms balance the marginal costs and benefits of hiring entrepreneurs, our results imply some firms operate sub-optimally. One demand-side explanation for this potential inefficiency stems from the stigma of failure facing unsuccessful entrepreneurs (Landier, 2006; Zunino et al., 2021), such that the expected benefits of entrepreneurial hires are underestimated. Failure stigma not only hinders firm entry, but may also limit entrepreneurship in established companies and impose larger costs on society as a whole than previously considered. Firms may also worry about integrating former founders into established structures. Entrepreneurs exhibit preferences for autonomy that contrast with existing bureaucracies (Corbett and Hmieleski, 2007; Sørensen, 2007; Butler, 2017), so a rigid environment would limit firms' ability to extract execution skills' full value. While one could bypass this problem by hiring entrepreneurs in middle management, affording them increased decision rights and autonomy, firms may be constrained in the availability of such positions.¹⁷

On the supply side, entrepreneurial human capital may indeed be scarce. Only a small fraction of

¹⁷ In addition, former founders may lead other workers to leave the organization and pursue entrepreneurship (Nanda and Sørensen, 2010); execution skills and financial capital may also be complements in generating innovation, so capital constraints may limit the acquisition of entrepreneurial human capital; moreover, firms may expect entrepreneurial hires to engage in internal competition for scarce resources, with possible negative effects on morale and productivity (Baumann and Stieglitz, 2014).

the population enjoys recent founding experience and many prefer becoming serial entrepreneurs to returning to paid employment. A systematic inquiry into the drivers of entrepreneurial hires could thus unpack these explanations, providing valuable insight into where and how post-entrepreneurship careers unfold, as well as the availability of execution skills.

Our focus on entrepreneurial action inside the firm is related to corporate (Covin and Miles, 1999; Sharma and Chrisman, 1999; Kuratko et al., 2001; Burgers and Covin, 2016) and strategic (Hitt et al., 2001; Kuratko and Audretsch, 2009; Teece, 2016) entrepreneurship literature. While we link a specific input to an entrepreneurial output through the ‘execution skills’ channel, we cannot test precisely *how* those skills are used (Teece, 2016). Future research could advance this line of inquiry by studying how entrepreneurs differ from other employees in their ability to act as selection agents (Burgelman, 1991; Mollick, 2012), orchestrate resources inside the firm and assemble new venture teams (Burgelman, 1983a; Sirmon et al., 2011), or instill entrepreneurial spirit (Kuratko et al., 2001). Moreover, do organizations organically become more entrepreneurial by (inadvertently) hiring former entrepreneurs, or must they deliberately pursue an entrepreneurial strategy in order to develop innovation commercialization capabilities? Similarly, does hiring entrepreneurs signal an appealing work environment to other former founders, allowing the firm to develop an entrepreneurial culture? Closely linking entrepreneurial inputs, processes, and outputs holds much promise for both researchers and practitioners.

Managerial Implications A natural implication of our study is that companies hiring entrepreneurs may enjoy larger sales from new products and services. Our findings lend credence to the following quote from Dell’s Entrepreneur-in-Residence, Ingrid Vanderveldt: “If a large corporation is going to stay relevant, they have to be innovative. Those corporations that reach out to embrace entrepreneurs can be the innovators. They are leading the way” (Smith, 2018). However, our results suggest that it is not enough to hire former founders; firms must also assign them to positions where execution skills can be better exploited. Middle management roles are

particularly important, since they provide a compromise between market knowledge and access to firms' technical assets, as well as the decision rights necessary for acquiring and mobilizing resources (Foss and Klein, 2012). So while entrepreneurial hires in non-management enhance innovation outcomes, this relationship is stronger when former founders are hired in middle management. Although such positions may be scarce, moves towards firm decentralization may aid the creation of middle manager positions; in turn, this organizational design choice can favor the deployment of execution skills (Foss et al., 2011, 2013).

Firms should also consider the type of innovation entrepreneurial hires bring about: execution skills primarily build on firms' existing knowledge base and favor incremental relative to radical innovation (although they retain a positive effect on the latter). While one may be concerned that such improvements are marginal or imitative, this need not deter firms from hiring entrepreneurs. In fact, companies allocate substantial resources to R&D activities directed at incremental innovation and extract significant value from it; moreover, incremental product offering improvements may ultimately pave the way for strategic renewal and generate long-run competitive advantage (Covin and Miles, 1999). That said, entrepreneurial human capital may be subject to depreciation, such that regular inflows of entrepreneurial hires may be required for sustained innovation.

Companies are often concerned with the possible negative performance implications of losing employees to competing spin-offs (Dobrev and Barnett, 2005; Sørensen, 2007; Campbell et al., 2012b; Gambardella et al., 2015; Tåg et al., 2016). Our findings suggest that established firms may counteract the loss of such workers by hiring former entrepreneurs. Since their execution skills have been honed in practice (beyond any predisposition), fewer such hires may be needed to replace the lost entrepreneurial human capital from employees exiting the firm and starting a competing venture. Organizations may thus be able to achieve savings even when entrepreneurs command a labor market premium, while new entrepreneurial hires allow them to appropriate a larger share of the rents they generate. If so, firms could perhaps worry less about competing

spin-offs and focus more on attracting and retaining relevant human capital. To enhance their ability to recruit entrepreneurial human capital, firms may also consider setting up their human resource practices with a view towards avoiding the biases and blind spots that often preclude entrepreneurs from returning to the best jobs possible (Butler, 2017).

Limitations Our study provides an initial foray into the effect of entrepreneurial human capital on firm innovation and is not without its limitations. The observational nature of our data renders our analysis liable to endogeneity concerns, as noted above. While we have attempted our best to tackle such concerns, our results could still be driven by unobserved confounders, so empirical analyses exploiting instrumental variables or two-sided matching may be necessary. Nonetheless, we view our efforts as a first step in a systematic analysis of entrepreneurial human capital and firm performance. We are also limited in our ability to address specific mechanisms potentially linking entrepreneurial human capital and sales from innovation. Most notably, although we rule out alternative channels based on technical or managerial skills, our empirical analysis is silent on how execution skills affect resource allocation inside firms. Moreover, former entrepreneurs may be able to affect firms' inventive capabilities in more subtle ways than we can pick up. The results we obtain by disaggregating turnover from innovation into its radical and incremental components are consistent with the idea that entrepreneurial hires add relatively more value in identifying market gaps suitable for existing products with smaller improvements, although they are still positively related to the more technical radical innovation. Future research using detailed patent data could more directly assess entrepreneurs' contribution to inventive activities, perhaps comparing the relative importance of execution and technical skills, as well as their complementarity.

Conclusion We propose that former entrepreneurs possess execution skills, a generalist ability to create and exploit opportunities by acquiring and mobilizing resources, beneficial for their new employers' innovation. We argue that this effect is stronger when new entrepreneurial hires

are coupled with middle management decision rights and that execution skills' attendant market knowledge favors incremental over radical innovation. In doing so, we open a set of research avenues at the interface of entrepreneurship, innovation, and strategy.

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Appendix A Innovation production function

Our sales from innovation production function assumes a Cobb-Douglas specification regularly used in the innovation literature, including studies of hiring multi-dimensional human capital (see Kaiser et al., 2015, 2018, and references therein). Our dependent variable is a firm's share of sales from innovation in a given year, I . This variable takes values in the $[0, 1]$ interval and is a function of (entrepreneurial) labor and capital inputs. In turn, labor is a differentiated input: a firm's labor force, L , is split into newly hired entrepreneurs, L_E , newly hired non-entrepreneurs, L_N , and stayers, L_S , with $L = L_S + L_N + L_E$. To accommodate the fact that many firms will not hire former founders in any given year (an important feature of our data), we construct a composite measure of labor, QL , that combines the different human capital inputs in a linear, additive way (Griliches, 1967; Hellerstein et al., 1999; Galindo-Rueda and Haskel, 2005). Expressed as a function of this quality-adjusted labor input and suppressing firm and time indices, the Cobb-Douglas production function is:

$$I = AK^\delta QL^\rho, \quad (\text{A.1})$$

where K denotes capital input and A includes additional control variables (other than capital or labor) such as industry, geographical, or time effects that we include in our empirical model. Each type of human capital x adds to the QL composite with a separate coefficient θ_x which measures its impact or marginal productivity relative to stayers (for whom the coefficient θ_S is normalized to 1), or the exchange rate at which one can be converted into the other (Griliches, 1967). Our specification for quality-adjusted labor is then:

$$QL = L_S + \theta_N L_N + \theta_E L_E. \quad (\text{A.2})$$

Expressing the count of stayers as a function of total labor force (i.e. firm size), newly hired non-entrepreneurs and newly hired entrepreneurs, and then factoring out the total labor force, the expression of quality-adjusted labor becomes:

$$QL = L(1 + ((\theta_N - 1)s_N + (\theta_E - 1)s_E)), \quad (\text{A.3})$$

where $s_N = L_N/L$ and $s_E = L_E/L$ are the shares of newly hired non-entrepreneurs and newly hired entrepreneurs in the total labor force, respectively. Since the labor shares add up to one, excluding stayers from the estimation prevents the model from becoming perfectly collinear. Plugging in the expression for quality-adjusted labor, taking logs in equation A.1, and exploiting the fact that $\ln(1 + z) \approx z$ for small z (which our employment shares satisfy), we obtain the following linear approximation for the (log) share of sales from innovation:

$$\ln I = \ln A + \delta \ln K + \rho \ln L + \beta_N s_N + \beta_E s_E, \quad (\text{A.4})$$

where $\beta_N = \rho(\theta_N - 1)$ and $\beta_E = \rho(\theta_E - 1)$. Using the resulting $\hat{\beta}_N$, $\hat{\beta}_E$, and $\hat{\rho}$ estimates we can then back out the relative impacts $\hat{\theta}_x$ of labor input x and test our theoretical hypotheses. Note that the many zero values introduced by our differentiated human capital inputs preclude a standard log-linear specification, such that β_N and β_E do not translate directly into elasticities; however, a positive β_x coefficient suggests that hiring an additional unit of labor type x provides higher returns in terms of sales from innovation than would an additional stayer. More importantly, we can compare β_N and β_E in order to examine the innovation effects of hiring an entrepreneur relative to a non-entrepreneur as a direct test of our hypotheses. The relative effect of hires with founding experience relative to hires without founding experience can then be calculated as $\theta_E/\theta_N = (\rho + \beta_E)/(\rho + \beta_N)$. Overall, this approach based on an innovation production function with differentiated labor inputs and a composite labor index provides a useful way of measuring the relative contributions of different labor shares to firm innovation.