

SPECIAL ISSUE ARTICLE

On open innovation, platforms, and entrepreneurship

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Research Summary: In recent decades, two emergent phenomena have jointly transformed the nature and pursuit of entrepreneurship across industries and sectors: open innovation and platformization. Open innovation involves a shift toward more open and distributed models of innovation, while platformization refers to the increasing importance of digital platforms as a venue for value creation and capture. Together, open innovation and platforms have created numerous opportunities for entrepreneurs and their firms—from serving as inputs for innovation for established firms to participating as complementors on existing platforms. While these entrepreneurial opportunities (and conditions) have manifested themselves in rich and varied ways, our understanding of these new forms of entrepreneurship has lagged behind. In this essay, and in this special issue, our objective is to bring a sharper focus on the important research issues and questions that frame open innovation, platforms, and entrepreneurship.

Managerial Summary: Digital platforms and open innovation environments have unleashed numerous promising opportunities for entrepreneurs, in industries ranging from consumer software, entertainment, and home appliances to auto, health, and energy. To pursue those opportunities, however, entrepreneurs will need to gain a deeper understanding of the factors that facilitate and constrain them. In this essay, we identify and discuss several of these factors and the associated challenges and highlight the need for additional research. We also consider some of the broader contextual factors, including regulatory policies, digitization, and globalization that shape the emerging opportunities.

KEYWORDS

ecosystems, entrepreneurship, open innovation, platforms

1 | INTRODUCTION

In recent decades, two emergent phenomena have jointly transformed the nature and pursuit of entrepreneurship across industries and sectors: open innovation and platformization. Open innovation (henceforth, OI) involves a shift toward more open and distributed models of innovation, while platformization refers to the increasing importance of digital platforms as a venue for value creation and delivery.

The OI paradigm suggests that firms are increasingly sourcing knowledge and technologies from outside their boundaries (inflows) to accelerate internal innovation, while also searching for external markets to commercialize or monetize their internal knowledge assets and technologies (outflows) (Chesbrough, 2003, 2006). OI questions earlier models of innovation, which emphasized keeping information internal and maintaining full control over the innovation process. This emphasis on openness has contributed to the development of novel methods of collaboration and partnerships in innovation and technology commercialization involving established and new firms, as well as a wide range of organizations, including universities, federal labs, and different types of innovation intermediaries (Chesbrough & Bogers, 2014; Nambisan & Sawhney, 2007; Perkmann & West, 2015; Schillo & Kinder, 2017; Von Hippel, 2005). In turn, these changes imply new approaches to the discovery, creation, and pursuit of entrepreneurial opportunities, both by new ventures and incumbent firms.

A second trend that is transforming entrepreneurship is platformization—a shift from individual products/services to *platforms* as intermediaries for transactions and for organizing value-creation processes (e.g., Gawer, 2014; Gawer & Cusumano, 2002, 2008; Hagiu & Altman, 2017; Parker, Van Alstyne, & Choudary, 2016). The goal of platform owners is to encourage the formation of ecosystems of complementors that build their businesses on the platform and, thereby, create value for users (Adner, 2017; Autio & Thomas, 2014; Jacobides, Cennamo, & Gawer, 2018; Nambisan & Sawhney, 2011). In essence, a platform provides a common foundation and a venue for a wide range of entities to converge in creating and delivering value to their customers (Evans & Schmalensee, 2007) and, in the process, generate both economies of scale and scope in innovation (Gawer, 2014).

By their nature, platforms entail some degree of openness, and it is through this openness that digital platforms provide opportunities for entrepreneurs. Platform owners provide boundary resources, such as application programming interfaces (APIs), software development kits (SDKs), and other resources to enable complementors to build their offerings (Ghazawneh & Henfridsson, 2013). Often, these boundary resources extend beyond the technical to include legal protection and other affiliated services. For example, Google promised to assume liability for Samsung when Apple sued for patent infringement (Fried, 2014). Platform ecosystems also offer other important benefits to the new ventures that join them—for instance, access to an established market, reputation derived from the platform owner, or guaranteed operability if the innovation meets the platform's specifications (Ceccagnoli, Forman, Huang, & Wu, 2012; Claussen, Tobias, & Mayrhofer, 2013; Huang, Ceccagnoli, Forman, & Wu, 2013). These free (or, nearly free, as there is almost always a license involved) resources can be used by entrepreneurs to access the platform's markets to build their businesses and develop yet other innovations.

Together, OI and platforms have created numerous and varied opportunities for entrepreneurs and their firms—from serving as an input for innovation for established firms to participating as complementors on existing platforms. While these entrepreneurial opportunities (and conditions) have manifested themselves in rich and varied ways, our understanding of these new forms of entrepreneurship has lagged behind. Specifically, while a few recent studies (e.g., Bogers et al., 2017; Ceccagnoli et al., 2012; Gruber, MacMillan, & Thompson, 2013; Huang et al., 2013; Nambisan, 2017; Nambisan & Baron, 2013; Zahra & Nambisan, 2011) have highlighted some of the related issues, there has been limited examination of the broader implications of OI and platforms for entrepreneurship.

Further, research on OI and platforms has focused largely on their positive effects on entrepreneurship, that is, how they facilitate business success or fuel entrepreneurship. It is also important to note that innovation openness and platforms can hinder entrepreneurship or present challenges for entrepreneurs and their initiatives (for both new ventures as well as corporate ventures) (Nambisan & Baron, 2013). Our understanding of how and when

entrepreneurial pursuits are constrained by open innovation and platform strategies of established firms is limited. This constitutes another important gap in the literature.

In this essay and special issue, our objective is to bring a sharper focus on the important research issues and questions that frame open innovation, platforms, and entrepreneurship. To this end, we first briefly review prior research on open innovation and platforms, with the intent of identifying a set of key common themes that hold important implications for entrepreneurship. By exploring these themes in detail, we identify promising avenues for future research that could enhance our understanding of *how* and *when* (under what circumstances) OI and platforms together may facilitate, hinder, or channel entrepreneurship. In particular, we first address the “how” question—that is, the specific ways by which entrepreneurship is facilitated or hindered. Next, we address the “when” question—that is, the specific contingencies that may shape the above. In discussing these issues, we not only identify a set of promising questions for future research, but connect them with existing entrepreneurship theories/concepts as well, thereby offering a broader research agenda for entrepreneurship scholars. We start with a brief review of OI and platforms.

2 | A BRIEF REVIEW OF OI AND PLATFORMS AND SOME COMMON THEMES

On a broad level, OI refers to the collaboration between companies, individuals, and other types of institutions to develop innovative products and services and, in the process, share the risks and rewards of research, development, and commercialization (Chesbrough, 2003, 2006). The OI framework is based on the notion that in a world of distributed knowledge, companies cannot rely solely on their own research and can benefit greatly from sharing their knowledge and innovating with partners. As our world becomes more connected, open innovation constitutes a mechanism for reducing research costs, spreading risks, and commercializing innovations more rapidly. The OI framework can be applied in many industry contexts, such as health care and IT, as well as in key public policy issues, such as academic entrepreneurship (Siegel & Wright, 2015), government innovation (Gascó, 2017; Mergel, 2018), and social innovation (Nambisan, 2009).

In the past 10–15 years or so, research on open innovation has advanced on different fronts. A recent review (Bogers et al., 2017) notes that the predominant focus of OI research has been at the firm (or organizational) level. For example, extant studies have considered formal (and informal) organizational designs, structures, and managerial practices that support different forms of openness (e.g., Dahlander & Gann, 2010; Foss, Lyngsie, & Zahra, 2013; Lee, Park, Yoon, & Park, 2010; Robertson, Casali, & Jacobson, 2012). Similarly, studies have also considered issues related to organizational culture and other employee-focused programs that address individual- and team-level challenges and coping strategies for OI (e.g., Alexy, George, & Salter, 2013; Salter, Criscuolo, & Ter Wal, 2014). At the firm level, OI also relates to business strategies and business models that connect open knowledge flows and the economic activities of the firm (Gruber et al., 2013).

At the same time, the implications of OI extend beyond individual organizations and underscore the need to analyze this phenomenon at higher levels of aggregation (Chesbrough & Bogers, 2014; West, Salter, Vanhaverbeke, & Chesbrough, 2014). These higher levels include the extra-organizational level (focused on the role of users and communities for OI), the interorganizational level (focused on how OI reshapes business processes, relationships, and outcomes in interfirm alliances and networks), and at the industry and societal levels (focused on how OI principles and practices reshape industry growth and evolution and facilitate new forms of democracy and public sector management). Such studies that consider OI at multiple levels of analysis and adopt multiple disciplinary perspectives could offer valuable insights on a whole range of factors and their interactions that shape OI processes and outcomes.

The notion of platforms has its roots in the engineering and product development literature, where it was conceptualized as modular technological (or product) architectures that involve a stable, shared set of core components and a variable set of peripheral components (e.g., Baldwin & Clark, 2000; Krishnan & Gupta, 2001; McGrath, 1995;

Meyer & Lehnerd, 1997; Robertson & Ulrich, 1998). While many of the early studies in this area considered the application of platforms in auto and other industrial contexts, recent work has focused largely on digital industries (e.g., software). However, the essential concepts underlying their application have remained the same—modular architectures have standardized interfaces that: (a) enable the reuse of shared components or assets that, in turn, leads to economies of scale and scope in innovation (Bresnahan & Trajtenberg, 1995; Gawer, 2014); and (b) allow the participation of a broader set of partners with more heterogeneous knowledge and capabilities in complementary innovation (Gawer & Cusumano, 2002). Many platforms are established by firms with the explicit goal of encouraging partners to develop complementary offerings that contribute to the overall value of the platform. The most successful platforms are those that are able to incentivize the creation of entire ecosystems—that includes the platform leader, who defines the architecture of participation and structures the direction of innovative activities (Nambisan & Sawhney, 2011), and the complementary innovators, including customers (Lusch & Nambisan, 2015).

While research on OI and platforms has been conducted in different contexts and in parallel, some key themes have emerged on both topics that are relevant to the study of entrepreneurship. First, both involve the notion of *openness*, albeit with different meanings and implications. While OI studies have focused largely on openness, in terms of sharing knowledge (both inflows and outflows),¹ platform studies have defined openness in terms of technological openness (architectural interface specifications) as well as organizational openness (governance). Indeed, OI is often confused with the open source software movement and platforms that provide open APIs for complementors. Second, both OI and platforms relate to the *sharing of risks*, albeit with different focus on the nature of risks shared as well as the risk-sharing mechanisms employed. While OI studies have considered how firms could reduce the risks and costs of technology (innovation) commercialization, platform studies have considered how encouraging (facilitating) complementary offerings allow firms to reduce consumers' risks of platform adoption (and, in turn, reduce the risks for the platform owner). Third, *innovation collaboration* among partners underlies both OI and platforms, albeit with different focus on the nature and extent of collaboration. Again, while the OI literature has by and large emphasized dyadic partnerships, as well as individual firms' collaborations with user (and customer) communities, the platform literature has focused on collaboration in the context of a broader ecosystem of partners. As we will discuss in the following sections, each of these themes has important implications for entrepreneurship—both in terms of facilitating and constraining entrepreneurial pursuits (Table 1).

3 | HOW OI AND PLATFORMS FACILITATE ENTREPRENEURSHIP

Most research on OI and platforms has focused on their impact on innovation, not specifically on entrepreneurship. Both OI and platforms can facilitate entrepreneurial pursuits in different ways. We examine some of these, relate them to one or more of the common themes identified earlier, and raise a number of issues for future research.

3.1 | Openness & entrepreneurship

The openness that underlies both OI and platforms approaches—and the associated sharing of knowledge and assets—creates numerous entrepreneurial opportunities for new firms. However, in both cases, the nature and extent of openness exercised by established firms would likely shape the nature of such entrepreneurial opportunities created and, thereby, present a wide range of issues for future research.

An inbound OI approach—when an existing firm is receptive to ideas and technologies sourced from elsewhere—allows new ventures to license out new technologies or market-demonstrated product concepts (Bogers et al., 2017). For example, an inbound OI approach has been employed in the pharmaceutical industry, where the OI strategies of large pharmaceutical companies have created opportunities for new biotechnology ventures. Studies have also

¹The Open Innovation paradigm is, in certain respects, a modern-day reformulation of the critique of the “not-invented-here” weakness of traditional firms (West & Bogers, 2014).

TABLE 1 Research issues and themes at the intersection of open innovation (OI), platforms, and entrepreneurship

Key OI & platform concepts related to entrepreneurship		Representative research issues and questions for entrepreneurship
Openness	OI: Inflows and outflows of knowledge Platforms: Technological (architectural) and organizational (governance)	<ul style="list-style-type: none"> How do the type and degree of openness associated with different OI strategies shape entrepreneurs' conceptualization of new opportunities as well as their subsequent decisions/actions? How do entrepreneurs' strategies differ between monetized and non-monetized inbound and outbound knowledge flows? How does the impact of inbound/outbound knowledge flows on entrepreneurship change with the phase of the industry life cycle (early high-growth phase vs. mature phase)? What are the venture-related factors (e.g., initial capabilities) and contextual factors (e.g., novel institutional arrangements, community norms) that shape entrepreneurs' approaches to OI? How does the nature and degree of platform openness (technological and organization) shape the intensity and scope of the entrepreneurial opportunities generated and/or pursued? How does the gradual evolution of platform owner's "selective revealing" strategy over the lifetime of the platform promote and/or constrain entrepreneurship? What contextual factors (e.g., regulations) shape platform owners' openness decisions and entrepreneurs' (complementors') responses to them?
Sharing of risks	OI: Innovation commercialization risk, operational risk, IP leakage risk, etc. Platforms: Technology development risk, market access risk, etc.	<ul style="list-style-type: none"> In what different ways do platforms and OI reduce the cost of entry and associated operations/business risks for entrepreneurs? What new types of dependencies (e.g., platform-specific investments) and risks (e.g., IP leakage) are created? What new capabilities will entrepreneurs (and their ventures) need to manage such risks? How can entrepreneurs acquire/build such capabilities? What specific mechanisms and avenues do digital platforms and OI approaches allow for entrepreneurs to share their risks associated with venturing? What is the impact of such mechanisms on the rate (and success) of venturing? What is the role of public policies and regulations (e.g., antitrust policy, labor market policy, IP policy) in alleviating entrepreneurial risks associated with OI and platforms?
Collaboration	OI: Collaboration between new firms and established firms, between new firms and innovation communities, between universities and new firms Platforms: Collaboration with platform owners, peer complementors, customers, and diverse other actors in the platform ecosystem	<ul style="list-style-type: none"> What are the roles entrepreneurs play in the context of OI and platforms? How do entrepreneurs engage with customers, innovation intermediaries, and diverse other actors in OI and platform ecosystems? What new types of relationships do they form, and what types of capabilities do they need to build and manage those relationships? How do OI and platforms redefine academic entrepreneurship? What are the effects of "open science" on university-firm relationships and on entrepreneurial behavior (of faculty and students) at universities? How do collaboration and competition coexist in platform ecosystems, and in what ways would that shape entrepreneurial strategies and outcomes?

shown how innovation intermediaries may facilitate the identification and placement of such new venture-sourced and market-demonstrated product concepts in established firms (Nambisan, Bacon, & Throckmorton, 2012). But, an outbound OI approach—when an existing firm shares ideas or technologies created in-house—allows new ventures to build on such technologies in furthering their own new products or technologies. Thus, openness (in terms of information flows) allows for diffusing knowledge and inventions and enhancing awareness of entrepreneurs that are distant to their own knowledge endowments (e.g., Gruber et al., 2013), thereby enhancing the vision of the opportunity landscape available to them.

While entrepreneurs may adopt inbound strategies, outbound strategies, or both, our understanding of why they choose a particular strategy and how they utilize it, is limited. In an interesting empirical study, Greul, West, and Bock (2018, this issue) examine these issues in the context of new ventures making 3D printers. Their findings indicate

that the degree of openness for inbound and outbound knowledge flows relates to the firms' initial capabilities and founding strategies. More broadly, openness decisions seem to be influenced more by initial factor endowments than a firm-specific process of emergent strategy development. Future research may examine how the type and degree of openness associated with different OI strategies shape entrepreneurs' conceptualizations of new opportunities as well as their subsequent decisions and actions.

Similarly, by creating platforms and publishing APIs, platform owners enable new ventures to pursue opportunities with demonstrated business models and well-established markets. The openness of the platform architecture as well as the ecosystem governance could potentially shape the intensity and scope of the generated entrepreneurial opportunities as well as how readily they are pursued and enacted (Nambisan, 2017). To establish a successful platform, its owner must attract complementors that create value for platform users. In most cases, this involves the provision of community resources, such as application user interfaces and software development kits to entice complementors. Platform owners must balance the provision of such boundary resources and the structuring of rules and incentives so as to encourage the commitment of complementors to invest their resources in creating platform-specific products. *Ceteris paribus*, the more open the platform, the less concerned entrepreneurs (complementors) should be in making asset-specific investments. For the platform owner, openness also comes with risk; thus, one of the most important decisions is what to reveal (open) and what to keep secret. In this sense, open innovation is also a theory of selective revelation (Alexy et al., 2013; Alexy, West, Klapper, & Reitzig, 2018; Henkel, 2006) rather than a prescription that openness is inherently "good." It is possible that too much openness can allow competitors to "fork" the platform, which may create problems not only for the platform owner, as their intellectual property is used by a competitor (Karhu, Gustafsson, & Lyytinen, 2018), but also for new ventures that serve as complementors. Thus, future research should examine how the nature/type and degree of platform openness shape an entrepreneur's decisions to pursue associated opportunities, as well as the survival and performance of their ventures.

3.2 | Sharing of risks and entrepreneurship

Digital platforms and OI are not simply enabling entrepreneurship; in many respects, they are also changing the underlying risks and, thereby, transforming the social and economic processes of entrepreneurship. It is useful to consider the vectors of this transformation and how OI and digital platforms are changing our concepts of entrepreneurship. Since the Great Depression, it has been recognized that entrepreneurship can be roughly parsed into two types: The first and most common type is the establishment of small businesses that are not particularly innovative or transformative. The second type is Schumpeterian entrepreneurship that leads to the creation of innovative new firms. This type of entrepreneurship has a powerful impact on industrial sectors or, in certain cases, can reorganize the entire economy. It is increasingly becoming evident that both OI and digital platforms may redefine the nature and the distribution of risks associated with both types of entrepreneurship, thereby shaping future entrepreneurial pursuits.

Let us first consider the impact of digital platforms on both types of entrepreneurship. Digital platforms (and related digital infrastructure) enable small businesses to rapidly establish their new ventures and gain access to both domestic and global markets. For example, platforms such as Alibaba, eBay, Etsy, and Amazon Marketplace have helped redefine the nature and extent of market risks for small businesses by broadening their market access. Similarly, cloud computing platforms and associated digital infrastructures may help enhance the overall agility of small businesses and enable them to scale up their new ventures without assuming greater levels of investment risks. For example, today a typical digital start-up can use GitHub or another open source software development platform to build its product/service and then can contract with Amazon Web Services, Microsoft Azure, or other cloud services to lease software, storage, computing, and other IT infrastructural services. Effectively, today's start-up can "bolt together" different types of resources and services needed to develop and deliver its offerings to diverse markets. All of these dramatically decrease the cost of entry and associated business risks for small businesses. While it is clear that such factors associated with digital platforms have the potential to encourage the establishment of small businesses, there is a lack of empirical work in this area, and it is a promising field for future research.

If it is perhaps easy to exclude these traditional small businesses operating on digital platforms and the gig workers from our definition of entrepreneurs; another vast swath of individuals and organizations—namely those who innovate and build their offerings on digital platforms for potential monetization—may be much closer to our definition of entrepreneurs. Of course, the most important of these digital platforms are Apple's iOS platform (and associated Apple App Store) and Google's Android (and Google Play Store), which have created entirely new “markets” for the results of entrepreneurial activity. Such digital platforms have changed the underlying economics of establishing a start-up (capable of “disrupting” existing firms and/or creating new markets or reforming old ones) by lowering its initial technological barriers and market risks (Zysman & Kenney, 2018). As Eckhardt, Ciuchta, and Carpenter (2018, this issue) show, digital platforms not only constitute a basis for entrepreneurial activity, but also facilitate deploying a graduated risk approach toward venturing. The authors demonstrate how innovators developed and uploaded apps to the Blackberry platform and then, based on technology and market signals received from the platform ecosystem, converted them to paid applications.

Both OI and digital platforms also imply the opportunity for entrepreneurs to distribute their venture risks among a larger set of actors. For example, platforms such as Kickstarter, Indiegogo, and Patreon provide new sources of capital for start-ups, allowing entrepreneurs to reduce their dependencies on traditional venture capitalists. As Sorenson, Asenovna, Li, Boada, and Fleming (2016) found, the impact of such platforms is greater on entrepreneurial activities that are outside traditional venture capital-rich regions. Crowdsourcing approaches and digital platforms are also changing labor sourcing in new ventures, thereby enabling entrepreneurs to assume lower operational risks. For example, platforms such as CrowdSpring and Cad Crowd allow entrepreneurs to engage with a global pool of product designers, while Upwork and Amazon Mechanical Turk provide access to low-cost, less-skilled workers. Indeed, such crowd-based platforms exist for most routinized tasks associated with establishing start-ups and enable entrepreneurs to save time and money (Caspin-Wagner, Massini, & Lewin, 2018). Importantly, they also alleviate the need to hire personnel to undertake relatively mundane tasks or particular tasks that require skills that are not needed permanently, thereby lowering operations risk.

Thus, more broadly, digital platforms and open innovation approaches appear to be lowering entry barriers, creating more venues for raising capital, and allowing entrepreneurs to apportion the risks associated with venturing in different ways. However, our understanding of the specific ways or mechanisms of risk reduction and their impact on the rate (and success) of venturing remains limited and indicate avenues for future research.

4 | COLLABORATION AND ENTREPRENEURSHIP

As noted previously, both OI and platforms redefine the nature of partnerships and collaboration involved in entrepreneurial pursuits and this, in turn, raises a number of interesting questions for future research. Entrepreneurs' adoption of open innovation approaches—and their collaboration with established firms and innovation communities—presents them with considerable market and technology learning opportunities (Dahlander, 2007; Greul et al., 2018; Gruber & Henkel, 2006). At the same time, the complex and dynamic relationships that underlie such collaboration imply the need to understand the relational capabilities that entrepreneurs will need to navigate them. Such OI-based collaborations may also require entrepreneurs to adopt venture strategies and processes that are responsive to the needs and norms of their partners. Similarly, in the platform context, entrepreneurs (complementors) have a lot to gain by playing the role of a “platform follower” and adhering to the norms and policies established by the platform leader (Gawer & Cusumano, 2002). Further, entrepreneurs' engagement and collaboration with other sets of actors (including customers and peer complementors) in platform ecosystems (Jacobides et al., 2018; Lusch & Nambisan, 2015) could also be highly beneficial for their ventures. However, all of these would require the acquisition of skills and capabilities that would allow them to manage a host of collaboration-related issues, including the sharing of incentives and intellectual property rights. As such, future research that carefully examines the varied roles that entrepreneurs play in both OI and platform contexts and their implications in terms of collaboration capabilities would be invaluable.

Prior research has also placed limited focus on how OI and platforms redefine the nature of partnerships between universities, firms, and entrepreneurs, that is, on academic entrepreneurship. Both OI and platformization can affect academic entrepreneurship, or efforts to commercialize federally funded research at universities by faculty and students. Two issues assume particular significance. The first is the role of “open science” and its effects on entrepreneurial behavior at universities and on the propensity of firms to partner with faculty and student entrepreneurs. From the firm's perspective, collaborations with universities differ from collaborations with other firms because of the university culture of open science, which can conflict with the firm's objective to protect and maximize the financial return on intellectual property (Siegel, Waldman, & Link, 2003). The second issue relates specifically to the intellectual property regime at the university, as noted by Kenney and Patton (2009).

Recently, Perkmann and West (2015) examined the role of OI in the sourcing of knowledge by firms, through their direct and formal interactions with universities and, more specifically, to engage in “university technology transfer” via the licensing of patents. Although in some sectors, universities are a key source of knowledge for firms, OI research has paid relatively scant attention to university-industry relations. Perkmann and West identify three main modes of direct interaction between firms and universities: IP licensing, research services, and research partnerships. While licensing remains an important mechanism of technology transfer, research services and research partnerships are becoming more important. The authors conclude that some of these relationship-based interactions enable appropriation via intellectual property rights, while others are more aligned with the norms of open science and create benefits for firms by generating basic knowledge, creating skills, and enabling follow-on innovation. They suggest that despite different emphases, there is no necessary contradiction between any of these modes of interaction and open science. Technology transfer via licensing occurs when the science has already been conducted and, in many instances, research results have been published in the open literature (in parallel to applying for a patent). The creation of intellectual property rights often arises from work conducted during research partnerships and research services, and research services are often provided by academics whose inventions have been licensed to firms but require more inventor involvement to successfully exploit the technologies concerned. Thus, the broader conclusion is the need for additional research on OI from the firm's perspective, in the context of academic entrepreneurship.

As shown in Siegel and Wright (2015), universities appear to be moving in the direction of more open approaches in the context of academic entrepreneurship. Some have argued that we should vest ownership of university technology with the inventor and that we should adopt an open source strategy to make inventions publicly available (Kenney & Patton, 2009). This is becoming especially popular when it comes to student entrepreneurship, where university intellectual property rights are often relinquished.

The growing importance of OI also has important implications for research on university-based start-ups and their interactions with universities. Siegel and Wright note that universities are increasingly focused on the start-up dimension of university technology transfer, as opposed to emphasizing patents and licenses. They also point out that many universities are adopting a more “strategic” approach to university technology transfer and academic entrepreneurship. Balven, Fenters, Siegel, and Waldman (2018) discuss the paucity of “microlevel” behavioral research on academic entrepreneurship and, specifically, the lack of research on micro topics, such as organizational justice. An interesting research question to explore would be how OI strategies at universities (with respect to academic entrepreneurship) affect the propensity of academics to engage in academic entrepreneurship and whether such policies reduce tensions between firms and universities. One might also expect OI strategies to have a positive influence on the entrepreneurial identity of faculty engaged in academic entrepreneurship.

5 | HOW OI AND PLATFORMS MAY HINDER ENTREPRENEURSHIP

Open innovation approaches and platforms can also raise a number of obstacles for entrepreneurs, hindering either their venturing process and/or the survival and continued success of their ventures. Specifically, entrepreneurial firms operating in platform ecosystems (as complementors) and other open innovation environments face significant

vulnerabilities related to their decision making under uncertainty, market distinctiveness, and growth, all of which, in turn, imply issues for future research consideration.

As noted previously, *openness* forms a key underlying principle of OI and platforms; however, for platform firms, the fundamental issue is what to reveal and what to hide, since their knowledge is often the valuable, rare, or inimitable source of competitive advantage. This, in turn, sets up a potentially uncertain world for entrepreneurs to operate in. Few platform firms will reveal the algorithms and other key innovations that underlie their business models (for example, innovations such as the Google page rank algorithm or the algorithms that determine what should be included in a user's Facebook feed are not open to outside parties), as they form crucial trade secrets that power the platforms.² Entrepreneurs who base their offerings and business models on such platform innovations are, to a great extent, operating in darkness, complicating their strategic and operational decision making. Changes in those algorithms and associated policies—often dictated by public policies and new regulations or the platform owners' newest strategy—could have significant impact on the future viability of the new ventures. For example, Facebook's recent revamping of its feed algorithm and data sharing policies (partly due to the EU's adoption of the new General Data Protection Regulation) could make obsolete the “behavioral data collection”-based business models of numerous new ventures that populate the digital marketing space (Ghosh, 2018). Future research could adopt a business model lens (Teece, 2010; Zott, Amit, & Massa, 2011) to examine the dependencies and vulnerabilities of entrepreneurs and their ventures vis-à-vis the openness practiced by platform firms and other OI partners, in terms of both value creation and value capture.

Another vulnerability for entrepreneurs relates to the platform firm's ability to appropriate its complementary innovations and, more broadly, for new ventures' *collaborators* to transform into *competitors*. Such a platform “feature creep” strategy (Gawer & Cusumano, 2002) and related platform envelopment strategy (Eisenmann, Parker, & Van Alstyne, 2011) can prove to be existential threats to entrepreneurs and their ventures. For example, the popular flashlight application for the early iPhones was introduced by an entrepreneur (independent app developer). However, with the release of the iPhone 4, Apple integrated the app into the iOS, thereby destroying that business (Winfrey, 2015). Platform firms have also been known to “open” their ecosystems in order to seek out innovative ideas they could then incorporate into their base offering. For example, in 2011, Spotify, still a relatively small firm, created an app store to attract third parties to build a richer ecosystem. However, in 2013, the ecosystem that was “initially leveraged as a way to diversify the service offering by mobilizing external app developers” was closed by Spotify “after a limited number of apps had been cherry-picked and integrated within the platform” (Skog, Wimelius, & Sandberg, 2018, p. 4570). Such a vulnerability is enhanced because platform owners have significant visibility into the entrepreneurs' business. For example, for merchants using Amazon Web Shops, Amazon can “see” every sale made by a merchant and, more importantly, retain all of the data regarding customers' purchase histories and, of course, the shop's sales history (Khan, 2017). This remarkable visibility into all of the partner activities creates a powerful information asymmetry between the platform owner and the entrepreneurs, thereby endangering the viability and very survival of the new ventures. Research that focuses on specific strategies that would enable new ventures to manage their collaboration and competition (and more broadly) dependencies with other actors may be particularly valuable as entrepreneurs evaluate promising opportunities in the OI and platform ecosystem context.

A third type of OI and platform-related vulnerability faced by entrepreneurial firms is that of acquisition, before the new firm can grow to sufficient size to threaten incumbents. This has been quite evident in the context of inbound OI. For example, many large pharmaceutical companies have employed such an acquisition strategy to address potential competitive threats from biotechnology new ventures. Similar acquisition strategies in the platform world (for example, Facebook's purchases of What's App and Instagram and Google's purchase of Android and

²While this has raised significant public criticism (Taplin, 2017), for competitive reasons, platform owners have shown little interest in opening their algorithms to the public or to complementors. Of course, recent revelations regarding Facebook suggest that it may have taken openness too far, as its systems revealed massive amounts of user data.

YouTube) have had powerful impacts on the results of entrepreneurship, as fewer firms than ever are growing to become important competitors. While such acquisitions may benefit the entrepreneurs and venture capitalists (by monetizing the value that was created), arguably, the broader benefits due to entrepreneurship—such as the growth of new firms and the creative destruction of existing firms—are truncated.³ Importantly, such acquisition strategies could also lead to increased power of incumbent firms and lead to a monopoly-like situation that further decreases the possibility new venture entry (Khan, 2017). All of these raise interesting issues for future research regarding the role and impact of public policies and regulations (regarding mergers and acquisitions) on new ventures in specific industry contexts and, more broadly, on entrepreneurship.

6 | CONTINGENCIES THAT SHAPE THE IMPACT OF OI AND PLATFORMS ON ENTREPRENEURSHIP

We now examine some of the contingencies—and the ensuing research issues—that shape the impact of OI and platforms on entrepreneurship.

6.1 | Digitization

The greater the extent of digitization of the opportunity, the more accessible the opportunity will be to diverse types of external entities (Nambisan, 2017). However, the nature of the digital technologies (artifacts, platforms, infrastructure) could critically shape the ease with which entrepreneurs pursue the opportunities.

As noted earlier, the openness of the digital platforms—and the consequent easy access to boundary resources—lowers the cost of entry for start-ups, thus allowing for many more entrepreneurial experiments. If one conceives of disruption as reorganizing a value chain or links in a value chain, then the sheer number of experiments means there are more opportunities for successfully disrupting a chain or parts of a chain and, thereby, the underlying business model itself. Importantly, digital infrastructures critically shape new ventures' reach and scope of innovation and operations, thereby radically transforming the nature and process of venture scaling (Constantinides, Henfridsson, & Parker, 2018; Henfridsson & Bygstad, 2013; Huang, Henfridsson, Liu, & Newell, 2017). All of these indicate promising directions for future research in entrepreneurship that takes into consideration the unique characteristics of the digital technology context or, as importantly, the changing digital context—in which OI and platform strategies are practiced—to understand their impact on new ventures.

6.2 | Institutional arrangements

Successful enactment of entrepreneurial opportunities may be contingent on a broader set of institutional and infrastructural arrangements, including innovation intermediaries, crowdsourcing and crowdfunding platforms, and makerspaces. Makerspaces, for example, provide new entrepreneurial opportunities, as the cost of experimentation for making physical goods or, at least, prototypes is decreased (West & Greul, 2016). To illustrate, there has been a proliferation of new clothing and makeup brands created by entrepreneurs and then sold exclusively through platforms such as Instagram or Amazon (Cheng, 2017). What is remarkable about these brands is that they are not only entirely online, but they use global contracting networks to have their creations produced and then dropshipped to either the brand creator's place of business or to contracted warehouses. These new types of business are possible because of an ability to reach customers through digital retail platforms, and, as importantly, because supply chain management platforms make it possible to identify producers and organize a supply chain (Lisa, 2015). More broadly, the

³It should be recognized that these acquisitions frequently result in the creation of former entrepreneurs and managers that have significant and, in some cases, enormous amounts of capital that can act as "angel" investors and invest in yet newer entrepreneurial firms.

emergence of novel institutional arrangements to support OI and platformization present yet another set of important issues for future research in entrepreneurship.

Individual (entrepreneur) capabilities/competencies: Entrepreneurial success may be contingent on entrepreneurs (and their new ventures) acquiring a new set of capabilities or competencies that would enable them to navigate the dynamic OI/platform contexts (Nambisan & Baron, 2013). As is the case with the new clothing brands described previously, individual entrepreneurs or small teams are developing competencies to use the digital platform and infrastructure affordances for creating their offering, as well as for appropriating their revenue (logistics options, payment systems, etc.). In the process, entrepreneurs become platform complementors whose entire businesses are dependent upon a core platform that becomes the intermediary between them and their customers. Effectively, the individual entrepreneur develops competencies whose exercise is “scaffolded” by the structure of the platform or platforms within which they are embedded and upon which they are dependent. One might almost term the associated competencies of the entrepreneur as “contingent competencies,” as changes by the platform owner can destroy the ability (or the context) to exercise such competencies. The nature and acquisition of these new competencies (required by entrepreneurs in the context of OI and platforms) form a promising line of inquiry in entrepreneurship marrying individual-level concepts with firm- and ecosystem-level concepts.

6.3 | Regulations and policy-related factors

Several macro-level public policy factors (e.g., antitrust/competition policy) could shape the implications of OI and platforms on entrepreneurship. As platforms become central to ever greater swathes of the economy and, in cases such as Amazon and Google, mediate access to markets, entrepreneurial opportunity will naturally be affected. To illustrate, today 45% of all U.S. e-commerce is conducted through the Amazon platform; much of this is through independent third-party merchants—many of whom are entrepreneurs. These merchants are at the mercy of the Amazon recommendation algorithm, where even simple changes can have dire effects. Recently, Google received a \$2.7 billion fine for illegally promoting its Google Shopping results above similar comparison results from its European comparison shopping rivals (Price, 2017). Had this feature not been removed, these shopping comparison engines that had been introduced by entrepreneurial firms might have been driven out of business.

The Apple and Google app stores discussed earlier have resulted in an enormous entrepreneurial outpouring. In 2017, Apple paid content creators for its app store approximately \$20 billion. Despite this considerable flow of revenues, the app developers are entirely dependent on the goodwill of the platform owners. A decision to delist an app could be devastating for an entrepreneur's business (even if the venture adopts multi-homing to manage associated risks). Recently, some YouTubers have seen their revenues cut or even eliminated for a variety of reasons (including changes in platform policies), effectively destroying their businesses.⁴ These digital platforms ease entrepreneurial entry but concentrate enormous power to the platform owner regarding the conditions for entrepreneurial action (Kenney & Zysman, 2016). Antitrust policy may be revived in an effort to ensure that entrepreneurship is protected from the power of the very platforms that make much entrepreneurial activity possible.

Both OI and platformization have many important public policy implications as well (Kenney & Zysman, 2016). It is important to note that several changes in U.S. national innovation policy may have helped to stimulate OI. As noted in Siegel (2003), the number of “strategic research partnerships” involving firms, universities, nonprofit organizations, and public agencies has increased markedly in recent years. Some of this growth can be attributed to three policy initiatives: (a) an expansion of public-private partnerships (e.g., NSF Engineering Research Centers and Industry-University Cooperative Research Centers); (b) relaxation of antitrust enforcement to promote collaborative research (e.g., the National Co-operative Research Act), and policies promoting more rapid diffusion of technologies from universities to firms (e.g., the Bayh-Dole Act and SBIR/STTR).

⁴The recent shooting at the YouTube headquarters was perpetrated by a disgruntled YouTuber, who was angry that YouTube had demonetized her videos. Such experiences may contribute to the entrepreneurs' feeling of hopelessness.

Given that OI is focused on new, more open business models for innovation, three aspects of public policy can influence the propensity of this activity and, more importantly, the rate at which entrepreneurial opportunities are pursued. These include: (a) competition/antitrust policy, which relates to market structure as well as to incentives to innovate and “exploit” the innovative outcomes; (b) labor market policies that can range from portable benefits to decisions to not permit innovative firms such as Uber, Lyft, or Airbnb to operate in certain jurisdictions and, more specifically, to “flexibility” of the labor market; (c) intellectual property policies at universities and at the national level; and (d) the extent of public and private funding for R&D.

Public policies are also important at the state and regional levels, as numerous regions have adopted “cluster” strategies to promote technology-based, entrepreneurial economic development. Some of these policies allow firms to exploit OI and platform-based systems. It is clear that policies to promote national, state, and regional levels could have positive or negative influences on entrepreneurship. To illustrate, it is now widely accepted that the lack of enforceability of noncompete agreements in states such as California has had a positive impact on entrepreneurship (Marx, Singh, & Fleming, 2015).

6.4 | Globalization and entrepreneurship

The preponderance of the research has studied digital platforms in Western, primarily U.S., settings. However, dominant platforms such as Google, Apple, and Facebook provide entrepreneurs access to global markets. As an example, enormously successful gaming firms such as Supercell and Rovio based in Finland rapidly built a global customer base. Thus, being “born global” (Cavusgil & Knight, 2015; Knight & Cavusgil, 2004) has become easier than ever as platforms become the intermediary to monetization on a global scale. Similarly, crowdfunding platforms dramatically decrease the spatial constraints on entrepreneurs' access to capital (for the U.S., see Sorenson et al., 2016) and allows for a greater degree of cross-border funding. Despite all this, studies in entrepreneurship have so far not accounted for the effects of new ventures' presence and participation in global platforms and innovation ecosystems.

While U.S. platform owners are globally dominant, an enormous but separate ecosystem of platform firms has emerged in China. The Chinese platform economy is contributing to a rapid growth in Chinese entrepreneurship (the amount of venture capital investments in China is second only to that in the U.S.). And yet, the industrial structure of the Chinese platform economy is quite different, as the dominant platform firms have established interconnected platform business groups (Jia & Kenney, 2016). One hypothesis would be that the different industrial structures should affect the opportunities and strategies for entrepreneurial entry. However, little has been published examining platform-based entrepreneurship in China, and there have been no cross-national comparisons, despite the fact that two Chinese platform firms are among the 10 most valuable firms in the world. More broadly, how do national and global factors shape the nature and success of entrepreneurial pursuits fueled by platforms?

7 | CONCLUSION

As digital platforms and open innovation assume considerable significance in the contemporary business environment, it has become critical to develop a deeper understanding of how both these phenomena transform the nature and practice of entrepreneurship. Our objective in this special issue has been to throw a sharper light on their associated themes and issues and indicate promising directions for future research in entrepreneurship.

Platforms and OI environments have unleashed a remarkable outpouring of innovation and entrepreneurship in a wide range of industries and sectors. At the same time, such a rapid expansion of innovation and entrepreneurial opportunities has been accompanied by the emergence of new types of dependencies and risks that are, at best, ill-understood. Entrepreneurship is always precarious. However, never before has so much of entrepreneurs' decision making, strategies, and success been at the mercy of an external entity as is evident in the case of the platform economy. Platform firms can “tax” the entrepreneur's income, decide on the appropriateness of the entrepreneur's

creation, and make a wide variety of other unilateral decisions that could critically shape the survival and continued success of the new venture. Only four years ago, Autio, Kenney, Mustar, Siegel, and Wright (2014) created a typology of contexts that structured entrepreneurial action. However, they did not include the role of platforms as becoming an integral aspect of entrepreneurship. Today, it will be amiss to study entrepreneurship—at the firm-level as well as at more macro regional and societal levels—without examining the context-structuring role of platforms. Understanding how entrepreneurs and their ventures navigate the opportunities and challenges—brought about by OI and platforms—is one of the most exciting and fruitful new areas of entrepreneurship research.

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