Strategic Entrepreneurship Journal
Strat. Entrepreneurship J., **4**: 271–283 (2010)
Published online in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/sej.96

KNOWLEDGE SPILLOVERS AND STRATEGIC ENTREPRENEURSHIP

RAJSHREE AGARWAL,[1]* DAVID AUDRETSCH,[2] and MB SARKAR[3]
[1]*University of Maryland, Robert H. Smith School of Business, Department of Management and Organization, College Park, Maryland, U.S.A.*
[2]*Indiana University, Institute for Development Strategies, Bloomington, Indiana, U.S.A.*
[3]*Temple University, Fox School of Business, Philadelphia, Pennsylvania, U.S.A.*

Knowledge spillovers and strategic entrepreneurship has each been the subject of much scholarly attention, but have largely been considered separately rather than in conjunction with each other. In this article, we develop implications of the link between knowledge spillovers and strategic entrepreneurship and identify key topics, themes, and issues for future research. In doing so, we also showcase the articles of the special issue, as they shed light on some unanswered questions and identify additional areas for fruitful research. Copyright © 2010 Strategic Management Society.

INTRODUCTION

Investment in new knowledge has long been recognized as a key driver not only of firm-level competitive advantage (Grant, 1996; Spender, 1996), but also of regional and macroeconomic growth (Saxenian, 1994; Romer, 1990). Such knowledge-generating investments are, however, not automatically transformed into innovative output. Rather, entrepreneurial action is required to transform knowledge investments from possessing the potential to create value into a form that enables its appropriation (Hitt *et al*., 2001; Agarwal, Audretsch, and Sarkar, 2007). The need for entrepreneurial action, coupled with the non-rival and non-excludable public good nature of knowledge (Arrow, 1962) implies that appropriation of the value created through new knowledge is not limited to the organization making the investments alone. Accordingly, both knowledge spillovers and strategic entrepreneurship have been identified as critical to the process of creative destruction and creative construction (Agarwal *et al*., 2007) through which firms, industries, regions, and economies create and rejuvenate themselves.

Knowledge spillovers, defined as the external benefits from the creation of knowledge that accrue to parties other than the creator, occur at multiple levels of analysis, be it within or across organizations and networks. The idea of spillovers has been pervasive in scholarship in multiple literature domains, such as those related to real options, organizational learning, technology transfer, networks, employee mobility and entrepreneurship, spatial agglomeration, industry evolution, and endogenous economic growth. Strategic entrepreneurship, however defined, clearly relates to initiatives grounded in the search for competitive advantage and leading to new entry into products, markets, processes, or technological innovations by both incumbents and new ventures. Thus, the confluence

Keywords: strategic entrepreneurship; knowledge spillovers; knowledge spill-ins
*Correspondence to: Rajshree Agarwal, University of Maryland, Robert H. Smith School of Business, Department of Management and Organization, 4512 Van Munching Hall, College Park, MD 20742, U.S.A. E-mail: rajshree@umd.edu

of the two represents a powerful lens through which to investigate questions central to both strategy and entrepreneurship, namely the formation of new ventures, the origin and development of firm capabilities, strategic renewal efforts of incumbents, and the dynamics of innovation and macroeconomic growth.

The rich legacy notwithstanding, there exist exciting avenues for further development in the theories and empirical frameworks surrounding knowledge spillovers and strategic entrepreneurship. This special issue of the *Strategic Entrepreneurship Journal* has been designed and developed to provide a forum for addressing some of the issues, thus shedding light on the underlying mechanisms that impact not only intra- and interfirm dynamics and performance, but also the implications of the diffusion of innovations through entrepreneurship for regional and economic growth. Given the multifaceted nature of both knowledge spillovers and strategic entrepreneurship, a particular feature of this special issue is that it examines the issues from different theoretical traditions, using different methodological tools to provide evidence of the interlinkages between the two concepts.

Our introduction to the special issue begins with a brief discussion of both concepts and the implications of studying them in conjunction, and then it identifies potential research questions within the domain. We next highlight how the five articles in the special issue individually and collectively help address some of these research questions and conclude with a brief commentary on the need for continued scholarly attention. Thus, it is our hope that the special issue not only contributes meaningfully to an already rich research stream, but also sparks additional interest in studying knowledge spillovers and strategic entrepreneurship.

CONCEPTS AND IMPLICATIONS

Knowledge spillovers

The concept of spillovers refers broadly to the presence of externalities, defined as an *often unforeseen* external effect accompanying a process or activity (Webster's Collegiate Dictionary, 1992). Knowledge spillovers, more specifically, refers to the external benefits from knowledge creation that is enjoyed by parties other than the party investing in the creation. Critical to the concept, particularly in the domain of economic activity, is the lack of compensation to the creator by the parties that benefit economically from the knowledge. Knowledge investments differ from other investments made by individuals or institutions in that the public good nature of knowledge (both non-rivalness and non-excludability) implies a greater likelihood of spillovers (Arrow, 1962). Within economics, a rich literature stream has acknowledged the tension between value creation and value appropriation of knowledge investments, starting from Arrow's (1962) insightful recognition that the investment in knowledge creation may be less than socially optimal levels given the presence of spillovers. Nonetheless, even if one were to take the underinvestment in knowledge creation for granted, the presence of knowledge spillovers has long been recognized as an important element in stimulating economic development. At the macroeconomic level, knowledge spillovers are critical to models of multicountry development (Aghion and Howitt, 1992), international trade (Keller, 1998), and agglomeration and deagglomeration (Krugman, 1991) and are the central mechanism identified in modern growth theories that relate endogenous investments in knowledge to economic growth (Romer, 1990; Aghion and Howitt, 1992). Indeed, Griliches (1992) concludes after a careful review of the empirical literature on R&D expenditures that the significantly higher social to private rate of return to R&D investments can be largely attributed to the high levels of R&D spillovers across organizations.

While the beneficial effects at the macro levels are largely uncontested, the presence of knowledge spillovers poses a conundrum at the micro level, where the actual decisions for investments are being made. The question relates to the distinction between knowledge spillovers and knowledge transfer and the nature of the flow or transmission of knowledge. Knowledge spillover is similar to knowledge transfer in that the knowledge is available for economic benefit to parties other than the creating entity. However, it is different because it relates to both compensation and continued access. While knowledge transfer involves the cross-party compensation of the value of the knowledge flowing between individuals or organizational units in a market-like transaction, knowledge spillovers relates to knowledge flows that are un- or undercompensated. That is, the recipient of the knowledge spillover is able to access the knowledge without completely paying for the value of the knowledge. Further, knowledge transfer may also (though not always) connote rivalness of

DOI: 10.1002/sej

use, while knowledge spillovers entails that the knowledge is simultaneously available to both parties. As an example, Agarwal *et al*. (2010) distinguish between the *transfer* of knowledge embodied in people who quit an organization to create a new venture and the *spillover* of knowledge when the same routines are available at both the source and recipient organization. Particularly germane to the issue is the following: while knowledge spillovers clearly suggest a flow of knowledge resources and capabilities from one decision-making entity to another, *what* exactly is flowing, through *which* transmission mechanisms and *how* and *who* benefits the most from such transmissions is less clear.

Strategic entrepreneurship

The concept of strategic entrepreneurship highlights the complementarities within strategy and entrepreneurship (Ireland, Hitt, and Sirmon, 2003). As in Agarwal and Helfat (2009: 281), the term 'strategic' can be defined as 'that which relates to the long-term prospects of the company and has a critical influence on its success or failure.' Further, the term 'entrepreneurship' has found its most enduring definition in the Schumpetarian notion of the creation of new products, processes, markets, and organizational forms (Schumpeter, 1942).

In a series of papers that seek to integrate and summarize the basic premises of strategic management and entrepreneurship (Hitt *et al*., 2001; Ireland *et al*., 2003), these scholars have highlighted the need for entrepreneurial action with a strategic perspective. Whether undertaken by new ventures or established organizations, strategic entrepreneurship requires a dual focus on creating change, exploiting or appropriating the value through the change. For example, Ireland *et al*. (2003: 966) discuss the fact that wealth is created when firms 'combine effective opportunity-seeking behavior (i.e., entrepreneurship) with effective advantage seeking behavior (i.e., strategic management).'

Importantly, strategic entrepreneurship transcends levels of analysis and encompasses actions undertaken by individuals, teams, and firms, in an intra- or interorganizational perspective. Nor is strategic entrepreneurship the domain of new and small firms alone, since much innovation and entrepreneurship is undertaken by established firms seeking to strategically renew themselves through entrepreneurial activity (Agarwal and Helfat, 2009). It applies equally to the actions made by founders of new ventures (Bhide, 1994) and managers of existing organizations (Covin and Slevin, 2002). And collectively, these actions can explain the birth, growth, and demise not only of organizations, but also of industries, regions, and economies. Not surprisingly, Schumpeter (1942) discussed the competitive ramifications of entrepreneurial action at the individual, firm, industry, and economy levels when elaborating on the process of creative destruction.

Implications of knowledge spillovers and strategic entrepreneurship

Taken together, the concepts of knowledge spillovers and strategic entrepreneurship provide a valuable analysis of the causes and consequences of entrepreneurial action toward either creation and/or appropriation of value through investments in knowledge. In Agarwal *et al*. (2007), we elaborated on the *knowledge spillover view of strategic entrepreneurship*. We discussed the well- documented fact that organizations often do not transform their knowledge investments into economically valuable output, and that they are also imperfect repositories of knowledge due to the presence of knowledge spillovers. Accordingly, we had drawn out some of the important implications for entrepreneurship, strategy, and growth.

Building off the concepts discussed in Agarwal *et al*. (2007), we elaborate on some additional implications for the need to study knowledge spillovers and strategic entrepreneurship in tandem. First, and related to the enduring question of why organizations fail to appropriate all the value they create, is the issue of differential valuation of knowledge. At the one extreme, even if an organization chooses not to internally exploit the knowledge it created, it can engage in market transactions for knowledge transfer that allow it to appropriate value. However, while this may sound like a straightforward and mechanical accounting application that *merely* involves comparing the value of what is being transacted with the value of the compensation between the recipient and originator organization, there is significant ambiguity related to the value of knowledge. Arrow (1962) noted that the sanguine characteristic defining and distinguishing knowledge from other economic phenomena is that it is characterized more by uncertainty than by risk. As Alvarez and Barney (2005) point out, in an *a priori* sense it is virtually impossible to calculate the expected value of knowledge because of its inherent uncertainty. Drawing on

DOI: 10.1002/sej

Knight (1921), they show that the major distinction between risk and uncertainty is that the former is associated with a distribution of probabilistic outcomes, while neither the outcomes nor any associated probabilistic distributions can be identified for knowledge. Thus, whether a knowledge flow is better characterized by a financially compensated transfer of technology, or an un- or undercompensated knowledge spillover, is difficult to identify; this is because as a result of the inherent uncertainty, different organizations may, and most likely will, place a different valuation on the same *knowledge*. Some examples of firms that historically undervalued knowledge generated in their research laboratories are Bell Labs, Shockley Semiconductor, Fairchild, Xerox, and IBM. Indeed, the literature on employee entrepreneurship rests on the concept of underutilized knowledge that is subsequently used by the founders of spin-outs in a new venture (Agarwal *et al*., 2004; Moore and Davis, 2004). Whether the knowledge flowing from the parent to the spin-out organization is a *transfer* or a *spillover* is often difficult to ascertain, and is further complicated by the nature of the contractual solutions that may have been implemented while the individual was an employee (Anton and Yao, 1995). For example, Franco and Filson (2006) provide a model where employees with entrepreneurial aspirations accept a lower wage to work at firms that have high technological capabilities. However, to the extent that the ambiguity or uncertainty in the value of the knowledge results in the source organization not being fully compensated, the flow of knowledge is characterized by spillovers rather than transfers.

A second implication, closely related to the first, is that the uncertainty or ambiguity of the value of knowledge can be addressed or resolved only after subsequent entrepreneurial actions have been undertaken. In Agarwal *et al*. (2007), we developed our model of creative construction where knowledge investments by firms and universities had to be coupled with entrepreneurial action by employees and scientists who were the cocreators of the knowledge for the formation of new ventures. We then related knowledge spillovers and strategic entrepreneurship to the heterogeneity in capabilities and growth of firms, industries, regions, and economies. Here we build on that model further, and Figure 1 presents our modified view of knowledge spillovers and strategic entrepreneurship. Specifically, we now incorporate strategic renewal efforts by the firm making the knowledge investments, thus explicitly recognizing corporate entrepreneurship and intrapreneurship efforts by the firms that engaged in the knowledge investments or by other established organizations that leverage these investments. Strategic renewal efforts may include diversifying entry into industries (Penrose, 1959; Klepper and Simons, 2000; Chen, Williams, and Agarwal, 2010), and may entail both discontinuous transformation and

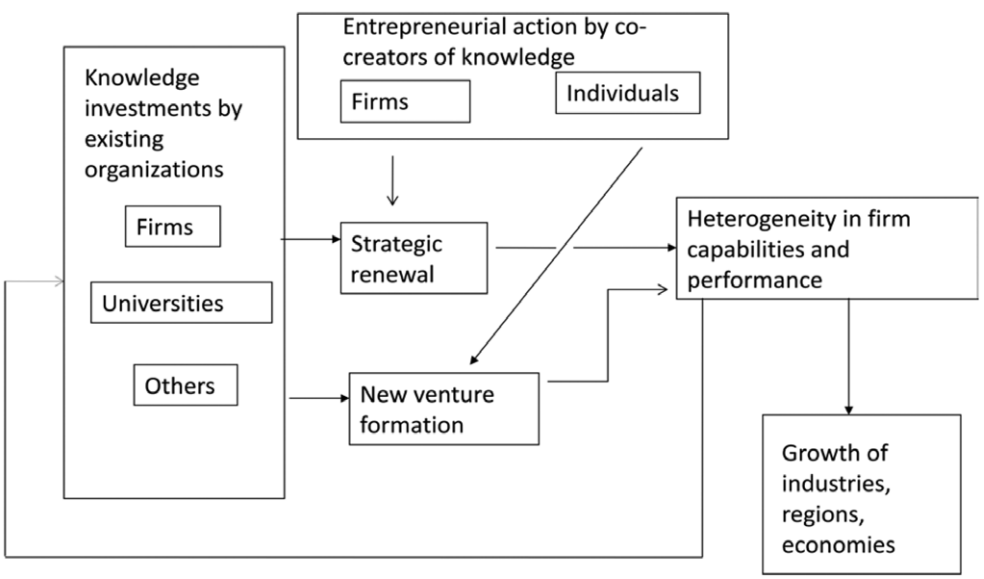

Figure 1. Knowledge spillovers and strategic entrepreneurship

DOI: 10.1002/sej

incremental renewal of the organization (Agarwal and Helfat, 2009). Importantly, such entrepreneurial action may require additional innovation or investments in knowledge. Whether the interaction occurs within the organizational boundaries or involves the interface of distinct organizations through strategic alliances or acquisitions, it may result in the creation of new knowledge that is combinatorial in nature. To characterize such intra- or interorganizational flows as constituting a knowledge spillover reflects the creation of entrepreneurial opportunities, where new knowledge is actually generated. Thus, knowledge spillovers can be viewed as involving either the creation of new entrepreneurial opportunities or else the discovery of (existing) entrepreneurial opportunities that had not been recognized previously. The recognition or generation of such entrepreneurial opportunities can be viewed as being strategic if entrepreneurial actions are required for achieving strategic competitiveness (Kuratko and Audretsch, 2009).

Finally, this issue also highlights the role of knowledge *spill-ins* as an important complement to knowledge spillovers. Implicit in much of the theoretical thinking behind spillover research, which takes the perspective of the investing organization as a *source* of knowledge, is the assumption that while the knowledge creator bears the cost of knowledge generation, others benefit. An extensive body of work examines how knowledge spillovers benefit both society and recipient firms, in the process hurting the knowledge-creating firm who fails to realize the full potential of its knowledge investments (e.g., Cohen and Levinthal, 1990; Griliches, 1992). In such regimes, where leakages in technical knowledge were inevitable, Arrow (1962) concluded that underinvestment in the knowledge-generating mechanism, or R&D, was likely. However, it is important to note that these knowledge investments also enable the organization to be a better *recipient* of knowledge generated by other firms given greater absorptive capacity (Cohen and Levinthal, 1990). Costly spillovers can also create beneficial spill-ins to an originating firm. The dynamic relationship between knowledge investments as creating both spillover and spill-in potential is perhaps underemphasized in the classic view following Arrow (1962), which focused only on commercialization or compensation of knowledge. The notion that firms underinvest in knowledge generation given spillovers does not account for the fact that the firm may invest in knowledge creation because it also enables them to better understand the knowledge that is being generated outside their organizational boundaries.

In Agarwal *et al*. (2007), we had raised the intriguing possibility that instead of a zero-sum game implied by the traditional spillover literature, spillovers may, in fact, result in a win-win situation if one considers multiple time periods as the knowledge creator and recipient change roles, or when spillovers result in a wider ecosystem that complements the focal firm's offerings. Based on this core thesis, we had articulated the concept of creative construction as an alternate worldview to the Schumpeterian notion of creative destruction. An important implication of the notion of creative construction is a slightly more nuanced role of R&D. There is adequate evidence that internal R&D (or other knowledge-generating investments) enables absorptive capacity (Cohen and Levinthal, 1990). Typically conceptualized as technological know-how and operationalized as R&D intensity (Ahuja and Katila, 2001; Cohen and Levinthal, 1990), the notion has been extended to 'business-related knowledge, including managerial techniques, marketing expertise, and manufacturing know-how' (Lane, Koka, and Pathak, 2006: 37). For example, market-based absorptive capacity exposes a firm to events in the marketplace and sharpens its ability to identify and value new ideas, including those of supply-side agents (Weigelt and Sarkar, 2009). Yang, Phelps, and Steensma (2010) invoke the recombinant view of innovation where the creation of new knowledge involves either the novel recombination of existing elements of knowledge (Fleming, 2001) or the reconfiguration of the ways in which knowledge elements are linked (Henderson and Clark, 1990), to argue—against conventional wisdom—that knowledge spillovers can provide some benefit to originating firms by enhancing their ability to innovate. When a knowledge pool of the originator spills over and is recombined with complementary knowledge by recipient firms, Yang *et al*. (2010) note that such spillovers provide viable opportunities for originating firms to learn vicariously from the recombinatorial innovations of recipient firms. Learning from how recipients exploit their knowledge, the originating firm can refine its search behavior and more effectively innovate through recombinatorial opportunities in the future. Since exploiting the knowledge of others requires the recipient firm to combine the spill-in knowledge with additional knowledge from their own idiosyncratic knowledge context (Sorenson,

DOI: 10.1002/sej

Rivkin, and Fleming, 2006), the role of R&D needs to be reconceptualized as one that allows for this reverse flow to occur and create value.

To summarize, this discussion adds three implications to prior work that has examined knowledge spillovers and strategic entrepreneurship in conjunction. One, since valuation of knowledge is fraught with uncertainties and ambiguity, there will be systematic differences between the concepts of knowledge transfer (where the source is adequately compensated) and knowledge spillover (where the source is un- or undercompensated). Two, these differences in valuation of knowledge arise from, and are resolved by, entrepreneurial action undertaken strategically to capitalize on hitherto unforeseen opportunities generated by the knowledge. Importantly, both the firms and the individuals involved in the knowledge creation have access to it, thus resulting in the potential for both strategic renewal and new venture formation. Finally, knowledge investments create the potential for both knowledge spillovers and spill-ins through a dynamic and multi-period process where spillovers may result in spill-ins in a recombinatorial process.

AVENUES FOR FUTURE RESEARCH

Taken together, there exist exciting avenues for further development in the theories and empirical frameworks surrounding knowledge spillovers and strategic entrepreneurship, with several tensions unresolved. For example, while the traditional view has emphasized the leakage of knowledge (spillovers) as disincentivizing R&D, spillovers can be a strategic lever through which a firm engages in distributed innovation, thereby also enhancing global competitiveness. Moreover, the spillover of knowledge through the mobility of human capital has profound implications for entrepreneurial activities, be it at the level of firm, region, or nation. For example, while employee mobility traditionally has been considered a conduit through which tacit knowledge is transferred between firms or from firms to start-ups, recent accounts of reverse migration of scientists from developed countries to emerging one demonstrate the importance of knowledge spillovers as critical to entrepreneurial resurgence in these countries.

Accordingly, there is much scope for research that enhances our understanding of how knowledge externalities link to literature in strategic management and entrepreneurship. Such research is likely to inform our understanding of different mechanisms through which knowledge spillovers occur, why certain recipients of knowledge spillovers are able to benefit more than others, and various boundary conditions that limit both losses and gains for knowledge generating and knowledge recipient firms. This may require linkages of the literature in knowledge spillovers to theoretical lenses such as networks, real options, technology and innovation strategy, spatial agglomeration, organizational learning, and diffusion of innovations among others in order to explore issues fundamental to strategic entrepreneurship. Doing so will provide insights into mechanisms that facilitate or inhibit knowledge spillovers across or within organizational boundaries, including (but not limited to) individual-level mobility, employee entrepreneurship, co-location in geographical or technological space, interfirm and intrafirm networks, and investments to facilitate vicarious learning. Further, there is clearly a need for work on how strategic entrepreneurship may be a link between knowledge spillovers and spill-ins, so that incumbent organizations may effectively benefit from knowledge spillovers that originate from entrants and, in the process, enhance their own competitiveness. Research that explores the linkages between intellectual property, organizational learning, and knowledge spillovers to explain innovation outcomes in inventor networks and growth dynamics in emerging technology clusters or across national borders will also enhance our understanding of the levers that connect individual- and firm-level decisions to the more macroeconomic consequences for regional or economic growth.

More specifically, we believe that the following research questions are an incomplete list of issues that are deserving of more scholarly attention:

1. What role does the institutional knowledge context have on subsequent spillovers of knowledge? What factors have an impact on knowledge spillovers and strategic entrepreneurship within and across organizational contexts (e.g., academic institutions and organizations occupying competing, complementary, or vertical supply chain relationships)?
2. What are the underlying mechanisms that relate knowledge spillovers and strategic entrepreneurship, and how might individual, organizational, strategic, institutional (including, but not limited to, level of intellectual property

DOI: 10.1002/sej

protection), or environmental factors affect these mechanisms? For example, how might employee entrepreneurship/mobility affect the strategy and performance of both the source and recipient organizations? What factors moderate these relationships? What win-lose or win-win scenarios may be created due to knowledge spillovers across organizational boundaries, particularly as they relate to entrepreneurial activity?

3. What factors have an impact on knowledge spillovers and strategic entrepreneurship in academic or scientific knowledge settings? What are the underlying mechanisms that enable or inhibit the transfer of *basic* knowledge to *applied* domains?
4. What are the positive or negative consequences of knowledge spillovers and *legacy effects* on subsequent *recipient* organization performance? Do knowledge spillovers always enhance competitive advantage for recipient firms or could they result in negative effects? What factors potentially moderate the knowledge spillovers-performance relationship?
5. What role do knowledge spillovers play in translating *failure* at one unit of analysis or *success* at another unit of analysis? For example, to what extent does a firm-level focus on performance consequences underestimate or overestimate the overall performance consequences at another level, say the individual, industry, or regional level?
6. Given that innovations are becoming increasingly more complex and recombinant in nature, how do organizational strategies that differ on the continuum of open versus closed systems of innovation affect knowledge spillovers and strategic entrepreneurship? Can knowledge spillovers become the source of growth options, and thereby affect investments under uncertainty?
7. What effects do knowledge spillovers through returning diasporas have on entrepreneurship in emerging economies? How do ethnic ties contribute to transfer of tacit knowledge among inventor networks? How can existing firms use intrafirm mobility of employees to benefit new cross-border initiatives?
8. Are there differences between the effect of market and nonmarket channels of knowledge transfer on strategic entrepreneurship? How does geographic proximity matter for market-based transactions and noncompensated spillovers? Do these differences in the outcomes between the two types of transactions dissolve over time? Do firm and industry characteristics matter?
9. How do positional characteristics in knowledge networks interact with type of knowledge spillovers to affect innovation outcomes? What are some of the boundary conditions that either mitigate or accentuate such relationships?
10. What is the relationship between organizational type and the ability to access and absorb external knowledge spillovers? Are some organizations more capable of benefiting from knowledge spillovers?
11. How might spillovers of nontechnical knowledge, such as information about markets, alliance partners, funding, or potential acquirers affect strategic entrepreneurship?

As this list exemplifies, not only have we just begun to scratch the surface on issues that are at the confluence of knowledge spillovers and strategic entrepreneurship, but we can rely on multiple theoretical lenses and empirical methodologies to address these questions. Examples of how some of the issues may be addressed are included in this special issue, and we now turn to brief discussion of these articles.

INTRODUCTION TO THE ARTICLES IN THE SPECIAL ISSUE

Collectively, the articles in the issue reflect diverse approaches. They examine different phenomena, investigate at different levels of analysis, use different theoretical lenses, and deploy different methodologies. For example, Parker (2010) uses a formal modeling approach, while Kotha (2010) and Oldroyd, Silvestri, and Gulati (2010) use an inductive analysis to develop new theory. Gambardella and Giarratana (2010) and Liu *et al*. (2010) use a quantitative analysis to test propositions and hypotheses developed in their articles. Within the context of Figure 1, Oldroyd *et al*. (2010) and Kotha (2010) are concerned with strategic renewal of established organizations through the leveraging of knowledge spillovers/spill-ins and entrepreneurial action. On the other hand, the focus of Liu *et al*. (2010) is on spin-outs formed by employee entrepreneurs to capitalize on both inter- and intra-regional knowledge spillovers. Parker (2010) examines the interplay between the two types of organizations, thus

DOI: 10.1002/sej

shedding light on the processes of creative destruction and construction, and Gambardella and Giarratana (2010) discuss implications for regional-level dynamics between skilled and unskilled labor when knowledge spillovers are primarily localized due to entrepreneurial activity within the region.

Importantly, the articles examine phenomena at different units of analysis, often with implications across levels. In Oldroyd *et al*. (2010) the focal unit of analysis is a business unit, with implications for intraorganizational knowledge spill-ins across business units. Kotha (2010), by contrast, focuses on the organization as a unit of analysis, with industry structure and firm-level factors determining who appropriates value from knowledge spillovers. Liu *et al*. (2010) also focus on the organization as a unit of analysis, but individuals who create the spin-out organizations, and intra- and inter-regional spillovers of knowledge play a very important role in determining organizational performance. For Parker (2010) too, the unit of analysis is the firm, however the focus is on industry dynamics that result in either incumbent or entrant advantage. Gambardella and Giarratana (2010) use cities as the unit of analysis, but draw out important implication of localization of knowledge spillovers for the relative productivity and wage premium offered to skilled individuals relative to unskilled ones. The use of different theoretical lenses is also evident across articles, be it organizational learning (Oldroyd *et al*., 2010), economic models of competition (Parker, 2010), agglomeration economies and resource markets (Gambardella and Giarratana, 2010), social capital theory, resource-based view, and international business (Liu *et al*., 2010), or strategic management and entrepreneurship (Kotha, 2010).

Individually, each article provides rich insights regarding the phenomena they examine. We provide a brief introduction of the articles in the order that they appear in the special issue.

Kotha (2010) addresses the important question of who appropriates the benefits of knowledge spillovers across organizational boundaries and why, by undertaking a qualitative study of the evolution of the commercial jet airplane industry and the rise of Boeing in commercial aviation. In particular, Kotha addresses the role of entrepreneurial action in being able to take advantage of spillovers and confronts the question concerning the role played by industry structure and firm-level factors in determining who appropriates value from knowledge spillovers. He argues that it is important to consider not only the interplay between knowledge generation, spillovers, and spill-ins but also the role of opportunity-seeking entrepreneurial behavior in explaining such firm-level outcomes. Using a narrative approach to generate and elaborate theory, Kotha (2010) constructs a rich case study from raw historical data to provide evidence that knowledge spillovers spurs innovation, enables new firm entry, and benefits recipients more than originators. Kotha (2010) finds that strategic action related to appropriating the benefits from knowledge spillovers in critical technical domains enabled Boeing to gain market power in the industry, even though it was initially a marginal player. In contrast, competing firms, including then-market leader the Douglas Aircraft Company, were unable to capitalize on these spillovers due to incumbent inertia, their focus on existing markets with influential and large customers, and hubris. Boeing's strategic entrepreneurship efforts were also due to concerns of survival in the face of financial duress in the post-war period, which led to search for more risky ventures and a general receptivity for new technical and market opportunities by the management team. Importantly, Boeing also realized the importance of protecting its knowledge assets from leaking to competitors and internalized testing facilities. Thus, Kotha (2010) attributes Boeing's ascendancy to a combination of risk taking, serendipity, and deliberate strategic entrepreneurship.

The article has a number of contributions. First, it establishes the emergent nature of the spillover process and how internal and external knowledge pools coevolve over time. Second, it identifies a wider set of mechanisms associated with knowledge spillovers than has been considered in the literature to date (unpredictable events, catastrophic accidents, competitive monitoring, and governmental actions), as well as different types of knowledge that spillover (conceptual, experiential, operating, and market knowledge). The author conclusions support the arguments in Agarwal *et al*. (2007), that viewing incumbents merely as knowledge factories for new entrants severely underestimates how innovations unfold as a consequence of knowledge spillovers and spill-ins. Arguing that the case study demonstrates a more nuanced reality of creative construction, Kotha (2010) underscores the importance of strategic entrepreneurship exhibited through opportunity-seeking behavior in firms being able to appropriate the value from spillovers, and he speculates on the competitive dynamics that are set into play as new entrants leapfrog with radically new technology

DOI: 10.1002/sej

and incumbents emulate, thus triggering off a Red Queen race in which the ability to leverage knowledge spillovers becomes critical.

Parker (2010) also examines the dynamics among firms as they seek to capitalize on knowledge spillovers due to entrepreneurial entry, though using a formal modeling approach. A core issue relates to the impact of spillovers on the organization that is the generator of the knowledge. Agarwal *et al*. (2007) suggest that creative construction occurs when incumbents learn through spill-ins when recipients use spillovers of their knowledge. However, Parker (2010) examines whether creative construction is a likely outcome *even in contexts where there is only a unidirectional flow from the incumbent source firm to the entrepreneurial entrant*. The analytical approach of this article has the attractive feature of providing a framework that models an interdependence between an incumbent organization that creates knowledge and an entrepreneurial firm that appropriates the value of the knowledge by accessing the spillover. The predator-prey model, in fact, shows that there is no unequivocal impact of knowledge spillover entrepreneurship on the incumbent organization. Rather, the results of the model suggest multiple contingencies. In other words, the outcome depends on the parameters of the model which, in turn, generate multiple equilibria, some of which are beneficial for the incumbent and some of which are detrimental. In addition to contributing to the literature by illustrating that the creative construction outcome can occur even in the absence of the knowledge spill-in mechanisms, Parker (2010) also highlights the potential of *destructive destruction* occurring due to incumbent entrant dynamics and, thus, providing a cautionary note for being overenthusiastic about creative construction- or creative destruction-related entrepreneurship.

Parker's (2010) conclusion that knowledge spillover entrepreneurship may actually have negative consequences for the knowledge-generating incumbent firm and, thus, may inhibit incentives to invest in new knowledge, echoes a similar warning against excessive entrepreneurship in Silicon Valley by Ferguson (1988: 61), who notes that 'fragmentation, instability, and entrepreneurialism are not signs of well-being . . . A combination of personnel mobility, ineffective property protection, risk aversion in large companies, and tax subsidies for the formation of new companies contribute to a fragmented *chronically entrepreneurial* industry. Companies avoid long-term R&D, personnel training, and long-term cooperative relationships because these are presumed, often correctly, to yield no benefit to the original investors.' While these dire predictions were not realized in Silicon Valley, Parker's (2010) model certainly underscores the potential of a negative spiral that thwarts, rather than promotes, industry and regional growth.

In the same vein, the mixed implications for localized knowledge spillovers and strategic entrepreneurship is the subject of Gambardella and Giarratana's (2010) attention. While the beneficial effects of knowledge spillovers through agglomeration economies to regions and firms have been discussed extensively in prior work (Saxenian, 1994; Almeida and Kogut, 1999; Rosenkopf and Almeida, 2003), the implications for localized knowledge spillovers on skill premiums has been relatively unexplored. Using data across 146 U.S. cities, Gambardella and Giarratana (2010) investigate whether localization of knowledge spillovers disproportionately benefits skilled workers more than unskilled workers, thus increasing their wage premium. The authors define localization of knowledge spillovers as the extent to which firms in a local vicinity draw upon knowledge generated by other firms in the same location, and they empirically measure this construct by the share of patent citations that are attributed to firms in the same region as the focal firm. They define the skill premium or productivity ratio as the ratio of the wages of those employed in managerial positions to those employed as production workers. Theoretically, they begin by noting that regions with greater knowledge spillovers create a reduction in uncertainty regarding the valuation of knowledge, since entrepreneurial experimentation creates increasing returns to the knowledge by increasing the number and simultaneity of innovative projects undertaken. This, in turn, has important ramifications for the skill distribution in the region and the wage premium for skills—the greater the knowledge spillovers, Gambardella and Giarratana (2010) argue, the greater the likelihood that the regional demand and supply conditions favor skilled versus unskilled labor. Localization of spillovers ultimately decreases the complementarity between skilled and unskilled workers, either due to regional specialization in more skilled activities or replacement of the unskilled labor by a combination of capital intensive processes and more skilled labor. In this context, Gambardella and Giarratana (2010) highlight the role of entrepreneurship in enabling the likelihood of greater localization of knowledge

DOI: 10.1002/sej

spillovers. Since new ventures that form to capitalize on local knowledge also stay local (Klepper, 2002; Tucci, Berchicci, and King, 2010), there is an increased demand for skilled and talented labor that enables the creation of new business models, activities, or technologies. The authors note that the likelihood of spin-out creation is not random—more skilled and higher-ability employees are more likely to create new ventures (Campbell *et al*., forthcoming), and the transfer of technological and market pioneering capabilities to spin-outs (Agarwal *et al*., 2004) is more likely to occur through skilled employees than nonskilled employees. Further, greater rates of spin-out generation imply that source firms need to replenish their skilled work force at a more disproportionate rate than their unskilled work force, thus increasing the demand for skilled force, and thereby their premium. Thus, Gambardella and Giarratana (2010) highlight an important consequence of the process of creative construction—more localized knowledge increases the productivity of skilled employees disproportionately relative to less-skilled employees. A key outcome of their analysis is the interesting speculation that to the extent that open cultures, such as Silicon Valley, also enhance the productivity gap, paradoxically, more open societies could become more unequal.

While Gambardella and Giarratana (2010) focus on the role of *localized* knowledge spillovers, Liu *et al*. (2010) examine the combined effect of inter- and intra-regional spillovers, particularly when employee entrepreneurs serve as the critical conduit of inter-regional spillovers. Liu *et al*. (2010) examine the international diffusion of knowledge from developed to an emerging market country, namely China, through strategic entrepreneurship by utilizing survey data collected from a sample of small and medium enterprises in high-tech industries located in a Science Park in China. The authors examine, on one hand, the implications of potential knowledge leakage from the traditional multinational enterprises (MNEs) to emerging market firms and, on the other hand, the implications of reverse migration in the development of entrepreneurship in emerging economies. Integrating the knowledge-based view of the firm and social capital theory, the authors examine how mobility and social interaction of individuals with work experience in Western MNEs helped in international knowledge diffusion. Since returnee entrepreneurs have the advantage of both discovering and creating entrepreneurial opportunities through arbitraging knowledge from one geographical space to another, they benefit their own enterprise and create spillover benefits for other firms in proximity (through social interaction-related knowledge spillovers). The article also theorizes about the conditioning role played by a *technology gap* and how this effect would vary between situations where the conduit of knowledge spillovers is the returnee scientist versus someone who works in the MNE in the home country. Accordingly, they propose that a technology gap may act as a boundary condition which positively affects the impact of returnee spillovers, but negatively moderates MNE work experience on non-returnee firms' innovations. Thus, the authors provide an in-depth analysis of both the benefits of executive mobility and entrepreneurship across countries and some boundary conditions to the extent of this benefit.

While Liu *et al*. (2010) underscore the importance of individuals for inter-organization knowledge spillovers, a critical issue remains regarding how firms may enhance intraorganizational spill-ins, particularly when confronted with dynamic environments. Extant literature in knowledge spillovers and strategic entrepreneurship is silent on what goes on inside the black box of the firm, since most of this literature has implicitly assumed that knowledge is ubiquitously available and known within all business units of the organization and that there is costless transfer or spillover of knowledge from the source unit to the recipient unit. This process is far from obvious or easy though, given knowledge stickiness (Szulanski, 1996). Anecdotally, it is perhaps best exemplified by the failure of General Motors to leverage the learning within Saturn to other divisions, ultimately killing this very successful experiment (Hanna, 2010). The intraorganizational spill-ins challenges faced by organizations and the importance of developing heuristics is the subject of scholarly attention by Oldroyd *et al*. (2010). Using an organizational learning lens, the authors study four organizations undertaking strategic renewal under four different dynamic environments, and they show that firms have to combine their experiential knowledge with entrepreneurial experimentation within the business unit that possesses the relevant knowledge and create mechanisms for intraorganizational knowledge spill-ins. Thus, Oldroyd *et al*. (2010) examine *how* organizations capitalize on the knowledge they create and *what* strategic entrepreneurship activities relate to their ability to renew themselves. Building from the need for reliability and validity so that learning may

DOI: 10.1002/sej

occur through inferences, the authors highlight the need for entrepreneurial experimentation for organizations confronted with dynamic environments, so that they not only understand and anticipate, but also *shape* causality. To do so, Oldroyd *et al*. (2010) highlight the need for the development of heuristics at a local level, given less than ideal conditions of reliability and validity. Identifying challenges in generating reliability and validity, the authors develop their model for creating intraorganizational knowledge spill-in mechanisms, which permits knowledge developed in one unit to flow to other organizational units. They discuss how organizations can enhance their performance through repurposing of local heuristics through the combination of knowledge and entrepreneurial experimentation. Proximate organizational units to which these heuristics are transferred have to additionally engage in reformulating the heuristics for their own context. The authors also underscore the need for subsequent feedback to the originating unit in a recursive, inferential learning process that builds on the interaction of knowledge spillovers/spill-ins and entrepreneurial experimentation.

Oldroyd *et al*.'s (2010) insights regarding *what* processes organizations need to develop to transmit knowledge and *how* it is integrated and repurposed across units is not only relevant to organizations seeking to strategically renew themselves, but also to organizations seeking to leverage interorganizational spill-ins. Presumably, differences in local heuristics are going to be even higher across organizations than within organizations. Thus, their work provides some boundary conditions on interorganizational spill-ins, while at the same time underscoring the need for explicit mechanisms for the transfer of knowledge and heuristics. These mechanisms may include movement of people, as well as formal and informal relationships across organizational boundaries.

Thus, all five articles provide an in-depth examination of issues within their focal levels of analysis, but with implications across levels. Collectively, they help us understand the entire process within which new firms are created due to spillovers of knowledge investments undertaken within established institutions and existing firms renew themselves due to subsequent entrepreneurial actions that build on spillovers and spill-ins. In doing so, there are important ramifications for industry, regional, and macroeconomic growth due to the interplay between knowledge spillovers and strategic entrepreneurship.

CONCLUDING THOUGHTS

The twin concepts of knowledge spillovers and strategic entrepreneurship are intricately linked to each other, and examining issues at their interface is key to understanding the causes and consequences of value creation, value appropriation, diffusion of knowledge, and ultimately, the growth and prosperity of regions and nations. In this article, we build on extant work to draw out additional implications of studying the two in conjunction with each other. We have created an incomplete list of research questions that arise, which may require new theoretical perspectives or fresh empirical insights on issues related to knowledge spillovers and strategic entrepreneurship. Some of these research questions are already subjects of close scrutiny, while much work remains to be done in others. For example, taken together, the articles contained in this special issue forge important new ground in developing fresh insights, be it at an individual or intraorganizational level or at a regional or international level. We expect this special issue to be more of a promising new beginning rather than the final word in a highly fertile area of research. In particular, there exists significant potential for scholarly work that examines the underlying causal mechanisms, the processes through which knowledge spillovers and strategic entrepreneurship manifest themselves, and the consequences in terms of individual, firm, industry, and regional performance.

ACKNOWLEDGEMENTS

We thank the Ewing Marion Kauffman Foundation for their support of this research. We are also grateful to Jay Barney, Mike Hitt, and Dan Schendel for their support of the special issue and are indebted to the many reviewers and authors who tirelessly worked under time pressure to improve the quality of the submitted manuscripts. A special thanks to Lois Gast for her dedication, hard work, and stellar assistance. All authors contributed equally, and their names are in alphabetical order.

REFERENCES

Agarwal R, Audretsch D, Sarkar MB. 2007. The process of creative construction: knowledge spillovers, entrepreneurship, and economic growth. *Strategic Entrepreneurship Journal* **1**(3/4): 263–286.

Agarwal R, Campbell B, Franco AM, Ganco M. 2010. What do I take with me: the impact of transfer and replication of resources on parent firm performance. Working paper, University of Maryland, College Park, MD.

Agarwal R, Echambadi R, Franco AM, Sarkar M. 2004. Knowledge transfer through inheritance: spin-out generation, development, and performance. *Academy of Management Journal* **47**: 501–522.

Agarwal R, Helfat C. 2009. Strategic renewal of organizations. *Organization Science* **20**: 281–293.

Aghion P, Howitt P. 1992. A model of growth through creative destruction. *Econometrica* **60**(2): 323–351.

Ahuja G, Katila R. 2001. Technological acquisitions and the innovation performance of acquiring firms: a longitudinal study. *Strategic Management Journal* **22**(3): 197–220.

Almeida P, Kogut B. 1999. Localization of knowledge and the mobility of engineers in regional networks. *Organization Science* **45**: 905–917.

Alvarez SA, Barney JB. 2005. How do entrepreneurs organize firms under conditions of uncertainty? *Journal of Management* **31**: 776–793.

Anton J, Yao D. 1995. Start-ups, spin-offs, and internal projects. *Journal of Law Economics and Organization* **11**: 362–378.

Arrow K. 1962. Economic welfare and the allocation of resources for invention. In *The Rate and Direction of Inventive Activity*, Nelson RR (ed). Princeton University Press: Princeton, N.J.; 609–626.

Bhide A. 1994. How entrepreneurs craft strategies that work. *Harvard Business Review* **72**(2): 150–161.

Campbell B, Ganco M, Franco AM, Agarwal R. Who leaves, where to, and why worry? Employee mobility, employee entrepreneurship, and effects on source firm performance. *Strategic Management Journal* Forthcoming.

Chen PL, Williams FC, Agarwal R. 2010. Growing pains: pre-entry experience and the challenge of transition to incumbency. *Strategic Management Journal* Forthcoming.

Cohen W, Levinthal D. 1990. Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly* **35**: 128–152.

Covin JG, Slevin DP. 2002. The entrepreneurial imperatives of strategic leadership. In *Strategic Entrepreneurship: Creating a New Mindset*, Hitt MA, Ireland RD, Camp SM, Sexton DL (eds). Blackwell Publishers: Oxford, U.K.; 309–327.

Ferguson C. 1988. From the people who brought you voodoo economics. *Harvard Business Review* **66**: 55–62.

Fleming L. 2001. Recombinant uncertainty in technological search. *Management Science* **47**: 117–132.

Franco A, Filson D. 2006. Spin-outs: knowledge diffusion through employee mobility. *RAND Journal of Economics* **37**: 841–860.

Gambardella A, Giarratana S. 2010. Localized knowledge spillovers and skill-biased performance. *Strategic Entrepreneurship Journal* **4**(4).

Grant RM. 1996. Prospering in dynamically competitive environments: organization capability as knowledge integration. *Organization Science* **7**(4): 375–387.

Griliches Z. 1992. The search for R&D spillovers. *Scandinavian Journal of Economics* **94**: 29–47.

Hanna D. 2010. How GM destroyed its Saturn success. *Forbes*, 8 March.

Henderson RM, Clark KB. 1990. Architectural innovation: the reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly* **35**: 9–30.

Hitt MA, Ireland RD, Camp SM, Sexton DL. 2001. Strategic entrepreneurship: entrepreneurial strategies for wealth creation. *Strategic Management Journal* **22**(6/7): 479–492.

Ireland RD, Hitt MA, Sirmon DG. 2003. A model of strategic entrepreneurship: the construct and its dimensions. *Journal of Management* **29**(6): 963–989.

Keller W. 1998. Are international R&D spillovers trade related? Analyzing spillovers among randomly matched trade partners. *European Economic Review* **42**: 1469–1481.

Klepper S. 2002. The capabilities of new firms and the evolution of Detroit as the capital of the U.S. automobile industry. *Management Science* **53**: 616–631.

Klepper S, Simons KL. 2000. Dominance by birthright: entry of prior radio producers and competitive ramifications in the U.S. television receiver industry. *Strategic Management Journal* **21**(10/11): 997–1016.

Knight F. 1921. *Risk, Uncertainty, and Profit*. Houghton Mifflin: New York.

Kotha S. 2010. Spillovers, spill-ins, and strategic entrepreneurship: America's first commercial jet airplane and Boeing's ascendancy in commercial aviation. *Strategic Entrepreneurship Journal* **4**(4).

Krugman P. 1991. Increasing returns and economic geography. *Journal of Political Economy* **99**(3): 483–499.

Kuratko DF, Audretsch D. 2009. Strategic entrepreneurship: exploring different perspectives of an emerging concept. *Entrepreneurship Theory and Practice* **33**: 1–17.

Lane PJ, Koka B, Pathak S. 2006. The reification of absorptive capacity: a critical review and rejuvenation of the construct. *Academy of Management Review* **31**: 833–863.

Liu X, Wright M, Filatotchev I, Dai O, Lu J. 2010. Human mobility and international knowledge spillovers: evidence from high-tech small and medium enterprises in an emerging market. *Strategic Entrepreneurship Journal* **4**(4).

Moore G, Davis K. 2004. Learning the Silicon Valley way. In *Building High-Tech Clusters: Silicon Valley and Beyond*, Bresnahan T, Gambardella A (eds). Cambridge University Press: Cambridge, MA; 7–39.

Oldroyd J, Silvestri L, Gulati R. 2010. A learning perspective on intraorganizational knowledge spill-ins. *Strategic Entrepreneurship Journal* **4**(4).

Parker S. 2010. A predator-prey model of knowlede spillovers and entrepreneurship. *Strategic Entrepreneurship Journal* **4**(4).

DOI: 10.1002/sej

Penrose E. 1959. *The Theory of the Growth of the Firm*. Oxford University Press: Oxford, U.K.

Romer PM. 1990. Endogenous technological change. *Journal of Political Economy* **98**: 71–102.

Rosenkopf L, Almeida P. 2003. Overcoming local search through alliances and mobility. *Management Science* **49**: 751–766.

Saxenian A. 1994. *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*. Harvard University Press: Cambridge, MA.

Schumpeter JA. 1942. *Socialism, Capitalism, and Democracy*. Harper & Brothers: New York.

Sorenson O, Rivkin JW, Fleming L. 2006. Complexity, networks, and knowledge flow. *Research Policy* **35**: 994–1017.

Spender JC. 1996. Making knowledge the basis of a dynamic theory of the firm. *Strategic Management Journal* **17**(Winter Special Issue): 45–62.

Szulanski G. 1996. Exploring internal stickiness: impediments to the transfer of best practice within the firm. *Strategic Management Journal* **17**(Winter Special Issue): 27–43.

Tucci C, Berchicci L, King A. Does the apple always fall close to the tree? The geographical proximity choice of spin-outs. *Strategic Entrepreneurship Journal* Forthcoming.

Webster's Collegiate Dictionary. 1991. Random House, Inc.: New York.

Weigelt C, Sarkar MB. 2009. Learning from supply-side agents: the impact of technology solution providers' experiential diversity on clients' innovation adoption. *Academy of Management Journal* **51**(1): 37–60.

Yang HY, Phelps C, Steensma HK. 2010. Learning from what others have learned from you: the effects of knowledge spillovers on originating firms. *Academy of Management Journal* **53**(2): 371–389.

DOI: 10.1002/sej