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THE INFLUENCE OF TECHNOLOGICAL INTERDEPENDENCE ON EMPLOYEE ENTREPRENEURSHIP AND MOBILITY: EVIDENCE FROM THE SEMICONDUCTOR INDUSTRY

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Abstract:
The intra-industry activities of employees post-exit from incumbent firms have been identified as an important determinant of industry dynamics and structure. The post-exit founding of startups employee entrepreneurship is widely heralded as an important driver of innovation, firm creation and growth. Similarly, post-exit employee mobility to rival firms has been recognized as a crucial channel for knowledge spillovers. Far less is known, however, about how technology influences this flow of talent. This study investigates one attribute of technology technological interdependence. Drawing on a unique database of intra-industry inventor entrepreneurship and mobility events as well as patent citations in the U.S. semiconductor industry, I find that the propensity to engage in employee entrepreneurship increases, but to join a rival firm, decreases with the technological interdependence of inventor s prior patents. This study sheds new light on how technology shapes patterns of employee entrepreneurship and mobility with implications for knowledge flows and competitive dynamics.

JEL - codes: O33, -, -

THE INFLUENCE OF TECHNOLOGICAL INTERDEPENDENCE ON EMPLOYEE ENTREPRENEURSHIP AND MOBILITY: EVIDENCE FROM THE SEMICONDUCTOR INDUSTRY

The intra-industry activities of employees post-exit from incumbent firms have received increasing scholarly attention within a wide range of disciplines. This is not surprising, given that a significant portion of a firm's knowledge - a core source of competitive advantage - is embedded in the human capital of employees who are free to quit at will. Employee entrepreneurship - the post-exit founding of a new venture by an individual who worked for an incumbent firm - has been heralded as a hallmark of innovation (Klepper, 2005; Klepper & Thompson, 2008), a critical source of new firm capability development and heterogeneity in performance (Almeida & Kogut, 1999; Rosenkopf & Almeida, 2003; Agarwal*,* Echambadi, Franco & Sarkar, 2004; Dahl & Reichstein, 2006) and an impetus to the creation and growth of industries and regional clusters (Klepper, 2001; Dahl, Østergaard & Dalum*,* 2005; Agarwal, Audretsch & Sarkar*,* 2007). Through employee entrepreneurship, the new venture not only inherits the industry-specific knowledge brought in by its founders (Agarwal *et al*., 2004; Chatterji, 2008) but its strategies bear the imprinting mark of the founders' prior work experience (Klepper & Thompson, 2008). Similarly, scholars have long recognized intra-industry employee mobility as a powerful engine of knowledge spillovers between established firms as well as between incumbents and startups (Almeida & Kogut, 1999; Rosenkopf & Almeida, 2003; Agarwal *et al.*, 2004; Agarwal, Ganco & Ziedonis, 2008).

At the heart of the issues raised above is a question that relates to the causes of the origin of new ventures and the sources of heterogeneity in their capabilities and performance. Entrepreneurship scholars have noted that entrepreneurial opportunities arise due to information asymmetries and access to "knowledge corridors" (Venkataraman, 1997). In particular, individuals working at existing organizations have preferential access to knowledge related to new technological developments, untapped markets, and environmental or regulatory drivers (Agarwal *et al.,* 2004; Chatterji, 2008; Sørensen, 2007). Employee entrepreneurship represents a key mechanism for opportunity identification. A central question, however, relates to why and when it occurs. From the perspective of the employees, it implies the choice to pursue ideas outside of the parent firms. Why do they opt for risky and costly formation of new firms, often giving up the security and support of being with the parent? From the perspective of the incumbent organization that has invested the critical resources necessary for the knowledge creation, it implies internal imperfections and lost opportunities. Why and when do the incumbents not exploit all profitable opportunities?

The main focus of this paper is to contribute to a better understanding of origins of employee entrepreneurship and related patterns of knowledge flows. In particular, I study an area which seems an uncharted territory - how the technological context within incumbent firms affects employee entrepreneurship and mobility. The key variable that I analyze is the technological interdependence/modularity of inventors' prior patenting activities within incumbent firm which I measure at the level of an individual invention. The technological interdependence is typically defined at the component level – if components A and B are interdependent then change in a component A affects performance of component B (Kauffman, 1993; Levinthal, 1997; Rivkin, 2000). Modularity, on the other hand, tends to be defined at the system level as the extent to which components of the system can be modified independently of the remainder of the system (Baldwin & Clark, 2000). However, as suggested in prior studies (Fleming & Sorenson, 2001; Ethiraj & Levinthal, 2004), I adopt the view that interdependence and modularity represent the same underlying construct (i.e. high interdependence equals low modularity) and I use the terms interdependence and modularity interchangeably - referring to the component (patent) level of analysis.

To uncover the underlying mechanisms and provide a robust comparison, I juxtapose the employee entrepreneurship decisions not only with the decision to stay employed within incumbent firms but also with the intra-industry employee mobility. It is possible that technological interdependence affects employee entrepreneurship and employee mobility through different mechanisms. Consequently, different types of employees (in terms of the degree of technological interdependence of their prior activities) move to established firms versus start new ventures. If indeed different mechanisms are at work it has implications for the type of knowledge that flows to rival firms versus emergent startups.

Combining the complexity theory (Kauffman, 1993; Levinthal, 1997; Gavetti & Levinthal, 2000; Rivkin, 2000) with other extant approaches (Penrose, 1959; Anton & Yao, 1995; Hellman, 1997), I develop two propositions connecting technological interdependence with employee entrepreneurship and mobility. I test these propositions within the context of the U.S. semiconductor industry providing a canonical example of an industry driven by technological intensity, knowledge spillovers, employee mobility and entrepreneurship (Freeman, 1986; Agarwal *et al.*, 2008). I base the analysis on a unique hand-collected dataset on 465 dedicated semiconductor firms operating between 1973 and 2003. To briefly foreshadow the main results, I find that incumbent firm inventors patenting inventions with higher technological interdependence (lower modularity) are more likely to become entrepreneurs but less likely to move to rival firms than incumbent firm inventors patenting inventions with lower technological interdependence (higher modularity).

The paper contributes to multiple literature streams. Within the context of employee entrepreneurship literature (Agarwal *et al*, 2004; Klepper, 2005; Klepper & Sleeper, 2005) the study provides the needed focus on factors that condition emergence of employee entrepreneurship (Klepper, 2008)[1]. I also contribute to the literature on employee mobility and knowledge spillovers (Almeida & Kogut, 1999; Rosenkopf & Almeida, 2003; Agarwal, Echambadi, Franco & Sarkar, 2004; Agarwal, Ganco & Ziedonis, 2008) by suggesting that, consistent with the simulation studies (Rivkin, 2000), technological interdependence is an important contingency affecting knowledge flows through employee mobility. Analogous to the organizational theory literature (Lee & Mitchell, 1994; Lee, Mitchell & Holtom, 1999; Holtom, Mitchell & Lee, 2005), I analyze antecedents of particular types of employee exit as residing in the decision-making process unfolding within the parent firms.

[1] Klepper, S (June 2008). Keynote speech presented at the 25th DRUID Celebration Conference 2008. Copenhagen, Denmark.

LITERATURE ON EMPLOYEE ENTREPRENEURSHIP AND MOBILITY

The scholars within economics and strategy have focused on explaining employee entrepreneurship through imperfections or frictions within parent firms. At the individual level of analysis, researchers have typically relied on the decision making process for the individuals involved (Anton & Yao, 1995; Cassiman & Ueda, 2004; Franco & Filson, 2006; Hellman, 2007; Klepper & Thompson, 2008). More specifically, some studies suggest that the employee entrepreneurship events occur due to the agency problems and contractual hazards arising from employees having an option to not disclose their inventions (Anton & Yao, 1995) or employees deriving private benefits from exploratory search effort (Hellman, 2007). At the firm level of analysis, studies typically attribute the presence of idle opportunities to frictions in knowledge transfer (Franco & Filson, 2006), managerial diseconomies of scale and under-exploited knowledge (Agarwal *et al.,* 2004) or intra-firm information transfer (Klepper & Thompson, 2008). For instance, in the model by Franco and Filson (2006), the parent firm does not distinguish between the employee who has mastered the parent firm knowledge and the one who has not and it compensates them equally. Consequently, the superior employees leave to start their own firms since their knowledge is not fully appreciated within the parent firm. Agarwal *et al.* (2004) theorize that spinouts occur when parents have under-exploited knowledge due to the lack of dual capability development related to market opportunity identification and technological capabilities. They show how firms that have developed complementary capabilities are less likely to generate spinouts than are firms that develop capabilities in a single dimension. Klepper and Thompson (2008) assume that some employees are inherently better in recognizing new opportunities but their suggestions are not given full weight by the rest of the firm. The firm is thus assumed to be boundedly rational in a sense that it does not behave in its best self-interest. The gap in the ability to recognize superior ideas leads to disagreements and the tendency of the better employee to seek the commercialization of the recognized opportunity outside of the firm boundaries.

Even though the underlying mechanisms suggested in the theoretical explanations differ, research in this stream underscores the existence of profitable opportunities within parent firms that are left unexploited as leading to employee entrepreneurship events. Supporting empirical evidence has been found in a variety of industry contexts including disk drives, automobiles and lasers (Agarwal *et al.*, 2004; Klepper, 2005; Klepper & Sleeper, 2005; Franco & Filson, 2006). Similarly, in a survey of 100 fast-growing private companies, Bhide (1994) found that 71% of the entrepreneurial founders commercialized ideas they had encountered or discovered while working at other companies.

The literature on employee mobility (Almeida & Kogut, 1999; Rosenkopf & Almeida, 2003; Agarwal *et al.*, 2004; 2008) typically focusing on implications of employee mobility on knowledge flows is equally vibrant. One of its most robust findings is that employee mobility facilitates knowledge flows. The knowledge flows tend to be geographically localized (Almeida & Kogut, 1999) but mobility is also a strong conduit facilitating the knowledge flow over large geographical and technological distances (Rosenkopf & Almeida, 2003). The knowledge brought in by mobile inventors tends to diffuse within hiring firms (Tzabbar, Silverman & Aharonson, 2005), is especially beneficial for small hiring firms (Almeida, Dokko & Rosenkopf, 2003) and has been hypothesized to be a driving force behind successful industrial clusters like Silicon-Valley (Saxenian, 1994; Gilson, 1999; Fallick, Fleischman & Rebitzer, 2005). On the other hand, parent firms try to reduce knowledge outflows through employee mobility by patenting more (Kim & Marschke, 1999) or building reputations for litigiousness (Agarwal *et al.*, 2008).

While the bulk of the literature related to employee entrepreneurship and mobility has employed an economic, strategic or sociological lens, the related literature in organizational behavior on voluntary turnover (Lee & Mitchell, 1994; Lee *et al.*, 1999; Holton *et al.*, 2005) is also relevant to the issue of why employees exit incumbent firms. The theories related to voluntary turnover focus on the process-related antecedents of voluntary exit and provide a window into micro level decision-making. The core idea is that the decision to exit is a result of a multi-stage process that unfolds when several possibly sequential conditions are met. The process of decision "unfolding" is assumed to be triggered by a shock. While the literature does not pay much attention to whether the exits lead to mobility to existing firms or to new firm formation, it suggests the possibility that the initial shock could very well be the recognition of a profitable idle opportunity within the parent firm. However, opportunity recognition is only a first stage of the unfolding process and multiple conditions (like the availability of job alternatives, etc.) must be met in each stage before the employee decides to exit and start a new venture.

CONCEPTUAL FRAMEWORK

Despite the focus on employee entrepreneurship and mobility, little is known about their relationship with technology. The results in the extant literature have been limited to the finding that more technologically advanced firms generate more employee entrepreneurship events (Brittain & Freeman, 1986; Agarwal *et al.*, 2004; Franco & Filson, 2006). From the perspective of the contextual approaches to entrepreneurship in economics, strategy and sociology, it is unclear if and how the technological environment, as it varies across and within firms, affects employee entrepreneurship and mobility. Connecting employee entrepreneurship and mobility with technology seems important since some dimensions of technology appear to play an important role in opportunity recognition and exploitation. In particular, technological interdependence/modularity seems like a viable candidate for an important contingency. Christensen *et al.* (1999) in their study of thin film heads in the disk drive industry find that modularization has an inverted U-shaped relationship with performance and that typically "…modularity narrows degrees of freedom in design". Similarly, Fleming and Sorenson (2001) suggest that "…onset of complete modularity severely limits opportunity." Funk (2008) in his description of the semiconductor industry notes that firms focusing too much on the modular improvements were more likely to miss opportunities emerging from technological discontinuities.

Interdependent Technological Environments and Employee Entrepreneurship

First, to connect technological interdependence with employee entrepreneurship, I utilize the notion that employee entrepreneurship is primarily driven by underexploited knowledge discovered while working within parent firms. To exploit this assumption in building the theory connecting employee entrepreneurship with technological interdependence, I need to answer the following question: *how does the interdependence/modularity of technological context in which employees operate affect the presence of underexploited opportunities*? It is useful to rely on the fundamental properties of interdependent technological spaces to answer this question. The centerpiece of imagery of complex systems research and related NK modeling literature is the notion of a rugged landscape (Figure 1). The rugged landscape (Kauffman, 1993, 1995; Levinthal, 1997; Rivkin, 2000) represents the problem space searched by the agents (i.e. in our context individual inventors solving a given technological problem). The agents are assumed to be bounded in their ability to optimize over the decision elements of this space and thus have to search for the optima in the space by adaptive and iterative trial-and-error local search process (Kauffman, 1993). As the ruggedness of the space increases (the space has more "peaks" and "valleys"), the boundedness of the agents' search behavior creates lock-in problems – the agents are unlikely to find the global optimum of the space and may stay locked-in at a suboptimal lower peak. Kauffman (1993) showed that ruggedness of the problem space increases with the level of interdependence (density of linkages between components). For instance, if an inventor makes decisions on N components and all component decisions are perfectly modular or independent (in the sense that changing the decision about the component N_i does not affect the performance contribution of any other component N_j) then the space is perfectly smooth and the inventor is able to locate the global optimum (the best possible solution). However, when there are interdependencies the decision about the component N_i affects the performance of not only itself but also of all components N_j that are linked to (depend on) the component N_i. Consequently, small changes – e.g. change in one decision component N_i – can lead to dramatic changes in overall performance of the system (defined as the average of the performance contributions of the individual components). What follows is that when the space is searched by a boundedly rational agent that can evaluate only options in the local neighborhood of the current decision (e.g. those decisions that differ by one decision component), the lock-in problems emerge and agents are unable to improve on the suboptimal local peak. To get to the higher peaks the agents would have to traverse valleys. However, they are unable to evaluate distant points and chose the direction of higher optima due to the myopia of their local search.

[Insert Figure 1 about here]

Technological Interdependence and Under-exploitation of Opportunities

The economics and strategy literatures (Agarwal, *et al.*, 2004, Klepper & Sleeper, 2005; Klepper & Thompson, 2008) suggest that the existing firms are prone to leave some opportunities idle. At the same time, it is the existing employees who are best positioned to exploit such opportunities relative to other entrants (Agarwal *et al.*, 2004; Klepper & Sleeper, 2005). Based on this body of work, I assume that when an individual leaves his or her current employer to start a venture (an employee entrepreneurship event) it is predominantly to exploit opportunities identified while working for the current employer.[2]

Since knowledge is likely to be dispersed within firms, the employees who are working in the particular context (Sørensen, 2007) or knowledge corridor (Venkataraman, 1997) that creates idle opportunities are most likely to recognize them. Consequently, even within firms, not all employees are equally likely to recognize all opportunities created by the parent firm. However, the question still remains - how does the presence of underexploited opportunities vary with the technological interdependence?

Smooth landscape typically has one or few local peaks as opposed to a rugged space that has many. If the firm is inhabited by agents that have perfect information about the space (i.e.

[2] It is interesting to note that Freeman (1986), based on interviews with semiconductor firm founders, identifies three motives for exiting the parent and starting a new firm: 1) Insufficient salary within the parent firm, 2) Technological opportunity, 3) Political conflict with the parent. I assume that employee entrepreneurship is mainly driven by 2). Since 1) and 3) are unobservable in my sample, I assume that my controls (firm and individual characteristics) fully capture their correlation with 2).

zero search myopia) it will implement the best technological solution – whether it has to search through one or many local optima. One of the key assumptions of the complexity literature is that myopia in local search leads to lock-in issues and potentially suboptimal proposed solutions. However, to establish that rugged landscapes may give rise to idle opportunities, I need to introduce an additional friction beyond search myopia. The assumption of myopia, on its own, would not preclude the focal firm from implementing the best *discovered* solution and would not lead to under-exploitation of *identified* opportunities even in a rugged landscape. If the focal agent discovers a superior solution the idea's superiority would be recognized by other agents and implemented by the firm. Consequently, the friction has to relate to the ability of other agents to *evaluate* or *implement* the idea.

As a first alternative, let's assume that agents (inventors and managers in our case) are boundedly rational and myopic in their *ability to evaluate alternatives*. The assumption entails that inventors and their managers are much better at evaluating choices which are similar or close to the currently implemented technological solution. Note that this assumption is in addition to the assumption of local search in the NK model (Kauffman, 1993; Levinthal, 1997). Inventors within firms are likely to be distributed across the technological space (i.e. come up with different solutions to the given technological problem), but they will converge to the same solution when the landscape is smooth. However, when the space is rugged they may work on and end up being locked into different solutions to the given problem. If the firm management perfectly evaluates inventors' proposals the firm will still implement the best solution. However, if the firm is more likely to make an error (i.e. reject profitable opportunity) when a more distant solution is proposed, the employee entrepreneurship will increase with interdependence since dispersion of peaks increases with the ruggedness of the space (Kauffman, 1993; Levinthal, 1997; Rivkin, 2000).[3]

[3] Kauffman (1993, 1995) shows that the local peaks are less clustered in space with the increases in ruggedness of the space.

What can justify such an assumption? For instance, within the context of Penrose (1959) one could perceive the boundary of the firm (and the extent to which projects outside of this boundary are rejected) as determined by scarce managerial talent and path dependency. Penrose argues that the bundle of current resources (i.e. its current position in the space) determines the services the firm is capable of rendering (Penrose, 1959, p. 5; Kor & Mahoney, 2004). A manager evaluating proposals is thus bounded by the current position of the firm. Due to the managerial diseconomies of scale or scope, the manager may even become a bottleneck in the efficient growth of the firm (Penrose, 1959, p. 237; Kor & Mahoney, 2004). It is then reasonable to expect that these managerial diseconomies will increase with the ruggedness of the space as the manager will have to evaluate more distant technological solutions proposed by the inventors.

As a second alternative, the inability to evaluate ideas may be due to increased communication cost. Rivkin (2000) shows that it is more difficult to transfer more interdependent knowledge and that small errors in the knowledge transfer lead to large performance penalties. If the ability to transfer knowledge for decision-making purposes within the firm decreases with its interdependence then higher interdependence will lead to more project rejection resulting in higher prevalence of employee entrepreneurship events originating in technologically interdependent settings[4].

Third, the firm may be unable or unwilling to *implement* proposed ideas (even if it can evaluate them correctly) due to agency considerations. Agency theorists (Anton & Yao, 1995; Hellman, 2007) model profitable project rejections as emerging from various incomplete contract settings. The complexity literature (Kauffman, 1993; 1995; Rivkin, 2000) shows that the peaks are not only more dispersed in more interdependent spaces but also the variance of their performance is greater. When the space is smooth (modular), improvements tend to be incremental. When it is rugged (interdependent) a given profitable opportunity may represent a

[4] Within the context of the decision-making model of Klepper and Thomspon (2008) this would translate into such projects receiving lower weight by managers.

dramatic improvement in the current status quo of the firm. Consequently, the potential for abrupt improvements in firm performance may amplify agency costs. For instance, both the private benefits of search on inventors' personal projects as opposed to assigned tasks (Hellman, 2007) and benefits of not disclosing some projects to the management (Anton & Yao, 1995) will increase with the expected "upswing" in interdependent environment which will in turn increase project rejection and employee entrepreneurship.

The above theories suggest different mechanisms, but they all imply that the extent of underexploitation by parent firms and subsequent employee entrepreneurship should increase with technological interdependence. Consequently, being agnostic about the exact causal mechanism, I can formulate the main hypothesis:

H1: The probability of exiting and starting a new venture for a focal incumbent firm inventor increases with the technological interdependence of the inventor's prior inventions.

Technological Interdependence and the Flow of Talent

In the previous section, I proposed that interdependent technological environments give rise to more underexploited opportunities and more employee entrepreneurship. Since employees are a strong conduit of knowledge (Almeida & Kogut, 1999; Rosenkopf & Almeida, 2003; Agarwal *et al.,* 2004), this prediction implies that knowledge underexploited within parent firms flows to entrepreneurial startups. The natural question that follows is whether *the underexploited knowledge originating in technologically interdependent settings also flows to existing rival firms*. In other words, is there something unique about the entrepreneurial startups in their ability to exploit these opportunities? If firms operating in interdependent technological domains leave unexploited opportunities it may be in the best interest of rival firms to exploit them, as well. At the same time, the rival firms may be best positioned to do so – they are operating in the same industry and may use similar technology. However, do mobility events – similar to employee entrepreneurship - increase with the technological interdependence?

First, as the theoretical complexity literature (Rivkin, 2000; Ethiraj & Levinthal, 2004) proposes, the imitative ability decreases with the interdependence of the problems solved by the firm. The interdependent problems create unique challenges in which small errors have dramatic negative impact on performance. This error rate may be greater when the ideas are implemented into existing structure (mobility to rivals) as opposed to creating a structure designed to exploit the given opportunity (employee entrepreneurship).

Second, the existing organizational structures of rival firms originally designed to exploit other opportunities may create situations analogous the ones that caused employee exits from the parent firms. Just as parent firms end up not exploiting all opportunities the potential hiring rival firms may not see the benefit of proposed projects – whether this is due to managerial diseconomies (Penrose, 1959), communication cost (Klepper & Thompson, 2008) or agency issues (Anton & Yao, 1995; Hellman, 2007). The best option for inventors may be then to start their own ventures. Once again, however, the fact that rival firms may have difficulty implementing knowledge originating in an interdependent environment is insufficient to make a prediction about the causal relationship between technological interdependence and mobility.

When inventors leave their parent firms to form startups, based on the literature (Bhide, 1999; Agarwal *et al.*, 2004; Klepper & Sleeper, 2005; Klepper & Thompson, 2008), I assume that it is *predominantly* to exploit opportunities identified during their prior employment. Nevertheless, the inventor mobility across existing firms may be motivated by a plethora of other reasons – e.g. search for a better fit between the individual skill set and the organization, or personal reasons. The organizational theory literature maintains that the exit choice is a function of job satisfaction and perceived number and type of job alternatives (March & Simon, 1958; Lee & Mitchell, 1994). Since exploiting parent firm opportunities within rivals is likely to be difficult – i.e. if we expect that the motivation for inventor mobility is predominantly *not* an exploitation of such opportunities - the interdependence of the technological environment is more likely to be a burden limiting the number and scope of job alternatives. The more interdependent knowledge may be more tacit, more embedded within the structure of parent organization and its successful transfer may be more prone to errors (Rivkin, 2000). Consequently, the interdependent inventions lock the inventor into the structure of the parent firm and inhibit his or her movement options. In general, the interdependence of technological environments will negatively affect the flow of knowledge by restricting inventor mobility. It is the less interdependent (more modular) knowledge that spills out more easily via employee mobility.

H2: The probability of moving to an existing rival firm for a focal incumbent firm inventor decreases with the technological interdependence of the inventor's prior inventions.

DATA AND METHODOLOGY

Industry Context and Data Description

The context of the study is the U.S. semiconductor industry. The industry exhibits a high degree of employee entrepreneurship and mobility and prior studies document that such mobility facilitates inter-firm transfers of technological knowledge (Almeida & Kogut, 1999; Rosenkopf & Almeida, 2003). Firms in this industry also have high propensity to file patents (Hall & Ziedonis, 2001) which allows construction of a patent-based measure of technological interdependence (Fleming & Sorenson, 2001; 2004; Ganco, 2008). Empirically, I trace the innovative activities of 649 U.S. semiconductor firms over a three-decade period, 1973-2003. The construction of the sample is analogous to prior studies on mobility (Rosenkopf & Almeida, 2003; Agarwal *et al.*, 2008) by distinguishing between firms that are potential *sources* of inventive talent and other firms in the industry that are potential *recipients* (rivals or employee founded startups).

The source firm sample is drawn from a comprehensive list of publicly-traded U.S. firms that a) compete primarily in semiconductor product markets and b) are founded prior to 1995. Restricting attention to firms that are public by the mid-1990s (n=136) allows a sufficiently long window through which to view possible employee entrepreneurship and mobility events. In 2000, these firms collectively generated over $88 billion in annual revenues and spent $12 billion in R&D. To assemble a larger pool of potential “recipients” of inventive talent within the industry, I add to source firms (a) 454 additional venture-backed semiconductor firms that were founded between 1980 and 2001, and (b) 59 additional firms in the industry (SIC3674) that went public post-1995. Recent public entrants are identified from Compustat. The additional venture capital-backed startups are identified using data provided by VentureOne. Including recent entrants and startups in the pool of potential recipients is particularly useful for employee entrepreneurship analysis.

Since I am interested in an inventor-level analysis and the USPTO patent data does not provide person’s identifier, I match inventor names to reconstruct individuals’ patenting history. I implement the matching algorithm described in Agarwal *et al.* (2008) that creates inventor patenting and employment histories at focal firms within the sample. This algorithm identifies 28,123 unique inventor names listed in patents awarded to sample firms of which 25,339 appear within the source firm sample. I also require that the source firms receive at least one patent which eliminates 7 source firms. The final source firm sample includes 129 firms.

By searching press releases in LexisNexis, analyzing archived websites of the recipient firms (www.archive.org) and several online resources (e.g. smithsonianchips.si.edu) I identify founders of the recipient firms. Since I am interested in how past employment histories shape the emergence of new firms, I need to identify inventors whose ideas lead to the emergence of startups and not simply early “board members”. Consequently, I employ a relatively stringent requirement to define a person as a founder – the word “founder” or “co-founder” needs to appear with the person’s name on either the archived corporate website (as early as possible after the year of entry), early press releases or industry materials. To look at how prior inventive activity affects decision to start a new firm I match the founder names (I verify and clean the matches using LexisNexis and corporate websites to precisely reconstruct the founder employment histories) with the source firm inventor pool of 25,339 inventors. Using this procedure yields 141 inventor-founders who originated from 49 source firms and founded 114 spinouts. Of these, 10 were started by 3 inventor-founders, 19 by 2 inventor founders and the rest by single inventor-founders.[5] It is important to note that the identification procedure does not require the founder to be an inventor within the startup firm. He or she only needs to appear as an inventor within the source firm population.

Similarly, I identify mobility events. Since the only method to identify inventor employees within the recipient firms is if they patent, I require that recipient firms receive at least one U.S. patent. This restriction eliminates 14 public and 188 startup firms.[6] The final recipient sample therefore includes 266 private startups and 181 public firms. The above matching algorithm yields 1,166 mobility events.[7]

For the combined set of firms, I integrate financial, founding and exit year data from Compustat, Hoover's Business Directories, VentureOne,10-k filings and LexisNexis, patent data from Delphion and the National University of Singapore.

Estimation Strategy

I estimate the regressions using discrete time conditional logit as well as linear probability models with the employee entrepreneurship or mobility event as the positive outcome. Due to likely unobserved heterogeneity across firms and over time, I utilize a relatively stringent empirical approach by using the "source firm-year" combinations as the fixed-effect. Consequently, the results are based on the within firm-year. Such approach significantly simplifies estimation since all time variant firm-level controls are subsumed in the time-variant firm fixed-effect. Beyond individual level differences proxied by patenting patterns, I also control for traditional variables used in the labor literature – gender and race – and at the same time I account for the differences in the opportunity space that may vary with technological

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[5] The results remain unchanged when estimated on the sample of firms started by a single inventor-founder. The questions related to team founding are being developed as a separate project.

[6] The disproportionate omission of startups is not surprising. Many startups in the larger sample fail or are acquired at very young ages, thus reducing the likelihood of observing patent awards for these firms.

[7] As a comparison with existing literature, at the source-recipient firm dyad level (Agarwal *et al.*, 2008) the mobility rate is approximately 0.08% per dyad-year. This estimate is slightly higher than 0.05% mobility rate reported in Rosenkopf and Almeida (2003). The higher rates captured in my sample could be due to the inclusion of more recent data. As Kim and Marschke (2005) report, turnover among college educated electrical engineers has risen steadily over the past few decades. Other recent studies report mobility rates in the range of 1%-2% per inventor-year (Fallick *et al.*, 2006; Tzabbar *et al.*, 2006). On an inventor-year basis, my estimates are similar, at 1.88%.

interdependence. The sample is constructed as an unbalanced panel with the inventor-year observations.

Variable Definition

Dependent variable

I test H1 using the dependent variable *employee entrepreneurship.* This binary variable is set to 1 if the event of employee entrepreneurship follows the given employment spell in the focal year and 0 if the employee stays employed with the parent or joins a rival firm (depending on the comparison group). For H2, the dependent variable *mobility* is a binary indicator set to 1 if the given employment spell in the focal year is followed by a mobility event to a firm in the recipient sample different than the source firm and 0 if the employee stays employed with the parent. Figure 2 shows the prevalence of employee entrepreneurship and mobility events within the sample and indicates that they are strongly correlated over time.

Main explanatory variable: Technological Interdependence

To measure the interdependence of technological environment, I rely on prior studies (Fleming & Sorenson, 2001, 2004; Ganco, 2008; Sorenson *et al.,* 2006) that utilize the patent classification into subclasses to infer invention interdependence. As the NK literature shows (Kauffman, 1993, 1995; Fleming & Sorenson, 2001) the search dynamics as well as the performance on rugged landscapes is mainly driven by the ratio between the K – the number of interdependencies per component (or the number of component choices that the performance of a focal component depends on) and N – the total number of components.

The measure of interdependence K is adopted from a prior study (Ganco, 2008) which is a single-industry measure analogous to the cross-sectional measure developed by Fleming and Sorenson (2001; 2004). The measure is based on the representation of the interaction matrix from Kauffman's NK model (1993, 1995). The key idea behind the measure is that when two underlying functions (represented by patent sub-classes) are coupled we are more likely to observe components belonging to these classes in a single invention. If there is a high coupling between the functions *A* and *B* and the component *a* is classified in patent subclass *A*, $a \in A$ and *b* is in *B*, $b \in B$ (USPTO classifies patents into subclasses by their functions), then we are more likely to encounter subclasses *a* and *b* appearing on a patent together. In other words, high interdependence between *A* and *B* implies that whenever an inventor solves a problem related to one of these functions she needs to redesign or include the coupled function as well, and we are likely to observe the components optimizing these functions together in a patent. Similarly, if the patent improves the architecture of multiple functions we are likely to observe all components that correspond to these functions coupled to the architecture. On the other hand, if *A* and *B* are modular with respect to each other (have no interdependence or only interdependence through standardized interfaces), we are likely to observe *A* combined with other subclasses without *B* being present.

The measure of interdependence *K* is computed in several steps. In the first step, I tabulate co-occurrence frequencies for all subclass combinations and also create a table of occurrence frequency for each subclass. Then, by selecting entries from the tables, I compute the interdependence K_i for each focal component (subclass) of patent *l*:

$$\text{Interdependence of subclass i} \equiv K_i = \sum_{j \in l_{-i}} \frac{\text{count of patents in subclasses } i \text{ and } j}{\text{count of patents in subclass } i} \qquad [1]$$

where *j* belongs to all subclasses except *i*. The measure *K* for the patent *l* is calculated as follows:

$$\text{Interdependence of patent } l \equiv K_l = \frac{1}{\text{count of subclasses of patent } l} \sum_{i \in l} K_i \qquad [2]$$

For instance, when calculating the interdependence of the first subclass (first subclass is focal "*i*") the interdependence between the first and the third subclasses is the number of patents where the first and third subclasses appear together divided by the number of patents where only the first subclass appears.

Using the focal industry dataset to derive this measure assumes stability in the nature of interdependencies between the functional components of an innovation over time within a given industry. The variable K_i thus captures the interdependence between functions *A* and *B* in general and not interdependence that is "patent-specific". In other words, the inventions are assumed to consist of building blocks that have a certain level of interdependence associated with each pair of its functions represented by observable components. If functions *A* and *B* appear on two patents, one in the beginning of the sample (along the time dimension of the sample) and another at the end, the interdependence between them would be the same. The assumption of the stability of interdependencies between the subclasses ("building blocks") is not entirely realistic but assuming stability within an industry and at least within a certain time frame is a necessary simplification. The measure of K has the correct scaling consistent with the NK model since it is in the interval [0,*N*-1].[8]

Similar to prior studies (Fleming & Sorenson, 2001, 2004; Sorenson, Rivkin & Fleming, 2006), I operationalize the total number of components *N* by the number of patent sub-classes. I obtain the final technological interdependence measure by dividing the number of interdependencies *K* with the number of components *N*.[9] To obtain the final measure of technological interdependence for a given inventor within a given year, I average the *K/N* for all patents awarded to the inventor in the given year.

Control variables

Beyond the firm-year fixed effect all models include a set of control variables. To control for individual heterogeneity, I introduce variables capturing inventor quality or other differences that may affect the propensity to engage in employee entrepreneurship or mobility at an individual inventor level. These variables include: *Log Number of Patents, Log Number of Citations, Female, Nonwhite, Technological Proximity, Log Number of Co-inventors, Log Number of Main Classes* and *Log Years Patenting within Parent*. Table 1 describes all variables in more detail.

[8] Ganco (2008) highlights the mechanics of the measure and tests its validity.
[9] Alternatively, one could specify the model using N, K, K/N and their squared terms (Fleming & Sorenson, 2001; Ganco, 2008). However, using only K/N parsimoniously captures the effect of the full set of variables and the robustness checks showed that having a fully specified model yields identical results.

Even after controlling for individual heterogeneity, it is possible that the within firm differences in the opportunity space, both for mobility and employee entrepreneurship, vary with technological interdependence. Thus, it is necessary to rule out the possibility that unobserved availability of attractive opportunities within the industry (unrelated to under-exploitation within the parent firm and correlated with technological interdependence) drives the findings. To address this problem and control for the differences in the attractiveness of the opportunity space, I introduce attractiveness proxies - variables that rely on the firm entry and exit rates into a particular technological interdependence "segment": *Entry Rate of Firms with Similar Tech. Interdependence* and *Exit Rate of Firms with Similar Tech. Interdependence.* Table 1, again provides more detail on the variable construction. Table 2 provides bivariate correlations.

[Insert Table 1 and 2 about here]

Results

Table 3 shows the results of the regression analysis. Models 1 and 2 include only controls with employee entrepreneurship and mobility as the dependent variables, respectively. The significant coefficients on the controls indicate that female inventors and inventors with many patents are less likely to move to rival firms. Nonwhites in the industry are more likely to both move and start employee founded firms. The coefficients on the number of co-inventors and the number of main classes are negative and significant in the mobility regression suggesting that inventors embedded in collaborative networks and inventors with broader knowledge – inventor generalists –are less likely to move. After controlling for technological interdependence, the number of main classes negatively predicts employee entrepreneurship, suggesting that specialists are more likely to exit either founding firms or joining rivals. Number of years inventors patent with the parent firm is associated with higher likelihood of both mobility and employee entrepreneurship. The coefficient on the entry rate of firms with similar technological interdependence is not significant suggesting that attractive segments (those with high rate of firm entry) do not spur more employee entrepreneurship. It is possible that greater attractiveness also makes within-firm opportunities more attractive with zero net effect on employee entrepreneurship. However, the exit rate of firms with similar technological interdependence is negative and highly significant in all regressions implying that if a given technological domain is in decline employees opt for the safety of their present employment.

Models 3 and 4 add the main variable of interest – technological interdependence – and analyze the effects relative to inventors who stay within the parent firm as a comparison group. Consistent with H1, in Model 3 the coefficient on technological interdependence is positive and significant (employee entrepreneurship as the dependent variable). Consistent with H2, the coefficient on technological interdependence is negative and significant in Model 4 (mobility as the dependent variable). One standard deviation increase in technological interdependence causes the likelihood of employee entrepreneurship event to increase by 17% and mobility to decrease by 13%.

Model 7 re-estimates the relationship as conditional on exit - with employee entrepreneurship as the dependent variable and mobility as the zero outcome (comparison group). As expected, the coefficient on technological interdependence is positive and significant. Interestingly, the effect of entry rate of firms with similar technological interdependence is only marginally insignificant ($p = 0.12$) implying that in attractive environments if inventors exit they do tend to opt for employee entrepreneurship. The coefficient on the control variable Exit rate of firms with similar technological interdependence is negative and significant. This suggests that conditional on exit, in failing technological domains inventors choose employment with existing rivals relative to employee entrepreneurship.

[Insert Table 3 about here]

To test the robustness of the results, I perform several alternative estimations. First, Models 5, 6 and 8 repeat the test of H1 and H2 for both comparison groups with a residual form of the technological interdependence measure. To obtain the residual form of the measure, I first regress using fixed-effects OLS the raw measure of technological interdependence on all exogenous variables including the firm-year fixed effect. Residuals from this regression are then used as a measure of technological interdependence in the conditional logit estimation. Results in Models 5, 6 and 8 are fully consistent with the main findings while the use of the residual form of the measure slightly sharpens the estimates (smaller S.E.). To further check for robustness, in Table 4, I repeat the entire analysis using the fixed-effects linear probability model. The findings once again support conclusions of the main analysis.

[Insert Table 4 about here]

DISCUSSION AND CONCLUSION

Employee entrepreneurship is widely heralded as an important driver of innovation, firm formation and growth. Similarly, employee mobility is considered a vibrant channel for knowledge transfer. However, far less is known about how the nature of technological context affects propensity of employees to engage either in employee entrepreneurship or mobility. Assuming that employee entrepreneurship is driven by underexploited opportunities identified while working within parent firms, I investigate how technological interdependence affects propensity of inventors to engage in employee entrepreneurship and mobility. In doing so, I shed new light on a contingency that has received little empirical attention despite the fact that it relates to a large body of theoretical literature. Importantly, the study highlights that technological context has wider implications for knowledge flows and competitive patterns.

Drawing on a uniquely rich database of employee entrepreneurship and mobility events, and firm patenting in the U.S. semiconductor industry during a three-decade period, I find (consistent with H1) that the technological interdependence of inventor's prior patents positively affects the inventor's propensity to engage in employee entrepreneurship. Such finding is consistent with the view that the prevalence of underexploited opportunities increases with the technological interdependence. The inventors directly working with potentially underexploited technologies are in the best position to recognize these opportunities due to being in the appropriate "knowledge corridor" (Venkatamaran, 1997) or work context (Schoonhoven & Romanelli, 2001; Sørensen, 2007).

The results further suggest that the mobility of inventors to rival firms decreases with technological interdependence (consistent with H2). This finding supports the view that mobility is mostly driven by considerations other than the transfer of unexploited opportunities to rival firms. Although, as the theoretical argument suggests, the prevalence of valuable idle opportunities increases with the technological interdependence, the nature of such knowledge hampers its transfer and applicability within rival firms. As interdependence of inventors' prior experience increases, the potential hiring firms face difficulties in deploying the knowledge within their existing structures which translates into limited job alternatives (Lee *et al.*, 1994) and lower probability of actual mobility.

The findings of the study have important implications beyond the finding that employee entrepreneurs originate in technologically interdependent settings and mobile inventors in modular ones.

First, the results imply that it is the more general or modular knowledge that flows easily through the channel of inventor mobility to rival firms. This finding is consistent with prior studies that find that modular knowledge tends to easily diffuse (Fleming & Sorenson, 2004; Sorenson *et al.*, 2006). Nevertheless, the findings in this study suggest that the most easily assimilated knowledge within the structures of the hiring firms is not necessarily the most valuable. Hiring firms may want to accommodate inventors originating from more technologically interdependent environments to exploit potential opportunities brought in by these inventors.

Second, the analysis also suggests that the underexploited knowledge tends to flow to startups through employee entrepreneurship. This implication may partly explain the "startup phenomenon" – where startups rather than the established firms are more innovative and better performers in some settings (Christensen, 1997; Khessina, 2002, 2003; Agarwal *et al.*, 2004; Carrol & Khessina, 2005; Ganco & Agarwal, 2008). At the same time, the findings also suggest that inventors exiting to start their own firms are likely to have a more negative impact on parent firm performance than inventors exiting to join a rival. The exiting future startup founders are more likely to transfer firm-specific specialized knowledge as opposed to mobile inventors who may carry more generic modular knowledge. Such an argument has implications for parent firms that may use strategic levers to protect their intellectual property (Agarwal *et al.*, 2008) – i.e. it may be useful to protect interdependent technological knowledge even though such knowledge may be less prone to imitation by rival firms (Rivkin, 2000).

Contributions

The study makes several important contributions. Within the context of employee entrepreneurship literature (Agarwal *et al.*, 2004; Klepper, 2005; Klepper & Sleeper, 2005) the study shows that the nature of technology is an important contingency in the emergence of employee entrepreneurship. By looking at the technology at a finer-grain, the study goes beyond the results in the prior literature that firms with better technology produce more employee entrepreneurship events (Freeman, 1987; Franco & Filson, 2006).

The study contributes to the literature on employee mobility and knowledge spillovers (Almeida & Kogut, 1999; Rosenkopf & Almeida, 2003; Agarwal, Echambadi, Franco & Sarkar, 2004; Agarwal, Ganco & Ziedonis, 2008) by showing that the nature of technology may affect not only how much of the knowledge flows, but also what kind of knowledge flows and its destination.

In conclusion, my study theorized and found evidence that technological interdependence of prior activities positively affects the propensity of employee inventors to engage in employee entrepreneurship and negatively affects their likelihood of joining a rival firm. The study sheds new light on one of the important contingencies affecting entrepreneurship and mobility patterns and reveals promising pathways for continued research.

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Table 1 Variable Definition and Descriptive Statistics

Variable	*Description*	*Mean*	*S.D.*
Employee entrepreneurship	1 if the event of employee entrepreneurship follows the given employment spell and 0 otherwise. Employee entrepreneurship events that coincide with corporate venture investment or direct parent involvement are excluded.	0.002	0.045
Mobility	1 if the event of employee mobility to a within-sample firm other than the source follows the given employment spell and 0 otherwise. The mobility events that correspond to acquisition events are excluded from the sample.	0.017	0.127
Technological Interdependence	As defined in the text.	0.095	0.072
Technological Interdependence (residual form)	Residuals after regressing Technological Interdependence on all independent variables and firm-year fixed effect.	7.76e-12	0.079
Log Number of Patents	Capturing inventor "quality". Log number of valid patents the focal inventor applied for in the focal year.	0.621	0.511
Log Number of Citations	Capturing inventor "quality". Log number of citations the focal inventor received within the next 5-years for patents applied for in the focal year.	1.37	1.33
Female	Capturing gender differences in propensity to exit focal firms. 1 if the first name on the patent application sounds female, 0 otherwise.	0.024	0.152
Nonwhite	Capturing race differences in propensity to exit focal firms. 1 if the first and last names on the patent application sound as having non Anglo-Saxon origin, 0 otherwise.	0.242	0.428
Technological Proximity	Capturing how "close" is the inventor to technological core of the parent firm. Inventors who are closer may posses more valuable knowledge. Calculated as the angular distance (Jaffe, 1989) between the "technology" vectors of focal inventor and all other inventors in the parent firm in the focal year.	0.358	0.279
Log Number of Co-inventors	Capturing extent of collaboration with others. Log of the average number of patent co-inventors at the parent firm in a given year.	0.701	0.641
Log Number of Main Classes	Captures technological breadth or generalization vs. specialization. Log of the average number of patent main classes for the focal inventor in the focal year.	0.914	0.258
Log Years Patenting within Parent	Captures experience. Calculated as the difference between the focal year minus the application year of the first patent within the given parent firm plus one.	1.29	0.617
Entry Rate of Firms with Similar Tech. Interdependence	Captures attractiveness of the focal technology domain. The technological interdependence variable is split into 10 equally-sized bins. The measure is then calculated as the firm entry rate within the same bin as the focal inventor in the focal year.	0.182	0.151
Exit Rate of Firms with Similar Tech. Interdependence	Captures default risk of the focal technology domain. The technological interdependence variable is split into 10 equally-sized bins. The measure is then calculated as the firm exit rate within the same bin as the focal inventor in the focal year. Only actual bankruptcies are considered as exits.	0.015	0.061

Table 2 Correlations

	1)	*2)*	*3)*	*4)*	*5)*	*6)*	*7)*	*8)*	*9)*	*10)*	*11)*	*12)*	*13)*
1) Employee entrepreneurship	1												
2) Mobility	-0.0045	1											
3) Technological Interdependence	0.0036	-0.0154	1										
4) Technological Interdependence (residual form)	0.0083	-0.0123	0.9311	1									
5) Log Number of Patents	-0.0003	-0.0332	0.0195	0	1								
6) Log Number of Citations	0.0028	0.0039	0.0637	0	0.4989	1							
7) Female	-0.0054	-0.0144	0.007	0	-0.0301	-0.0158	1						
8) Nonwhite	0.0144	0.0247	-0.0015	0	0.0111	0.0001	-0.0583	1					
9) Technological Proximity	0.0061	0.0006	-0.0314	0	0.3199	0.2479	0.0036	0.0593	1				
10) Log Average Number of Co-inventors	0.0015	-0.0443	0.0454	0	0.1181	0.1367	0.0451	0.0411	0.1162	1			
11) Log Average Number of Main Classes	-0.0068	-0.0087	-0.0882	0	-0.0179	0.0437	0.0043	-0.0541	-0.0051	-0.0297	1		
12) Log Number of Years Patenting within Parent	0.0169	-0.0021	0.0441	0	0.2151	0.091	-0.0416	-0.0478	0.0913	0.0115	-0.0303	1	
13) Entry Rate for Firms Entering with Similar Tech. Interdependence	-0.0047	-0.0044	-0.058	0	-0.0813	-0.0934	-0.001	-0.0382	-0.0649	-0.0289	0.0246	-0.0561	1
14) Exit Rate for Firms Entering with Similar Tech. Interdependence	-0.008	-0.0094	-0.0418	0	-0.0342	-0.0944	-0.0003	0.0035	0.0026	0.0106	0.0025	0.0074	-0.1216

Table 3 Conditional Fixed-Effects Logit

	Employee entrepreneurship or Mobility relative to Staying						Employee entrepreneurship relative to Mobility	
	Controls Only		Main Model		Residual Form of Tech. Int.		Main Model	Residual Form of Tech. Int.
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Dependent Variable (Positive outcome)	Employee entrepreneurship	Mobility	Employee entrepreneurship	Mobility	Employee entrepreneurship	Mobility	Employee entrepreneurship	
(Zero outcome)	Staying within Parent						Mobility	
Technological Interdependence			**2.130****	**-1.296*****	**2.129****	**-1.295*****	**4.613****	**4.612****
Log Number of Patents	-0.232	-0.217**	-0.594**	-0.589***	-0.609**	-0.580***	0.251	0.218
Log Number of Citations	0.046	-0.056	0.107	-0.027	0.124	-0.037	0.123	0.159
Female	-0.656	-0.523***	-0.651	-0.573***	-0.643	-0.579***	-0.983	-0.964
Nonwhite	0.417**	0.367***	0.384*	0.348***	0.386*	0.347***	0.144	0.148
Technological Proximity	0.185	0.045	0.438	0.103	0.384	0.136	0.242	0.127
Log Number of Co-inventors	-0.106	-0.319***	-0.085	-0.305***	-0.072	-0.313***	0.269	0.298
Log Number of Main Classes	-0.486	-0.227*	-0.677*	-0.368***	-0.749*	-0.324**	-0.237	-0.392
Log Years Patenting within Parent	0.909***	0.224***	0.853***	0.246***	0.863***	0.240***	1.022***	1.043***
Entry Rate of Firms with Similar Tech. Interdependence	-0.929	-0.222	-0.575	-0.268	-0.652	-0.221	1.686	1.519
Exit Rate of Firms with Similar Tech. Interdependence	-11.916**	-0.504	-10.631**	-0.707	-10.806**	-0.601	-15.109**	-15.489**
Constant								
Fixed Effect	Firm-year	Firm-year	Firm-year	Firm-year	Firm-year	Firm-year	Firm-year	Firm-year
Pseudo R-square	0.043	0.012	0.047	0.016	0.047	0.016	0.131	0.131
χ^2	60	162	50	294	50	294	187	187
p-value	0	0	0	0	0	0	0	0
Log Likelihood	-450	-3353	-423	-3158	-423	-3158	-103	-103
N	14396	36745	13310	34359	13310	34359	345	345

* p<.1, ** p<.05, *** p<.01

Table 4 Fixed-Effects Linear Probability Model

	Employee entrepreneurship or Mobility relative to Staying						Employee entrepreneurship relative to Mobility	
	Controls Only		Main Model		Residual Form of Tech. Int.		Main Model	Residual Form of Tech. Int.
	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16
Dependent Variable (Positive outcome)	Employee entrepreneurship	Mobility	Employee entrepreneurship	Mobility	Employee entrepreneurship	Mobility	Employee entrepreneurship	
(Zero outcome)	Staying within Parent						Mobility	
Technological Interdependence			**0.005****	**-0.022*****	**0.005****	**-0.022*****	**0.394*****	**0.394*****
Log Number of Patents	0.00	-0.003	-0.001**	-0.007***	-0.001**	-0.007***	0.057	0.054
Log Number of Citations	0.00	-0.001	0.00	-0.001	0.00	-0.001	0.002	0.005
Female	-0.001	-0.006**	-0.001	-0.006***	-0.001	-0.007***	-0.032	-0.031
Nonwhite	0.001*	0.008***	0.001*	0.007***	0.001*	0.007***	0.017	0.017
Technological Proximity	0.00	0.001	0.00	0.001	0.00	0.002	0.024	0.014
Log Number of Co-inventors	0.00	-0.006***	0.00	-0.006***	0.00	-0.006***	0.021	0.023
Log Number of Main Classes	-0.001	-0.004*	-0.001	-0.007***	-0.002*	-0.007**	-0.049	-0.062*
Log Years Patenting within Parent	0.002***	0.004***	0.002***	0.005***	0.002***	0.005***	0.071***	0.073***
Entry Rate of Firms with Similar Tech. Interdependence	-0.001	-0.004	-0.001	-0.005	-0.001	-0.005	0.128	0.113
Exit Rate of Firms with Similar Tech. Interdependence	-0.007**	-0.006	-0.007**	-0.008	-0.007***	-0.006	-0.146*	-0.178**
Constant	0.002	0.031***	0.002*	0.039***	0.002**	0.036***	-0.076	-0.029
Fixed Effect	Firm-year	Firm-year	Firm-year	Firm-year	Firm-year	Firm-year	Firm-year	Firm-year
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N	46549	47482	43818	44713	43818	44713	1116	1116

* p<.1, ** p<.05, *** p<.01

Figure 1
Visualization of an Interdependent Technological Problem

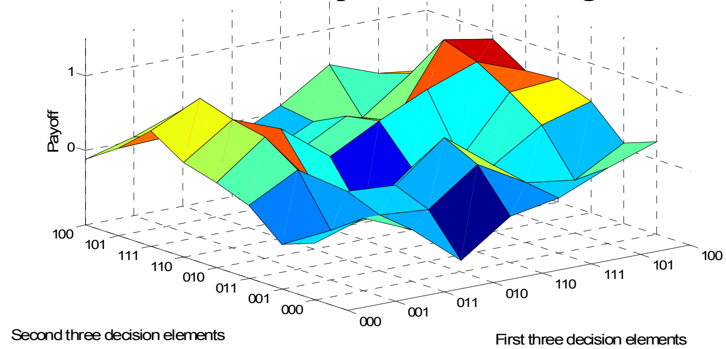

Figure 2
Within-sample Employee Entrepreneurship and Mobility Events, 1973-2003