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Knowledge Spillovers on the Product Innovation Activities
of New Ventures**

by

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on the Product Innovation Activities of New Ventures**

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ABSTRACT

Geographic clusters have an impressive track record for producing innovative firms. In this research, we examine whether a geographic cluster location and the knowledge spillovers new ventures assimilate influence both their explorative and exploitative innovation activities. We hypothesize a stronger relationship of industry clustering on exploitative innovations but a stronger relationship of knowledge spillovers on explorative innovations. We expect the interaction will result in more exploitative innovations than explorative innovations. The data support most hypotheses.

The Influence of Geographic Clusters and Knowledge Spillovers on the Product Innovation Activities of New Ventures

Geographic cluster locations have developed a well-documented track record for affecting firm's innovative capabilities (e.g. Baptista & Swann, 1998; Bell, 2005; Deeds, Decarolis & Coombs, 1997; Feldman & Florida, 1994; Porter & Stern, 2001). One explanation given for the stronger innovative behavior of clustered firms is the competitive rivalry that cluster firms face (Porter, 1998). High levels of competition force firms to innovate to remain competitive in their technological and geographic space. Since firms rarely directly imitate the technologies of other local firms (Zander & Kogut, 1995), the industry competition in the local area may generate innovative new product behavior. New firms operating from cluster locations have also been found to offer products in niches which incumbents do not explore (Almeida & Kogut, 1997). This finding may further suggest that industry clustering influences encourages new product exploration (Crossan, Lane & White, 1999). For many firms, however, it is difficult to consistently engage in explorative innovation, or innovations deriving from the creation or application of novel knowledge, because explorative innovations draw upon competencies that are unique and oftentimes new to the firm. Explorative innovations typically involve long development times, high uncertainty, and require large capital investments by the firms. Yet, in spite of the constraints they place on the firm's resources, explorative innovations have potential to add high economic value to firms employing this form of innovation (March, 1991).

For many firms, however, the value of explorative innovations is only fully maximized when investments are made into exploitative innovation activities, which involve the incremental enhancements and refinements to the existing product lines a firm has developed (Holmqvist, 2004). Exploitative innovations are important because they typically require less time, fewer resources, involve less uncertainty, and provide financial returns that are more certain and closer in time than explorative innovations. Consequently, exploitative innovations are often necessary for continued success of the firm (Banbury & Mitchell, 1995). However, the contribution of exploitative innovations to economic gain tends to be less than what is true for explorative innovations. Moreover, too much emphasis on exploitative innovations can lead to inertia, myopic learning, outdated capabilities, and even failure of the firm (Sorensen & Stuart, 2000). Balancing explorative and exploitative innovation activities is an important strategic objective for managers of innovating firms, yet research has shown that the industry clustering in a firm's geographic location disrupts the balance firms could achieve.

We believe there are strong arguments why the industry clustering in a geographic region should actually influence the exploitative innovations more than the explorative innovations. This relationship, however, has not been previously explored in prior research. The absence of attention given to this issue is likely due to the fact that most studies examining geographic cluster firms relied upon the biotechnology industry. For biotechnology firms, explorative innovations are the bloodline of the business so new product innovations are of the gravest concern. In many other industries, however, explorative and exploitative forms of innovation are important for the ultimate performance of the firms (He and Wong 2004; Schoonhoven et al., 1990; Henderson, 1999). With this research we intend to investigate this gap in the literature regarding the potential influence of industry clustering on both forms of product innovation. Specifically, this research examines the influence of industry clustering within a geographic region on the product innovation behavior of high-technology new ventures. We use a sample of high-technology new ventures that undertook an initial public offering (IPO) as they are most likely to still be establishing their innovative capabilities, yet still have a great need to offer new innovative solutions to the market. For this group of firms, the influence of geographic location on their product innovation activities could be more important than for other populations of firms (Shaver & Flyer, 2000).

We also focus on the knowledge spillovers firms receive as an additional factor likely influencing the innovative capabilities of the firms. Knowledge spillovers are another commonly attributed cause of higher innovative activity within geographic cluster regions that we believe also has the potential to differentially influence product innovation activities. This investigation, therefore, will enable us to develop an understanding of the independent contributions knowledge spillovers and industry clustering make to firm product innovations. Our theoretical development begins with an understanding of the nature of geographic cluster regions and presents the corresponding hypotheses for the expected influence of industry clustering within the ventures' geographic regions on its product innovation activities. We then continue with the arguments predicting the expected relationship of knowledge spillovers to product innovations, and the joint effect of knowledge spillovers and industry clustering on product innovation. The latter sections of the paper explain our sample, analytical techniques, results and the discussion of their meaning.

This study makes two important contributions to the field. First, by examining innovation along the explorative and exploitative dimensions, this study will enable us to uncover whether the higher innovative output of cluster firms is attributed to exploitative innovations, explorative innovations, or a combination of both. Second, whereas extant research makes the presumption that knowledge spillovers contribute to the greater new product innovation performance of geographic cluster firms but with little empirical validation, the theoretical and empirical development in this paper will enable us to explicate the independent and joint roles of industry clustering and knowledge spillovers in the firm's geographic region on a firm's total product innovation performance.

Geographic Clusters and Firm Innovations

A geographic cluster is a geographic region where there are higher concentrations of industry activity located in close proximity across geographic space. In contrast to industry agglomerations, which are locations with concentrations of a given industry sector, geographic clusters encompass the concentration of a "geographically proximate group of interconnected companies, suppliers, service providers and associated institutions in a particular field, linked by externalities of various types" (Porter, 2003: 562). Geographic cluster regions are known to provide access to human resources with industry-specific skills, specialized service providers, knowledge spillovers, and financial capital (Porter, 1998; Saxenian, 1990), each of which is a resource that is regarded as essential for the innovation process (Abernathy & Clark, 1985). The recognition that many of the resources that are needed for innovation are available within geographic cluster regions has made innovation activity one of the most commonly assessed outcomes of geographic cluster firm performance (e.g. Bell, 2005; Decarolis and Deeds, 1999; Deeds et al., 1997). The results from cluster firm performance studies confirm that cluster firms tend to introduce more new products to market than other firms (e.g. Baptista and swann, 1998; Decarolis and Deeds, 1999). This hypothesis, however, has mostly been tested on firms from industries for which new products are the primary innovative thrusts. Consequently, there is little that is known about how industry clustering might influence the exploitative innovation activities of firms operating from industries for which exploitative innovations are important.

For firms operating from such industries, there are several reasons why industry clustering should influence both forms of innovation, but is likely to have a stronger influence on exploitative innovations. Foremost theories of cluster research emphasize that competitive dynamics of clusters induce innovation by elevating firm motivation (Porter and Stern, 2001). Competitive rivalry due to resource commonality, visibility, and psychological comparisons among competitors perpetuate a self-reinforcing cycle of innovation as firms intensify their innovative efforts in response to competitors' new product launches. The necessity for a venture to innovate for legitimacy and competitiveness increases as competitors release more innovations (Abrahamson and Rosenkopf, 1993). The desire to meet the innovation pressures may push managers and scientists within cluster regions to rely more upon innovations that have

lower levels of uncertainty and shorter development times, rather than innovations that have greater uncertainty and longer development times.

Geographic clusters are also known to provide new firms with access to sophisticated customers in the region (Saxenian, 1990; Chung & Kalnins, 2001). Sophisticated customers often have demanding tastes which can foster new innovation opportunities for supplier firms (Porter, 1998). Frequent interactions with customers and suppliers can improve a firm's problem-solving capabilities, which can lead to higher levels of innovation activity (Brown & Eisenhardt, 1995). Extant research confirms that cluster firms produce a higher number of patented technologies than firms in other locations (Audretsch, 1998; Porter, 2003). Patented technologies are an interesting measure of performance because they must be different from existing patented products for the patent to be awarded. This finding may further suggest that cluster firm activities are more focused on unique, explorative innovations. The feedback from local suppliers and customers, however, oftentimes relates to current product or service offerings. For new ventures, which tend to have limited resources and a high dependency upon their customer base for survival, the need to resolve the concerns of existing customers or suppliers may escalate the tendency for these firms to innovate around their existing product lines. Moreover, since customers that attend to existing customers are more constrained in their ability to pursue more explorative innovations (Christensen, 1997; Daneels, 2003), we fully expect that the customer pressures combined with the more limited resources the firms hold, would push cluster firms to innovate around their existing product lines to a greater extent than pursue new product endeavors.

H1: Industry clustering will positively influence explorative and exploitative innovations,
but will have a stronger positive relationship with exploitative innovations than with explorative innovations.

Knowledge Spillovers and Firm Innovations

The external knowledge firms assimilate is one key factor that influences their innovation success (Cohen & Levinthal, 1990; Keeble & Wilkinson, 1999). A higher level of knowledge spillover assimilation is one of the primary factors believed to enable firms in cluster regions to establish and maintain an innovative edge. Knowledge spillovers provide technological information, competitor information, market trends, operating or management procedures, or other industry trends to receiving firms (Brown & Duguid, 2000). A transfer of knowledge can occur through a variety of mechanisms such as industry networks and firms (Harhoff, 1996), conferences or trade publications (Appleyard, 1996), firm deaths and births (Pinch & Henry, 1999), or simply when people interact (Fallah and Ibrahim, 2004). In spite of these various ways through which transmission can occur, spillovers are thought to occur more regularly when employees interact formally or informally with employees of other firms (Acs et al., 1994; Baum and Ingram, 1998; Audrestch and Feldman, 1996). Even still, there are limits to the type of knowledge that can be exchanged through informal interactions. Knowledge that is tacit requires that individuals engage in close and frequent interactions (Nonaka, 1994). For this reason, tacit knowledge is believed to remain within a limited geographic region until the knowledge becomes codified and gains greater mobility (Jaffe et al, 1993; Anselin et al., 2001). During the initial development of innovations, the firms within an innovating firm's geographic location are the likely recipients tacit knowledge spillovers.

Although operating from a location with high concentrations of industry clustering increases the potential firms have to receive spillovers from other firms within their industry (Glaeser, Kallal, Scheinkman & Shleifer, 1992), the transmission of spillovers can occur in any location where public or private sector innovation exists (Anselin, Varga & Acs, 2001; Feser, 2002). Knowledge spillovers, therefore, simply require the presence of innovation activities

within the region making it important to understand how knowledge spillovers may influence receiving firm's innovations. Bairoch (1988) found that in regions where diverse industry activity exists firms located in those regions often applied technological solutions adopted in complementary industry sectors into their technological endeavors. Spillovers originating from within or outside a given firm's industry are likely to create knowledge diversity which enables firms to develop more innovative product solutions (Hargadon & Sutton, 1997) and offer products that fill unique market niches (Almeida & Kogut, 1997). Research has confirmed that firm innovation outputs are influenced by the local knowledge spillovers firms receive (Almeida, 1996; Birkinshaw and Hood, 2000; Frost, 2001). This stream of research, however, has also only examined the influence of spillovers on new products the firms have introduced making it difficult to conclusively determine how knowledge spillovers may affect a firm's full product innovation activities.

Like industry clustering, knowledge spillovers have properties which make them potentially useful for explorative or exploitative innovations. For example, the incorporation of knowledge about other local firm's technological activities reflects learning on the part of the receiving firm (Almeida, 1996). Learning enhances the quality and quantity of firm innovations (Harhoff, 1996) and other key outcomes (Wallsten, 2001), and enables firms to align their technologies with current trends (Brown and Duguid, 2000) at reduced costs (De Fraja, 1993). Knowledge spillovers, therefore, can be particularly useful for helping firms strengthen their existing products and technologies. But when observing knowledge spillovers through patent citations to other local firms, however, (e.g. Almeida, 1996; Jaffe et al., 1993; Frost, 2001), which is the operationalization for knowledge spillovers that is commonly employed, knowledge spillovers reflect the latest innovation activities of public institutions or private firms in the firm's local area (Feser, 2002). These spillovers likely represent cutting edge innovations that bring new and potentially diverse knowledge to the firm's operations, particularly for firms in locations with diverse industry representation rather than homogenous industry representation (Jacobs, 1969). Since knowledge diversity leads to more creative innovation solutions (Hargadon & Sutton, 1997), we would expect to find evidence that spillovers from local firms should correlate highly with explorative innovations, but less so with exploitative innovations. With one exception, which we'll discuss in greater detail below, a firm assimilating local knowledge spillovers into its operations should be well positioned to combine and reconfigure existing knowledge with newly acquired knowledge (Nonaka, 1994), with new innovations being the result.

H2: Knowledge spillovers will positively influence explorative and exploitative innovations, but will have a stronger positive relationship with explorative innovations than with exploitative innovations.

Joint Effect of Industry Clustering and Knowledge Spillovers on Product Innovations

We recognize that the type of knowledge a firm assimilates will largely depend upon the firm's ability to (1) recognize the relevance of the knowledge and (2) assimilate the new knowledge into its current operations (Cohen and Levinthal, 1990). In other words, we acknowledge the greater ease with which a firm evaluates and internalizes knowledge when the knowledge is similar to the technological competency of the receiving firm (Stuart, 1998; Cohen and Levinthal, 1990). It is this similarity of technological competencies held by cluster firms, combined with the competitive pressures from the cluster location, which may generate negative consequences for the type of knowledge firms assimilate, and how that knowledge is incorporated into their product innovations. Within clusters, the innovation activities occurring in public institutions or private firms within a cluster region are likely to be related to the technologies of the local industries (Bresnahan, Gamberdella & Saxenian, 2001). The knowledge spillovers firms receive from this local area may be technologically proximate to a

focal firm's technologies (Rosenkopf & Nerkar, 2001). This similarity would make it easier for a cluster firm to assimilate knowledge received from another cluster firm into existing product lines. Because firms embed the behaviors which have been effective in the past into the routines of the organization (Crossan et al., 1999), once established, firms naturally become less likely to deviate from their routines (Sorenson and Stuart, 2000), which can limit the the range of learning that could occur within the firm.

Since spillovers within clusters are likely to occur when employees move between firms in the region (Audretsch, 1998; Almeida and Kogut, 1999; De Noble and Galbraith, 1992), there is an increased propensity for managers and scientists to develop a shared cognitive framework that leads to similar perceptions, biases, and heuristics (Schwenk, 1988; Sull, 2001). As a consequence, we would expect cluster firms to filter new knowledge through their current understanding of the technology or industry, leaving behind information which deviates substantially from what they currently know (Sull, 2001). Within clusters, therefore, knowledge spillovers may have a stronger relationship with exploitative innovation activities of the firms than would be true of spillovers in locations with less industry clustering. Knowledge spillovers within a cluster may also foster exploitative innovations more than explorative innovations because the prevalence of knowledge spillovers within cluster regions makes it difficult for firms to appropriate value from their innovations (Beal, 2001). Cluster firms may experience reduced motivation to engage in cutting edge innovation activities when it is evident that their ability to protect new innovations generated within the cluster may be limited. As a consequence, cluster firms may focus on refining the performance of existing product lines rather than exploring new technological endeavors.

Firms operating from cluster regions that assimilate less knowledge from other local firms may not be as similarly entrenched in the cognitive frameworks of the cluster environment. Such firms may have a greater ability to incorporate new knowledge into diverse applications. Similarly, firms operating from locations where less industry clustering exists may have greater motivation and willingness to assimilate diverse knowledge into their operations in order to remain connected to new innovations being introduced. For these firms we would expect that high levels of local knowledge spillovers may be more likely to be incorporated into explorative innovations than into exploitative innovations. These arguments suggest that the combination of higher levels of industry clustering in the venture's geographic region and the receipt of high levels of local knowledge spillovers may elevate the level of exploitative activities in which cluster firms engage, while concomitantly constraining the level of explorative innovations the firms produce. As a consequence, firms that possess these attributes may be more likely to favor exploitative innovation activities over explorative innovation activities.

H3: High industry clustering and high knowledge spillover assimilation will have a stronger positive relationship with exploitative innovations than explorative innovations.

METHODOLOGY

Sample

To test the hypotheses advanced in this study, we selected a sample of software-related initial public offering (IPO) new ventures. Software new ventures are attractive for consideration because they engaging in higher levels of product innovation activities. In fact, Cottrell and Nault (2004: 1005) acknowledged that software firms exhibit innovative flexibility in "offering products over different computing platforms ... [introducing] new products into old or new categories and for old and new platforms, and ...[extending] existing products into new categories or for new platforms." We also found the software industry to be attractive because it exhibits an attractive blend of geographic concentration within a few U.S. locations, while also exhibiting geographic presence in locations with very limited concentrations of industry

clustering. This characteristic of the industry is particularly important as we desire to have ventures operating from both locations with higher and lower levels of industry clustering.

Our use of IPO firms is equally important as it ensures our sample is comprised of performance-oriented firms (Gimeno-Gascon, Folta, Cooper & Woo, 1997). IPO firms have pressures to be innovative before and after IPO to attract and retain investor attention. By using this sample of firms, we are able to obtain a sample of firms active in both forms of product innovation activities that are also located in various geographic regions across the U.S. Two concerns associated with using this sample of firms, however, is that the results will neither generalize to smaller, privately-held firms nor to ventures that are less innovative in nature. Even still, we believe there are many insights that can be gained from using this sample of firms that are applicable to firms operating from industries with similar characteristics. The ventures selected for the sample primarily operate in the computer programming (Sic7370-7371), prepackaged software (SIC 7372) or systems design and integration (SIC7373) industry sectors. Due to data availability, we limit the IPO years to 1996-2000, and founding years to 1990-2000. However, no venture exceeded eight years of age at the time it undertook its IPO (Biggdike, 1976), and each of the 128 ventures in our sample had two years of product innovation data available for analyses.

Data Collection and Variable Operationalization

We use an archival methodology to gather data for each of the variables operationalized. Firms were identified through the Securities Data Corporation (SDC) Platinum New Issues database and matched to the Compustat Financial database, where their financial data and control variables data were drawn. Detailed information on the operationalizations of our dependent, independent, interactive, and control variables is provided below.

Dependent Variables

Following prior research, we operationalize a firm's explorative innovations as its new products introduced (Crossan et al., 1999), and its exploitative innovations as the refinements and improvements to existing product offerings (Holmqvist, 2004). We use these operationalizations rather than objective comparisons of the innovativeness of the firm's products relative to other products in the industry (e.g. Banbury & Mitchell, 1995; Cottrell & Nault, 2004) because new firms commonly introduce products in niches that incumbent firms do not explore (Almeida & Kogut, 1997), making objective comparisons to other firms products difficult. Product introduction information was obtained from press releases stored in the Lexis-Nexis academic database. New products were identified through verbiage indicating the product is a new addition to the venture's product line or the product version designation is 1.0 (Beal, 2001). We count all new products introduced during the two immediate calendar years after the venture undertook its IPO. Product enhancements are the count of existing products for which subsequent versions were created during the same two year time period. We identified these products through verbiage indicating the product is a change to an existing product or the product version designation is greater than 1.0 (Beal, 2001).²

Independent Variables

The *Industry clustering* variable we use is a location quotient measure, which reflects the extent to which the Information Technology industry cluster is overly, similarly, or under-represented in the venture's metropolitan statistical area (MSA)³. The Cluster Mapping Project

² To construct these variables, each firm's prospectus was analyzed and a list of products introduced by the firm as of the time of IPO was prepared. Lexis-Nexis was used to identify other products introduced during the year of IPO. This list was then compared to the data gathered on new and enhanced product innovations gathered from the press releases for the two years post IPO. Products not listed in the firm's prospectus, or in the list of product releases from the year of IPO, but announced during the two years after IPO were categorized as "new" products. Products listed in the prospectus or announced during the year of IPO, that also received announcements during the two years after IPO were categorized as enhancements.

³ MSA's reflect the traditional political, economic and social integration of a region and is the most commonly used operationalization of communities (Marquis, 2003).

of the Institute for Strategy and Competitiveness at the Harvard Business School defines a cluster as interdependent industries which are co-located across geographic space. It determines interdependence by correlating employment levels across industries. Industries with high correlations are grouped together as a cluster and the employment level for that cluster of industries within a geographic region is determined⁴. The measure used in this study reflects the proportion of information technology cluster employment in the venture's MSA relative to the proportion of information technology cluster employment in the U.S.⁵ To ensure our measure of clustering temporally precedes our knowledge spillovers value, we determine the industry clustering quotient for the year in which the venture was founded.

Consistent with other studies (e.g. Frost, 2001; Jaffe et al., 1993), we utilize patent citations to operationalize *knowledge spillovers*. Our measure is a proportion variable which reflects the extent to which knowledge spillovers assimilated into a firm's innovations came from the local area in which the firm operates. Since Anselin et al. (2001) found that knowledge typically flowed within a 50 mile radius of the innovating firm, a citation to another firm is considered "local" if the firm operates within the same economic area as the citing venture. An economic area consists of adjacent metropolitan statistical areas and counties not assigned to a metropolitan statistical area which are economically interdependent upon one another. The Bureau of Economic Analysis division of the U.S. Department of Commerce defines these regions based on commuting data from the decennial population census, newspaper circulation data and statistical areas defined by the Office of Management and Budget. More plainly stated, these regions are close enough in proximity that it is common for individuals to move between them regularly on a daily basis. We feel this operationalization better reflects the geographic boundaries across which knowledge could realistically flow.

We use all of the venture's patents awarded to it from founding through the second year after IPO. However, we only count the citations made to patents that were filed within four years of the filed date of the venture's patent application. Our rationale for this cut-off point is the pace of change within technological industries results in new technological generations emerging within approximately three years (Timmons, 1997). Since most of the citations are between two and six years of the venture's filing date, and knowledge is reported to lose its economic value within five years (Griliches, 1979; 1984), we deemed a four-year time period long enough to ensure the firm had opportunity to assimilate knowledge into its operations that was not widely available to firms in more distant locations (Jaffe et al., 1993). This time period also ensures that the knowledge may still be of economic value to the firm. Patent data are sourced from the U.S. Patent and Trade Office database.

A growing number of software firms are patenting their technologies (McQueen & Olsson, 2003). In this sample, 60% of the ventures had patented their innovations. As operationalized, the knowledge spillovers value for these firms would have been zero. Likewise, firms patenting their technologies but without citations to firms in their local areas would receive a zero for their knowledge spillovers value. To distinguish between firms that don't patent and those that do but don't rely upon the technologies of other firms in the local area, we included a dummy variable of '1' to a firm's proportion of knowledge deriving from the local area. Those without local spillovers, therefore, have a value of '1.0' while those receiving local spillovers have a value equal to '1.0' plus the proportion value.

Interaction Variable

In addition to a direct effect of independent variables on the dependent variables, our hypotheses include an interaction effect between our two independent variables. The interaction

⁴Porter (2003) provides a description of industry sectors comprising industry clusters. This information can also be found on the Cluster Mapping Project website, maintained by the Institute for Strategy and Competitiveness at the Harvard Business School – www.isc.hbs.edu.

⁵ The formula used is $(IT \text{ Clustering in MSA} / \text{Total Employment in MSA}) / (IT \text{ Clustering in U.S.} / \text{Total Employment in U.S.})$.

term is the multiplicative of the knowledge spillovers and industry clustering variables, each mean-centered before multiplication (Aiken and West, 1991).

Control Variables

We include controls for several variables whose relationship with both the independent and dependent variables in our model could influence the results. *Age* measured at the time of IPO is included to account for the fact that older firms have greater potential to enlarge their portfolio of products. Older firms may be more inclined to filter the knowledge they receive through a biased lens, which may influence their orientation towards product enhancement activities (Sorenson and Stuart, 2000). To account for the fact that the greater level of resources within clusters could result in cluster firms being larger and, therefore, more capable of initiating and executing product development activities, we control for the *size* of the firm as of the year of IPO. Since knowledge spillovers are argued to be transferred through mobile employees (Almeida and Kogut, 1999), we use the number of employees as of the year of IPO as our measure of size.

Because we are measuring the performance of these firms after they undertook their IPO, we include a control for the innovative capabilities the firms may have developed, which naturally would influence their innovation performance. We use the *R&D expenditures* to determine the financial commitment the ventures were making towards their innovation objectives. We use the number of alliances the ventures established prior to and inclusive of the year of IPO to reflect the attractiveness of the venture and its products to other firms. We attempted to use the number of patents the ventures received as a third indicator of venture innovation capability. This measure, however, was not significant in any of the models, and, therefore, was excluded from consideration.

Our final set of control variables enable us to partial out differences due to the markets in which the firms competed and the conditions in the economic environment during the time period when the performance measures were drawn. Software firms can produce a variety of products/ services that are sold into various markets. The markets from which these ventures operate include the e-commerce, web portals and online communities, information management systems, information technology services, custom software development, internet service provider, and internet other, and a general other category⁶. Descriptions of each of these markets and the firms that operate from them are provided in the appendix. To minimize the number of market controls utilized, we ran tests to determine whether results differed significantly across each of the industry sectors. We found only the internet service providers, other, and information technology services to differ significantly from the other market sectors. Moreover, ecommerce, web portals and online communities and information management systems firms were not significantly different from one another in their innovation performance. Subsequently, these three markets were combined into one dummy variable. Similarly, internet other and custom software development firms did not differ from one another and were also collapsed into one dummy variable. The “other” market variable serves as the reference category in all analyses. Dummy variables representing each year of IPO are also used with the year 1996 as the reference category in the analyses.

Analyses

Before running the analyses, we tested all variables for outliers and found that outliers were present in each of our independent and dependent variables. To delete all firms with outlying values would have resulted in a reduction in sample size by 35 ventures. To avoid limiting the size of our sample we winsorized the outlying values to rescale them to the top

⁶ We used software industry market definitions provided by The Gale Group to categorize the firms into their respective markets. We provided descriptions of each market to two graduate students along with descriptions of the firm’s activities as taken from their prospectus. There was 90% congruence across the two coding schemas. The discrepancies for the remaining 10% were resolved by the first author, who read over descriptions for each of the 13 and classified them as appropriate.

percentile of values within the sample. We use negative binomial regression to test the product innovation models because it relaxes the constraint of equal mean and variance required for Poisson regression analyses. Because our dependent variables are tested on the same set of independent variables and firms, we employ seemingly unrelated estimation (SUEST) techniques to jointly estimate the variables across two dependent variables. This procedure ensures the standard errors are adjusted to account for the fact that the innovation activities were occurring simultaneously and, therefore, the error terms needed to be adjusted given the test of the models on the same sample. We also employ the SUEST procedure because it creates a joint estimation that enables us to analyze the estimates with post-hoc non-linear Wald tests to determine whether the independent variables differentially affect the two dependent variables. We run all analyses in Stata 8.1.

Results

Table 1 provides descriptive statistics of the average knowledge spillovers, new products, and enhanced products introduced by the ventures in locations with varying levels of industry clustering. The Table shows that firms at lower levels of industry clustering averaged fewer spillovers from their local area, but confirmed that firms operating from locations with lower levels of industry clustering still received knowledge from their local area. In fact, one firm whose location had slightly more IT representation than what exists in the U.S. as a whole, made 100% of its citations to firms in its local area (spillovers value of 2.0 encompasses a ‘1.0’ value for its proportion of knowledge from local firms and a ‘1.0’ value indicating a patenting firm). At higher levels of industry clustering, the largest spillovers values are 55% and 53% respectively for ventures in locations with greater than 2 times the IT industry clustering representation in its location. Also of importance to note is that during the time period of this study, although firms operating from locations with the highest concentrations of industry clustering introduced the most new products to market and enhanced the most products as well, there were no differences in the maximum number of new products introduced by firms operating across the four types of geographic regions. Table 2 provides correlations, means and standard deviations for all independent variables analyzed in this study.

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Table 3 presents the results of the negative binomial regressions run to test hypotheses 1-3. Model 1 provides the estimates for the control variables for each form of product innovation analyzed. To test Hypothesis 1, which predicted a stronger effect of industry clustering on exploitative (enhanced) innovations than on explorative (new) product innovations, we use the estimates from Model 2. Model 2 enables us to assess the effect exclusive of any measured influence of knowledge spillovers. The results indicate that industry clustering is positively related to both forms of product innovation, but only significantly related to product enhancements. The non-linear Wald test reveals the difference in effect is moderately significant ($p < .10$), lending moderate support for Hypothesis 1. Figure 1 provides a pictorial representation of the relationship between industry clustering and product innovation. As expected, it clearly indicates an increasing trend for firms at higher levels of industry clustering to be engaging in higher levels of exploitation activities than firms at lower levels of industry clustering. The exploration innovation activity did not differ significantly based on the industry clustering in the venture’s location.

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Hypothesis 2 predicted a stronger effect of knowledge spillovers on explorative than on exploitative innovations. We use Model 3 to test this relationship as it reflects the influence of knowledge spillovers exclusive of industry clustering. Model 3 reports a moderately significant

positive relationship between knowledge spillovers and both forms of product innovations. In fact, the estimates are exactly the same and as the non-linear Wald test confirms, not significantly different from one another. We find some support for the positive effect of spillovers on both forms of innovations that Hypothesis 2 predicts, but no support for the differential effect of spillovers on explorative innovations.

With Hypothesis 3, we expected to find that the relationship between industry clustering and product innovations would differ depending on the level of spillovers assimilated into the firm's operation. As Model 4 indicates, the interaction term is negative and significant for explorative innovations. For exploitative innovations, on the other hand, the interaction term is positive but not significant. The non-linear Wald-test reveals that the relationship is highly significantly different ($P=.001$). As Figure 2 confirms, the interactive effect of high clustering and high knowledge spillovers influences exploitative innovations to a greater extent than explorative innovations, with the relationship between industry clustering and exploitative innovations being positive and steep for firms receiving high levels of knowledge spillovers. As would be expected of firms exhibiting an increased focus on exploitative innovations, the relationship between industry clustering and explorative innovations for firms assimilating high levels of knowledge spillovers is negative. Low levels of knowledge spillover assimilation do not have a substantive effect on explorative or exploitative innovations. We find some support for the relationships proposed through Hypothesis 3.

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DISCUSSION

This paper sought to determine the independent and joint influence of industry clustering and knowledge spillovers on the product innovation activities of high-technology new ventures. Whereas prior research suggested that firms operating from cluster locations have higher levels of explorative innovations, our results suggest precisely the opposite: that firms operating from cluster locations have higher levels of exploitative innovations. This contradictory finding may suggest that the generalizability of extant research, which has focused on firms in industries where explorative innovations may have greater importance than exploitative innovations, is less applicable to firms in industries that must also enhance their existing product lines to remain viable. Our theoretical development led us to expect that the pressures associated with operating from a location with high industry clustering would push new ventures to accelerate their innovation activities around those that are more certain and more easily implemented. The close proximity to competitors combined with the greater awareness of one another's actions may motivate firms to intensify their innovation efforts in order to respond to competitor's product launches, maintain legitimacy (Abrahamson & Rosenkopf, 1993) or simply to remain competitive (Lawless & Anderson, 1996; Porter, 1998). As a consequence, we expected to find a stronger relationship of industry clustering with exploitative innovations than with explorative innovations, which our analyses confirmed.

We also predicted that the knowledge spillovers received from local firms likely represent cutting edge knowledge for the firms which would push the firm into more explorative innovation activities. The significant relationship between knowledge spillovers and explorative innovations may confirm that knowledge spillovers provide the pulse of new technological trends (Brown and Duguid, 2000) and aid firms' abilities to create more explorative innovations (Kogut and Zander, 1992), but also to perfect their existing products. There was no significant difference, however, in the effect of knowledge spillovers on exploitative innovations, which suggests that for this sample of firms, knowledge spillovers may be as beneficial for existing technologies as they are for new technologies.

The joint effect of industry clustering and knowledge spillovers revealed that firms operating from locations with higher industry clustering that also assimilated more local knowledge into their operations were significantly more likely to be creating exploitative innovation activities than they were to be creating explorative innovations. We believe this finding is of extreme importance since high levels of exploitative innovations can contribute to the demise of new firms (Banbury & Mitchell, 1995; Cottrell & Nault, 2004), while explorative innovations are important for firm survival and growth (Eisenhardt & Schoonhoven, 1990; Henderson, 1999; Cottrell & Nault, 2004). Since the technologies of firms that engage in a local search become peripheral to those of the industry over time (Rosenkopf & Nerkar, 2001), the finding that cluster new ventures are engaging in higher levels of exploitative innovations may provide additional empirical validation of the fact that over time, clusters will contribute to the demise of firms operating within them (Pouder & St. John, 1996).

We used industries for which the costs associated with creating and implementing products for the customer base mandated a need for the firms to maintain existing product lines, but also to continue to create new products. The customer base associated with these industries represent “power users” for the firms, which are sophisticated high use customers whose demands would make it easy for this sample of firms to become preoccupied with improving existing products rather than creating new ones (Lee, Lee & Lee, 2003). For this user base, exploitation innovations are often maintenance-related, but necessary to keep the customers satisfied with the products so they will continue their use of them. Some have argued that for firms with such customers, exploitation activities are unlikely to contribute to the growth of the firms (Lee et al., 2003). We assessed this hypothesis by examining the relationship between our measures of explorative and exploitative innovations and the sales growth of the firms. As expected for this sample of firms, we found a positive and significant effect of explorative innovations on venture growth, but a non-significant effect of exploitative innovations on growth. The absence of a relationship between exploitative innovations and growth may highlight the severity associated with having cluster firms engaging in higher levels of exploitative innovations when those activities do not provide economic value to the firm.

Our results have intriguing implications that are of importance for entrepreneurs to consider. Since innovation activities can be both stimulated and constrained by the industry clustering in the firm’s location, in the long term it may be necessary for cluster entrepreneurs that found their firm within a location with higher industry clustering to protect their innovative capabilities by relocating the innovation component of the firm to a more remote location (Shaver and Flyer, 2000). Alternatively, cluster entrepreneurs may want to consider creating and empowering subsidiaries in other locations to source knowledge from the new location and share it with the parent firm (Frost, 2001). Employing the aforementioned strategies may help cluster firms balance enhancing their existing product lines with the necessity of creating new competencies to preserve long-term growth and survival.

The prevalence (Bresnahan et al., 2001) and importance (Gilbert, Audretsch & McDougall, 2004) of cluster regions as instruments for regional economic development, suggests there are also important implications from this research for policy officials as well. The finding that cluster firms give greater attention to exploitation innovations, and that the knowledge spillovers they receive also contribute to this effect, is a finding of utmost importance. If cluster firms continue to engage in higher exploitation activities, over time their technologies will become obsolete (Rosenkopf and Nerkar, 2001). As scholars (e.g. Pouder and St. John, 1996; Sull, 2001) have suggested that the inability of a cluster region to incorporate new knowledge into the activities of the cluster will contribute to eventual demise of the cluster, strategies such as technology transfer alliance programs with entities from other geographic regions which may change the knowledge structure of the region, may be one key to ensuring the technologies of the region do not become obsolete. Moreover, favorable policies towards foreign direct investments into the region (whether by firms from other U.S. regions or other

countries) can position the region to evolve with the technological trends of the industry (Crossan et al., 1999).

There are several theoretical implications stemming from the results we have presented from this research. One is the importance of understanding how the industry clustering within a geographic regions and any variable related as an important characteristic of a cluster, may influence the firm's total product innovation activities. For this sample of firms, considering explorative innovations only would have had us conclude that there is no effect of industry clustering, when, in fact, there is a negative effect of industry clustering on explorative innovations when firms assimilate high levels of knowledge spillovers. Similarly, only considering the exploitative innovations would not have painted a comprehensive picture of the gravity of the effect of industry clustering to explorative innovations for this group of firms. Joint consideration of both forms of product innovations enabled us to provide a better understanding of the implication of cluster regions for new venture product innovations. A second implication relates to the importance of considering how industries exhibiting characteristics that differ from those previously analyzed may influence the interpretability of the results. For firms with products for which refinements are an ongoing and essential component of innovation activities, operating from a cluster location may limit the type of knowledge that is received and exacerbate the rate at which those exploitation activities occur. As a consequence of this behavior, those firms may be left with highly uncertain futures.

Limitations and Research Extensions

While the results mostly confirmed our expectations regarding the influence of geographic clusters and knowledge spillovers on product innovations, there are many limitations which must be acknowledged that influence the generalizability of this research. We consider these limitations as building blocks upon which future research can be built. The first limitation is that we focused on a sample of new ventures that undertook an IPO. IPO firms represent a very small percentage of all firms and an especially elite sample of new firms. However, in our sample, not all firms were successful at introducing new products or enhancing existing products during the time period under consideration. While we suspect that the rate at which these firms innovated may be higher than would be true of the general population of new ventures, these IPO new ventures still exhibited high variance in their product innovation capabilities. Future research will need to explore what the effect is on a broader sample, specifically of privately held new ventures.

Our use of software firms also restricted our ability to conduct a longitudinal analysis of the effect of industry clustering and knowledge spillovers. Software firms often fill specific niches and are typically acquired by other firms to complete product line offerings. This characteristic of the industry not only limited the number of firms we could use to conduct our analyses, but also restricted the number of years of data we were able to collect. Use of an industry with lower acquisition activity may enable researchers to examine the effects for a longer period of time. Additionally, using industries whose customers are not "power users," where exploitative innovations could increase the revenue growth experienced, will also enhance understanding of the influence of cluster locations on the product innovation activities of new firms. There is also a need to examine the product innovations generated over a longer period of time to determine whether firms increase or decrease their ability to introduce products to the marketplace. We especially encourage research that measures the innovation activity of the firms from startup over a period of time, with an assessment of the effect to growth or profitability performance.

The time period from which we drew the sample of firms was a unique period of time – the onset of the internet revolution and also the height of the internet bubble. While these results are likely to generalize most closely to other firms that are riding the wave of an emerging industry, the extent to which these results would hold for firms that were founded in industries at

later stages or that undertook their IPO during more stable periods of time must be determined by future research.

Another limitation is our use of patent citations, which are a coarse measure of knowledge spillovers into a firm's operations, to reflect the knowledge spillover assimilation into the venture's operations. Our measure attempts to capture the extent to which firms assimilate knowledge from other local firms into their operations, but there are many other sources of spillovers that should be considered for their influence. Employee turnover, alliances or customer-supplier relationships can all be sources of spillovers for firms. We encourage future research to consider finer-grained measures of knowledge spillovers and their influence on product innovations.

CONCLUSION

This research provides a greater understanding of the impact of geographic cluster locations and knowledge spillovers on new venture product innovations. By examining product innovations along the explorative and exploitative innovation dimensions, our results enable us to conclude that the higher innovation activity for at least some cluster new ventures is largely attributed to their exploitative innovation activities. These results confirm the negative prospects presented by some regarding the future of firms operating from geographic cluster regions. External knowledge appears to be useful for helping firms engage in explorative innovation activities, which may help to preserve their longevity. Still, entrepreneurs operating from these regions must be educated on how to exploit the advantages of cluster regions without succumbing to their disadvantages. It is imperative for future research to continue to illuminate the intricacies relating to cluster locations, knowledge spillovers and new venture performance.

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Table 1
Sample Descriptive Statistics

Percentage IT Clustering*	Representative MSA Locations*	# of Firms	Average Knowledge Spillovers			Average New Products			Average Enhanced Products		
			Min.	Max.	Ave.†	Min.	Max.	Ave.	Min.	Max.	Ave.
Less than U.S. IT Clustering	Atlanta, GA; Chicago, IL; Denver, CO; Washington D.C., Miami-Fort Lauderdale, FL; New York, NY.	39	0	1.67	1.10	0	11	3.51	0	21	5.31
Between 1- 2X U.S. IT Clustering	Dallas, TX; Seattle, WA; Houston, TX	18	0	2.00	1.15	0	11	3.94	0	21	5.94
Between 2- 4X U.S. IT Clustering	Albuquerque, NM; Boston, MA; Phoenix, AZ; Portland, OR; San Diego, Ca; San Francisco, CA;	42	0	1.55	1.19	0	11	2.88	0	21	4.95
>4X U.S. IT Clustering	Austin, TX; Raleigh, NC; San Jose, CA	29	0	1.53	1.24	0	11	4.72	0	21	10.00
Totals		128									

* Percentages as of the venture's year of founding. Not all locations are represented.

† Average excludes non-patenting firm values

Table 2
Correlations, Means, Standard Deviations

	1	2	3	4	5	6	7	8	9	10	11	12	13
Means	3.64	6.34	0.36	0.38	0.06	0.08	0.12	3.79	0.28	0.08	0.15	0.20	0.44
Standard Deviations	3.22	6.10	0.48	0.49	0.24	0.27	0.32	1.64	0.21	0.27	0.36	0.40	0.50
1 Explorative Innovations	1.00												
2 Exploitative Innovations	0.29***	1.00											
3 Ecomm Online Info Mgs	0.08	-0.02	1.00										
4 Internet Other, Systems Design	-0.02	.25**	-0.58***	1.00									
5 Internet Service Provider	-0.12	-0.11	-.19*	-.20*	1.00								
6 Information Technology Services	-0.15†	-.26**	-.22*	-0.23**	-0.08	1.00							
7 Others, NEC	0.14	-0.03	-.27**	-.28***	-0.09	-0.11	1.00						
8 IPO Age	0.07	0.06	0.04	0.02	-0.11	-0.05	0.05	1.00					
9 Size (Employees, IPO Year)	0.02	0.03	-0.09	-0.06	0.10	.28***	-0.10	-0.13	1.00				
10 1996 IPO	-0.17†	-0.03	0.03	0.08	-0.08	0.02	-0.11	-0.12	-0.05	1.00			
11 1997 IPO	-0.03	0.03	-0.22**	0.04	0.07	.21*	0.05	-0.05	-0.05	-0.12	1.00		
12 1998 IPO	0.03	-0.02	-0.16†	0.15†	0.04	0.00	0.00	0.05	-0.03	-0.14	-0.21*	1.00	
13 1999 IPO	0.09	-0.07	.23**	-0.13	0.03	-0.08	0.13	0.06	0.05	-0.26**	-0.37***	-0.43***	1.00
14 2000 IPO	0.00	0.12	0.07	-0.08	-0.10	-0.12	.20*	0.01	0.06	-0.12	-0.17†	-0.20*	-0.36***
15 R&D Expenditures	0.02	0.28**	0.05	.16†	-0.15†	-.24**	0.02	0.05	0.34**	-0.06	-0.11	-0.15†	0.03
16 Industry Clustering at Founding	0.07	.21*	0.16†	0.08	-0.14	-0.15†	-0.12	0.00	-0.01	0.06	-0.14	-0.11	.18*
17 Alliances thru IPO year	0.20*	0.31***	0.17†	-0.04	-0.02	-0.17†	-0.02	0.07	0.31***	-0.08	-0.03	-0.14	-0.02
18 Knowledge Spillovers	0.17†	0.20*	0.10	0.02	-0.07	-.19*	0.06	0.04	-0.05	0.06	-0.06	-0.14	0.11

*** p<.001

** p<.01

* p<.05

† p<.10

Table 2 (cont.)

	14	15	16	17	18
Means	0.14	7.11	0.44	11.2	0.70
Standard Deviations	0.35	6.05	0.78	10.3	0.60
1 Explorative Innovations					
2 Exploitative Innovations					
3 Ecomm Online Info Mgs					
4 Internet Other, Systems Design					
5 Internet Service Provider					
6 Information Technology Services					
7 Others, NEC					
8 IPO Age					
9 Size (Employees, IPO Year)					
10 1996 IPO					
11 1997 IPO					
12 1998 IPO					
13 1999 IPO					
14 2000 IPO	1.00				
15 R&D Expenditures	0.29**	1.00			
Industry Clustering at					
16 Founding	-0.03	.20*	1.00		
17 Alliances thru IPO year	0.28**	0.33***	0.12	1.00	
18 Knowledge Spillovers	0.02	0.28**	0.34***	0.10	1.00

*** p<.001

** p<.01

* p<.05

† p<.10

Table 3

Seemingly Unrelated Estimation (SUEST) of Negative Binomial Regression Analyses Robust Estimation

	New Product Innovations				Product Enhancement Innovations			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Control Variables								
Age at IPO	-0.003 (.05)	-0.001 (.05)	-0.001 (.05)	-0.00 (.05)	.01 (.05)	.02 (.05)	.02 (.05)	.02 (.05)
Size (Employees)	.35 (.47)	.35 (.46)	.41 (.45)	.37 (.44)	.31 (.51)	.33 (.46)	.33 (.49)	.39 (.46)
EC. ONL. IMS	-.25 (.22)	-.28 (.23)	-.25 (.22)	-.27 (.23)	-.03 (.24)	-.10 (.26)	.07 (.24)	-.07 (.25)
INTOther. CSD.	-.32 (.22)	-.34 (.22)	-.31 (.22)	-.36 (.22)	-.31 (.26)	.20 (.26)	.34 (.25)	.25 (.26)
ISP	-1.1**(.40)	-1.03*(.41)	-1.05**(.39)	-1.02**(.39)	-.54 (.40)	-.46 (.41)	-.45 (.43)	-.47 (.42)
IT. Systems	-1.0**(.40)	-1.04*(.40)	-.96* (.41)	-.92* (.41)	-1.85**(.65)	-1.83**(.62)	-1.71**(.67)	-1.79**(.64)
1997 IPO	.62† (.35)	.62† (.35)	.71* (.34)	.64* (.34)	.39 (.47)	.66 (.42)	.52 (.47)	.79† (.41)
1998 IPO	.75* (.35)	.75* (.36)	.81* (.34)	.84* (.32)	.04 (.45)	.27 (.37)	.14 (.44)	.35 (.36)
1999 IPO	.73* (.32)	.70* (.33)	.77* (.30)	.72* (.29)	.003 (.42)	.12 (.34)	.06 (.41)	.22 (.33)
2000 IPO	.41 (.43)	.42 (.37)	.47* (.35)	.44 (.34)	-.02 (.43)	.23 (.37)	.08 (.43)	.33 (.36)
RDExpand	-.01 (.01)	.01 (.01)	-.02 (.14)	-.02† (.01)	.02 (.01)	.01 (.02)	.01 (.02)	.01 (.02)
Alliances (Pre-IPO)	.02† (.01)	.01† (.01)	.01* (.01)	.01† (.01)	.02** (.01)	.02* (.01)	.02** (.01)	.02** (.01)
Independent Variables								
Industry Clustering		.01 (.01)		.08** (.03)		.04** (.01)		-.02 (.05)
Knowledge Spillovers			.25† (.13)	.28* (.14)			.25† (.14)	.11 (.14)
Interaction Variable								
Indclus*Knowspil				-.61* (.25)				.44 (.36)

Wald Tests

Industry Clustering: $\beta(\text{New Product Innovation_Industry Clustering}) = \beta(\text{Enhanced Product Innovation_Industry clustering})$ (Model 2)
 Chi-sq (1) = 2.88† p=.09

Knowledge Spillovers: $\beta(\text{New Product Innovation_Knowledge Spillovers}) = \beta(\text{Enhanced Product Innovation_Knowledge Spillovers})$ (Model 3)
 Chi-sq (1) = .00 p=1.00

Interaction: $\beta(\text{New Product Innovation_Interaction}) = \beta(\text{Enhanced Product Innovation_Interaction})$ (Model 4)
 Chi-sq (1) = 10.47**p=.001

Figure 1 – Relationship between Industry Clustering & Product Innovations

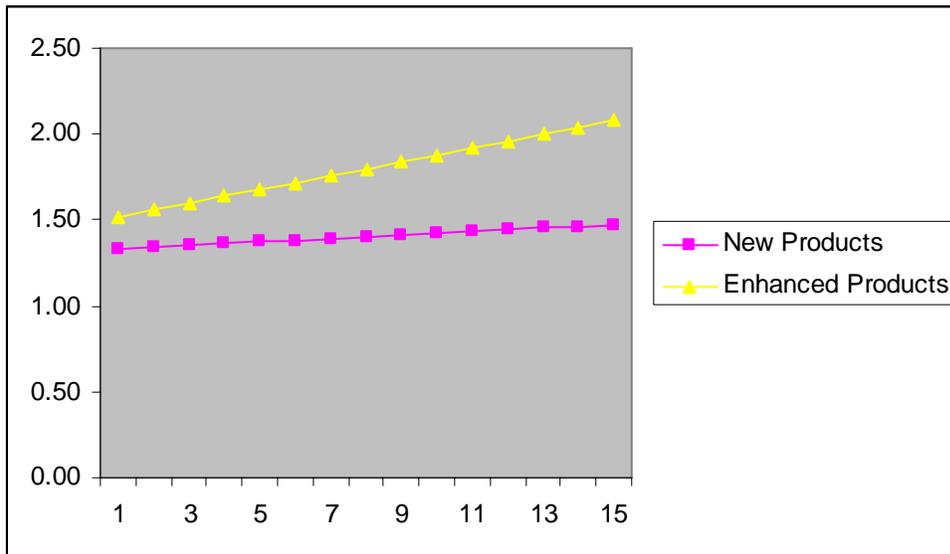
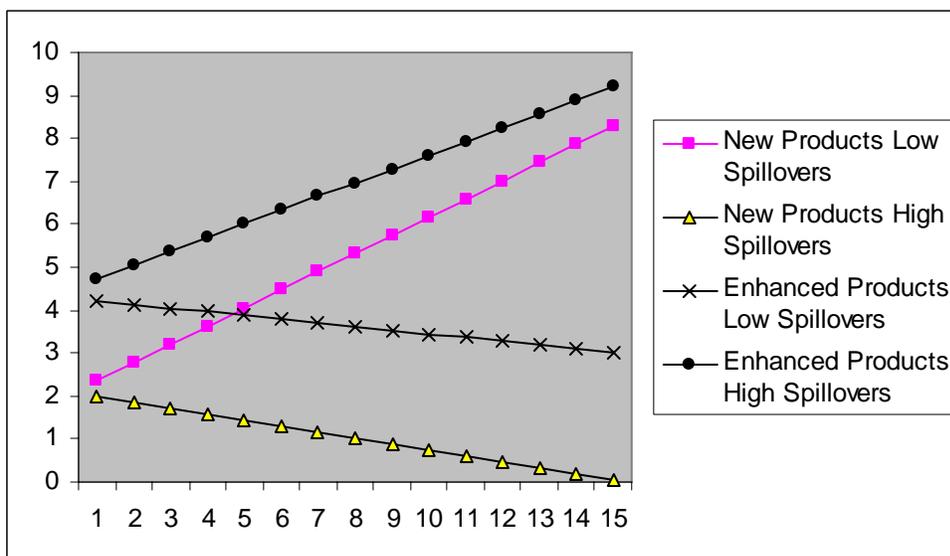


Figure 2 - Influence of Knowledge Spillovers in the Industry Clustering - Product Innovations Relationship



APPENDIX

Internet Service Providers: Allow users to access the Internet

At Home Corp.	Internap Network Services Corp.	Verio, Inc.
Biznessonline.com	Internet America, Inc.	Worldgate Communications, Inc.
Earthlink Network, Inc.	Log On America, Inc.	

Ecommerce Firms: General Ecommerce, those who conduct some aspect of their normal line of work over the Internet; Retail B2B - online retail sites that cater primarily or exclusively to business clientele; Business exchanges or Electronic marketplaces that provide a forum and tools to facilitate transactions among a range of participant companies; and, Ecommerce Software and Service Providers, which provide systems that enable other firms to engage in one of the other forms of B2B e--commerce.

Agile Software Corp.	Cysive, Inc.	Open Market, Inc.
Ariba, Inc.	eBay, Inc.	Persistence Software, Inc.
Art Technology Group, Inc.	Egain Communications, Inc.	Sciqwest, Inc.
Click Commerce, Inc.	Imanage, Inc.	webMethods, Inc.
Commerce One, Inc.	Keynote Systems, Inc.	Wink Communications, Inc.

Information Technology Services: computer programming services, custom computer software design and analysis, modifications of custom software, training software end users and systems administrators, integrated systems design, computer maintenance and repair, including hardware and peripheral installations, upgrades, replacements, and troubleshooting, hardware and software consulting. Additional IT services include computer services outsourcing, disaster recovery, and overall facilities management, which involves on-site management of a customer's computer systems and networks, including computer maintenance and repair.

Answerthink, Inc.	Razorfish, Inc.	UBICS Inc.
Cotelligent, Inc.	Tenfold Corp.	USWeb Corp.
Digital Fusion, Inc.	Tier Technologies, Inc.	
Navidec, Inc.	Trizetto Group, Inc.	

Web Portals & Online Communities: Web portals include generalist sites, featuring a search engine, links pointing in all directions of the Internet, and an array of content for the average Internet surfer. Online communities are often a part of Web portals or can be completely separate entities. Such communities provide space where those with common interests or characteristics--such as women, basketball lovers, musicians, or any other group--can virtually meet and exchange information and ideas through bulletin boards, chat rooms, and e-mail lists.

Dice, Inc.	iVillage, Inc.	Quepasa.com
Excite, Inc.	Knot, Inc.	Sportsline.com
Go2Net, Inc.	Looksmart, Ltd.	

Custom Software Design: High-end business software that straddles the packaged and custom classifications; it comes with standard functions and interfaces, but requires customization for a particular company's needs.

Avantgo, Inc.	Forte Software, Inc.	Pumatech, Inc.
Axeda Systems, Inc.	Genesys Telecomm Labs. Inc.	Realnetworks, Inc.
Bea Systems, Inc.	Inktomi Corp.	Red Hat, Inc.
Blue Martini Software, Inc.	Latitude Communications, Inc.	Resonate, Inc.

Custom Software Design (Cont.)

Clarus Corp.	NetIQ Corp.	Silverstream Software, Inc.
Concur Technologies	Netsmart Technologies	Towne Services, Inc.
Corillian Corp.	Omtool Ltd.	Ultimate Software Group, Inc.
Corsair Communications	Packeteer, Inc.	Viador, Inc.
Eclipsys Corp.	PC-Tel, Inc.	Vitria Technology
Flexinternational Software	Pervasive Software, Inc.	

Information Management Systems: Information management systems are the means whereby information is collected, identified, and analyzed, then distributed to the points within an organization where decisions are made and customers are served. Information management systems streamline and automate the often complex processes of coordinating a company's many activities with employees, suppliers, and customers.

Accrue Software, Inc.	Interactive Intelligence, Inc.	Priceline.com
Actuate Corp.	Interwoven, Inc.	Quadramed Corp.
Docent, Inc.	Kana Software, Inc.	Sagent Technology
E.Piphany, Inc.	Marimba, Inc.	Seachange International, Inc.
Evolve Software, Inc.	Muse Technologies, Inc.	Supportsoft, Inc.
Exchange Applications	Net Perceptions, Inc.	Vantagemed Corp.
Extensity, Inc.	Onxy Software Corp.	Vignette Corporation
Informatica Corp.	Pharsight Corp.	

Internet Other: Internet-related firms whose activities are not specifically, ISP's, e-commerce, or web portals/online communities related.

Akamai Technologies, Inc.	F5 Networks, Inc.	Promotions.com Inc.
AppliedTheory Corp.	Frontline Communications	Saba Software, Inc.
Broadvision, Inc.	Infospace, Inc.	Tumbleweed Communications
Critical Path, Inc.	Internet Security Systems, Inc.	Verisign, Inc.
Digital Insight Corp.	Intervu, Inc.	V-One Corp.
DoubleClick, Inc.	N2H2, Inc.	Watchguard Technologies, Inc.
Exodus Communications	Network-1 Security Solutions	

Other Firms, Not Elsewhere Classified: Includes voice recognition software firms, security systems (not internet specific), application service providers (ASP), Digital encryption services etc.)

Bindview Development Corp.	New Era of Networks	Sonus Networks
Corio, Inc.	One Voice Technologies, Inc.	Speechworks International
Digimarc Corp.	Redback Networks	Take-Two Interactive Software
eCollege.com	Scientific Foundry	Virage, Inc.
Netspeak Corp.	Sonic Foundry	VoiceFlash Networks, Inc.