# Networks as Institutional Support: Law Firm and Venture Capitalist Relations and Regional Diversity in High-technology IPOs[*]

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**Abstract**

Networks connecting two important supporting institutions -- law firms and venture capital partnerships -- explain regions' disparate abilities to sustain diverse high-technology ventures. In order to explain the diversity of entrepreneurial activity in a region, we distinguish between institutional *capacity* – the number of law firms and venture capitalists in a locale – strong inter-institutional *connections* that span legal and financial domains, and cohesive structural *communities* of directly and indirectly connected supporting organizations. We argue that strong connections and cohesive communities are essential, but little examined contributors to the development of diverse research-based economies. We find support for the argument in an empirical analysis of initial public offerings (IPOs) by U.S. high-technology companies in five industries between 1993 and 2005. Linking regional outcomes to strong ties that span local legal and financial institutions and to cohesive structures that weld them into communities offers new insights for research on the institutional and network underpinnings of entrepreneurship and regional economic development.

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**Introduction.**

Industrial diversity is a source of regional sustainability. High technology industries, particularly information and biotechnology, are notoriously counter-cyclical (Gompers and Lerner 1999). Thus, economies that rest on multiple research-intensive sectors will be more resilient in the face of downturns than will more homogeneous ecologies. Industrial diversity is also associated with greater innovation. For instance, Glaeser and colleagues (1992) find that knowledge spillovers across industries are as or more important to the economic growth of cities than those within industries. Henderson, Jaffe, and Trajtenberg (1998) link the fertility of innovations to the diversity of fields that cite them. Likewise, Fleming (2001) demonstrates that innovations which combine more disparate technological elements are more likely to fail, but when successful are more likely to yield breakthroughs. Attending to the sources of industrial diversity in regional economies can thus yield insight into two important questions: (1) Why do some regions thrive while others falter? And (2) Why to scientific and technological breakthroughs so often cluster in particular locales?

Our work extends the analysis of regional economies beyond studies that overwhelmingly focus on agglomerations in a single sector (Casper and Murray 2005; Powell et al. Forthcoming; Saxenian 1994; Sorenson and Audia 2000). We use a unique dataset of IPOs in five broad high technology sectors to identify the factors that facilitate the development of a diverse, science-driven industrial base at the state level in the USA. Our argument suggests that broad range of entrepreneurial activity emerges from repeated connections and cohesive structures linking legal organizations and venture capitalists (VCs). Law firms and venture capital partnerships are organizational reservoirs of general business know-how that can benefit high technology firms across a range of

industries (Johnson 2000; Suchman and Cahill 1996). We argue that the pattern of network connections that exists among them in a region creates an institutional spur toward diverse local entrepreneurship.

The contention that industry evolution requires the development of complementary "supporting institutions" – ranging from public goods and felicitous policies to educational infrastructures and trade associations – is neither new nor controversial (Nelson 1994), but few have examined how ongoing, generative relations integrate such institutions into a network that supports various forms of entrepreneurship. We develop our ideas by building on recent theories of entrepreneurship and regional economic development that integrate network and institutional explanations for economic action and outcomes (Owen-Smith and Powell 2008; Powell et al. Forthcoming). By emphasizing the relational and structural sources of regional community, we more tightly wed theories about the embeddeness of economic activity in networks (Granovetter 1985; Moody and White 2003; Uzzi 1997) to institutional thinking about the contingent effects of social structure on organizational and industrial outcomes (Powell et al. 2005; Whittington et al. 2009).

In what follows, we briefly survey existing approaches to regional entrepreneurship that focus on capacity, connections and community as a means to develop hypotheses about the relationship between Law-VC networks and the industrial diversity of initial public offerings (IPOs) that take place in a state. We then describe our analytic approach and data before turning to a descriptive comparison of four states with significant numbers of high tech IPOs but different levels of industrial diversity. The next section presents findings from a series of models of IPO diversity that test our

hypotheses. We close with a consideration of the implications our findings have for theories of regional agglomeration, for network and institutional approaches to entrepreneurship, and for policy makers concerned with facilitating the development of robust economies anchored on young research-intensive firms.

**Capacity, Connection, and Community.**

Why do some geographic regions become homes to thriving clusters of entrepreneurial firms in high technology sectors while others languish? The question has motivated a cottage industry of research spanning economics (Glaeser et al. 1992; Jaffe et al. 1993; Krugman 1991), economic geography (Feldman 1994; Kenney 2000; Saxenian 1994), management (Fleming et al. 2007; Porter 1990; Safford 2009), sociology (Owen-Smith and Powell 2004; Sorenson and Stuart 2001; Suchman 2000), and political science (Best 1990; Piore and Sabel 1984). Two famous statements anchor much of this contemporary literature on regional economic development. In 1991, Paul Krugman brought the tools of economic modeling together with insights drawn from studies of industrial organization to propose an answer to the fundamental question of economic geography: "Why and when does manufacturing become concentrated in a few regions, leaving others relatively undeveloped?" (Krugman 1991: 484). His answer hinged analytically on the development of regional externalities that lowered costs for co-located producers. Small initial differences in concentration of firms in similar industries led some regions to develop scale economies in, for instance, transportation and pools of skilled labor. These capacity differences lowered operating and search costs for producers in the region, thus attracting more firms in the industry and creating a dynamic of

increasing returns. On this view, the pronounced geographic agglomeration of economic activity is a result of regional differences in institutional *capacity*.

At around the same time, Annalee Saxenian (1994) brought interview and archival data to bear on a complementary question about the dynamics of regional clusters in the semi-conductor and computer hardware industries. Noting that the two power-house clusters in this industry in the 1970s, California's Silicon Valley and Massachusetts's Route 128 Corridor, had similar origins and capacities but suffered very different fates, Saxenian asked "Why has Silicon Valley adapted successfully to changing patterns of international competition while Route 128 appears to be losing its competitive edge?" (Saxenian 1994: 2). Her answer emphasized not differences in regional capacity, but varied patterns of industrial organization. Where Route 128 was anchored by a relatively small number of secretive and vertically integrated semi-conductor producers and local labor markets were largely internal to these large corporations, Silicon Valley was characterized by a "network-based industrial system that promotes collective learning and flexible adjustment among specialist producers" (Ibid.).

This form of regional organization was founded on dense social and inter-organizational networks facilitated by open labor markets that together resulted in a "culture of competition" among porously bounded firms connected to each other and to local supporting institutions such as venture capitalists, trade associations and universities. In short, while Krugman's explanation for the origin of regional agglomerations emphasized capacity, Saxenian's account for their resilience focused on *connections* and *community*.

The later line of work has strong affinities with efforts to analyze industrial sources of regional and national competitiveness other than vertical integration and mass production (Best 1990; Piore and Sabel 1984), and with more theoretical efforts to treat networks as alternative forms of governance to markets and hierarchies (Powell 1990). The conceptual link between network-based Italian industrial districts and the dynamics of high technology clusters in the US stems from a sense that in both cases relational forms of governance develop along with a community and culture that supports both intense competition and flexible forbearance. Much of the contemporary literature on regional agglomeration in high technology industries addresses the challenge of understanding competition and community though the lens of relationships (but see Bell et al. 2009).

We enter this discussion with a focus not on the sources of agglomeration but on the correlates of diverse regional high-technology economies. We do not gainsay the importance of capacity-based explanations for the origins of regional agglomeration in particular industries. Nevertheless, our goal in this paper is to explore the ways in which networks can facilitate the development of general institutional capabilities that are able to support entrepreneurship in multiple industries simultaneously. We thus turn our attention to the roles that venture capitalists and law firms play in regional development with an eye toward identifying dyadic and structural sources of high-technology communities.

*Networks as Institutional Support: Law-VC Relationships and IPO Diversity.*

The role of venture capital in sparking and maintaining high technology entrepreneurship is well-known (Kortum and Lerner 2000; Powell et al. 2002). Venture

capitalists' tendency to invest locally coupled with a financing model that emphasizes hands-on managerial involvement, staged investments, and broad syndication (Gompers and Lerner 1999; Sorenson and Stuart 2001) make VCs key players in seeding regionally-based entrepreneurship and motors for the development of networks that can span industries. In the terms we use here, local venture capitalists represent an important but not industry specific regional capacity. The syndication networks that commonly connect them can support local community while mobilizing resources and expertise to develop a wide range of ventures.

The role of law firms in the entrepreneurial process is less well articulated, but has increasingly been a focus of both practitioner and academic discussions. Most notably, Mark Suchman's work on the development of Silicon Valley law firms articulates a clear role for lawyers that mobilizes the very language of community through connection that we seek to develop (Suchman 1995; Suchman and Cahill 1996). In Suchman's view lawyers serve as facilitators by maintaining relationships with entrepreneurs and venture capitalists.

> By virtue of their distinctive location within the Silicon Valley community, lawyers quite literally produce and reproduce the social structures underpinning the local high-risk capital market. Through their relations with both entrepreneurs and investors, they identify, create, transmit, and enforce the emerging norms of community. In so doing, Silicon Valley Lawyers absorb and control some of the central uncertainties in encounters between venture capitalists and entrepreneurs, facilitating what might otherwise be prohibitively costly, complex, and unpredictable transactions (Suchman and Cahill 1996: 683).

In other words, law firms in Silicon Valley are brokers not in the sense that that they necessarily span structural holes (Burt 1992), though they quite often will, but in the sense that they ease otherwise difficult, uncertain transactions and relationships (Obstfeld

2005). This view is further supported by the descriptions of practitioners who emphasize the key role lawyers play in facilitating entrepreneurship in terms that mix breadth of experience and the role of connection.

> My principle role [in the founding of start-up Garage.com] was to provide contacts and correct sequencing for the development of the business, which mainly meant raising enough money to keep the doors open as we built the business. . . . At each stage it was necessary to evaluate whether our strategy was working, much like trying to steer a sailboat out of a crowded harbor to the open sea in a brisk breeze. I had the most experience of getting companies started, so the team members often looked to me for guidance (Johnson 2000: 336)

Both the academic and the practitioner's description share several key features. Note first that far from being distant, arms-length mediators of bureaucratic and legal details, lawyers are key players in the thick of the entrepreneurial process. Their engagement with young corporations is facilitated by two important forms of experience: capabilities and know-how developed in the course of advising multiple entrepreneurial enterprises, and strong connections to local investors built through shared engagement with the same clients.

Unlike the social networks linking individuals or the producer networks linking buyers and suppliers in a region, networks linking counselors and investors proceed through the process of firm founding and growth. These law-VC networks form the basis of a structure that, in Suchman's terms, enforces community norms, reproduces local capital markets and eases the costs of entrepreneurial activity. Engaging in these forms of entrepreneurial networks leads law firms themselves to adapt their internal arrangements for billing and promotion to facilitate a more relational approach to the needs of clients (Price 2003). Network connections between law firms and venture capitalists may thus be a key source of general institutional support for high-technology entrepreneurship in

multiple industries. But how can such connections be understood to yield the kinds of cultural, community-based results that Suchman proposes?

We believe networks spark communities with shared norms of governance and interdependence when one of two conditions is met. First, repeated interactions result in strong dyadic relationships that are more richly social and "embedded" than one off, arms-length exchanges (Granovetter 1985; Uzzi 1997). Second, connections that link many players together in a cohesive structure facilitate broad exchange of information and widespread access to the reputations of individual participants while rendering the overall community resilient to the removal of some players (Moody and White 2003). In the terms used by Granovetter (1992) repeated ties at the dyadic level create a relational form of embeddedness, while cohesion at the level of the group contributes to the structural aspects of network embeddedness. We address each possibility in turn.

*Strong Law-VC Ties.*

Brian Uzzi's ethnographic work examining buyer-supplier ties among co-located firms in New York's garment district was among the first to empirically link repeated inter-organizational connections to both the positive and negative features of relational embeddedness. In Uzzi's (1997: 42) view, the difference between a single transaction governed by written contracts and coordinated via the market and a more embedded tie founded on reputation and reciprocity is both the depth of personal relationships between key members of connected organizations and the frequency with which transactions and interactions are repeated. Where strong connections prevail, key organizational participants report lesser reliance on formal dispute resolution mechanisms, limitations on price competition, greater novelty and innovation, and increased reliance on trust.

Uzzi's picture was not entirely rosy as such strong ties made it more difficult for suppliers and buyers to reduce their orders in times of fiscal distress, but the general point holds. Repeated economic exchanges between partners forge connections whose center of gravity shifts from short term advantage and formal governance mechanisms to longer term cooperation and informal norms for managing and coordinating shared activity. We believe that a similar transformation occurs when law firms and venture capitalists collaborate repeatedly in efforts to found or launch different entrepreneurial ventures.

Strong ties that cross two key supporting institutions for high-technology industries will facilitate the development and maintenance of reciprocity, trust, and well-tuned collaborative routines that, in Suchman' terms, reduce the costs and uncertainty of complex and risky engagements with new ventures. The general entrepreneurial expertise and cooperative approach of relationally embedded local investors and counselors will facilitate easy transitions across start-ups in multiple industries. Thus, we propose that deeper connections between pairs of law firms and venture capitalist in a state will increase the diversity of the high-technology ventures located there by instantiating general capabilities for facilitating the start-up and launch of new ventures in strong partnerships between legal counselors and venture financiers. The institutions we expect to arise from strong law-VC interactions are thus more general than the industry specific institutional capacities that accompany industrial density or the interpersonal and buyer-supplier connections that directly link competitors in single sectors. Hence:

*H1: As strong ties linking law firms and venture capitalists become more common in a region, the industrial diversity of entrepreneurial activity increases.*

Strong network connections that cross financial and legal institutional pillars in a region, however, are not the only potential source of robust, diverse economies.

*Cohesive Law-VC Structures.* Even when most relationships are not strong, the overall structure of a network can facilitate the development of shared governance norms and reciprocal attention that are key features of socially embedded economic relationships. Even arms length or 'one-off' dyadic relationships take place in larger context that can generate multiple indirect ties between participants. Consider a stylized example. If two parties to a tie, let's call them Firm A and Firm B, have no prior connection to one another and intend to have no future interactions, their relationship is arms length in the sense used by Uzzi, Powell, and others. However, if A and B each have ties to other alters – call them C and D – and if C and D are themselves connected then A and B's reputations and potential for future interaction with other alters can come to depend on their management of a single, arms-length dyadic tie with each other. In more formal terms, when parties to a relationship who are new to each other are indirectly connected via shared partners they are structurally embedded even if they have even no partners in common (Moody and White 2003). Cohesive clusters of indirectly connected and geographically co-located organizations are a source of precisely the kinds community norms and shared expectations that Suchman takes to be at the heart of the Silicon Valley.

As more indirect pathways connect the firms in a network the group that is formed by those connections becomes stronger. In short, structural cohesion in networks facilitates the development of communities where economic activity is deeply embedded

in ongoing social relationships and local governance norms by facilitating the spread of information and reputation throughout a group (Owen-Smith and Powell 2004), and by generating normative and cultural systems that shape individual behavior at a level of analysis higher than the dyad (Granovetter 1992; Powell et al. 2005). Thus, we expect locations where greater numbers of counselors and financiers are connected in a cohesive structure to develop broadly shared capabilities for supporting the launch of high technology ventures. In short, more cohesive legal-VC networks will support greater diversity in entrepreneurial ventures by creating and maintaining supporting institutions whose interconnections forge them into local communities. Thus:

*H2: As more law firms and venture capitalists in a region become indirectly connected in a cohesive structure, the diversity of entrepreneurial activity increases.*

In short, we expect stronger ties to create dyads of counselors and financiers who are skilled at supporting, developing and launching new ventures and adept at switching those skills across industries. In contrast more cohesive structures will facilitate broadly shared know-how and norms for supporting entrepreneurial endeavor across sectors. We test our two hypotheses using data on initial public offerings (IPOs) in several high technology industries over a 13 year period.

**Data and Method.**

IPOs are rare, high-profile events that represent a small but very important slice of all entrepreneurial activity in a region. We turn to data on IPOs for this initial analysis for several reasons. First, IPOs are among the most profitable and visible outcomes of entrepreneurial activity. They represent a key transition point for new ventures from

private to public ownership and are often accompanied by an influx of working capital and a period of growth and expansion. Thus examining the diversity of IPOs in a state provides a snapshot of activity among the largest and often most successful high-technology ventures.

More practically, IPOs are one of the few shared milestones in the life course of firms in many research intensive industries. While product cycles, hiring practices, capital requirements, styles of innovation, reliance on external partners, and attention to intellectual property can all vary across industries, making comparison difficult, the IPO process is, at least formally, equivalent. Every corporation that seeks to float stock on a public market in the United States must file a prospectus with the Securities and Exchange Commission. Finally, IPO prospectuses (S-1 forms) are required to contain information on the owners of a private firm and on its primary legal counsel. While information on VC investors can be gathered from a number of sources, we know of no systematic data that traces privately owned companies' relationships with law firms. In addition to representing an important and visible transition point in the life of high-technology firms, IPOs have the benefit of comparability across industries while providing rare information on the names and locations of both counselors and investors. Given our interest in tracking the evolution of law-VC networks in particular locations, we can think of no better systematic source of data.

Our analysis thus draws on a dataset of high technology IPOs in the period 1993-2005. We define high-technology to include manufacturing industries where corporate spending on basic research and development exceeds 10% of total spending according to National Science Foundation surveys of R&D expenditures by corporations. After

identifying 44 three-digit SIC categories that met this criterion, we turned to Securities and Exchange Commission (SEC) archives to identify corporations in these industries that had filed S-1 forms, prospectuses for an initial public offering of stock. We selected the period 1993-2005 as an initial window because of the ease of availability of electronic filings, and more importantly because this time period encompassed periods of boom and bust for two key industries (biotechnology and information technology) in the mid 1990s and early 2000s. 1,302 IPO companies meet this criterion in the period of interest. The companies are classified into five high-technology sectors: drugs and biotechnology, hardware and semiconductors, medical and laboratory devices, software and internet, and analytical services.

The dependent variable is a measure of industrial diversity among IPOs in each of the fifty U.S. states plus the District of Columbia. We focus on state-level activity rather than the smaller geographic communities (cities, regions) that have been the focus of much of this line of research to (1) broaden our lens beyond the relatively small number of regional success cases and (2) to facilitate efforts to craft policies that may support regional development, efforts that increasingly emerge from and are supported by state capitals.

We identify the location of each company in our sample using the headquarter address listed on the front page of the IPO prospectus. Because IPOs are rare events and measures of diversity are only calculable when multiple IPOs take place, we calculate all measures on moving three year windows. We selected three year windows to maximize the number of periods we could examine while also increasing the number of states for which diversity measures could be calculated. We operationalize industrial diversity

using the inverse Herfindahl index across high-technology sectors in a state and time period. The index represents the inverse of the squared proportion of IPOs that falls into each sector summed over all five sectors in our analysis. The resulting measure ranges theoretically from 1 to 5 where the lowest value indicates that all IPOs in the state and time period occurred in one sector and the highest value indicates that the IPOs were equally distributed across all five industrial sectors. A state that was home to five high technology IPOs by software and internet companies would have a diversity score of 1, while a state with five IPOs, one each in biotechnology, medical devices, software, hardware, and analytic services would have an IPO diversity score of 5.

To assess our hypotheses, we collected information about all law firms and venture capital firms that worked with these high-technology companies. Data on law firms and their addresses were hand coded from the front page of the companies' IPO prospectuses. A total of 541 local law firm offices participated in high-technology IPO deals in the years 1993-2005. We used the VentureXpert database to retrieve data about venture capital backing and the addresses of venture capital firms. 710 venture capital firms were identified as investors in these 1,302 high technology IPOs. We used these data to construct a network that links law firms and venture capitalists when the former is listed as primary counsel on an IPO prospectus in which the latter has invested. Thus, a tie between a law firm and a VC represents shared involvement in the same high-technology IPO. Because legal advice and venture financing represent two distinct supporting institutions for entrepreneurial firms, we dub such ties "inter-institutional" connections. Using this method also allows us to identify "intra-institutional" ties connecting law firms to each other as well as those linking VCs to one another. The

former represent co-counsel relationships when two law firms represent the same technology company. The latter are co-investment relationships, generated when VCs join syndicates together.

To assess Hypothesis 1, we examined the effect of strong inter-institutional ties on IPO diversity in a state. We constructed an affiliation network of law firms and venture capital firms in each state that have worked with the same IPO company, regardless of where the venture was located. In other words, if a law firm and a VC firm located in Boston, both participated in an IPO for a company located in New York, we treat the shared experience as a tie that connects counselors and financiers in Massachusetts. While it may be useful to distinguish between law-VC ties created via shared engagement with a local IPO from those generated by more distant clients, we make no effort to do so in this paper. Moreover our analyses do not account for ties between law firms and vc firms that are located in different states.

Following Uzzi and others, we call a relationship strong if it involves repeated connections. In our context, then, a strong inter-institutional tie represents a law firm-VC dyad that has collaborated on the IPOs of more than one high-technology company. In addition to inter-institutional ties, we collect data on single and repeated connections between law firms, and among venture capitalists, but we treat law-law and vc-vc connections as controls in order to identify the effects of the inter-institutional connections that qualitative case studies highlight as important for the production and reproduction of local high-tech communities. Two law firms have a tie if both of them were listed on the IPO prospectus, and vc firms have a tie if they co-invested in a

company. For each state and three-year period, we calculated the proportion of legal, VC, and inter-institutional connections that were strong ties.

We also use the affiliation network among law firms and venture capital firms to test Hypothesis 2, which postulates a positive effect of cohesion on IPO diversity. We measure structural cohesion as the share of law firms and venture capital firms in the state that are included in the largest network component. A network component is a set of firms that can reach each other through at least one direct or indirect connection. The size of the largest network component was calculated with the Igraph package in R. Membership in the local main component of a network has been shown to influence firm-level innovation in biotechnology clusters (Whittington et al. 2009), and similar measures of cohesion in co-inventorship networks are associated with the development of regional computer hardware economies in Boston and Silicon Valley (Fleming et al. 2007). The largest network component represents the lowest level of structural cohesion in a region as all members of the cluster are connected by at least one indirect pathway.

We estimate the effects of networks on the industrial diversity with a lagged data structure to established temporal priority. Network data for each three year period were used to estimate industrial diversity among IPOs in the subsequent three-year period. For example, the network data for 1993-1995 were used to predict diversity in the period 1996-1998, and data for 1994-1996 were used for estimating diversity in 1997-1999. Thus, all of our models represent the effects of network measures in one three-year time period on diversity in the subsequent temporal window. After lagging the independent variables, our dataset consists of 408 state X three-year periods.

Our models are estimated with a Heckman selection procedure. Since industrial diversity is undefined for states that lacked initial public offerings, the first stage of our model estimates the likelihood of IPO activity in the state. The first stage selection equation includes variables that measure institutional capacity -- the number of law firms and venture capitalists located in a state that participated in at least one US high-technology IPO in a three-year period. The two capacity measures were standardized by the total number of companies (in all industries) that existed in the state to take into account the population that these institutions were expected to serve. We collected data on the number of companies in each state from the U.S. Census Bureau. We also include a series of period effects in the selection equation to control for the fact that IPOs tend to be clustered in time. The probability of IPO activity in a state increases in years when investor optimism is high.

Our estimation of industrial diversity among IPO firms controls further for the diversity among the pool of potential IPO companies in each state. Since many privately held companies do not strive for an IPO, we decided to measure the diversity among companies with venture capital funding. For venture capitalists, IPOs represent a successful liquidity event, and thus companies with funding from venture capitalists are a suitable risk set for theorizing about IPOs. We collected data on all privately owned companies that received any venture capital financing from the VenturXpert database. Industrial diversity for each state was calculated as the inverse Herfindahl index over the eighteen VEIC industry codes that are used for classifying companies with venture capital funding. A company was included in the calculation from the year that it received funding to the year that it went public or was acquired. When we do not observe a

bankruptcy, IPO, or acquisition, we assume that the company remained an independent private entity for ten years after it first received venture capital funding. The measure was calculated for the year preceding the three year window for which the dependent variable was measured. To account for the possibility that IPO diversity is simply a function of IPO volume, we include a control for the number of successful offerings issued by technology companies located in a state.

The selection equation further includes measures of utility patents and research and development obligations to control for the high technology climate in the state. State level counts of utility patents come from the Technology Assessment and Forecasting reports archived by the U.S. Patent and Trademark Office. State level amounts of federal research and development obligations were collected from the National Science Foundation's WebCASPAR database. They are reported in constant year 2000 dollars and represent the depth of public resources devoted to science and engineering R&D in a state. The variables for patents and research and development obligations were converted into per capita measures (per 1000 persons) to account for variation caused by state size. Yearly population estimates come from U.S. Census Bureau. Taken together, these two measures capture the relative size of both public and private sector science and engineering endeavors in a state.

We test our hypotheses in the second stage of the Heckman selection procedure, which estimates the effects of our independent variables on IPO diversity contingent on the presence of IPO activity. Fully 227 State X Time period records had any IPO activity. This part of the model estimates the effect of our variables for strong inter-institutional connections and structural cohesion on the industrial diversity among IPOs,

controlling institutional capacity, and the presence of intra-institutional connections (repeated VC-VC and law-law ties).

**Findings.**

*Descriptive Findings*

Before turning to our hypothesis tests, consider some qualitative findings from a handful of states which vary dramatically in terms of the diversity of their IPOs over the entire course of our time period. Figure 1 presents a scatter plot that arrays states by the number and diversity of their initial public offerings in five high technology sectors for the entire time period we examine. The most prolific state in terms of volume was California with 535 high-tech IPOs followed by Massachusetts with 142 high-tech IPOs. California and Massachusetts are also two regions with diverse entrepreneurial bases. In California 10.7 % of the high-tech IPOs took place in drugs and biotechnology, 29.9 % in hardware and semiconductors, 12.5 % in medical and laboratory devices, 40.4% software and internet, and 6.5 % in analytical services. The state was the home of the internet giants Google and Netscape, hardware companies like Seagate Technology, and smaller biotechnology firms such as Alexza Pharmaceuticals and Maxygen. Similarly, entrepreneurship in Massachusetts spans multiple high-technology sectors.

=== Figure 1: IPO Volume and Diversity ===

While California and Massachusetts stand out as high volume, high-diversity locations, the states with moderate levels of IPO activity offer more interesting tests of our hypotheses. Several states with fewer IPOs have successfully launched companies in

multiple high-tech sectors. North Carolina (22 IPOs), Ohio (10 IPOs), and Wisconsin (6 IPOs) had at least one firm that reached the stage of an IPO in each of our five sectors. This picture can be compared to a cluster of states in the lower left side of Figure 1. These states had very few IPOs – all of them concentrated in one sector. States like California, Massachusetts, North Carolina, Ohio, and Wisconsin can also compared to Virginia and Georgia. In these two states, moderate numbers of IPOs concentrated in a very small range of industries. In Virginia, for example 26 of 30 high-tech IPOs involved software and internet companies. In this state, industrial agglomeration clearly depends on a single industry.

We argue that networks among law firms and venture capital firms help to explain difference in IPO diversity across states. Table 1 describes these networks in four states with significant IPO volumes, but different levels of diversity. In the following, we treat Massachusetts and Washington as illustrations of locales with relatively high levels of diversity and Georgia and Virginia as cases with relatively low levels of diversity. We do not include images for California, because the size of the state and the volume of its activity make it difficult to present in summary form. First consider Massachusetts, a state with high IPO volumes as well as high diversity. In 1993-2005, 33 law firms and 83 venture capital firms with experience in at least one high-tech IPO were based in Massachusetts. Many of these firms had worked together on multiple IPOs. 35 % of the ties between law firms and 24 % of the VC ties were repeated, strong connections.

=== Table 1: IPOs and law-VC networks ===

Moreover, note that the law-vc network in Massachusetts is characterized by a large share of strong inter-institutional ties that reach across the domain of legal advice and the domain of managerial support and capital. 34 % of the inter-institutional ties in Massachusetts were strong in 1993-2005. In the terms we use above, more than a third of inter-institutional dyads have developed strong ties that can represent deeper expertise and greater ability to transfer that know-how across industries. In addition, the network in Massachusetts is an example of a highly cohesive structure where firms are interlinked in one large component. 91 % of all law and vc firms in Massachusetts are connected by indirect network pathways through shared partners.

Washington state offers a second example for understanding entrepreneurial diversity. Like Massachusetts, Washington has a sizeable community of law firms (15) and venture capitalists (20) with some experience in high-technology IPOs. These supporting organizations are also linked via numerous intra and inter-institutional ties. But the strength of those ties is less pronounced than in Massachusetts. Despite having fewer repeated law-vc connections, the network in Washington state is highly cohesive with fully 81 % of the law firms and venture capitalists linked to a single network component. These networks of general business expertise are what we take to be central to development of local cultures and institutions that support robust, diverse high-technology economies.

Figure 2 uses network visualization techniques to further detail the patters of relations that exist in Massachusetts and Washington. The square nodes represent law firms, the circles are venture capital firms, and the lines connecting nodes illustrate shared work on a high-tech IPO. Black lines represent inter-institutional connections

while gray lines represent ties connecting organizations in the same realm. The thickness of the line displays the number of IPOs that two organizations have worked on in common. In these representations, thick black lines represent strong inter-institutional ties. Black nodes are members of the largest network component, while white nodes are isolated from that cohesive cluster. Note several features of these two images. The dense "snowball" of Massachusetts which is our model for a highly cohesive institutional support network, is anchored by a number of exceptionally strong ties among local counselors and financiers. While it is hard to discern visually given the complexity of this image, fully 42 percent of the ties that make up the main component are black, inter-institutional connections and more than a third of those are strong ties that reflect collaboration on two or more IPOs.

Washington state is a smaller, less dense (and thus more visually tractable) ecology. Here too we see significant cohesion (the large majority of nodes are black, representing membership in the main component), and that cohesion is founded on a relatively high number of inter-institutional ties (49 percent of main component connections). Many fewer of those ties are thick and the ones that are generally represent fewer shared IPOs. Law firms and VCs in Massachusetts have greater opportunities for experience and turn to the same partners more often than those in Washington. Clearly Massachusetts -- and California -- are in a class of their own. Washington, which was home to 46 IPOs in this time period is more akin to other moderately active states than to the two giants of high-technology industry.

=== Figure 2: Networks in High Diversity States ===

Consider Georgia and Virginia which both have moderately high levels of IPO activity (32 and 30, respectively) but score relatively low on measures of diversity. In both states, most high-tech IPOs were made by companies in software and internet sectors. Table 1 indicates the presence of both law and VC firms with high-tech IPO experience in both states, but note that where Massachusetts and Washington have a greater number of VC firms than law firms, the pattern is reversed in Georgia and Virginia. Institutional capacity in the form of VC clearly matters, as both our "low diversity" states have less than half the experienced VCs located in Washington and less than 10% of the volume of VCs located in Massachusetts. The numbers of law firms are much more similar and, in the case of Georgia, exceed those in Washington. This suggests that law firms are most important to regional ecologies when they work to bridge legal and financial realms. Moreover, supporting organizations in Georgia and especially Virginia are much more likely to gain their experience with high-technology IPOs in collaboration with VC or law firms located in other states.

These differences are evident when we consider network measures and images for the two "low diversity" locales. In Georgia most connections between firms are one time interactions. Only 8 % of the inter-institutional ties between law firms and venture capitalists are repeated connections. The degree of cohesion is also lower in Georgia than Massachusetts and Washington. 69 % of the law firms and venture capitalists are connected directly or indirectly into one structural community. Virginia illustrates the modal case in our analysis. Virginia, like many other states, hosts law firms and venture capitalists; yet there are absolutely no connections between them. While law firms and

venture capitalists in the region still depend on collaboration with other firms, they collaborate with partners in other locations. Such work patterns give rise to a region with institutional capacity, but neither strong ties nor cohesive community. The loosely connected, or even disconnected, networks of Georgia and Virginia are illustrated in Figure 3. Note the absence of think black lines (strong connections) and black nodes (cohesion) that we saw in the figures of Massachusetts and Washington.

=== Figure 3: Networks in Low Diversity States ===

Next we present a series of inferential models where we test the effects of strong connections and community on the industrial diversity among IPOs in the state. Table 2 shows descriptive statistics and bivariate correlations for the variables included in our models. The correlation between the capacity measure for law firms and variable for research and development obligations stands out as high (r = .83). In a robustness analysis without the variable for research and development obligations, we find qualitatively similar coefficients and slightly lower standard errors for the law firm capacity variable.

=== Table 2 Here ===

*Inferential Findings*

Table 3 presents results from a series of Heckman selection models. Focus your attention on the top panel of the table, which reports estimates of IPO diversity conditional on any IPO activity. Model 1 includes our control variables for diversity among private firms, IPO volume, and institutional capacity measured as the number of

law firms and venture capitalists. As expected, states with more diverse pools of privately owned, venture capital backed companies have higher levels of diversity among firms that IPO. Likewise, higher volumes of IPOs predict greater IPO diversity, but that effect disappears in later models that include measures of local network cohesion. IPO volume is primarily important because a higher flow of local issues offers more opportunities for VCs and law firms to collaborate with their neighbors.

Somewhat surprisingly, capacity variables are weak predictors of diversity. The number of VC firms in a state is never more than marginally significant. More law firms are associated with greater IPO homogeneity in models that include our cohesion measure. In hindsight this effect seems wholly consistent with arguments about the role that law firms play in successful high tech clusters. What is important to that argument is not the number of law firms present (ala the standard argument about venture capital capacity) but their ability to play matchmaking roles that are different than the standard practices of their field. All other things equal, a larger legal community seems likely to increase pressure to hew to well-established professional practices, decreasing counselors' ability to play the structural roles identified by Suchman.[1]

=== Table 3 Here ===

Model 2 expands our set of controls by adding measures of the strength of intra-institutional ties. Here we see no effect of stronger law-law connections, but find a positive, marginally significant effect of repeated interactions between local VCs. Model

[1] This also accounts for the persistent (though rarely significant) negative effect of strong law-firm law-firm ties in models that take inter-institutional connections into account. We suspect that repeated co-counsel relationships are more likely to represent a well defined division of labor between specialized legal advisors and thus diminish the development of shared and general capabilities in law-law partnerships.

3 tests our first hypothesis by including a measure of repeat inter-institutional ties. This model offers support for the idea that strong, repeated, interactions between counselors and financiers in a region can sustain a greater diversity of high-technology IPOs. We find a positive and statistically significant association between this variable and IPO diversity. As more of the inter-institutional ties in a state represent repeat collaborations, the diversity of local IPOs increases. This finding supports Hypothesis 1 which drew on ideas about reciprocity and trust to justify why strong ties are important for a region's resilience and development.

Model 4 assesses Hypothesis 2, finding a positive relation between structural cohesion and IPO diversity. We argued that that increasing the proportion of supporting organizations connected to the main network component in the region would positively influence IPO diversity by facilitating broad diffusion of expertise un-tethered from particular high-tech sectors, by enabling the development of local norms of exchange and collaboration, and by enhancing the importance of reputation for individual participants. The results show that states where law firms and venture capitalists are interconnected in a large network component are more likely to have high IPO diversity. This positive effect offers support for Hypothesis 2.

Model 5 reports the fully specified model including all controls and independent variables. Several interesting features stand out. Including our measure of main component membership in a model decreases the significance and strength of the law-VC tie effect. The effect of inter-institutional ties remains marginally significant while the effect of cohesion remains stable. It appears that if all other things are equal increasing local connections to a cohesive structure will be a more effective way to bolster the

institutional bases of diverse high-technology IPOs than strengthening the connections linking particular counselor-financier dyads. Repeated ties between key participants may be important anchors for local network communities, but these dyadic factors appear less important than broader, community-wide measures of cohesion. Both Hypotheses 1 and 2 find support in this model, but there is some suggestion of an interesting relationship between the relational and structural bases of local community.[2]

Model 5 also includes interesting but not hypothesized findings regarding the role of law firms in seeding high-technology regions. In this model, the presence of a stronger, more developed legal community (as evidenced by the positive effect of an increasing number of law firms and a higher proportion of strong law firm-law firm connections) is associated with decreases in the diversity of high-technology IPOs. We suspect this is the case because a stronger legal community militates against individual law firms taking the possibly illegitimate role of matchmaker and facilitator. We also note that in Model 5 and indeed all models that include measures of VC-VC interconnection that the effect of VC capacity becomes insignificant. In short, it appears that the number of VCs in a region is less important to IPO diversity than the strength of connections among them. Legal capacity, in contrast, must be built through ties to venture capitalists that strengthen cohesive regional clusters.

Networks among law firms and venture capitalists that are characterized by strong connections and structural cohesion are sources of general institutional support that foster entrepreneurship across multiple high-technology industries. The effects that we find are substantively meaningful. Assume a state and three-year period that is has the average

[2] In unreported analyses we tested for a multiplicative interaction between inter-institutional tie strength and structural cohesion. There was no significant moderating effect.

characteristics of the observations in our dataset. If we convert one of the weak inter-institutional ties in this state into a strong connection, we expect to find a 4.16 % increase in the diversity index. Moreover, we find a highly meaningful effect of cohesion. If one of the disconnected firms in our "average" state becomes connected to the cohesive community of inter-connected counselors and financiers, our models predict a 5.09% increase in diversity.

The suggestion for states looking to build diverse and sustainable high-technology economies is clear. Capacity is necessary, but not sufficient to support diversity and in the case of law firms one can have too much of a good thing. More important are connections and particularly strong ties linking legal counselors and VC financiers. Such repeated ties are an important source of the trust, reciprocity, and forbearance that characterize strong network connections. Cohesion too is important. In addition to deepening the joint experience of dyads, our findings suggest that collaborations that link together many of the supporting organizations in a region facilitate the development of local capabilities that are neither specific to relationships nor to industries and thus may be a surer route to the development of supporting institutions from networks.

**Limitations and Next Steps**

While we think they are compelling, our findings are preliminary in that our data and approach face some limitations. Consider two. First, and most importantly, we have little sense of how the decision to go public is made by firms in these industries and whether the mechanics of that decision differ significantly across sectors. Because we have no information on firms that never filed prospectuses and thus simply remained

private, we cannot say whether our findings are driven by the peculiar features of the IPO process or by more general characteristics of entrepreneurial activity in high-technology regimes. If the legal and financial expertise necessary to start up a firm or keep one growing through private financing are dramatically different than the skills required to take firms public, then more expansive data may lead to revisions of our findings. The same is true if there is a strong division of labor among law and VC firms with regard to participation in foundings and private placements as opposed to IPOs.

Second, and similarly, our focus on IPOs misses the great majority of entrepreneurial activity in even these capital-intensive industries. Only a small proportion of new ventures ever goes public and those firms that do tend to be distinguished by higher degrees of reliance on venture financing. Thus, we may over-estimate the role of both VC capacity and inter-institutional ties by focusing only on firms that seek public equity funding. We believe this danger is outweighed by the benefits of data that are comparable across industry categories and provide exhaustive information about little studied networks connecting two key types of supporting organizations. We also note that IPOs are an interesting and substantively significant outcome in their own right. Nevertheless, the selection problems and substantive issues raised by our lack of information about private firms suggest that our findings should be taken with a grain of salt, at least when drawing implications for high-tech entrepreneurship writ large.

Yet these limitations also suggest important next steps for research. We have documented what we believe to be the first evidence of the importance of tie strength and structural cohesion in networks that span and integrate institutional regimes. More work

should be done to deepen these findings by appeal to data on private firms, and to connections with other types of supporting organizations. Key among those are universities and trade associations, which also contribute to the development and maintenance of local high-technology ecologies.

Our findings are pitched at the state level, but more work could be done to explore firm-level effects both independently and in multi-level models. We know, for instance, that high technology IPOs backed by higher status venture capitalists (where status is measured in the intra-institutional, VC-VC syndicate network) perform better than those with no or lower status VC backing (Hochberg et al. 2007). We know little about how the relative expertise and visibility of law firms influences firm-level outcomes and functionally nothing about whether strong ties between a firm's counselors and financiers contribute to better outcomes. We also know little about how features of a larger community influence outcomes for the high technology companies formed within them. There is some evidence (Sorenson and Audia 2000; Whittington et al. 2009) that location in a well developed regional cluster is detrimental to the life chances of ventures because competition is more intense. Multi-level models that take into account both features of the region and of the particular partners that back specific firms may go a long way to untangling these complicated multi-level effects.

Finally, we note that while our decision to focus this analysis on the state is important as a means to facilitate both breadth and practical applicability of our findings. The cost of that choice comes in the possibility of treating as state-level outcomes phenomena which are properly situated at either sub or trans-state level. The action we document in the State of Massachusetts, for instance, is really concentrated in the greater

Boston area. The massively dense and diverse networks of California are perhaps better modeled in terms of the regional infrastructures of San Diego and the San Francisco Bay Area. Likewise, the dearth of connections and relative industry concentration of Virginia may result from artificially separating action in that state from activity in neighboring Maryland and the District of Columbia. Future research needs to examine the extent to which our focus on diversity resulting from the development of general capacities to support high tech entrepreneurship in multiple industries scales to MSA or city level and to the level of multi-state clusters.

**Conclusions and Implications**

Despite these limitations, we believe the approach we develop here is promising both for efforts to understand the dynamics of regional high-technology industries and for efforts to blend institutional and structural approaches to answer key puzzles about the geography of entrepreneurship. Our findings suggest several interesting implications. First, for students of high-technology industries, we note that models of IPO diversity that account for activity in multiple industries require attention not just to connections among titular competitors and the development of industry-specific externalities, but also to the networks connecting supporting organizations whose skills and inputs span multiple technology intensive sectors. We suggest that the next wave of studies in the economic geography of high-technology industries might do well to focus on the connections among organizations that provide general support to entrepreneurial activity. Law firms, venture capitalists, and universities seem likely to be key targets of such research.

Our analysis also suggests the continuing importance of efforts to identify the institutional and geographic features of regions that drive local networks to become more or less cohesive while positioning key players in that region in the global industrial networks that increasingly drive activity in high-technology sectors. We make no effort to distinguish between inter-institutional ties forged by shared involvement with geographically proximate clients as opposed to those that pass through distant ventures. We note, however, that physical proximity and institutional variation combine to create distinct high-technology infrastructures in regions. While our findings take steps in this direction greater attention the nuances of space and field seems necessary.

For network and institutional theorists we offer further evidence that efforts to explain how particular locales become hotbeds of entrepreneurial activity (Powell et al. Forthcoming), or social situations that facilitate the formation of particular types of network connections (Sorenson and Stuart 2008), should take pains to address the co-evolution of networks and institutions. In our case, we note that structures of particular sorts – those with high proportions of strong inter-institutional ties, and cohesive components that include large numbers of participants – pay dividends in the creation of infrastructures that support entrepreneurial activity in multiple industries. At least some of the salutary institutional features of a region emerge from the structure of its networks. But the network-institutional relationship is not unidirectional. The effects of increasing tie-strength, we find, differ depending on the institutional form of the parties to the tie. Where stronger inter-institutional and connections between venture capitalists increase IPO diversity, deepening linkages between law firms have the opposite effect. Networks are a source of institutional supports for entrepreneurship in local economies, but

understanding those effects requires attention to organizational starting points, and to both structural and dyadic sources of variation.

Finally, we note that our analysis has implications for policy-makers at the state level who seek to seed and maintain high-technology economies. First, we note that attention to industrial diversity is an important step toward building sustainable and successful high technology regions. More specifically, attending to industrial diversity suggests some alterations to common wisdom. First, capacity alone is not enough and, in the case of legal capacity, may be detrimental. Instead of focusing on building an increasing number of legal or financial support organizations, it appears that emphasizing local connections built on shared experiences in the entrepreneurial process is essential. Not every tie is equally as effective, however. Our findings suggest that deeper, repeated connections that span legal and financial domains are particularly important. In addition to emphasizing relationships developed through experience, then, policies designed to facilitate repeated connections between organizations oriented toward different aspects of the entrepreneurial process are likely to pay dividends. Perhaps more importantly, our findings suggest that attention should be paid not just to the shared experience of particularly active dyads but to the overall cohesion of local networks. States where more law and venture capital firms are even weakly connected to a cohesive cluster see substantively and statistically significant increases in the diversity of later IPOs. In addition to facilitating deeper connections between particular pairs of partners, efforts to engage a wider range of players by enticing established organizations to reach out to newcomers or isolates will likely see significant returns.

While remaining careful to temper our findings with key caveats, we believe that the analyses presented here take important steps in several directions. We demonstrate that attention to IPO diversity further emphasizes the need to consider the dynamics of multiple industries. Our focus on both structural and dyadic sources of community arising from network connections also implies the need to move beyond capacity-based arguments and industry-specific networks to nuanced treatments of connections among classes of partners that link ventures in multiple industries and build local capabilities that can transfer from sector to sector. Focusing on the networks that connect such supporting organizations, we contend, further strengthens a view of regional agglomeration that takes both structural and institutional features of regional ecologies into account. It is precisely here, at the intersection of network and institutional approaches to entrepreneurship, industrial dynamics, and innovation that the most fertile ground for future analysis is to be found.

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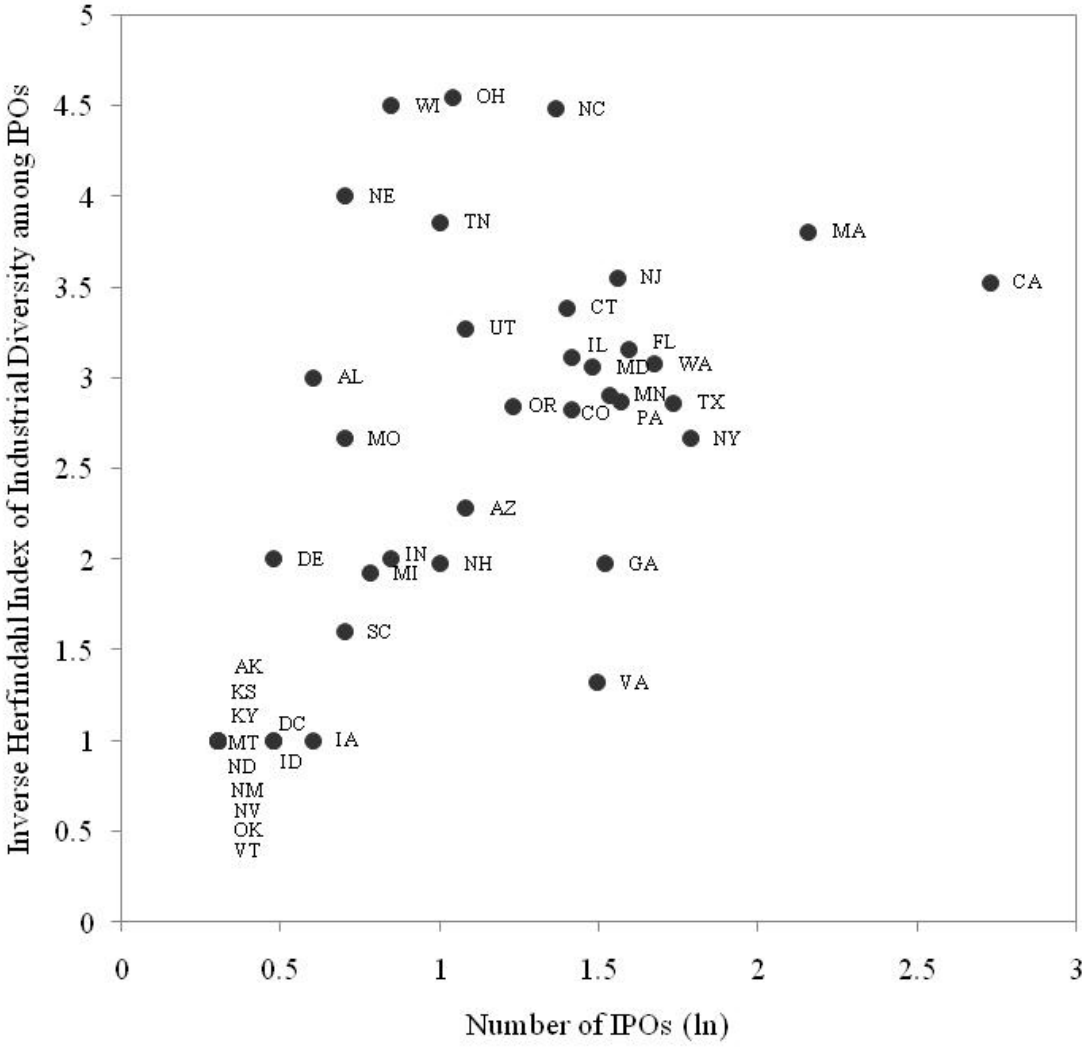


**Figure 1** IPO Volume and Diversity, 1993-2005.

Note: States with no high-technology IPOs in this time period (AR, HI, LA, ME, MS, RI, SD, WV, WY) excluded.

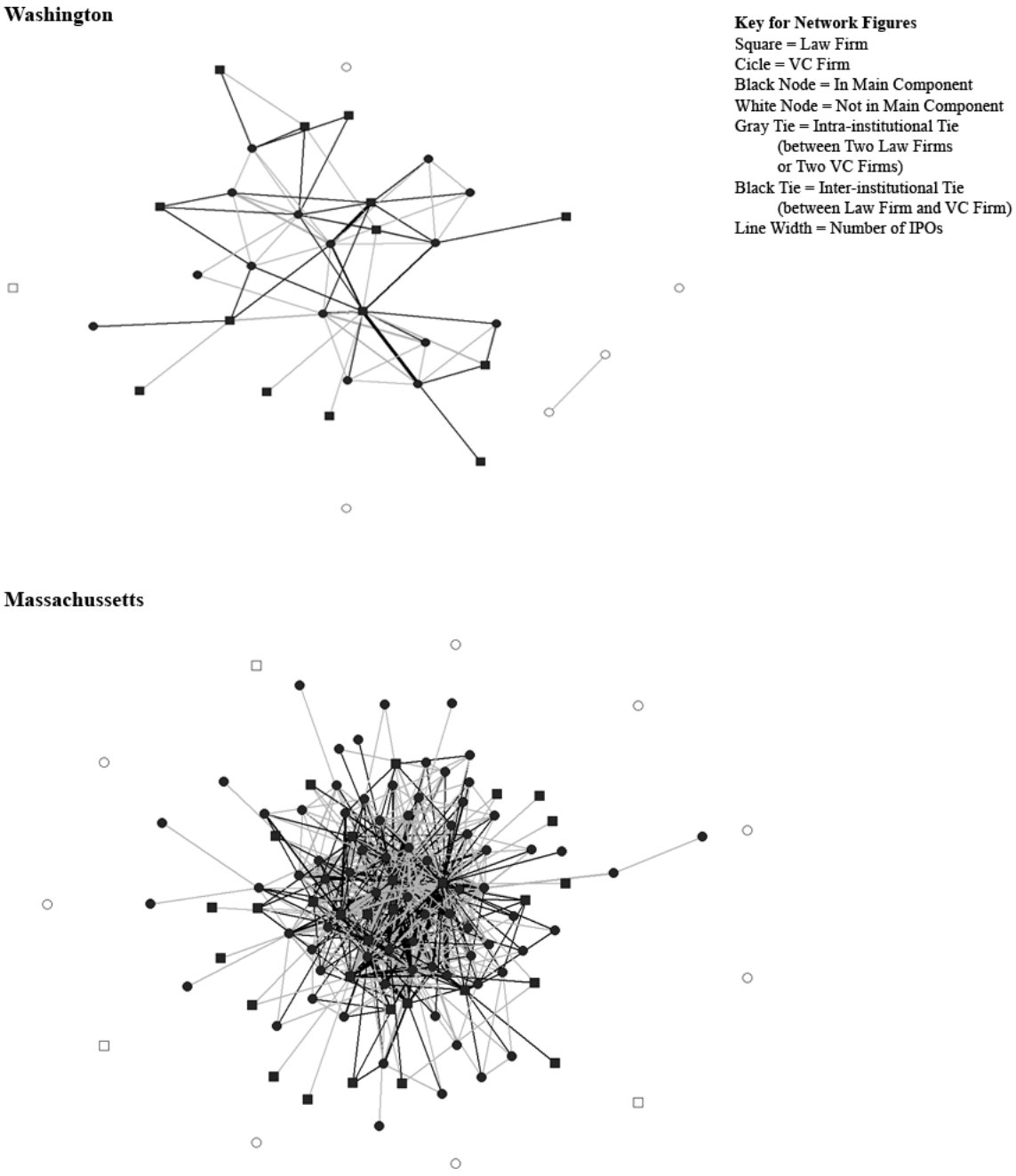


**Figure 2** Law Firm - Venture Capital Network for High IPO Diversity States, 1993 – 2005

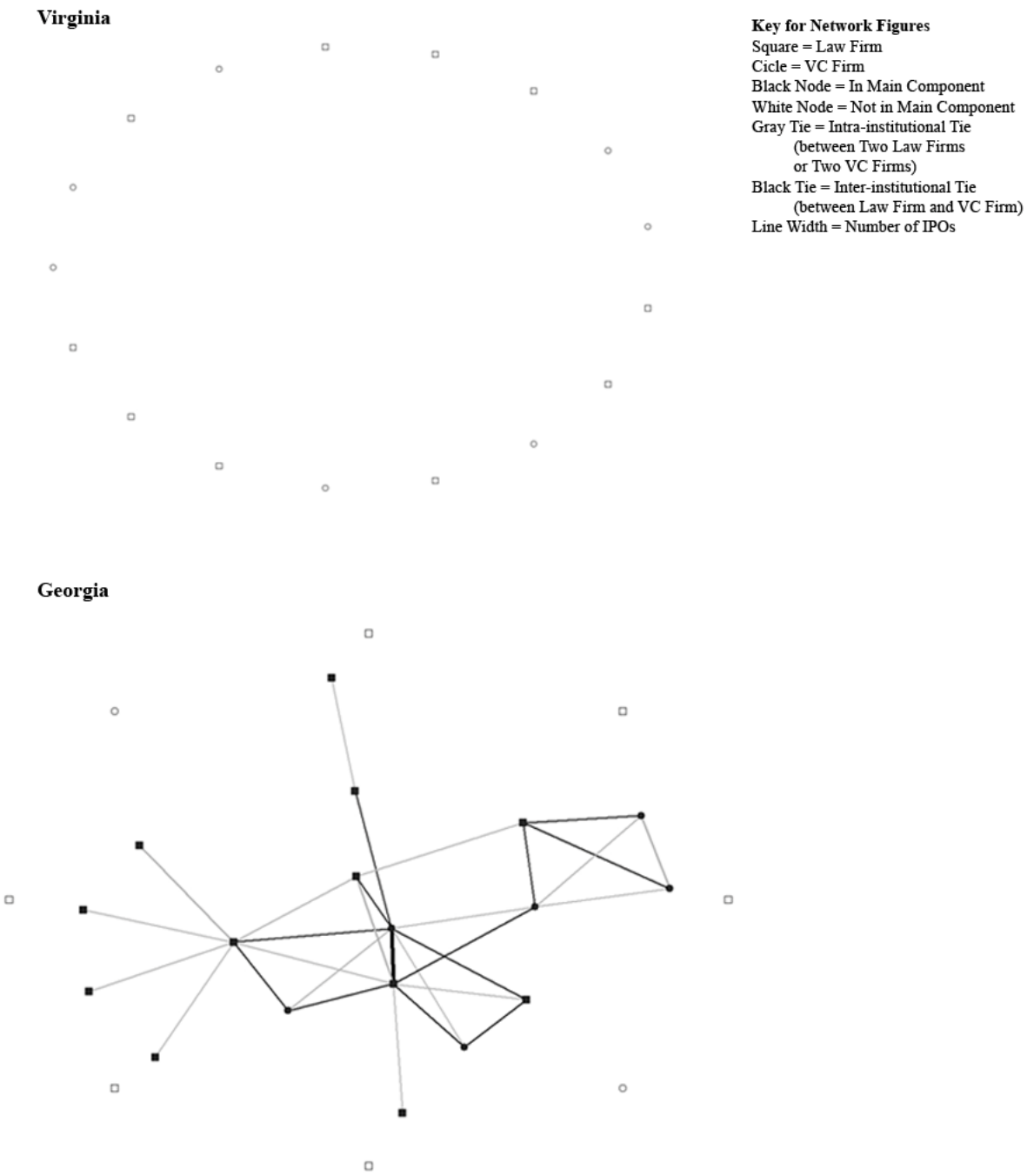


**Figure 3** Law Firm - Venture Capital Network for Low IPO Diversity States, 1993 – 2005

**Table 1** IPOs and Law Firm - Venture Capital Networks, 1993-2005

| | High Diversity | | Low Diversity | |
|---|---|---|---|---|
| | MA | WA | GA | VA |
| # IPOs | 142 | 46 | 32 | 30 |
| IPO diversity | 3.81 | 3.08 | 1.98 | 1.32 |
| # Law firms | 33 | 15 | 18 | 10 |
| # VC firms | 83 | 20 | 8 | 7 |
| % Strong law firm relations | 0.35 | 0.25 | 0.18 | N/A |
| % Strong vc firm relations | 0.24 | 0.15 | 0.17 | N/A |
| % Strong inter-inst. relations | 0.34 | 0.15 | 0.08 | N/A |
| % in main component | 0.91 | 0.81 | 0.69 | N/A |

**Table 2** Descriptive Statistics and Bivariate Correlations

| Variable | n | Mean | S.D. | Min | Max | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) IPO diversity | 227 | 1.775 | 0.837 | 1 | 4.829 | 1.00 | | | | | | | | | | |
| (2) Any IPO activity | 408 | 0.556 | 0.497 | 0 | 1 | n.a. | 1.00 | | | | | | | | | |
| (3) IPO volume | 408 | 1.807 | 6.684 | 0 | 72 | 0.40 | 0.24 | 1.00 | | | | | | | | |
| (4) Diversity among private firms | 408 | 7.421 | 2.457 | 1 | 11.910 | 0.24 | 0.48 | 0.17 | 1.00 | | | | | | | |
| (5) Law firms (capacity) | 408 | 0.033 | 0.101 | 0 | 0.921 | 0.02 | 0.18 | 0.12 | -0.02 | 1.00 | | | | | | |
| (6) VC firms (capacity) | 408 | 0.037 | 0.069 | 0 | 0.421 | 0.36 | 0.34 | 0.39 | 0.21 | 0.46 | 1.00 | | | | | |
| (7) Strong law firm connections (%) | 408 | 0.023 | 0.103 | 0 | 1 | 0.20 | 0.13 | 0.32 | 0.11 | 0.21 | 0.39 | 1.00 | | | | |
| (8) Strong VC firm connections (%) | 408 | 0.022 | 0.088 | 0 | 1 | 0.27 | 0.20 | 0.23 | 0.19 | 0.06 | 0.36 | 0.12 | 1.00 | | | |
| (9) Strong inter-inst. connections (%) | 408 | 0.023 | 0.070 | 0 | 0.500 | 0.38 | 0.28 | 0.51 | 0.23 | 0.14 | 0.47 | 0.43 | 0.30 | 1.00 | | |
| (10) % in main component (cohesion) | 408 | 0.087 | 0.139 | 0 | 0.585 | 0.47 | 0.44 | 0.55 | 0.34 | 0.22 | 0.56 | 0.41 | 0.23 | 0.53 | 1.00 | |
| (11) Patents per capita | 408 | 0.229 | 0.163 | 0.041 | 1.286 | 0.14 | 0.30 | 0.15 | 0.32 | -0.01 | 0.38 | 0.15 | 0.19 | 0.19 | 0.30 | 1.00 |
| (12) R&D obl. per capita | 408 | 0.331 | 0.699 | 0.023 | 5.333 | -0.05 | 0.08 | 0.03 | -0.06 | 0.83 | 0.34 | 0.08 | 0.08 | 0.05 | 0.03 | -0.07 |

**Table 3** Industrial Diversity among IPOs in a State Conditional on IPO Activity

| | M1 | M2 | M3 | M4 | M5 |
|---|---|---|---|---|---|
| Industrial Diversity among IPOs | | | | | |
| IPO Volume | 0.026 ** | 0.025 ** | 0.022 * | 0.017 | 0.014 |
| | (0.009) | (0.010) | (0.009) | (0.010) | (0.010) |
| Diversity among private firms | 0.071 * | 0.067 * | 0.061 * | 0.057 * | 0.053 * |
| | (0.031) | (0.030) | (0.030) | (0.027) | (0.027) |
| Law firms (capacity) | -0.636 | -0.559 | -0.536 | -0.592 * | -0.572 * |
| | (0.395) | (0.396) | (0.345) | (0.274) | (0.250) |
| VC firms (capacity) | 1.806 + | 1.393 | 1.124 | 0.890 | 0.711 |
| | (1.024) | (1.138) | (1.012) | (0.957) | (0.878) |
| Strong law firm connections (%) | | 0.000 | -0.284 | -0.274 | -0.469 * |
| | | (0.461) | (0.268) | (0.351) | (0.218) |
| Strong VC firm connections (%) | | 0.865 + | 0.743 + | 0.912 + | 0.817 * |
| | | (0.452) | (0.380) | (0.475) | (0.405) |
| Strong inter-inst. connections (%) | | | 1.338 * | | 1.026 + |
| | | | (0.811) | | (0.771) |
| % in main component (cohesion) | | | | 1.334 * | 1.223 * |
| | | | | (0.601) | (0.579) |
| Constant | 1.235 *** | 1.263 *** | 1.300 *** | 1.173 *** | 1.214 *** |
| | (0.277) | (0.273) | (0.269) | (0.229) | (0.229) |
| Any IPO Activity | | | | | |
| Patents per capita | 2.197 + | 2.188 + | 2.199 + | 2.226 + | 2.226 + |
| | (1.221) | (1.220) | (1.220) | (1.206) | (1.206) |
| R&D obl. per capita | -0.494 + | -0.519 + | -0.522 * | -0.492 + | -0.495 + |
| | (0.279) | (0.266) | (0.264) | (0.268) | (0.266) |
| Law firms (capacity) | 2.810 | 2.992 | 3.004 | 2.882 | 2.891 |
| | (2.642) | (2.558) | (2.545) | (2.590) | (2.574) |
| VC firms (capacity) | 12.578 + | 12.374 + | 12.330 + | 12.043 + | 12.039 + |
| | (6.854) | (6.757) | (6.742) | (6.834) | (6.806) |
| Period 1996 - 1998 | 0.650 ** | 0.647 ** | 0.646 ** | 0.610 * | 0.614 ** |
| | (0.229) | (0.228) | (0.228) | (0.238) | (0.237) |
| Period 1997 - 1999 | 0.534 * | 0.531 * | 0.528 * | 0.526 * | 0.524 * |
| | (0.225) | (0.225) | (0.225) | (0.231) | (0.231) |
| Period 1998 - 2000 | 0.305 | 0.303 | 0.298 | 0.285 | 0.282 |
| | (0.221) | (0.219) | (0.219) | (0.225) | (0.224) |
| Period 1999 - 2001 | 0.359 | 0.360 | 0.350 | 0.321 | 0.318 |
| | (0.222) | (0.221) | (0.223) | (0.228) | (0.228) |
| Period 2000 - 2002 | 0.073 | 0.052 | 0.042 | -0.007 | -0.007 |
| | (0.218) | (0.214) | (0.215) | (0.226) | (0.224) |
| Period 2001 - 2003 | -0.873 *** | -0.877 *** | -0.885 *** | -0.894 *** | -0.899 *** |
| | (0.209) | (0.209) | (0.210) | (0.221) | (0.220) |
| Period 2002 - 2004 | -0.172 + | -0.172 + | -0.174 + | -0.171 + | -0.173 + |
| | (0.094) | (0.095) | (0.096) | (0.097) | (0.098) |
| Constant | -0.710 * | -0.696 * | -0.692 * | -0.678 * | -0.676 * |
| | (0.311) | (0.310) | (0.310) | (0.309) | (0.310) |
| Rho Constant | -0.594 *** | -0.601 *** | -0.597 *** | -0.460 * | -0.477 * |
| | (0.175) | (0.173) | (0.173) | (0.211) | (0.205) |
| Sigma Constant | -0.267 *** | -0.274 *** | -0.283 *** | -0.326 *** | -0.328 *** |
| | (0.074) | (0.074) | (0.074) | (0.081) | (0.080) |
| N | 408 | 408 | 408 | 408 | 408 |
| chi2 | 42.483 | 47.560 | 67.520 | 110.337 | 134.874 |

+ p<.1, * p<.05, ** p<.01, *** p<.001 (one tailed for hypothesized variables and two tailed for control variables).
Period 2003 - 2005 is the ref. category for the period effects