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# Related Variety, Global Connectivity and Institutional Embeddedness: Internet Development in Beijing and Shanghai Compared

Jun Zhang

Utrecht University
Urban & Regional research centre Utrecht

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# Related Variety, Global Connectivity and Institutional Embeddedness: Internet Development in Beijing and Shanghai Compared

Jun Zhang
Department of Geography, National University of Singapore
Email: geozj@nus.edu.sg

**Abstract**

This paper contributes to the Evolutionary Economic Geography literature by employing the conceptualization of 'related variety' to compare the emerging internet industry in China's two largest city-regions: Beijing and Shanghai. Official website registration records, Alexa internet traffic counts, venture capital investment data and information gathered through interviews with internet entrepreneurs were combined to develop the analysis. The findings confirm that the replication and diversification of related variety play a leading role in shaping the locational dynamics of an emerging industry. However, the localized nature of new firm formation should not be taken for granted as transnational entrepreneurship and venture capital are playing an increasingly salient role. The contrasting experience of internet evolution in these two Chinese city-regions also suggests that a region's enduring political-institutional embeddedness significantly influences the generation and evolution of their related variety.

**Key words:** related variety, institutions, connectivity, Internet, China

**JEL classifications:** B25, B52, L25, L26, L52, L86, O18, O53, P25, R00, R11

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## INTRODUCTION

Studies of regional development are increasingly concerned with the spatialities of economic novelty such as new firms, new industries, and product and process of innovations (POLENSKE, 2007; ASHEIM and GERTLER, 2005). Nevertheless, we still know very little about why a new industry emerges in particular locations and not others, nor do we understand why certain regions are able to forge ahead through continuously adapting to a changing economic environment and creating new paths, despite firm-level routines and institutional inertia, whereas others are left behind due to their lock-in to an increasingly uncompetitive past (MARTIN and SUNLEY, 2006).

By focusing on industrial emergence and dynamics, evolutionary economic geography (EEG) has made considerable contribution in explaining such spatial unevenness of innovation and economic development. This paper seeks to contribute to the emerging EEG literature by drawing particularly the key concept of 'related variety' (FRENKEN *et al*., 2007; BOSCHMA and WENTING,

2007), which concerns the regional heterogeneity of firms and industries and the emergence of a new sector that grows out of preexisting, related industries. The overarching research question asked in this paper is how the regionally uneven emergence and evolution of a particular technological sector is shaped by the spatial distribution of related variety, and in turn, how the regional supply of related variety is influenced by a region's institutional embeddedness and spatial connectivity.

Existing EEG studies, by emphasizing the self-organization of the economic landscape in the absence of central coordination, commonly take a 'neutral space' perspective, arguing that the emergence of a new firm population is mainly to be explained by the initiatives of private agencies starting from the same scratch line within a homogeneous and constant institutional environment (BOSCHMA and MARTIN, 2007; BOSCHMA and FRENKEN, 2006). Unquestionably, power, politics, and state institutions influence the selection and retention of regional development paths by setting up the structure of incentives, opportunities and

constraints for new knowledge creation and diffusion at the regional scale (MACKINNON *et al.* 2009). However, to date institutional analysis is only 'loosely related to theories of economic evolution' and the complexity of the selection environment is yet to be treated in a sophisticated manner (ESSLETZBICHLER and RIGBY 2007, p. 558). This paper tries to strike a middle ground by embedding meso-level regional analysis on macroeconomic structures and institutions, while keeping EEG's microeconomics of firm routines (LAGENDIJK, 2006). Specifically, I explain how the historically and institutionally constructed region-specific industrial structure has placed Beijing and Shanghai in an unlevel playing field when the opportunity of internet arrived.

Among the multitude of institutional approaches, this paper departs from the popular 'soft institutionalism' by focusing on politically constructed institutions of the market and their specific forms of spatiality (LAGENDIJK, 2006). Findings of this study suggest that regional political-institutional embeddedness, which is produced by both historically-inherited legal-political structures and ongoing power interplay between local and central states, contributes to uneven regional economic development independent from the force of economic self-organization through its enduring influence on new variety generation and connectivity building at the regional scale.

The existing 'related variety' argument is essentially built on the presumption that new firms locate near their founders or parent firms thus the existing spatial unevenness is reproduced and reinforced through the process of industrial growth (e.g. BOSCHMA and WENTING 2007). To build a new technological sector in a latecomer region in the global periphery, however, knowledge transfer from the remote global technological center such as Silicon Valley is more essential than localized learning processes at least at the early stage. To explain new sector formation across heterogeneous geographic contexts, therefore, it is necessary to develop a more sophisticated account of related variety incorporating the complication brought about by external connectivity to localized entry dynamics and routine replications. This paper also demonstrates that the driver of regional variety generation, under the joint influence of territorial institutions and relational connectivity, is not just knowledge but the interplay between knowledge and

capital (POWELL et al., 2002; O'SULLIVAN, 2005). Consequently, venture capital (VC), a key supplier of both knowledge and capital to technological startups, is best to be viewed as a generic variety vital to the growth of technological sectors such as the internet.

Seeking to go beyond the commonly found one-off single-location case studies in geography (GERTLER 2010), this paper also offers a systematic comparison of the formation of the internet industry in two major Chinese metropolitan areas, Beijing and Shanghai. The analysis is developed on the basis of data gathered through interviews with around 300 founders and chief managers of internet startups and venture capitalists between 2000 and 2008, as well as two major databases constructed by the author on Chinese internet websites and venture capital investment. The remaining part of the paper is organized as follows. Part two explains the theoretical constructions of a related variety approach, and how it can be strengthened by a more serious take on institutional embeddedness and global connectivity, as well as the interplay between knowledge and capital. Part three introduces the data sources of this paper and clarifies methodological and conceptual issues. After briefly discussing the national institutional environment of internet development in China, the fourth section compares the experience of internet development in Beijing and Shanghai in two stages in great detail. Finally, some general conclusions are drawn out of the empirical findings.

## THEORETICAL BACKGROUND: RELATED VARIETY, GLOBAL CONNECTIVITY AND INSTITUTIONAL EMBEDDEDNESS

A major strength of an evolutionary approach to regional economic development is in explaining the spatial evolution of a newly emerging industry (BOSCHMA and FRENKEN, 2007; ASHEIM and GERTLER, 2005; MARTIN and SUNLEY, 2006). From an evolutionary perspective, FRENKEN and BOSCHMA (2007) suggest that industrial dynamics and urban growth can be understood as a progressive process of diversification centered on the notion of related variety, which is defined from a cognitive perspective as industrial (sub)sectors that are related in terms of shared or complementary knowledge bases and competences (see also, BOSCHMA and IAMMARINO, 2009). A related variety approach to the geography of industrial dynamics focuses on the spatially-uneven replication and modification of organizational routines from parent to progeny firms.

Growth through diversification means that the creation of new knowledge is most likely to be enabled and accelerated by prior specialization in related or complementary streams of knowledge. In this view, industrial innovation is a Schumpeterian process of 'recombinant growth' (WEITZMAN, 1998) as existing pieces of knowledge are recombined or modified in unprecedented ways. The initiation of the 'recombinant growth' of a new industry depends on a region's concentration of related older industries, offering a stock of potential individual and organizational founders for new ventures together with their pre-entry knowledge and capabilities (KLEPPER, 2002; BOSCHMA and WENTING, 2007; HELFAT and LIEBERMAN, 2002). The subsequent process of 'recombinant growth' is self-feeding because the probability of innovation increases with the related variety available for recombination. The more product varieties already present in a region, the higher the probability that new product varieties can be generated by recombining existing routines. Cities or regions with a larger concentration of early market entrants of a new industry thus face better growth opportunities and a decisive

first-mover advantage for a sustained period of time. In so far as experienced entrepreneurs locate their new firms in the same region, the pre-existing structure and spatial pattern of related variety are reproduced and reinforced through localized self-reproduction (BOSCHMA and WENTING, 2007; WENTING, 2008). We therefore expect: *the size and performance of a regional firm population in an emerging sector at a time period $t_1$ is positively correlated to the stock and quality of firms in the focal industry and its related ones at the previous time period $t_0$* (Hypothesis I).

FRENKEN *et al.* (2007), treating intra-sector variety as related and inter-sector variety unrelated, argue that knowledge spillovers within the region should occur primarily within, rather than between, sectors. However, varieties across sectoral boundaries can also be mutually related. BOSCHMA and WENTING (2007), for example, demonstrate that the emergence of Coventry to become the UK center of the car industry can be explained by the prior concentration of firms in related industries such as bicycle and coach making and the regional spin-offs they generated. Technological relatedness, therefore, should be defined contingently, relative to the characteristic of the particular technology in question. The arrival of a radical innovation, especially the birth of a general purpose technology such as the internet, opens up enormous new possibilities for 'recombinant growth' across sectors, which can render previously 'unrelated' sectors related. For example, the birth of the internet technology offers a novel opportunity for a traditional media to be transformed into internet media, hence relating the otherwise unrelated sectors of the internet and media. Therefore, a radical innovation will create an extended period of rapid market entry by a diverse set of entrants, including experienced ones from other related industries and inexperienced ones without much relevant pre-entry specialization (ibid.). Over time, as the product space becomes more crowded and selection pressure rises, other market entrants are expected to be progressively replaced by spinoff entrants with prior experience in the same industry due to an even better learning environment (BOSCHMA and WENTING, 2007; FRENKEN and BOSCHMA, 2007). Hence, we anticipate:

*the predominant mode of new market entry shifts from inter-sector recombination to intra-sector recombination led by spinoffs as an industry grows* (Hypothesis II).

Crucial to the related variety argument is a frequently taken-for-granted assumption, or 'banal fact', that new firms tend to locate at the places of their founders or parent firms (MASKELL and MALMBERG, 2007, p. 612; BOSCHMA and WENTING, 2007; FELDMAN *et al.,* 2005; KLEPPER, 2002). By locating near existing firms, new firms can certainly take advantage of established labor specialization and social networks, and to gain early exposure to knowledge produced by nearby firms. In an era of globalization when entrepreneurship has become increasingly transnational, however, such a phenomenon should not be a presumption but subject of empirical inquiry (YEUNG, 2009). New and related variety may very likely be brought into a region through established extra-local linkages of local firms and entrepreneurs, as well as through the inflow of foreign direct investors, venture capitalists, skilled immigrants, and returning expatriates (BOSCHMA and IAMMARINO, 2009; SAXENIAN, 2006; BATHELT *et al.*, 2004). In this view, a region's external connectivity can be a crucial complementary element to its local concentration of related variety in determining the trajectory of the region's 'recombinant growth'. For an emerging peripheral region, global connectivity is the necessary precondition to the building of a new technological sector, because firms must rely predominantly on replicating routines originated from remote global technological centers such as Silicon Valley. The stock of related variety in a well-connected region can be enlarged and enhanced by substantial inflow of information, knowledge, resources and people. For these reasons, we expect, *latecomer regions' asymmetric connectivity to the global technological center, which can import novel variety into a region and complement its existing pool of related variety, to a large extent explains their disparity in the formation of a new technological sector* (Hypothesis III).

The related variety approach can be further advanced by an explicit recognition of the key influence of finance capital on regional industrial dynamics, especially venture capital, because firm financing is not logically prior to or separate from knowledge production (POWELL *et al.,* 2002; O'SULLIVAN, 2005). There has been clear empirical evidence that local access to venture financing and experienced venture capitalists significantly increases the number of high-tech startups in a region and the likelihood of their success (e.g., ZOOK, 2002, 2005; POWELL *et al*., 2002; MARTIN *et al.*, 2005, KENNEY and PATTON, 2005). VC obviates the need to learn and grow slowly via self-financing, and fuels more rapid learning and growth. More importantly, venture capitalists provide 'infrastructural knowledge' (GERTLER and WOLFE, 2006), business experience, network connections, initial public offering (IPO) opportunities, and so on to enhance the survival and success of their investees. In this view, the role of VC is similar to a generic variety that can facilitate technological entrepreneurship across sectoral boundaries. Compared to developed economies, VC is in greater demand in developing economies where, in addition to the shortage of original technology, "capital generally has low availability and high costs" due to "poorly developed financial markets, weak institutions for distribution of capital, and volatility in economic development" (HITT *et al.* 2000, p. 451). Hence it is reasonable to suggest, *venture capital, by playing the role of a generic variety, makes salient contribution to the differential regional growth of technological entrepreneurship* (Hypothesis IV).

EEG generally assumes that when a new industry emerges, regions constitute 'neutral space' – free from institutional constraints – that is only transformed into institutionalized 'real places' mainly through the initiatives of private business agents (BOSCHMA and FRENKEN, 2006). Apparently, regions are always institutionalized 'real places' in the real world, and locally distinctive institutional architectures governing entrepreneurship and organizational investment

play a decisive role in narrowing the window of locational opportunity for a nascent industry at the regional scale (ESSLETZBICHLER and RIGBY, 2007). Yet this role of institutions in regional technological dynamics is still poorly understood and the complexity of selection environments is yet to be treated in a sophisticated manner (GERTLER, 2008; MACKINNON *et al.,* 2009).

Institutions are a multi-layer system of norms, routines, and rules, crystallized from past socio-political practices, that guide and govern economic behaviors in spatially differentiated ways (MARTIN, 2000; NELSON, 1995). Many institutional elements, especially legal-political ones, of an advanced market economy that are taken for granted by theorists, e.g., private firms competing under a mature and stable regulatory regime with a largely irrelevant government, are highly heterogeneous and problematic in emerging market economies. Spatial variations in such harder, legal-political institutions of capitalist market systems, which to date have only received scant attention in regional studies, are likely to alter the selection environment of entrepreneurship and new variety generation in significant ways (LAGENDIJK, 2006). Legal-political institutions of the market, among other things, may crucially influence the choice set of firms and entrepreneurs through the creation, distribution, and protection of property rights or who have claim to the profit, the governance of market entry, competition, and labor mobility, as well as the governance of venture capital and the financial sector (cf. FLIGSTEIN, 2001). Market institutions are produced and reproduced through a process, usually long-term, of inter-scalar interactions between regional and national institutional architectures (GERTLER, 2010). Thus, we anticipate, *a region's political-institutional embeddedness exerts strong and enduring influence on both the initiation and evolution of a new technological sector therein through affecting both its related variety and global connectivity, especially in an emerging large national economy such as China characterized by a high level of state intervention, exogenous technological dependence, and regional disparity* (Hypothesis V).

## DATA SOURCES, METHODOLOGY AND DEFINITION

The author has studied China's Internet industry for a decade. Interviews with around 300 Internet startup founders and chief managers, and venture capitalists, were conducted during 2000, 2002, 2003 and 2008, mainly in Beijing and Shanghai. The interviews were open-ended, lasting about one hour each, and conducted mainly in Chinese. Questions asked covered general firm information, the processes of the firm's founding and financing, the personal and professional background of the founders, the firm's locational considerations, the firm's principal business linkages and interactions with the state, and the perceived strength and weakness of the business environment at both local and national scales. In addition to the interview data, this paper mainly uses two sets of statistical data – Alexa and Zero2IPO to elucidate the subtle dynamics of related variety. The first dataset termed Alexa data was created in the following ways. First, Chinese commercial website registration records, mainly from Provincial (or Municipal) Communications Administrations (PCAs) and the State Administrations of Industry and Commerce (SAIC), were used to measure Internet firm population and their attributes. A national list was compiled of 11,699 commercial websites established between 1994 and 2004. This is a nearly complete census of commercial websites owned by corporations with legitimate legal status, whom can be understood as broadly defined Internet content providers (ICPs). Each firm had at least one commercial Internet website attracting a significant amount of Internet traffic, though its revenue need not only be generated from online services. Each of these websites was then searched on www.alexa.com, to determine their three-month average global traffic rank as measured by daily page views in the last week of December 2004. The 2,554 websites that ranked among Alexa's top 100,000 were further

analyzed, to determine the office addresses and the identity of their principal founders. Finally, websites headquartered in Beijing and Shanghai were isolated for comparison.

In order to take into account both the mixed nature and global connectivity of China's transitional economy, a special taxonomy of Internet firm founders was also developed for the Alexa data (Table 1). This is based on two dichotomies: 1) organizational and entrepreneurial, and 2) state and non-state. When state owned enterprises (SOEs) and other state organizations were the founder, four categories were highlighted: state media, state telecom, state agency and academic unit. For non-state organizational founders, domestic firms and foreign firms are distinguished. In order to highlight the role of returning expatriates, I also distinguish domestic entrepreneur founders from overseas returnee founders.

(Table 1 about here)

The second, Zero2IPO dataset contains more recent information. Zeo2IPO, China's leading VC consulting company, based in Beijing, has tracked active venture capital and private equity (VC/PE) investment institutions and their investment portfolio companies on a day-to-day basis since 2000. Zero2IPO keeps close communication with investment institutions in China, regularly conducting questionnaire surveys and crosschecks. Its online database contains detailed information for over 750 VC/PE investment funds in mainland China, around 4000 transactions, including cases on VC/PE investment and public listings, and over 3000 investment recipient enterprises, including financial information and career trajectories of the founding and management teams. From the Zero2IPO database, 275 VC-backed Internet firms in Beijing and 105 in Shanghai were extracted. Internet firms here include not only broadly defined ICPs in

Alexa data, but also those offering technical services exclusively targeting the internet sector whose very existence is based on the internet.

In order to understand the pattern of sub-sector variety, these firms were further classified into nine related categories: 1) comprehensive portal (or web aggregation such as Yahoo), 2) vertical portal (online services targeting a particular sector such as travel or housing), 3) e-commerce (Internet based retail and wholesale services including both Business-to-Business and Business-to-Customers), 4) e-media (Internet TV and other Internet-based media services) 5) e-game (Internet-based game services); 6) e-learning (Internet-based commercial education services), 7) e-community (Internet-based services specialized to facilitate the interaction of certain social communities, such as Facebook); 8) wireless services (Internet-based text messages, ringtones, and other services for mobile phone users); and 9) Internet software and services (search engine, email, network security, web hosting, online advertisement solutions, online payment solutions, and instant communications, etc. that exist for the Internet). [1]

With reference to KLEPPER (2002), BOSCHMA and WENTING (2007), and WENTING (2008), three types of market entrants in the Internet industry are differentiated: spinoffs, experienced entrants, and inexperienced entrants. Spinoffs are stand-alone new firms founded by incumbent firms or their (former) employees in the same industry. Stand-alone new firms founded by pre-existing firms or their employees in a different but related industry are called experienced entrants. Companies set up by students, scholars, business entrepreneurs or firms holding no related pre-entry experience are called inexperienced entrants. Whenever a firm had

[1] Whenever a firm had multiple types of operations, the single most significant operation was viewed as determining the sub-sector to which the firm is assigned. This is determined by the author with reference to my interview data, Zero2IPO data, the company's website, and other published information available on reputable newspapers and business magazines.

multiple founders, the one with the most related experience to the Internet industry was viewed as the founder determining the entrepreneurial background of the firm. For the Internet industry, ICTs and media are generally considered as the related industries. Given the broad application of the internet, experienced entrants in this paper are defined as those entrepreneurs and firms combining their preexisting technical and/or commercial expertise from non-Internet sectors with the Internet technology to form a new business operation. For example, when a pre-existing retailer came to offer its conventional retail services online, it is considered as an experienced entrant given the complementarity of its preexisting knowledge base to the new business operation; but if a former offline retailer chose to do e-education, then it is classified as an inexperienced entrant.

Market entry dynamics in the two city-regions is presented through a comparative case study approach incorporating micro-, meso-, and macro-level data, designed to catch causal factors, endogenous and contextual, leading to differentiated, path-dependent regional growth trajectories through time. At the firm level, comparative, longitudinal data are acquired from Alexa and Zero2IPO data, supplemented by interviews and published secondary sources. At meso and macro levels, contextual information on economic and institutional features is mainly obtained from relevant empirical literature on Beijing, Shanghai and China, corroborated by my interview data and some analytical business reports.

## INTERNET DEVELOPMENT IN BEIJING AND SHANGHAI

### The Institutional Architectures of Internet Development in China

Unmistakably, China's industrial capitalism remains heavily shaped by the visible hand of the state. China's reform era did not start from a clean slate but rather originated from a centrally-planned socialist system in which the state owned the vast majority of productive assets

and controlled all dimensions of production and distribution. NEE and OPPER (2007, pp. 93-94) entitle China's hybrid institutional order 'politicized capitalism', where "recombinant elements of central planning and state control combine and interact with emergent markets and private ownership forms". In general, China's transitional economy is characterized by a mixed economy with a diversity of organizational forms and a plurality of property rights, continued importance of bureaucratic power, nontransparent and often arbitrary decision-making in the public domain, as well as ever-increasing global interactions (e.g., ZHOU *et al.,* 2003; MCNALLY, 2007; HUANG, 2008). Such an institutional and market environment means that firms face relatively high and changing sources of uncertainty. As an emerging sector, the Chinese Internet industry suffers even greater institutional uncertainty since its decentralized, participatory nature threatens the Chinese Communist Party's ideological hegemony and media censorship. As a result, the Internet industry faces a regulatory and business environment that is a complicated maze and must be navigated with particular caution (BATJARGAL 2007).

In China's mixed economy there are various types of institutional links between firms and political authorities, especially in the form of different property-right relationships among firms. Such varying institutional links generate firm-specific resources and constraints and induce distinct incentive structures and firm behaviors (ZHOU et al. 2003; ERNST and NAUGHTON 2007). In the Internet sector, private firms have to face the challenge of meeting intimidating license requirements, reducing political uncertainty, securing finance capital outside of the state-dominated bank sector, and accessing other state-controlled resources such as Internet bandwidth that SOEs normally do not have to worry about (cf. SEGAL 2003). SOEs, however, are generally under the tight control of a party committee, especially in terms of their

management, personnel appointment, salary system, and source of financing[2]. Therefore private Internet firms enjoy a larger degree of freedom in financing and decision-making than SOEs. Foreign investment in Internet and telecom sector was officially banned before China's WTO entry in 2001, and remains restricted. Practically, however, private firms are able to loosen such restrictions through subtle organizational designs and connections with regulators. Hence both state and non-state Internet firms have been "dancing with shackles," to quote one of my informants, even though they face fairly different choice sets[3]. In general, state-owned units face lower barriers to market entry, but higher barriers to growth, than non-state firms.

The particularity of China's national institutional environment has also created a distinctive financial system. China's banking sector is still dominated by the state, and is designed to support large SOEs rather than financially-stricken private, small and medium enterprises. China's domestic VC industry, also closely tied to the state, started to emerge only in late 1990s, largely stimulated by the Internet boom. Thus far, China's VC market has been largely dominated by foreign investors with international reach of knowledge and capital (WHITE *et al.,* 2005). By the end of 2007, 72 percent of the $21.3 billion of fund targeting the Chinese market managed by active VC institutions were controlled by foreign invested VC institutions (ZERO2IPO 2009).

In addition to the idiosyncrasy of the national institutional environment, China's market-oriented transition has been geographically uneven, in which place-specific institutions persist in importance. China's large size also introduces starkly differing local conditions, creating many local forms of capitalism, from predatory to enabling local governments

[2] Interview with the director of a major state-owned Internet media, Beijing, 25 May 2002.

[3] Interview with the founder and CEO of a pioneering Internet firm, Beijing, 29 April 2002.

(MCNALLY, 2007, p. 118). On the one hand, distinct local economies in China were directly created by major policy decisions made at the center. [4] For example, the establishment of Shenzhen Special Economic Zone (SPZ) in 1980, the launch of Shanghai's Pudong New Area as another major SEZ in 1992, and the official establishment of Beijing's Zhongguancun (ZGC) Science and Technology Park in 1999 [5] are the three most salient landmark central state initiatives in China's post-Mao economic development with profound local and national impact (cf. ZHOU 2008). On the other hand, as SEGAL (2003, p.4) argues, local economic heterogeneity in China was created when local authorities implemented central government directives in property rights, investment structures, and government regulation differently. Due to different levels of autonomy granted by the central government, and different local power geometries and industrial structures inherited from the centrally-planned economy, both the state power and socio-political networks function in different ways at the local scale. In sum, China's unique national institutional architecture unfolds in different ways at the local scale, setting the backdrop for the variegated evolutionary trajectories of the Internet industry in Beijing and Shanghai.

**Beijing's First-mover Advantage during the Incipient Stage: Before the 1999 Internet Boom**

Beijing and Shanghai are noteworthy because they are the two largest metropolises in China, two of China's most salient economic powerhouses, and two of the most noticeable rising global cities in the global South. Compared to Beijing, Shanghai has a larger population base, and a

[4] I thank an anonymous reviewer for bringing this point to my attention.

[5] In 1988, Zhongguancun was already recognized by the central government of China as "Beijing High-Technology Industry Development Experimental Zone" (cf. Zhou 2008).

larger and more advanced economy as measured by GDP per capita (Table 2). Moreover, Shanghai has a much more impressive record of attracting foreign direct investment (FDI) than Beijing. Surprisingly, however, Shanghai's Internet sector is only a small fraction of Beijing's, however it is measured. Why has this been the case? More specifically, what are the political-institutional and self-organizational mechanisms leading to such divergent regional paths of Internet development, and how may this be explained by the notion of related variety?

(Table 2 about here)

Understanding the disparity of Internet development between the two city-regions should begin with a comparison of their initial conditions (Tables 3 and 4). With the concentration of elite universities and research institutes, especially the 'talent triangle' in its ZGC area - Peking University, Tsinghua University and Chinese Academy of Sciences, Beijing is the dominant national center of advanced education and talent in China (ZHOU 2008). In comparison, Shanghai's talent base is weaker, although the second best nationally. Complementary to the local differentiation of talent bases, state policy of high-tech zone development has had profound influence on the uneven spatial development of high-tech industries in China. Beijing's ZGC Science Park (ZSP), first established in May 1988, is the first and also the largest science park in China. Dubbed China's Silicon Valley, the innovative and competitive atmosphere in ZGC has benefited from active bottom-up development of many small and medium sized non-state companies in a market environment since mid-1980s (ZHOU 2008). Many of the early leading ICT firms were spinoffs from the academic community in ZGC. Meanwhile, Beijing is also unique in its exclusive concentration of central media units directly under the arm of Chinese Communist Party, which are closely related to Internet content services within this capital city.

(Table 3 about here)

SEGAL and THUN (2001) argue that the disparity of ICT development between Shanghai and Beijing is more a consequence of Shanghai's interventionist municipal government than the weakness of its talent resource. In sharp contrast to the active entrepreneurship and dominance of small and non-state high-tech firms in Beijing, the limited entrepreneurship in Shanghai's technological development mainly originated from a few large SOEs. Shanghai's high-tech development also benefited from favorable state policy and the opening up of a number of high-tech zones, but these were developed through a top-down approach, controlled and orchestrated by the municipal government (WALCOTT and XIAO, 2000). Although it is China's largest urban economy, Shanghai has one of the smallest domestic private sectors in the country (ZHANG, 2003).

Beijing, in contrast, had a more fragmented local bureaucracy that was unable to effectively control local firms or build new business groups. Instead, they promoted multiple property rights and were relatively less likely to intervene in the internal operation of firms (SEGAL, 2003). Furthermore, firms in Beijing, the national center of policy-making, apparently had much better access to political resources through localized networks than those in Shanghai (ZHAO *et al.,* 2005). Consequently, Beijing ICT firms both are linked to a wider range of state agencies at all levels, and have a higher degree of autonomy and horizontal connections, than their counterparts in Shanghai, where vertical ties dominate mutually isolated firms (SEGAL, 2003).

While Shanghai's heavy-handed, micro-level state intervention was favorable to large,

state controlled business groups at the expense of small indigenous entrepreneurship, its selective liberalization policy was highly accommodating to returnee entrepreneurs and FDI (HUANG 2008, p. 178). Shanghai municipal government has made great effort to make up the deficiency of indigenous entrepreneurship through 'importing' exogenous entrepreneurs since 1992, when the Pudong New Area was granted an SEZ status by the central government. As Dai Haibo, general manager of the state-owned Zhangjiang High-tech Park Development Inc. in Pudong, said, "Due to a lack of local entrepreneurs, the strategy of Zhangjiang was to import overseas returnees, importing entrepreneurs from other regions and cities, to transplant an 'innovation culture' to Zhangjiang and cultivate it locally" (LIU, 2002). To achieve such a policy objective, massive investment was devoted to infrastructure upgrading, tax incentives and other subsidies were offered to firms in Zhangjiang and other high-tech Parks, incubator functions were made available to start-ups, and attractive incentive packages were also presented to overseas returning entrepreneurs.[6]

The early disparity in the number and structure of Internet firm founders between Beijing and Shanghai clearly demonstrated the gaps in their initial conditions. Fig. 1, based on the Alexa data, compares the firm population and founder structure in Beijing and Shanghai during the inception period (1994-1998). Although Internet entrepreneurship in both cities was severely constrained by minimal market demand, a lack of finance capital and exceedingly high uncertainty, the size of Beijing's Internet startup population as measured by Alexa top 100,000 websites was more than triple that of Shanghai's. Beijing dominated Shanghai in state founders, particularly state-owned media entities and various state agencies, who were privileged in terms of not only shorter cognitive distance for 'recombinant growth', but also better access to

[6] Personal interviews with executives of several Shanghai Internet firms, Shanghai, September 2003.

regulatory permissions and state resources. Beijing's advantage over Shanghai in the non-state sector was equally significant[7]. Beijing had a particularly large number of non-state organizational founders, whose lineage could often be traced back to the first generation ICT firms founded in ZGC. For example, the organizational founder of Sina, a leading Chinese portal, was Stone Rich Sight Software (SRSS), a spinoff of Stone Group, one of the most well-known ZGC ICT firms started in 1984. For subsequent, path-dependent 'recombinant growth', a city-region's initial parent firm population matters not only in terms of its size but also its ownership structure and institutional linkages. As it will be made plain in the next section, this is because different types of firms are characterized by different choice sets and 'reproductive capacity'.

(Fig. 1 about here)

In the early 1990s, VC was a virtually non-existent industry whose political legitimacy was debated in China. Some American VC institutions such as the IDG VC, the VC investment arm of International Data Group, were able to legitimize their practices through joint-ventures with local divisions of China's Commission of Science & Technology. According to Zero2IPO data, by the end of 1998 there were 6 domestic and 15 localized foreign active VC firms[8] in mainland China. These firms were largely concentrated in Beijing and Shanghai, with Beijing

[7] In the non-state sector, the dominance of organizational founders over individual entrepreneurs reveals the stringent constraint of finance capital at the time. Financing was largely unattainable for individuals, except from informal channels or some established firms in the high-tech sector, whereas organizational founders could be financed at least partly through corporate retention.

[8] Defined as those VC firms with at least five investment deals by the end of 2008.

hosting 17 of their offices and Shanghai 14[9]. The disparity in VC-backed Internet firms, however, was much larger than that of VC institutions between these two cities. Zeo2IPO data show that among the 275 VC-backed Internet firms by 2008, 32 were already founded and 11 actually financed by VC by 1998 in Beijing. In Shanghai, however, only nine such firms were founded and one VC-financed by 1998. This only VC-financed firm in Shanghai then was American Wireless Communication, founded in Silicon Valley in 1994 by a Chinese Ph.D. from Stanford University, and relocated to Shanghai in the same year. This disparity between Beijing and Shanghai was partly caused by the fact that foreign VC investment was first allowed only in some 'politically-harmless' IT media, and Beijing had the double advantage of being China's IT center and media center.

Similarly, a national survey by CNNIC in July 1998 revealed that 24 out of the 35 most popular websites were found in Beijing, but only one in Shanghai (CNNIC, 1998). This local champion, Shanghai Online, was an all-encompassing giant, with services ranging from ISP, to news, entertainment, and stock trading, jointly founded by Shanghai Municipal Government and Shanghai Telecom Administration. This exemplifies how Shanghai's heavy-handed government intervention impeded participation by the non-state sector, channeling large amounts of public funds into a few dominant government-owned and operated initiatives (CLARK *et al.*, 1999).

In contrast, a more enabling institutional environment in Beijing was accompanied by a more active VC investment, and equally active Internet entrepreneurship generated from highly diversified origins with rich local and non-local connections. 12 of the 24 popular Beijing websites identified by the CNNIC 1998 survey aforementioned had direct connections to the knowledge base of ZGC in different ways, founded either by ZGC IT firms or universities, or by

[9] One firm may have multiple offices: headquarter, subsidiary, or representative.

entrepreneurs tied to them. Four of them were founded or cofounded by returnees and five were foreign VC-backed IT media such as PCWorld and Chinabyte. Table 4 provides profiles of a selected set of anchor firms in Beijing at the time. One can see that Beijing's related variety in the form of an earlier generation of nongovernmental IT firms served as important parents of Internet startup founders. Global connectivity established by overseas returnees, with or without related working experience, from North America also played a crucial part.

Charles Zhang, the founder of Sohu and a graduate of Tsinghua University in 1986, is exemplary to the returnee Internet entrepreneurs at the time[10]. After received his Ph.D. at MIT in 1993, Charles joined an American company Internet Securities Inc. (ISI) in November 1995 and returned to Beijing to establish the ISI China operation. While at ISI, Charles envisioned an Internet search engine company and started his own company Internet Technologies China (ITC) in 1996 after persuading two fellow MIT Professors to pony up $225,000, enough to get started.[11] Charles changed the name of his company first to Sohoo and later Sohu, after a meeting with Yahoo's co-founder Jerry Yang, and in March 1998 received $2.2 million venture funding from Beijing-based IDG VC, Intel VC, and others.

Just like Charles Zhang, it was through the initiatives of many returnees, mostly with their first tertiary degree received from ZGC's elite schools before going abroad, and their support received from increasingly localized overseas VC investors, that Beijing's Internet industry took its root. As another US returned forerunner of Beijing's Internet industry put it, "there was a

[10] This part of discussion here is based on a personal interview with Charles Zhang and his secretary in July 28, 2002 in Beijing. Special permission was granted for information disclosure. Zhang's story has become widely publicized in China with the subsequent success of Sohu.

[11] The two professors are Edward Roberts, Chairman of MIT's Entrepreneurship Center, and Nicholas Negroponte, the founder and Chairman of MIT'S Media Lab.

group of returnees like me who had basically five to ten years of living experience in the US. These people are not contented to stay in the states and to follow the conventional path to become a middle class and to lead a comfortable, but banal life. They have a strong motivation to do something in this market of China, and the advent of the Internet offered them a stage to put what they've learnt and understood into action." [12]

The building of global connectivity and associated knowledge transmission took an array of forms, in addition to the returning of entrepreneurial expatriates with prior exposure to the internet. For example, Beijing-based, returnee-founded, VC-backed, and US-incorporated AsiaInfo, together with UTStarcom, another system integrator of exactly the same kind, were the principal builders of China's Internet backbones before 1999. Another illuminating example is Wang Zhidong, the co-founder of Sina who did not have any overseas background. However, Wang visited Silicon Valley three times between late 1995 and early 1996 through the introduction of Feng Bo, a returnee then working for a Silicon Valley VC firm. The exposure to Silicon Valley's 'Internet heat' convinced Wang to make a strategic transition of his company to the Internet in mid 1996. Under the guidance of Silicon Valley venture investors, Wang's software startup was completely restructured according to Silicon Valley criteria, and subsequently in 1998 merged with SinaNet, a Silicon Valley based Internet startup founded by a group of Taiwanese. Wang, later in retrospect to his tremendous learning experience, said, "in two years and two months, I went through an excruciating process, which is equal to finishing a MBA degree. All the other leaders of our company also completely changed, our mental models were able to break through a lot of previous limits." (Fang et al. 2000)

A larger number of founders in Beijing with certain Internet-related prior specialization and varied connections to the Internet innovation center Silicon Valley therefore brought about

[12] Personal interview, June 11, 2002, Beijing.

more varieties of ideas and a higher level of subsector diversification and specialization (Table 5). In general, at the time, subsector variety was limited; the dominant business model was ISP bundling some preliminary content services, imitating the American role models AOL or CompuServe. 17 out of 35 most popular commercial websites identified by the CNNIC 1998 survey were of this kind (CNNIC, 1998). However, as indicated by Table 5, e-game, e-learning, e-commerce, wireless services, comprehensive portals, and a variety of sector- or community-specific vertical portals already emerged out of Beijing's active Internet entrepreneurship in addition to its domination of ISP, even though all of them were at a unprofitable, experimental phase. In sharp contrast, Shanghai's Internet industry by 1998 was characterized by a much smaller firm population under the dominance of Shanghai Online, and consequently limited subsector diversification and specialization. As a result, Beijing firmly established its first-mover advantage during the inception stage of the industry through its endowment of a favorable institutional environment and a more abundant stock of related variety supplied by ZGC's pre-established ICT base, further advantaged by rich global connectivity through returnee entrepreneurs and foreign VC support. Such observations are hardly compatible to the assumption of 'neutral space', and the belief of localized characteristic of new firm formation as suggested in the literature. Rather, they lend support to Hypotheses III, V, and also IV, pointing out the criticality of global connectivity to technological development in the global periphery, the profound and lasting institutional influence on the window of locational opportunity behind the scene of entrepreneurial initiatives, as well as the decisive role played by venture capital.

(Table 5 about here)

**Beijing's Renewed Advantage during the Growth Stage: from 1999 onwards**

The global Internet boom between 1999 and 2000 and subsequent bust also swept China. However, a new boom quickly returned in China due to rapid expanding domestic markets. Through years of trial-and-error, China's Internet practitioners learnt that many of the American business models that they were trying to emulate were unlikely to work, at least in the short run. Rather, the most reliable, but unanticipated, profit sources are China's enormously large number of online gamers and mobile subscribers, both having grown into the largest market segment of the world in number since 2003 (IRESEARCH 2008). E-game, Internet-based mobile services, and e-advertisement deeply engaged with the domestic market have since been discovered as the primary goldmines and firmly established as the dominant revenue sources for Chinese Internet firms (ibid.).

The resurgence resulted in a dramatic enlargement of the Internet firm population in both metropolises since 1999 despite the temporary slump. From 1999 to 2004, Beijing had 822 newly-founded Alexa top 100,000 websites, and Shanghai had 253 (Fig. 2). The absolute rise and relative fall of Shanghai's firm population compared to Beijing's indicates the self-organizational and path-dependent nature of geo-industrial dynamics at the most general level as anticipated by Hypothesis I. Relatively speaking, the state sector shrank greatly but the non-state sector, both firms and entrepreneurs, rose to become the main source of new market entrants. This reveals the enduring growth-impeding "shackles" on the state sector, and the viability of the non-state sector under enhanced institutional stability and expanded support from international VC, particularly after China's WTO entry when restrictions on foreign investment in ICPs were progressively relaxed.

(Fig. 2 about here)

The internet resurgence in China after 2003 resulted in the overseas IPOs of VC-backed top players one after another, dramatically altered the returns and expectations of venture investors. Led by the Internet resurgence and a booming Chinese economy, the year 2004 witnessed a skyrocketing of overseas IPO opportunities for Chinese firms, 89 as compared to 14 in 2003 (ZERO2IPO, 2008). Consequently, 2004 became the first year for venture capitalists in China to celebrate their success when 60 VC institutions together achieved an exit amount of US$ 802 million (ibid.). For VC institutions, profitable exits led to a virtuous circle of exit-fundraising-investing that never happened before in China. [13] Such success finally convinced mainstream Western VC institutions to put China seriously onto their global operational map. Consequently, the number of active VC institutions with five or more investment deals in China rose from 21 by 1998 to 146 by 2008, over 73 percent of which having a foreign origin. By 2008, Beijing hosted 83 and Shanghai hosted 84 of active VC offices.[14] Foreign VC firms also dominated in terms of the amount of investment, accounting for about 80 percent of the annual total VC investment in China consistently from 2003 to 2007 (Zero2IPO

[13] A typical VC firm begins with fundraising by its general partners from its limited partners, including institutional investors and wealthy families. Once the target amount of money has been raised, the fund is said to be closed and a lifecycle (normally 10 years) begins. Cash is then made available to selected firms with high growth potential in exchange for shares. Returns are expected to be realized within a time frame (usually 3-7 years) through exit events such as an IPO or trade sale of the company. A new round of fundraising starts once an existing fund is liquidated. Larger VC firms usually have several overlapping funds at the same time.

[14] 53 VC firms had offices in both Shanghai and Beijing by 2008.

2009).

The vast expansion of foreign VC firms in town dramatically eased the barrier to Internet entrepreneurship, offered domestic entrepreneurs added accessibility to foreign technology, financial markets, business models, management expertise, and other complementary resources, while at the same time intensifying competition in both cities. By 2008, according to Zero2IPO data, 17 Internet firms from Beijing and 6 from Shanghai had achieved overseas IPOs, all foreign VC-backed. For Internet startups, market success without VC-backup basically ceased to be an option. By the end of 2008, Zero2IPO data suggest that 275 Internet firms in Beijing and 105 in Shanghai had received some VC financing (Table 6), basically covering most of the top players in all subsectors of China's Internet market, offering further evidence to Hypothesis IV. Among these VC-backed Internet startups, 40 percent in Beijing and 50 percent in Shanghai were actually founded by non-local, primarily overseas returnee, founders.[15] Equally significant, for VC-backed spinoffs, 45 percent in Beijing and 64 percent in Shanghai were of a non-local, predominantly overseas, origin. These observations prove the enduring salience of global connectivity built through overseas returnees in both cities, as indicated by Hypothesis III.

A more vibrant and mature business environment in Beijing and the success of Internet predecessors attracted more overseas returnees to follow suit. For example, Baidu, later to dominate the Chinese search engine market, was launched by two former graduates of Peking University, Eric Xu and Robin Li, in a hotel room overlooking Peking University's campus in January 2000. After received his Ph.D. in biochemistry at Texas A&M in 1994, Eric spent two years at UC Berkeley as a research fellow and then joined a Silicon Valley biotech company. He

[15] 45 of Beijing firms and 7 of Shanghai firms were founded by overseas returnees or foreigners after they worked in a local company for a couple of years. They are also considered here as non-local founders.

was fascinated by the technological success of Silicon Valley to an extent that he produced a documentary in Chinese entitled *Stepping into Silicon Valley* (*Zou Jin Gui Gu*), based on interviews with many major entrepreneurs and venture capitalists there. Robin Li, after receiving a computer degree at the State University of New York, Buffalo, began to work for Infoseek, a pioneer Internet search engine company, from July 1997 at Silicon Valley, where he met and became friends with Eric. In December 1999, the two partners flew back to Beijing with $1.2 million seed money raised from two Silicon Valley venture capital firms. Eric explained to the author in 2003, "From day one, we're determined to faithfully build a Silicon Valley-style technology company here in Zhongguancun. Like any typical Silicon Valley company we place technological excellence on top of our priority list. At the same time, we try to provide our employees a humane, relaxing, flexible, respectful and rewarding, Silicon Valley-style work environment. We offer stock options to all employees, and we call everyone by first name." [16]

Of course, many returnees were not as creative, down-to-the-earth, persistent, and/or lucky as Robin and Eric, and many of the 'me too' startups they created collapsed with the burst of the Internet bubble (cf. SAXENIAN, 2006, pp. 227-231). Nevertheless, with the accelerated returning of many others resembling Eric and Robin and the incessant opening up of new offices by foreign VC, the Silicon Valley system also accelerated its replication in Beijing. While Beijing kept its momentum in importing related variety exogenously through attracting overseas returnees, proportionally Shanghai received an even larger contribution from non-local founders since 1999, to certain extent remedied the shortage of local entrepreneurship (Table 6). Many influential Internet startups in Shanghai such as Ctrip and Eachnet were founded by returning

[16] Personal interview with Eric Xu in Beijing, August 16, 2003. Special permission granted by the interviewee for information disclosure.

expatriates after 1999. This offers evidence for the success of Shanghai Municipal Government's 'entrepreneurship importing' policy. It implies that negative lock-in as a result of a laggard region's initial disadvantage in terms of the short supply of localized related variety can be alleviated, at least to certain extent, by policy means aimed at enhancing the region's external connectivity.

(Table 6 about here)

During this stage, the majority of VC-backed firms were founded by individuals, 83 percent in Beijing and 87 percent in Shanghai. The share of state founders is minimal because they are either banned of access to VC by the central government, unqualified to be funded or purposefully avoided by venture capitalists for the reason of political uncertainty. Evidently, most founders came from related variety, either in the form of spinoffs or experienced entrants cultivated from related sectors. The percentage of Beijing's founders from related variety was 88 percent, significantly higher than Shanghai's 77 percent. Furthermore, about half of Beijing's new firm founders were spinoffs, much higher than Shanghai's 37 percent. Fig. 3 further compares the dynamics of the three types of market entrants in both cities. Each year more Beijing Internet spinoffs are financed by VC than Shanghai. The initial phase of growth of the Internet firm population in both cities was dominated by experienced entrants from related industries. However, in both cities, spinoffs from established Internet firms had the highest rate of increase and they have surpassed experienced founders to become the largest force of entrants in more recently. The more explosive increase of spinoff founders in Beijing further enlarged the gap between the two cities.

These observations provide further evidence to both Hypothesis I and II. Firstly, better-quality new market entrants in a more successful and competitive region are more likely to be generated from related variety, especially spinoffs nurtured by incumbents in the same industry. Secondly, corroborating the finding of BOSCHMA and WENTING (2007), the fastest growth of spinoffs indicates that they have received a better learning environment and thus can develop superior capabilities than experienced entrants as the industry grows. Nevertheless, such spinoff dynamics is not territorially bounded but involves non-local connectivity to a significant extent. Indeed, the probability for spinoffs to be attracted from overseas was as high as from the local entrepreneurial community. 45 percent of Beijing's VC-backed spinoffs and 64 percent of Shanghai's had a non-local origin (Table 6). Finally, from both Table 6 and Fig. 3 we see the lasting significance of experienced entrants from other related industries, largely from the local community and cumulatively accounting for 40 percent of all entrants for both cities. This further testifies the long shadow casted on new sector formation by the inheritance of region-specific industrial and institutional architecture.

(Fig. 3 about here)

With respect to the sub-sector variety, Fig. 4 shows consistent gap between the two cities in 2008 after over a decade of subsector diversification and specialization. In the larger subsectors such as Internet software and services, e-commerce, vertical portal, and e-community, the ratio of the number of Shanghai's firms to that of Beijing's basically falls between 30-40 percent, generally close to the 38 percent average. Consistent with Hypothesis I, this is an indication of the localized self-organizational recombinant growth in subsectors with less

asymmetry of crucial complementary sectors in the two cities. In the sub-sectors with a smaller size of VC-backed firm population, however, with the exception of newly emerging wireless services, Beijing maintained an overwhelming advantage in e-media, e-learning, and comprehensive portals, all necessitating the combination of Internet technology with the traditional media and education sectors that Beijing dominates. For example, the enduring significance of Beijing's traditional media sector to the growth of its e-media was stressed by the CEO of a leading IT media in Beijing, a graduate of Peking University who also had extensive working experience in Shanghai: "Beijing is the very place to do Internet media, because here you can easily find resources from, and collaborate with, a whole universe of leading traditional media units, and you have no difficulty to hire seasoned editors and journalists. But Shanghai has never really been a media center in China. Local government control in Shanghai extends from the economy to the media, indeed Shanghai is the place in China with most severe media control in China. It is weird that in such a cosmopolitan metropolis we don't even find one truly nongovernmental local newspaper or magazine, especially in the business category."[17]

(Fig. 4 about here)

Shanghai, however, produced almost equal number of VC-backed start-ups in e-game as Beijing.[18] This disproportional achievement of Shanghai should be explained by both favorable initial endowment of related variety as a result of its global connectivity and favorable historical

[17] Personal interview, Beijing, August10, 2003.

[18] According to Zero2IPO (2009), Shanghai also had China's largest concentration of VC-backed firms in the sector of integrated circuits (IC), especially IC manufacturing. This also implies the long shadow casted by Shanghai's historical strength in manufacturing activities.

contingency of Shanghai in this particular sub-sector. In the early 1990s, global game developers and publishers such as TOSE (Japanese), Konami (Japanese), Ubisoft Entertainment (French) already started to transfer some of their lower-end activities such as game development and testing to Shanghai.[19] All these firms became seedbeds for the subsequent formation of e-game startups. For example, French entrepreneur Gilles Langourieux, founder of Ubisoft Beijing (1997) and Ubisoft Shanghai (2000), founded a global e-game software outsourcing service provider Virtuos Games in Shanghai in 2004, together with three Chinese partners. In turn, Ubisoft Shanghai, together with Konami Shanghai, became the supply source of the senior management team and technical talent to 9You.com, a major new e-game player founded in 2003. Shanda, now the largest e-game power house in China, only started its experimental operation in November 2001. However, it surprised itself by exploding into the most profitable Internet business in China in two years. Its successful NASDAQ IPO in 2004 made its founder, Chen Tianqiao, the richest person in China (ZHANG and WU, 2007). Shanda's unanticipated success dramatically boosted Shanghai's e-game development, while Shanda itself became a key source of spinoffs. For example, Ximen Meng, the former R&D director of Shanda, the holder of a Computer Science degree from Carnegie Mellon University and MBA from MIT, founded Radiance Soft in 2005. Vigorous spinoff dynamics in this particular subsector thus has been enabled by a sizable preexisting knowledge base developed through global connectivity and further propelled by favorable unanticipated contingency.

[19] Without special notice, information of this section is extracted from Zero2IPO data and individual company websites.

## CONCLUSION

Through comparing the internet industry in China's two large metropolitan areas, Beijing and Shanghai, this paper confirms that "related variety," a key concept centered on the replication and diversification of firm-level specialization developed in the literature of evolutionary economic geography, plays an essential role in shaping path-dependent emergence and evolution of a new technological sector at the regional scale. A more adequate understanding of regional dynamics of technological innovation, however, entails not only an account of the evolving variety of firm routines, but also the complementary, changing variety of regional institutional embeddedness and global connectivity being brought to the analytical forefront.

The formation of the internet industry in both Beijing and Shanghai suggests an exceedingly high level of new variety generation through the combination of pre-existing routines of incumbent firms in the focal industry and/or prior-developed knowledge bases in other related sectors such as ICT and media. While market entrants predominantly came from other related industries during the incipient stage in both city-regions, spinoffs accelerated through time, particularly in the more successful city-region, to become the largest source of entrants. This corroborates the finding of BOSCHMA and WENTING (2007) that spinoffs are nurtured in a better learning environment and thus can develop more superior capabilities than experienced entrants as the industry grows. Furthermore, findings of this study indicate that self-feeding recombinant growth can be observed at both sector and subsector levels, subject to the constraint of the availability of complementary knowledge bases.

The presumed universal rule of localized recombination that is central to the 'related variety' argument (BOSCHMA and WENTING, 2007; WENTING, 2008), however, is questioned by my findings. The path dependent reproduction of related variety spans over regional and national boundaries. Aided by foreign venture capital, non-local founders, especially overseas returnees, made up a significant proportion of new market entrants in both Beijing and Shanghai. Logically, the formation of a new technological sector in peripheral regions has no option but to be based

primarily on the application and modification of imported technologies, business models, and organizational practices originated from remote global centers such as Silicon Valley. For this reason, connectivity to the global center is decisive in creating and expanding the local pool of related variety. The building of global connectivity can be achieved through a variety of ways, including short-term or long-term exposure of domestic entrepreneurs to overseas avant-garde technological development or business models, or the incoming of entrepreneurs, engineers, venture capitalists and transnational companies with pre-established experience or expertise in the focal industry. Regardless of the format, to be successful the supply of global connectivity to a region needs to be plenty. Both Beijing and Shanghai benefited substantially from a large pool of the Chinese diaspora trained in the U.S. and the emerging 'brain circulation' across the Pacific (SAXENIAN 2006). Such 'brain circulation', unfortunately, is geo-historically unique and unlikely to be available to many peripheral regions.

The process of recombinant growth is therefore both enabled and constrained by a region's changing accessibility, both local and non-local, to crucial complementary knowledge bases to be combined and recombined. The creation and alteration of such accessibility are largely influenced by a region's political, institutional, and industrial heritage and ongoing policy practices in shaping entrepreneurial capabilities, opportunities, and incentives. In this way, durable regional institutional architectures and industrial structures play a key role in determining where new firm populations emerge in an emerging technological sector. Such a view is confirmed by our observation, from the comparison of Beijing and Shanghai, that an overall high level of state involvement in technological development in China at the national scale has variegated manifestations at the regional scale. While internet development in Beijing has been characterized by a more diversified structure of ownerships and a more autonomous private sector, Shanghai has shown consistently a higher degree of state dominance, but lessened increasingly by 'imported' private entrepreneurship, also as a result of deliberate state promotion. These findings cast doubts on the 'neutral place' assumption that downplays the role of territorial institutions. Within the existing institutional and economic constraints, the gap between the

first-mover and the latecomer can still be possibly reduced through policy means by building connectivity to nonlocal technological powerhouses and venture capital, as well as enhancing the local entrepreneurial environment for innovation.

In many ways China's institutional system and mixed economic structure are idiosyncratic. The combination of a comprehensive license system, an active internet censorship, restrictions on foreign investment (especially direct) in internet content and services (particularly at the early stage), and a developmental policy aimed at boosting indigenous innovation and cultivating 'domestic champions' had the effect of advantaging established incumbents and raising the barriers to new or potential entrants, domestic and foreign. In this light, the effect of path-dependence as revealed by this study could have been 'artificially' augmented and thus stronger than under 'normal', less-regulated conditions. These institutional factors, added with further cultural and psychological barriers, also explain why globally dominant U.S. internet companies such as Yahoo, E-bay, Google, and Amazon have not been so successful in the Chinese market. The lack of performance of these international giants, in turn, offered a protected space for the growth of startups founded by domestic or returnee Chinese, an opportunity rarely found in the global periphery.[20]20 Throughout the years, however, the internet industry has been largely marketized, privatized, and further opened to foreigners, and the significance and influence of the state-owned part of the industry have been diminishing. When the general pattern of knowledge combination from a cognitive perspective is concerned, the 'distortion' imposed by the idiosyncrasy of the Chinese institutional system also has been limited. Rather, as a service-oriented industry, the idiosyncratic imprint of the domestic market demand has been fairly salient. Future research should offer more elucidation on the interplay of related

[20] In this view, the internet industry is essential different from other high-tech manufacturing industries such as telecom equipments and integrated circuits, characterized by heavy involvement of multinational corporations and export-orientation. Shanghai has been more successful than Beijing on the manufacturing side of high-tech activities, due to its historical strength in manufacturing and aggressive policies of FDI attraction. I appreciate an anonymous referee for pointing these out.

variety, global connectivity, institutional embeddedness and market demand within different geo-historical, institutional, and industrial contexts.

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## Tables and Figures

Table 1. *A taxonomy of Internet firm founders in China*

| | **Organizational** | **Entrepreneurial** |
|---|---|---|
| **State** | State media<br>State telecom<br>State agency<br>Academic unit<br>Other SOE | N/A |
| **Non-State** | Domestic firm | Entrepreneur (domestic) |
| | Foreign firm | Entrepreneur (overseas returnee) |

Table 2. *Beijing and Shanghai in comparison: the economy and the Internet*

| Indicators | Beijing (rank) | Shanghai (rank) |
|---|---|---|
| GDP 2007 (Billion Yuan)* | 935 (2) | 1219 (1) |
| Total population 2007 (Million)* | 16.3 (2) | 18.6 (1) |
| FDI used 1990-2007 (Billion US$)* | 36.2 (2) | 73.4 (1) |
| Number of Alexa top 1,000,000 websites (End-2004)** | 2070 (1) | 606 (2) |
| Aggregate Internet pageviews (Million pages per day) (End-2004) ** | 2318 (1) | 215 (3) |
| Venture capital backed Internet firms (end-2008)*** | 275 (1) | 105 (2) |

*Sources:* *BMSB 2008; SMSB 2008; **Author's calculation based on Alexa traffic data and official Internet website registration data in China; *** ZERO2IPO (2009).

Table 3. *Qualitative differences of the initial condition of Internet development in Beijing and Shanghai*

| | Beijing | Shanghai |
|---|---|---|
| Local Talent Resources | National best | Second-best |
| Size of High-tech Firms | Mainly small | Large |
| Entrepreneurial Resources | Rich | Deficient |
| Ownership Structure of High-tech Firms | Hybrid | State-owned |
| Local Government Function | Hands-off | Hands-on |
| Local Power Structure | Fragmented | Unified |
| Local Political Resources | Most abundant | Limited |
| Business Networks | Vertical and horizontal | Mainly vertical |
| Venture Capital Access | Limited | More limited |

*Source:* Compiled by the author with reference to Segal (2003), pp. 16-18.

Table 4. *Quantitative indicators of the initial condition of Internet development in Beijing and Shanghai*

| Initial Resource Endowments | Beijing (rank) | Shanghai (rank) |
|---|---|---|
| Number of top 100 universities in China (1999)* | 21 (1) | 13 (2) |
| Number of college students graduated (1999)** | 50,307 (1) | 40,316 (2) |
| Number of R&D employees per million employees (1999)** | 6,741(1) | 2,678 (2) |
| Number of high-tech firms (1999)** | 4591 (1) | 958 (8) |
| Number of new start-up firms per million residents (1999)** | 5,608 (1) | 3,593 (2) |

*Sources:* *Netbig 1999 Chinese University Rankings (www.netbig.com); ** RGCSTDS (2002).

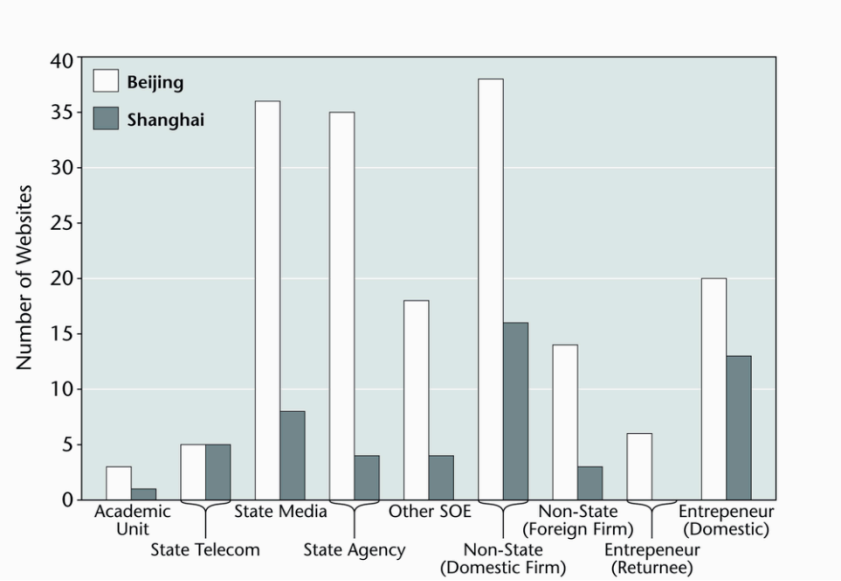


*Fig. 1. Firm population and founder structure based on newly founded Alexa top 100,000 websites in Beijing and Shanghai: 1994-1998*

*Source:* Author's calculation based on Alexa data.

Table 5: Profiles of Leading Internet Anchor Firms in Beijing by 1998

| Firm Name | Year Founded | Principal Founder | | | Subsector Specialization | Major Source of Financing |
|---|---|---|---|---|---|---|
| | | Name | Tertiary Education | Professional Background | | |
| Asiainfo | 1994 | Tian Suning | Beijing&USA | graduate student | system integration | foreign VC |
| NetChina | 1994 | Wan Pingguo | Beijing&USA | graduate student | ISP | local industrial & state capital |
| Sohu | 1996 | Zhang Chaoyang | Beijing&USA | employer of an American Internet company | comprehensive portal | foreign VC |
| Sparkice | 1996 | Zeng Qiang | Beijing&Canada | graduate student | e-commerce | foreign VC & local industrial capital |
| Soufun | 1996 | Mo Tianquan | Beijing&USA | employer of an American company | vertical housing portal | foreign VC |
| Infohighway | 1996 | Zhang Shuxin | Hefei, China | founder of a local IT company | ISP | local industrial capital |
| ChinaEDU | 1996 | Huang Yong | Beijing | graduate student | e-learning | private capital |
| Capital online | 1997 | Li Xiaolong | Beijing | founder of a local IT company | comprehensive portal and ISP | local industrial & state capital |
| Sina | 1998 | Wang Zhidong | Beijing | founder of a local IT company | comprehensive portal | foreign VC |
| Ourgame | 1998 | Bao Yueqiao | Hangzhou, China | employer of a local IT company | e-game | local industrial capital |
| BabyCare | 1998 | Matthew Estes | USA | employer of an | vertical mom & | foreign VC |

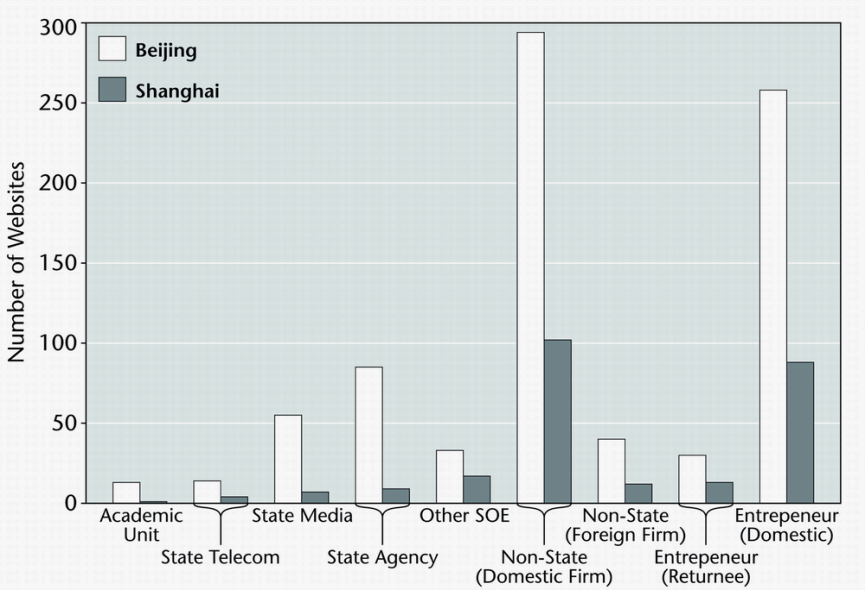


*Fig. 2. Firm population and founder structure based on newly founded Alexa top 100,000 websites in Beijing and Shanghai: 1999-2004*

*Source:* Author's survey based on Alexa data.

Table 6. Characteristics of the founders of VC-backed Internet firms by 2008

| | Beijing | | Shanghai | |
|---|---|---|---|---|
| | Number of firms | Percentage of total | Number of firms | Percentage of total |
| Local (metropolitan) | 166 | 60% | 52 | 50% |
| Non-local (domestic) | 13 | 5% | 11 | 10% |
| Non-local (international) | 96 | 35% | 42 | 40% |
| Organizational | 46 | 17% | 14 | 13% |
| State | 7 | 0.4% | 2 | 2% |
| Individual | 229 | 83% | 91 | 87% |
| Spinoff | 133 | 48% | 39 | 37% |
| Non-local | 60 | 22% | 25 | 24% |
| Experienced | 241 | 40% | 42 | 40% |
| Non-local | 30 | 11% | 15 | 14% |
| Inexperienced | 34 | 12% | 24 | 23% |
| Student | 21 | 8% | 11 | 10% |
| Non-local | 19 | 7% | 13 | 12% |
| Total | 275 | 100% | 105 | 100% |

*Source:* Author's calculation based on Zero2IPO data.

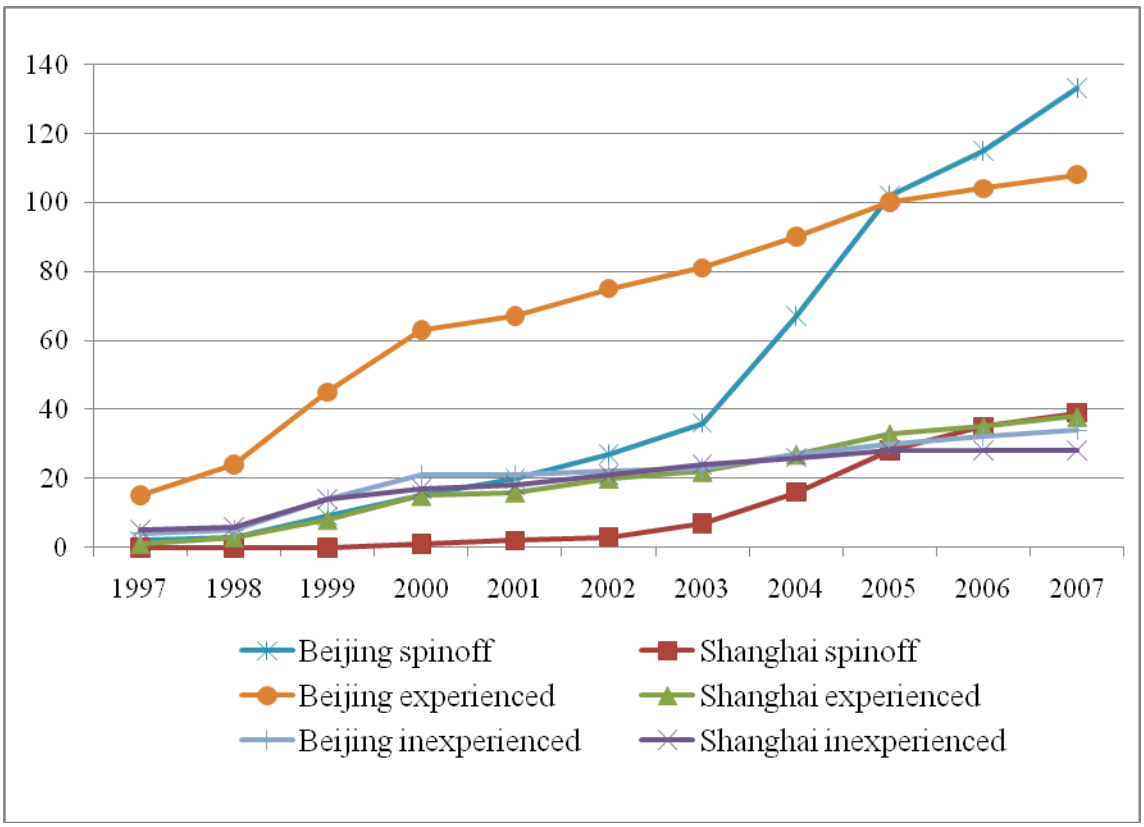


*Fig. 3. Cumulative VC-backed Internet market entry in Beijing and Shanghai*

*Source:* Author's calculation based on Zero2IPO data.

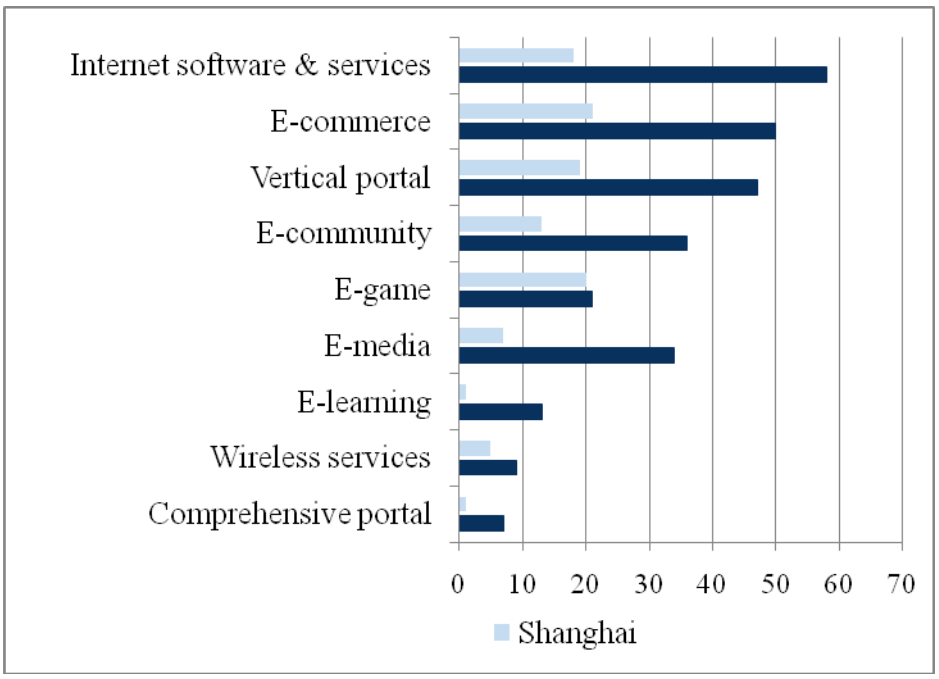


*Fig. 4. Sub-sector specialization of VC-backed Internet firms in Beijing and Shanghai: 2008*

*Source:* Author's calculation based on Zero2IPO data.