Entrepreneurship, Innovation and Networks: Lessons for Regional Development Policy

Robert Huggins[1], Professor of Economic Geography, Cardiff University http://dx.doi.org/10.18573/j.2016.10051

Introduction

Innovation is commonly acknowledged to be a principal element in economic growth and competitiveness (Capello and Nijkamp, 2009; Harris, 2011). Entrepreneurship is also a key source of such growth (Audretsch et al. 2006). There is a growing school of thought that the networks facilitating flows of knowledge within and across regions are an important underpinning factor (Huggins and Izushi, 2007). Furthermore, regions are increasingly considered to be important foci of economic development and organisation in a globalised economy (Malecki, 2007; Fritsch and Mueller, 2004). The ability of regions to gain from the positive effects of entrepreneurship is likely to depend on their capability to turn knowledge into regional innovation (Audretsch and Keilbach, 2008). The innovation systems literature, especially the regional variety, highlights the flow of knowledge across organisations as a crucial factor for effective innovation (Cooke et al. 2011).

This article focuses on those three contemporary determinants of development at the regional level: entrepreneurship; innovation and networks. Drawing on examples from Silicon Valley; Taiwan and Finland, it is argued that an open networked environment, built upon global knowledge search, is central to successful innovation and entrepreneurship, and subsequently regional competitiveness. In particular, it contrasts the open model of economic development adopted by Taiwan, especially the activities of its diaspora, and the more closed model associated formerly with Finland. Also, it shows how the enduring success of Silicon Valley has occurred through processes of networked connectivity and recombinant innovation.

Entrepreneurship and a Network-Based View of Innovation

Entrepreneurship is increasingly recognised as a crucial element in fostering economic growth (Carree and Thurik, 2006). The capability of entrepreneurs to influence economic development is related to their capacity to access and exploit knowledge and generate innovation. Romer (2007, p. 128) states that 'economic growth occurs whenever people take resources and rearrange them in ways that are valuable … [It] springs from better recipes, not just more cooking'.

Within the growth process, knowledge spills over from one organisation to others. Knowledge generation therefore has external benefits not entirely appropriated by one firm, resulting in the generation of increasing returns (Capello and Nijkamp, 2009). Such knowledge, however, is not a purely public good, but one that can be partially appropriated, such as through the use of intellectual property rights, hence organisations have incentives for investing in its creation. Theoretical models seeking to explain innovation outputs, such as patents, are based on a knowledge production function in which organisations (i.e. firms) intentionally pursue new economic knowledge as a means of generating innovation (Audretsch, 2000). This can lead to subsequent rounds of appropriation and exploitation of knowledge spilling over from organisations which have made investments. Despite these theoretical developments, endogenous growth theorists throw little light on the mechanisms by which knowledge is transmitted across firms and organisations (Storper and Venables, 2004), suggesting the need for a better understanding of the role of investments in generating spillover conduits (Audretsch and Feldman, 1996). Emerging theories of the firm such as the knowledge-based view (Grant, 1996) and extensions of the resource-based view (Lavie, 2006) recognise that the need to access knowledge is a key reason why firms build or enter networks with other organisations. These networks may arise through the need to access new technology, skills or expertise in order to keep pace with competitors (Ahuja, 2000).

Networks in this context consist of the interactions and production relationships organisations (principally firms) utilise to access knowledge. In other words, these networks consist of the means by which knowledge flows across organisations beyond the direct purchasing of it. Networks of this kind generally come into being because markets for knowledge are rare. Owing to inherent asymmetry in the existing information base of buyers and sellers (Arrow, 1971; Malecki, 2010) markets in knowledge are difficult to sustain. In the case of knowledge protected by property rights, such as patents and copyrights, market transactions are possible but in the case of implicit knowledge or know-how they are almost impossible. Networks, therefore, are increasingly found to act as a conduit facilitating the flow of skills and expertise in technology, R&D and the like (Weterings and Ponds, 2009). Increasingly, this process is a systematic undertaking, i.e. organisations no longer innovate in isolation but through a complex set of interactions with other organisations (Chesbrough, 2003). It is through the networks underpinning these systemic processes that organisations access knowledge that they cannot, or do not wish to, generate internally (Bergenholtz and Waldstrøm, 2011).

Recombinant Innovation and Silicon Valley

As the information revolution has greatly multiplied the types of potential solutions to any technical problem, the chances that the best answer is reached by further development of the current technique decrease. In developing new products, firms, therefore, rely less on internal units for whom pursuit of particular development paths may become an inviolable routine, and search out external partners and scan for novel solutions. That, with many other factors, contributes to the disintegration of the vertically integrated firm, and the concomitant growth of global supply chains in which suppliers all along the chain are expected to co-design, and continuously improve the performance of the products they provide their customers (Sturgeon, 2002; Sabel and Zeitlin, 2004).

With global competition and information technology creating a proliferation of new potential solutions and pathways, innovation has become unpredictable and recombinant, with multiple competing solutions with different strengths in different contexts. Hence, the progress of technology becomes increasingly unpredictable insofar as there can be no expectation that one good solution will lead by a natural progression to another. Counter-intuitively, the more knowledge about the world as a whole accumulates, the less confident we can be about the kind of knowledge that will prove useful in any particular enterprise. By the same token, the more development depends on applying knowledge from domains traditionally unrelated to an industry's core activities, the less meaningful is the idea of a technological frontier – it is everywhere and nowhere – and the less confident we can be that leadership

today assures leadership tomorrow. In these circumstances it may well be more important to be able to search effectively across domains than to dominate the generation of ideas and technologies within any one of them (Saxenian and Sabel, 2008).

Silicon Valley has grown through increasing specialisation and repeated waves of recombination of skills. As shown by Figure 1, productivity and value added continue to rise with each successive wave of technology. Through processes of fragmentation and reintegration there has been a repeated blurring of industrial boundaries from, for example, PC to internet to mobile web to the latest generation of web applications – web browsers, search engines, social networking – all combining similar components including programming languages, protocols, standards, software libraries, productivity tools, etc. While we often think of Silicon Valley as being made up of corporate giants – HP, Intel, Apple, Google, Facebook, Twitter - there is a remarkable amount of churn in the industrial system, with the majority of the region's largest 20 corporations in 1980s and 1990s no longer on that list. Indeed, small firms collectively represent a major force in Silicon Valley's dynamics, and they have made, and will continue to remake, the regional economy (Huggins, 2008).

Fundamentally, Silicon Valley's success stems from a regional ecosystem rich in high quality institutions that promote entrepreneurial experimentation, open labour markets, firm specialisation, venture capital networks, collective learning and regional adaptation.

Within Silicon Valley, firms of all sizes interact in the ecosystem, in which superior technology trumps business size, with innovation occurring in a highly decentralized environment, with the benefits of proximity - dense social and professional networks, informal information exchange, cross-firm collaboration, and serendipity - outweighing the high and rising costs of being in the area (Saxenian, 1994). Innovation, therefore, no longer occurs in isolated laboratories, but rather through collaborative co-development networks between increasingly specialist producers. Innovation at all stages of the production process is a highly iterative process. Learning happens through continuing interactions facilitated by social networks and open labour markets, which allow know-how and information to circulate freely. It is possible to contribute to the formation of such an ecosystem, but it cannot be planned from the top down, and once it gets started, the strength of such a system is that it fosters unanticipated re-combinations of skill and technology, and multiple, often parallel, experiments with technology, organisation, markets, and so forth. Learning happens through trial and error – and often through failure. Failure is common, not a stigma, and is a highly social process in which people learn through their own and others' mistakes and in which the trust that grows from face-to-face interaction, and the serendipity that grows out of the free circulation of ideas and talent, create positive feedback loops.

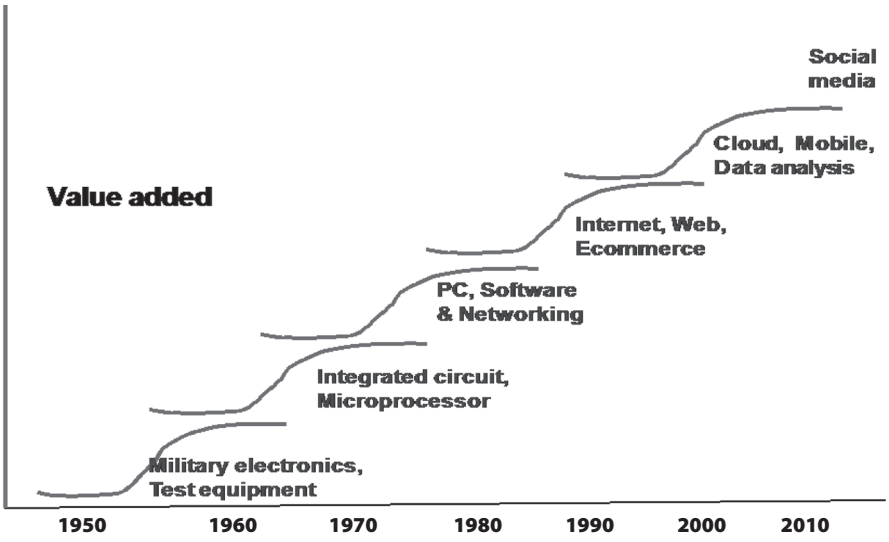
Open Innovation Networks and Diasporas

The open network paradigm means that innovation can come from anywhere, and that once "peripheral" and uncompetitive regions can link into global supply chains. Research has shown a powerful role played by the diasporas of particular nations and regions, which have been styled the New Argonauts after the heroes of Greek mythology, who travelled afar and endured great dangers in search of the golden fleece (Saxenian, 2006). In the case of Silicon Valley, foreign born, US educated engineers who have learned the Valley model, have had great successes and then collaborated with their home-country counterparts to develop the context for entrepreneurial development. They are ideally positioned (as both insiders and outsiders at home and abroad) to search beyond prevailing routines to identify opportunities for complementary "peripheral" participation in the global economy and to work with public officials on the corresponding adaptation and redesign of relevant institutions and firms in their native countries. They are, in other words, exemplary protagonists of the process of self-discovery and open industrial policy; although surely there are different institutional arrangements in other contexts that are as effective as well, (Hausmann and Rodrik, 2002).

Diasporas are not new, nor is the interest of policymakers and scholars in their developmental potential (Saxenian, 2006). What is new, or relatively so, is the focus on the highly educated migrants who have long been viewed as a serious loss to poor economies (the brain drain). Low transportation and communications costs now allow those who go abroad for further training or in search of work to interact and collaborate with their home-country counterparts far more extensively than was feasible in earlier eras of emigration. A small but growing number of migrants have even become fully "transnational", with dual citizenship and residences in both their home and their adopted countries. Early research on diaspora contributions investigated remittances or direct investments, which can provide a stable source of finance and alleviate poverty, but typically have a limited long-term impact. The recent literature, by contrast, suggests that skilled migrants can alter the developmental trajectory of a poor country through the diffusion of knowledge and/or technology transfers, in a shift from a brain drain of talent away from the home country to "brain circulation" between the home country and the core economies (Saxenian, Motoyama and Quan 2002, Saxenian, 2006). Much of the newer literature (and the public policies which it has stimulated) treats the diaspora as an asset, valuable insofar as it adds to the home country's stock of capital not through remittances, but in intellectual property or reputational capital or related forms of wealth.

Furthermore, the spatial differentiation of economic activity that is typically linked to industrial specialisation means that a focus on national indicators and institutions can obscure critical transformations that occur at the sub-national level. The state, in developing as well as in developed countries, is not a unified whole, but rather consists

Figure 1: The Evolution of Innovative Recombination in Silicon Valley



of multiple, differently organised, units with various political and economic resources, jurisdictions, and interests. It is precisely this heterogeneity that permits innovation and growth within a generally unpromising context (Kuznetsov and Sabel 2007). The new Argonauts bring to their home countries expertise in specific industries that are located in a small number of urban areas or regions, and they collaborate only with a subset of domestic entrepreneurs and policymakers (Saxenian, 2006). Thus, economic and institutional change begins in certain locations and/or domains and advances through partial and incremental (micro-level) reforms that aggregate into larger-scale transformations with time. A particular example of this is the role of the Taiwanese diaspora in helping establish Taiwan as an open networked and successful economy.

Comparing 'Open' Taiwan with 'Closed' Finland

At the end of the 19th century both Taiwan and Finland were in fact or in law colonies, and suffered the forms of economic marginality typically associated with that status. Finland, having passed from Swedish to Russian sovereignty in 1809, only became independent from Russia in 1917. Taiwan, having been occupied by Japan on and off since 1592 became a territory of that country in 1895, and came under the control of the Kuomintang (KMT), in flight from China, but was formally released from all Japanese claims in 1952. Economically, there are a number of commonalities in their evolution, and as recently as the 1960s both were small, economically marginal economies. Both were relatively late to industrialisation, and in the 1970s-80s strong developmental states led to resource mobilisation in technology sectors, with heavy investments in R&D and universities, and a goal to catch up to the 'global technological frontier'.

By 1980 Finland was the economically stronger with a GDP per capita of US$8,609m compared with US$3,571 in Taiwan.

In the 1990s, both emerged as global ICT leaders with Finland creating and leading the mobile phone industry, and Taiwan dominating integrated circuit (IC) design and manufacturing, and electronic systems production. By 2000, in Finland, Nokia was pioneering technical and design innovation, with dizzying growth (40% world market for mobile phones), supported by a "national" system of innovation, and expanded production to India, Hungary, and China. Taiwan pioneered the IC foundry business, with state investment in IC and electronics research, and the expansion of production to the greater Shanghai region.

By 2000, both Finland and Taiwan could be viewed as parallel global models of ICT success, but underlying processes differed dramatically, which only became apparent in mid-late 2000s. In Finland, a crisis in leading industries, including ICT led to a deepening recession, and whilst Taiwan also suffered an economic downturn there was continued export growth. As result by 2010, Taiwan had surpassed Japan, Korea, UK, France and Israel in GDP per capita, which stood at US$ 49,970, compared with US$ 34,454 in Finland. In the case of Finland, its problems can be viewed as stemming from the closed innovation model associated with Nokia and the nation's innovation system, with there being no vigorous mechanism for the exploration of new markets, and investment in the 'national system of innovation' emphasised refinements of existing technologies and more extensive exploitation of existing markets.

National systems of innovation, Finland's included, were often designed with the idea of closing the gap between a country's capabilities in particular areas and the respective world technological frontier (Saxenian and Sabel, 2008). Such systems, however, become less useful as the "boundary" begins to wander. In the worst case, the national system of innovation can actually impede progress by focusing attention, and fixing resources, on the problems that would have been central to an industry if unanticipated connections to other bodies of knowledge had not rendered them irrelevant. The risk of a monolithic strategy is self-blocking entrenchment, and in the case of Finland, that left Nokia – as by far the most dominant economic actor - unprepared for boundary-blurring innovations introduced by Apple, Google, and others.

As a result of such entrenchment, organisational trajectories become very difficult to change as engineering teams and product groups are locked in to existing cognitive and organizational routines. Nokia went from boom to almost-bust. After being an early innovator and mobile design pioneer, it continued to hone its mastery of complex supply chains and antennae technology. Yet, it has struggled to adjust to the idea – unlike Apple or Google – of the cell phone as mobile portal to the internet. At the same time, its success in emerging markets depended on relentless attention to lowering the costs of high-volume products, and so increased the pressures for and rewards to cost-reducing efficiencies, making the re-direction of the organization that much harder.

In contrast to Finland, Taiwan has economically forged ahead on the global stage. The diaspora has closely collaborated with the government to design institutions to support entrepreneurship and innovative search, and in stark contrast to Finland, venture capital has become a powerful search network to identify and (re) combine parts of firms — financial, technical or marketing expertise, managerial talent, IP — to form ventures that in turn become new nodes in networks for co-designing and building new products. By supporting a diverse portfolio of ventures and combining hands-on monitoring and mentoring with market selection, investors in Taiwan are thus institutionalizing a process of continuous economic restructuring, and learning about how to improve restructuring itself, which transforms the domestic economy by linking it to the most demanding and capable actors in global markets.

Entrepreneurship, vertical decomposition and the clustering of IC and electronic system production has facilitated deepening specialisation and the co-design of components, subsystems, and periodic re-integration. The diaspora is instrumental in collaborative exploration and innovative recombination, and establishing cross-regional collaboration, mutual upgrading and cross-cluster linkages between Taiwan and Silicon Valley. Firms in Taiwan shifting from vertical integration to collaborative exploration of new markets with outsiders have had to invent, and continue to adjust to changing circumstance, new forms of contracting, joint venturing and strategic alliance; a myriad of organisational forms between hierarchy and market that, taken together, are changing the boundaries of the firm and perhaps its very nature. In particular, novel institutions in the form of search networks are connecting actors, domestic and foreign, engaged in potentially complementary searches.

Whilst Taiwan sought to imitate Silicon Valley in 1980s, and acted as a provider of low cost labour and components, the strong connections that subsequently formed have led to a relationship based on parity of esteem. The co-creation of a venture capital industry facilitated return entrepreneurship, cross-regional collaboration and innovation, and a reciprocal upgrading along the value chain.

Policy Lessons

In his classic 1955 article, Francois Perroux (1955) argued that in the end "scale" and "innovation" are the predictors of success, whereas Albert Hirschman (1958) recognized the role of interdependence and linkages across related sectors in achieving economic growth. The process of consolidating and connecting knowledge clusters shows that these principles remain key to change in today's global economy. In particular, some of the world's most prominent regional clusters are open operating networks seeking new knowledge as the means to more efficiently exploit their existing knowledge base. In Silicon Valley, it is clear that cluster actors utilize the benefits of proximity to build and manage global-scale production networks (Sturgeon, 2002). The key aspect of these developments is that the knowledge base of the world's most

advanced regional economies is no longer exclusively local, but positioned within global knowledge networks, connecting clusters and their actors.

Furthermore, national innovation systems are becoming more "leaky" over time, whereby "the role of tacit knowledge and the spatial limits on knowledge spillovers have caused firms to locate R&D facilities where new knowledge is being created" (Carlsson, 2006, p. 65). As a result, regional policy making is seeking to shift toward fostering more open and connected systems, with clusters able to renew themselves and evolve through innovation. Clusters must themselves be subject to innovation and change in much the same way that products have to change if they are to diminish the risk of having a short shelf life.

Although it is undoubtedly impossible to replicate or clone regions such as Silicon Valley, or any other knowledge cluster for that matter, there are many lessons that can be learned about how to improve the competitiveness of regions and in particular the role networks have played in making regions with strong clusters centres of global growth. At the same time, it is important to recognise that the challenges involved in the creation and sustaining of such clusters are contingent on prevailing local and global factors. For instance, the past failure of many science parks as a policy response for generating high-technology activity can be related to the fact that, although they facilitated the co-location of companies, such policies ignored the processes through which this co-location could be developed into meaningful interaction and collaboration, particularly between industry and academia.

It has long been argued that most science park developments are no more than high-tech fantasies, contributing little to increased links between industry and the academic world (Massey, Quintas and Wield, 1992). An important lesson for most regions, especially the less competitive, is that the 'Silicon Valley recipe' of merely investing in ingredients such as technology parks, university research, engineers, venture capital, and incubators alone is unlikely to prove successful. Rather than seeking to replicate the components and ingredients of successful regions, a more fruitful approach is to connect with them through both firm-level and regional collaborations. In particular, there is need to nurture global and local open search networks, and to define and invest in distinct capacities through processes of experimentation. Diasporas potentially play an important role as global search networkers, connecting to the 'global leading edge' and scanning for new markets, partners and solutions. Furthermore, evidence suggests that diasporas can support policymakers in defining strategy, transferring global "best practice", linking to customers and partners, brokering technology and its institutional adoption, and overcoming political opposition to reform.

Note

1. This paper was inspired by the address that AnnaLee Saxenian of the University of California, Berkeley, gave to the International Symposium, and is written with her agreement. I am grateful to her for kindly providing access to some of the case-study data and other information used in this paper.

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