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Local Cluster Growth and Global Brain Circulation: Organic Process or Coordinated Effort?

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Abstract

This paper investigates the interplay between local cluster growth and 'global brain circulation' (GBC), i.e. exchange of knowledge, practices and opportunities through individual movements between clusters across national boundaries. Based on the cases of Bangalore-Silicon Valley and Sinos Valley (Brazil)-Korea, we examine the role of governance in this process. We find that for larger-scale clusters at a growth stage, GBC dynamics may unfold as an 'organic process' through self-reinforcing market forces, whereas smaller-scale clusters at an embryonic stage may depend on 'strategic coordination' as they lack initial market attractiveness for both individuals and firms. Coordination may build on a multi-level governance architecture of ties and talent/knowledge exchange at the firm, university and government level, which leverages local resources across sectors and aligns organizational ties with individual career paths. Our study has important implications for understanding cluster connectivity, the role of governance in cluster growth, and effective catch-up strategies of emerging economies.

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Key words: Cluster Development, Connectivity, Network Governance, Reversed Brain Drain, Talent, Knowledge, Global value chains, Catch-up strategies, Diaspora

Introduction

Clusters, in terms of geographic concentrations of firms and institutions in related industries (Porter, 2000), are important hubs of innovation and production in an increasingly interconnected global economy (Amin and Thrift, 1994; Poudier and St John, 1996). Only more recently, however, scholars have started investigating in more detail how clusters are inter-connected with each other, and how these connections may impact cluster development (see e.g. Bresnahan et al., 2001; Zaheer, 2009; Lorenzen and Mudambi, 2013). There is increasing consensus, for example, that global ties may complement local cluster ties in stimulating knowledge transfer, innovation, and upgrading (Humphrey and Schmitz, 2002; Bathelt et al., 2004; Owen-Smith and Powell, 2004). The importance of global connectivity has in particular been emphasized in the context of cluster development in emerging economies (Humphrey and Schmitz, 2002; Manning, 2013; Lorenzen and Mudambi, 2013). This study contributes to this stream of research.

Prior research has thereby distinguished between organizational and individual ties between (as well as within) clusters (Lorenzen and Mudambi, 2013). The majority of studies to date have focused on the role of global organizational ties in stimulating cluster growth, in particular through multinational corporations (MNCs) (Patibandla and Petersen, 2002; Enright, 2000) and global value chains (Humphrey and Schmitz, 2002). Less known are the effects of individual ties, in particular through diaspora networks and transnational communities (Saxenian and Hsu, 2001; Zaheer, 2009; Lorenzen and Mudambi, 2013).

In the latter context, in particular the concept of ‘brain circulation’ (BC) – or ‘reversed brain drain’ – has gained prominence (Saxenian, 2005). BC denotes dynamics of knowledge exchange, practice diffusion and cluster growth through the movement of students, professionals and entrepreneurs between clusters, e.g. Silicon Valley, Taipei and Bangalore (Bresnahan et al., 2001; Saxenian and Hsu, 2001). This includes permanent moves of ‘returnees’ back to their home countries, after gaining educational and professional experience abroad (Kenney et al., 2013), but it also relates to continuous mobility of workforce between globally dispersed locations. Importantly, we focus here on ‘global’ brain circulation (GBC) through movement of people between particular, emerging and/or established, clusters across national borders. While there is a rather long tradition of research on GBC (see e.g. Bresnahan et al., 2001; Saxenian and Hsu, 2001), we still know surprisingly little about the very conditions under which GBC takes off and effectively stimulate cluster growth.

Of particular interest to scholars has been the role of governance, i.e. often collective processes of deliberate intervention, in affecting GBC. For example, whereas some have argued that incentives for returnees can be crucial for cluster growth (see e.g. Kuznetsov, 2006), others are skeptical about the effectiveness of steering such processes (see e.g. Kenney et al., 2013). One

central problem with prior studies on GBC and governance, however, has been the neglect of size and stage of cluster development. Research on cluster governance in more general suggests that size mediates the effectiveness of steering, as a large number of players may complicate collective action (see e.g. Manning et al., 2012). At the same time, clusters that are already growing may have little ‘need’ for governance as further growth gets stimulated through self-reinforcing dynamics (see e.g. Poudier and St John, 1996). Against this background, it may be less surprising that the role of governance in stimulating GBC has been questioned in cases like Bangalore (see e.g. Kenney et al., 2013) where GBC started when the focal cluster was already sizable and growing. By comparison, our knowledge of GBC in the case of smaller, nascent clusters has been fairly limited. We thus seek to further investigate the role of governance in stimulating GBC while focusing on the effect of cluster size and stage of cluster development in this process.

More concretely, we explore through an inductive comparative study the role of governance efforts in stimulating GBC and cluster growth in the case of a larger/growing cluster vs. a smaller/nascent cluster. Specifically, we analyze, on the one hand, the dynamics of GBC between Bangalore and Silicon Valley in IT services primarily based on existing empirical studies (see e.g. Lorenzen and Mudambi, 2013; Bresnahan et al. 2001), and, on the other hand, GBC between the nascent cluster ‘Sinos Valley’ (Brazil) and Korea based on original both quantitative and qualitative data. We find that GBC in the Bangalore case can be described with hindsight as a rather organic, market-driven process with minimal direct governance intervention, whereas in the case of Sinos Valley we identify GBC as a rather coordinated process based on a multi-level governance architecture. We propose, based on our comparison, that organic GBC is likely to be effective in particular when clusters are already larger and/or growing, whereas coordinated GBC

is primarily effective for smaller/nascent clusters. To stimulate future research, we further depict various features of each type and discuss underlying mechanisms.

Our study mainly contributes to three interrelated debates. First, we add to growing research on the role of governance vs. market dynamics in cluster development (Schuessler et al., 2013; Sydow et al., 2010), by contextualizing when more governance-led approaches are likely to be effective and what their limitations are. Second, we add nuance to understanding the role and interplay of local and global, individual and organizational ties between clusters (see e.g. Bathelt et al., 2004; Lorenzen and Mudambi, 2013). For example, we find that, especially in nascent clusters, cross-sector collaboration between firms and universities, both locally and globally, can bundle cluster resources, and thereby promoting IBC and cluster growth. Third, we contribute to the long-standing interest in catch-up strategies of developing countries (e.g. Humphrey et al., 2002; Altenburg et al., 2008; Lorenzen and Mudambi, 2013), by emphasizing the role of GBC in complementing cluster insertion in global value chains (Humphrey et al., 2002). For example, we show the importance of providing career paths within and across clusters, as well as the leveraging of cross-sector links in compensating for late-comer disadvantages.

We start out with a critical review of prior literature on local cluster development, global linkages and the role of GBC. We thereby introduce a governance perspective to complement prior mostly evolutionary approaches. We then re-visit prior studies on GBC between Silicon Valley and Bangalore, and identify key mechanisms, conditions and limitations of what we call ‘organic’ GBC. We then present the contrasting case of Sinos Valley and Korea to depict major features of ‘coordinated’ IBC. We then discuss contributions to future research and policy-making.

Local cluster growth and global inter-cluster linkages: The neglected role of governance

Clusters are typically understood as geographic agglomerations of firms and associated institutions that are more or less interconnected and typically belong to a particular industry sector (Porter, 2000; Giuliani, 2005; Iammarino and McCann, 2006). Clusters are important generators of employment in particular sectors, but also serve as hubs of innovation and knowledge production (Maskell and Lorenzen, 2004; Poudier and St John, 1996; Malecki, 2010). Reasons include the co-location of related firms, knowledge spill-over effects and labor markets providing opportunities for ‘boundary-less careers’ (Song et al., 2003; Saxenian, 1994; Feldman et al., 2005). These effects are often reinforced by dense professional communities and networks between cluster firms and institutions that provide a social infrastructure for knowledge exchange, career-making and entrepreneurial innovation (Grabher, 2004; Maskell, 2001; Owen-Smith and Powell, 2004; Giuliani, 2005). Not least because of these advantages, cluster development has become a keen interest not only of policy-makers in advanced economies, but increasingly in developing countries (see e.g. Manning, 2013; Altenburg et al., 1999).

The question of how clusters can come into being, grow and sustain over time has been subject of a long-standing debate (Martin and Sunley, 2006; Belussi and Sedita, 2009, Menzel and Fornahl, 2009). Many scholars thereby distinguish between factors supporting mature cluster development from those facilitating early stage growth (see e.g. Poudier and St John, 1996; Bresnahan et al., 2001). Whereas mature, established clusters benefit from ‘local buzz’ (Bathelt et al., 2004), agglomeration and branding effects all of which attract firms and professionals, nascent and early stage clusters appear to much more rely on initial resource conditions, such as availability of labor, favorable infrastructure and policies; connection to markets; and location decisions of foreign firms and returning entrepreneurs (Bresnahan et al., 2001; Saxenian, 1994). Yet, what

stimulates the latter – firm and individual decisions – is still little understood. Some scholars even argue that ‘luck’ or ‘coincidence’ may ‘explain’ often unpredictable entrepreneurial events leading to initial cluster growth (Pouder and St. John, 1996). Also, as we see further below, many studies show tendencies of circular causality – the ‘chicken-and-egg problem’ (see also Bresnahan et al., 2001). For example, while firm investment decisions often rely on the availability of skilled labor markets (Pouder and St John, 1996), the latter typically only fully emerge as employment opportunities arise (Bresnahan et al., 2001). Not surprisingly, it has been difficult for policy-makers to effectively promote initial cluster development (Sydow et al., 2010). This study thus seeks to contribute to a better understanding of effective policy-making in initial cluster development, especially in the context of developing countries.

Independent of specific dynamics and policies, most studies agree that in the context of early cluster growth, in particular in developing countries, global linkages can be a critical factor (Bresnahan et al., 2001; Saxenian and Hsu, 2001; Humphrey and Schmitz, 2002; Manning, 2013; Lorenzen and Mudambi, 2013). Whereas clusters in advanced economies, in their early stage of development, used to benefit a lot from the favorable co-existence of local resource conditions and policies, entrepreneurial capacity and local/domestic product markets (see e.g. Saxenian, 1994, for Silicon Valley; Porter, 1990 in more general), new emerging clusters in developing countries are typically ‘late-comers’ within a much more competitive, globally dispersed landscape of innovation and production (Manning, 2013; Lorenzen and Mudambi, 2013). New cluster development is therefore intertwined with understanding dynamics of cluster embeddedness in global communities and production systems.

Most prior research has thereby focused on the role of global organizational ties in stimulating initial cluster growth (Lorenzen and Mudambi, 2013; Humphrey and Schmitz, 2002;

Patibandla and Petersen 2002). These so-called ‘organizational pipelines’ (Bathelt et al., 2004) facilitate the in-flow of capital, knowledge, business practices and standards, thus promoting capability development in clusters (Humphrey and Schmitz, 2002; Reddy, 1997). Organizational ties are often established through foreign multinational corporations (MNCs) that establish and interlink resource- or market-seeking subsidiaries across the world (Enright, 2000). The growth of many clusters in developing countries, e.g. Bangalore, Cordoba, and Guadalajara, has been linked to early MNC foreign investment decisions (Patibandla and Petersen 2002; Altenburg et al., 1999; Manning et al., 2010). Notably, organizational links may also establish through ties between local suppliers and global buyers in global value chains and production networks (Humphrey and Schmitz, 2002). However, one major limitation of relying on building global pipelines in developing new clusters is that location decisions of foreign firms in particular are typically determined or at least facilitated by several competitive factors, including a sizable skilled labor market, a fairly developed infrastructure, and prior knowledge and familiarity with the location (Patibandla and Petersen, 2002; Manning et al., 2010). Yet, many nascent clusters do not possess these advantages, or they are not visible enough to foreign firms (Manning et al., 2010).

More recently, research has shifted from focusing on organizational ties to recognizing the criticality of transnational communities of individual professionals and entrepreneurs in sparking cluster development (Lorenzen and Mudambi, 2013; Zaheer, 2009; Saxenian and Hsu, 2001). In this regard, the notion of ‘brain circulation’ (BC) has gained prominence (Saxenian, 2005). Introduced mainly by Saxenian and colleagues, BC denotes processes of knowledge, technology and practice translation through diaspora network ties between emerging and typically more established clusters, e.g. Silicon Valley and Taipei (Saxenian and Hsu, 2001). Unlike ‘brain drain’, which has described the one-way departure of talent from often developing to more advanced

economies, BC captures increasing ‘reversed brain drain’ – the returning of professionals and entrepreneur to their home countries after getting educated and experienced in work contexts abroad (Saxenian, 2005; Kenney et al., 2013). As individuals return, they combine their knowledge of global business practice and customer needs with their understanding of the local environment into globally oriented employment and entrepreneurial opportunities (Saxenian, 2005; Porter et al., 2012). Not surprisingly, the existence of such diaspora networks are an important pull for location and entrepreneurial investment decisions (Zaheer, 2009). Also, they help ‘insert’ new clusters into global value chains (Saxenian and Hsu, 2001), while also being affected by the latter (Bresnahan et al., 2001). Yet, how do these diaspora ties get built up in the first place?

Most studies indicate that an effective GBC dynamic is by itself dependent on various factors, in particular the abundance of home-grown talent abroad, and economic opportunity structures at home (see e.g. Saxenian and Hsu, 2001; Saxenian, 2005). However, the latter in particular often includes the existence of related local and foreign firms (see e.g. Lorenzen and Mudambi, 2013). This, in turn, reintroduces the ‘chicken-egg problem’. If GBC is stimulated by prior firm investment, yet if, at the same time, the latter may rely on the local availability of talent, this creates a complex foundation problem. Indeed, looking at prior studies more closely, most of them focused on clusters already ‘in-the-making’ – clusters with a growing industry that would attract talent to further stimulate that industry. In fact, Kenney et al. (2013) argue that returnees often impact cluster growth only after a certain ecosystem of local technological capabilities and domestic industry has already achieved international success. In other words, agglomeration effects are more or less explicitly incorporated to explain GBC dynamics. Less understood, however, are situations where growth has not begun yet, where MNCs have not yet set up operations, where clusters are nascent and in need of a ‘kick-start’. In other words: How and under

what conditions can GBC effectively come into being and stimulate cluster growth, and to what extent can this process be strategically promoted by cluster policies?

We address this question by focusing more than prior research on the role and contingent effectiveness of governance in stimulating cluster growth in general and IBC in particular. We denote ‘governance’ as deliberate processes of intervention in cluster development and related networks, either through policies, third-party strategies or a combination of the two (Sydow et al., 2010; Schuessler et al., 2013; Provan and Kenis, 2008). A governance view emphasizes the role of agency, shared goals and coordination in dealing with the complexity of initial cluster growth (Schuessler et al., 2013). Arguably, most cluster research, especially in the U.S. tradition, has not paid much attention to the role of governance. Instead, most studies on cluster development, including those analyzing the interplay of local and global ties, follow an evolutionary paradigm (see e.g. Poudier and St John, 1996). For example, the notions of agglomeration effect, path dependencies, and location competition for talent and firm investment fall within this paradigm. In fact, ‘luck’ and ‘circular/reciprocal causality’ are seen as ‘legitimate elements’ of evolutionary dynamics. By contrast, European scholarship has taken the role of governance, ‘cluster leadership’ and cluster administrative organizations more seriously (Sydow et al., 2010, 2009; Schuessler et al., 2013). Arguably, governance has played a role in particular in processes of cluster upgrading and transformation under resource constraints (Altenburg et al., 1999). We thus assume its importance in stimulating GBC effectiveness as well.

We now compare the well-known case of GBC between Bangalore and Silicon Valley with our own case of Sinos Valley (Brazil) and Korea, to understand various degrees and forms of governance in stimulating GBC processes, and important contingencies of effective governance. We then discuss results and implications for future research.

Global Brain Circulation from a Governance Perspective: Data and Methods

We investigate GBC dynamics, their governance and effect on cluster development based on two opposing cases, using both secondary and primary data. Qualitative case studies in the context of cluster development and diaspora effects often incorporate multiple data sources, including prior studies of the same subject (see e.g. Lorenzen and Mudambi, 2013; Kenney et al., 2013). The main goal of this empirical exploration is analytical generalization from the case findings (Yin, 2003) including the development of propositions for future research.

Case selection is theoretically motivated, but also facilitated by access to empirical data. The first case, Bangalore and its Silicon Valley Connection, has been utilized numerous times to better understand preconditions and dynamics of cluster growth (Lorenzen and Mudambi, 2013; Bresnahan et al., 2002; Reddy, 1997). Bangalore is an example of a large city with a history of economic development with a strong outward orientation, especially since the 1980s. However, rather than just reviewing this history, the main objective is to analyze what role returnees and ‘brain circulations’, especially with Silicon Valley, have played in cluster development and to what extent deliberate governance affected this process. We then selected an opposing case (Eisenhardt, 1989) – a rather small, nascent cluster – in order to stimulate theorizing around both similarities and differences of GBC across such cases. More concretely, based on empirical access of one author, we selected ‘Sinos Valley’ in Brazil and its connections with Korea as an example of a small and nascent cluster. Unlike in the first case, most data used for this case is based on original data collection, including interviews with local representatives in both countries (as a primary data source), a database of students in exchange programs, government policies and other documentation (as a secondary data source).

As primary data source for the second case we used open and in-depth interviews. The interview questions were related to the (a) evolution of the semiconductor industry in Brazil, (b) development of Sinos Valley, and (c) individual ties between Sinos Valley and Korea. The respondents were selected based on their involvement and leadership in cluster formation and in the talent mobility between the two countries. In this respect, we selected 16 representatives of the government, universities and companies in both countries. The interviews were conducted in person, and the data were collected through personal notes, and later complemented by email exchanges. This study took one year and a half (from early 2013 to middle 2014). Among others the following parties were interviewed: members of the Brazilian Embassy in Korea, the Korean Embassy in Brazil, the State Development Secretary of RS, the universities' international affairs offices (mainly at UNISINOS), faculty and entrepreneur members who participated at the Brazil & Korea International Forum at UNISINOS, members of the International Presidential Forum at KAIST, and a semiconductor industry specialist. All of these resources also provided important information through conversations and archival data.

In terms of data analysis, our main focus were preconditions and effects of movement of entrepreneurs and professionals as clusters developed over time, as well as the way in which such movements were stimulated by policies and governance attempts. We further paid attention to the interplay of individual and organizational, local and global ties as well as potential linkages across sectors, e.g. private sector, government and universities. Based on our analysis we arrived at two potentially generic 'types' of GBC – organic and coordinated – which differ not only in terms of their own dynamics and the role of governance, but also in how / the extent to which they apply to our main cases. Next, we discuss these types in greater detail.

Global Brain Circulation as Organic Process: The Bangalore-Silicon Valley Connection

Bangalore is regarded today as one of the major clusters of IT-enabled services for global business clients across industries (Global Services, 2008; Lorenzen and Mudambi, 2013; Manning, 2013). In fact, roughly 50% of all business services projects of U.S.-based firms and about 30% of projects from European clients are sourced from major Indian services hubs, including Bangalore, Chennai and Hyderabad (Hejmen et al., 2011). Services include not only IT and software services, but payroll transactions, insurance and mortgage processing, tax preparation, legal services, medical services, contact centers and analytical services (see e.g. Zaheer et al., 2009). Despite the growing importance of other service hubs in India, 35% of India's pool of IT service professionals is located in Bangalore. In addition, most major U.S., European and Indian business service providers, e.g. Infosys, Accenture, IBM Global Services, are either headquartered or at least located in Bangalore. So do many major IT companies today, including Google, Microsoft and Cisco.

The growth of Bangalore as a software and IT services cluster is rooted in a combination of industrial policies and supportive economic conditions in the mid-1980s. Before that time, Bangalore was home of a largely domestic electronics and military equipment industry. The boom in global software services only started around 1985 (Athreye, 2005). After the failed attempt of substituting imports of hardware and software in the early 1980s, deregulation of import licensing, a de-coupling of hardware and software policies, falling global hardware prices, and a resulting growing demand in software sparked entrepreneurial investment in software services, supported by a growing local pool of qualified, lower-cost software engineers. Initially, in the early 1990s, programmers were mainly hired 'onsite' by U.S. and UK firms, but later on, growing service capabilities; an improved local infrastructure, including software development parks; and reduced global communication and coordination costs, along with the establishment of process standards,

led to a growth of offshore service capabilities in Bangalore, especially since the mid-1990s (Ethiraj et al., 2005; Athreye, 2005; Dossani and Kenney, 2007). The so-called Y2K bug generated a further boost of demand of labor-intensive offshore IT services from India (Arora et al., 2001). Since 2000, the service industry in Bangalore has diversified into a range of IT-enabled services, beyond software and IT infrastructure, in response to a growing commoditization of and demand for services across business functions (Sako, 2006; Athreye, 2005).

Throughout this process, MNC linkages to other clusters, in particular Silicon Valley, have been of critical importance (Lorenzen and Mudambi, 2013). Many scholars regard the decision of Texas Instruments in 1985 to invest in research and development (R&D) operations in Bangalore as the starting point for cluster growth. Driven by increasing demand for high-skilled, yet lower-cost engineers, many firms, including Microsoft (1987), HP (1989) and Motorola (1991) followed by setting of IT, software and engineering centers. Arguably, these MNCs not only promoted the transfer of technological and process knowledge, but also helped improve the local IT infrastructure (Texas Instrument), set up collaborative ties with local universities (e.g. Texas Instruments and Motorola), established the Indian Institute of Information Technology, and ‘trained’ local suppliers to deliver services in line with high-level process standards (e.g. HP). Later on, sparked by these early experiments, various other firms, including U.S.-based and European service providers and high-tech start-ups established operations in Bangalore and thereby strengthened organizational ‘pipelines’ to other clusters.

At the same time, research suggests that diaspora networks with Silicon Valley were critical in promoting ‘brain circulation’ and cluster development in Bangalore (see Taube and Sonderegger, 2009; Saxenian, 2005; Arora et al., 2001). Typical patterns of GBC included either the return of India-born, but Silicon Valley-based entrepreneurs to Bangalore and their investment

in firms serving U.S. clients (e.g. Rakesh Mathur, the founder of Armedia, Jungle and Stratify), or the expansion of India-based entrepreneurs into Silicon Valley (e.g. A.V. Sridhar, former senior manager of Wipro; see also Kenney et al., 2013). In both cases, entrepreneurs would use their Silicon Valley contacts or operations to improve access to market and capital, while expanding their Bangalore operations to utilize access to lower-cost skills (Saxenian, 2005; Bresnahan et al., 2001). As a result, these movements would not only promote knowledge exchange between clusters but also a co-specialization of operations in Bangalore and Silicon Valley, thus shaping the way both clusters position themselves in global value chains (Saxenian, 2005). Next, we analyze in greater depth key properties of this particular GBC process, under what conditions it effectively emerged, and what its limitations have been. Thereby we also look at the interplay between local and global, individual and organizational ties.

One very early facilitating factor for Bangalore's diaspora were government investments in engineering education since the 1950s (Altenburg et al., 2008). It is the abundance of qualified engineers that attracted early foreign investments and that continues to drive today's cluster dynamic. However, the lack of domestic demand and production capacity for hardware and software products in the 1980s, as well as a lack of linkages between universities and local firms (Saxenian, 2005), led to an oversupply situation in the 1980s (Taeube and Sonderegger, 2009). This, combined with the attractiveness of lower-cost engineers along with a growing demand for software services in the U.S., stimulated a significant 'brain drain', in particular to Silicon Valley, at that time. In the late 1990s, the quota for temporary H1B visas further increased (in response to growing demand and a stagnating number of U.S. engineering graduates) which further accelerated emigration (see also Lewin et al. 2009). In 2000, 124,697 Indian nationals received H1B visa approvals – which amounts to almost 50% of the total quota (Saxenian, 2005). However, Indian

migrants maintained close contacts with their home country, facilitated by IT, which helped established transnational communication channels.

“The professional and personal networks linking Indians in Silicon Valley to family members, friends, and colleagues at home combined with access to e-mail and low-cost travel and phones to generate an unprecedented rate of information exchange between the United States and India.” (Saxenian, 2005, p. 53)

Until the late 1990s, most Indians who migrated into the U.S. – either for further education or for job opportunities – would not return to India. Despite cultural ‘pull effects’, such as the expectation to get married in India, the career advantage of staying abroad would prevail. Around the turn of the millennium, however, opportunity structures began to change. First, the demand for lower-cost IT and software services exceeded the availability of visas and jobs in the U.S., not least with the rather sudden Y2K bug problem (Arora et al. 2001). The aftermath of 9/11 further limited the availability of H1B visas, including a significant cut in 2003 (Lewin et al., 2009). At the same time, foreign MNC investment in India in general and Bangalore in particular had increased, promoting an improved IT and education infrastructure, and increasing career and entrepreneurial opportunities. In addition, venture capital firms emerged that specialize in promoting cross-regional business models – especially linking operations in Bangalore and Silicon Valley (Saxenian, 2005). Over time, the number of Indians returning to Bangalore and other Indian cities increased quite rapidly. Rakesh Matur is an example:

“The key constraint to starting a business in Silicon Valley in the late 1990s was the shortage of software developers. I realized that I could go to India. All three of my start-ups had design centers in Bangalore but were registered as American technology companies” (Mathur, 2002, cited in Saxenian, 2005, p. 52).

Today, we find a situation where in fact most entrepreneurs and senior managers in IT services firms with operations in Silicon Valley and Bangalore have an education and professional

background in both locations. Several business have dual headquarters, and continuous communication, travel and movement between these locations has become common practice and an integral part of sustained cluster growth of both Silicon Valley and Bangalore.

We specify this form of GBC as organic. It is organic because it has been mainly driven by shifting market and entrepreneurial opportunities. Whereas the initial brain drain of Indian engineers was driven by a domestic oversupply and a growing demand for software services in the U.S. and UK, reversed brain drain was equally driven by growing job opportunities in India (along with job constraints in the U.S. in particular). Actual circulation through continuous movement between clusters started based on a number of critical enabling conditions. First, a diaspora community already existed thanks to prior 'brain drain'. Second, Bangalore had grown into an attractive location for job creation and entrepreneurship prior to the return of migrants. Third, and relatedly, prior MNC investment, a favorable infrastructure, and pre-existing market connections between clusters created attractive conditions for returning entrepreneurs. In contrast to the importance of market and economic conditions, governance and policies played only a minor role in stimulating GBC directly, even though governance efforts were at play when growing local industries that would attract returning professionals later on (Saxenian, 2005; see also Kenney et al., 2013). However, like in similar cases, Kenney et al. (2013: 392) point out that "most returnee entrepreneurs returned only after the domestic industry had already achieved international success, re-joining their home country and contributing to the subsequent rapid expansion phase of the domestic industry" Specific diaspora-related governance was limited to professional associations and Internet platforms used to inter-connect the diaspora community.

Similar forms of organic GBC have been observed between Silicon Valley and a number of other emerging clusters in Israel, Taiwan and other countries (Bresnahan et al., 2001; Saxenian

and Hsu, 2001), as well as between Bollywood and Hollywood (Lorenzen and Mudambi, 2013). Yet, Saxenian (2005) argues that the transferability of this model is limited. First, organic GBC relies heavily on prior investment in higher education, business infrastructure and politically stable environments immigrants can return to. This may disadvantage clusters at an embryonic stage. Second, Saxenian (2005) argues that in particular large urban areas, such as St. Petersburg and Buenos Aires, may benefit from organic GBC whereas smaller places may lack labor pool size, market access and other facilitating conditions, such as MNC investment, to happen in the first place. Third, we argue that most of the clusters whose growth has been attributed partly to organic GBC were already growing or established at the time when the first wave of migrant entrepreneurs and professionals returned (see also Kenney et al., 2013).

We thus seek to better understand how those emerging clusters can benefit from GBC that do not share these preconditions. How can GBC emerge when locations are small, when MNC investments have not begun to gain traction yet, when there is perhaps not even a significant diaspora community who could be attracted back to their home country and town. We show, based on the example of Sinos Valley and Korea, how GBC as a coordinated – rather than organic – process can be effectively stimulated when conditions for organic IBC are not met.

Global Brain Circulation as Coordinated Effort: The Sinos Valley - Korea Connection

Sinos Valley in Southern Brazil marks an ambitious attempt of establishing the rather knowledge-intensive semiconductor industry in this region without prior industry experience, with a limited labor pool, with no prior related foreign MNC investment and non-existing branding power. This case needs to be considered in the context of a recent industrial policy push at the national level toward the development of the semiconductor industry in Brazil. The semiconductor industry

(design and production) is geographically concentrated in a few regions of the world (Byun, 1994; SIA website, 2014). Countries such as Korea, the US, Taiwan, China and Japan hold more than 90% of the global market share of semiconductors. Asia currently leads with approximately 60% of the market share (SIA website, 2014), and its semiconductor market share grew in the 1980s and 1990s. In this global scenario, the Brazilian industry's market share is barely noticeable. The global semiconductor market has shown high levels of growth (more than 15% on average annually, considering data from 1976 to 2014), and the total global revenue of the industry in 2013 was 303.3 billion USD (SIA website, 2014).

Although the Brazilian semiconductor industry has an insignificant global market share, Brazil has one of the largest end markets of electronics and semiconductors. Brazil is among the world's top four markets of computers, cell phones and technological applications, such as automotive and medical areas (MCTI, 2013). Semiconductors, mainly integrated circuit (IC) components, are in nearly all of these electronic products. Because there are few enterprise initiatives in the Brazilian semiconductor industry, there is no national production to cover the Brazilian market. This situation reflects a large trade deficit in semiconductor products (approximately 20 billion USD in 2013, according to ABINE).

Brazil has taken different approaches over time to develop its semiconductor sector. First, between the 1930s and the 1980s, Brazil adopted a protectionist policy with market barriers that resulted in low productivity and a large technological gap in the prominent semiconductor industry (Campanario et al., 2009). The market barriers were opened suddenly in the 1990s. At that time, the government believed that a liberal market (e.g., no restrictions on imported IC components) could attract foreign investment and consequently transfer technology to national industry development. However, the weakness of the Brazilian national innovation system was that it did

not support the national industry, which was faced with the entrance of competitive foreign products with updated technologies. As a result, most of the enterprise initiatives in Brazil broke down (Campanario et al., 2009). At the same time, the import barriers (created in the 1960s) were reduced to the entrance of foreign technology in the ‘free economic zone’ in Manaus. Based on this incentive, the free economic zone attracted a large number of electronic enterprises (e.g., computer assembly plants) by offering them the opportunity to import updated semiconductor components at competitive costs (by reducing import taxes). Brazilian companies essentially stopped purchasing national technology (see IC components) and started purchasing foreign technology. Most of the domestic semiconductor business vanished at that time.

After that period, in early 2004, the Brazilian government launched the ‘Industrial, Technological and Foreign Trade Policy’ (PITCE) along with other programs, all of which reflect the government’s renewed interest in promoting the semiconductor industry (along with other selected sectors) through interventionist policies. These policies aimed to promote R&D investments locally by providing tax incentives to companies. These initiatives focused mainly on four areas: the Porto Alegre metropolitan area, São Paulo, the Belo Horizonte metropolitan area and Recife city. Arguably, some of these regions, particularly São Paulo, benefited from these policies mainly as an ‘add-on’ to prior related clustering and size effects and the resulting competitive advantages. For example, even prior to these policies, São Paulo would benefit from the availability of highly skilled human resources, R&D investments, infrastructure, and specific policies on the state level. By contrast, other regions, such as the Porto Alegre and São Leopoldo areas, were rather disadvantaged due to a relatively smaller talent pool and a lack of prior related foreign investment. A combination of federal and state policies, along with the strong presence of

related university training programs, would eventually make up for these disadvantages and help the region become what local actors would call ‘Sinos Valley’.

Development of Sinos Valley

Sinos Valley is located in the state of Rio Grande do Sul (RS) in Southern Brazil. It started in the late 1960s as a shoe manufacturing cluster (Schmitz, 1999). Mostly small and midsize local firms produced initially for the domestic market and later on a larger scale for US buyers. The integration into the US footwear value chain facilitated the upgrading of Sinos Valley in this sector (Humphrey and Schmitz, 2002); it led to the growth of the cluster until the late 1980s and generated more than 500 jobs. In the early 1990s, Chinese producers undercut Brazilian products in the US market, which led to a sharp decline in the price of Brazilian products. This move affected more than 80% of the output of Brazilian producers and stopped 40% of their exports (Humphrey and Schmitz, 2002). However, Sinos Valley continues to be an important national production hub of shoes with an export-oriented strategy.

Since the early 1990s, the IT industry has become an important sector in Sinos Valley. This industry has grown by more than 10% per year in the last decade in the region (Fochezatto and Grando, 2008). More than 1,500 enterprise initiatives have generated approximately 35,000 jobs in RS (AGDI, 2014). Sinos Valley, including Porto Alegre and its metropolitan area, hosts more than 70% of all initiatives (Fochezatto and Grando, 2008). Most of them are located in regional Tech Parks, such as TECNOPUC, TECNOSINOS and VALETC. These parks have become important local innovation hubs within global value chains because they host several foreign MNCs, such as SAP in TECNOSINOS and Dell and HP in TECNOPUC. In addition, universities associated with the Tech Parks (PUCRS, UNISINOS and FEEVALE) and the Federal University

of RS (UFRGS) have opened more than 10,500 new student spaces per year at all levels of IT knowledge (both undergraduate and graduate). However, despite high numbers of graduates, the state of RS and Sinos Valley in particular have suffered from a limited availability of talent. The main reason is brain drain: graduates seek new opportunities in more metropolitan Brazilian states and abroad. State initiatives have not been able to retain talent or to attract it back.

Unrelated to developments in the shoe and IT clusters of Sinos Valley, policy efforts have been made by both the federal government and regional players to establish the semiconductor industry in the region. Although this cluster initiative could build on existing capabilities, resources and initiatives to a degree, one objective was to avoid prior mistakes. On the one hand, efforts were needed to make local employment less dependent on a volatile global competitive market (such as shoe manufacturing). On the other hand, harmful brain drain (such as in IT) had to be prevented. One starting point was the national ‘Semiconductor Industry Development Support Program’ (PADIS), which started in 2004. Part of this program has involved a zero tax policy for local enterprise initiatives with a mandatory and minimum local R&D investment of 5% of total revenue. Based on this, in 2008, the federal government decided to place CEITEC (a public semiconductor company linked to the Ministry of Science, Technology and Innovation - MCTI) in Porto Alegre. CEITEC develops integrated circuit design and wafer fabrication for RFID (radio frequency identification), sensors and digital TV technologies. It is a network linked to the Federal University of RS, UFRGS. Additionally, PUCRS and UNISINOS, both local private universities, launched semiconductor initiatives. UNISINOS hosts the Semiconductor Technological Institute (ITT Chip) and the research program in electrical engineering with an emphasis on the packaging and testing of semiconductors. The former IT Tech Park (presently TECNOSINOS) has also become an important platform for new corporate and research initiatives. Of particular importance

is HT Micron, a joint venture located at TECNOSINOS between the Korean firm HANA Micron (a spinoff of Samsung) and the Brazilian group PARIT, which focuses on industrial-scale production of the packaging and testing of semiconductors to supply the domestic market. When HT Micron started in 2010 (in São Leopoldo city), UNISINOS and the state government launched a strategic alliance with Korea to foster ST&I collaboration. This alliance became an important infrastructure for brain circulation between Sinos Valley and Korea.

Coordinating Brain Circulation between Sinos Valley and Korea

The alliance between Sinos Valley and Korea has evolved on multiple levels. Even before the alliance between HT Micron, UNISINOS and Korean partner universities, the Brazilian and Korean governments had a joint interest in developing the science and technology (S&T) capabilities of their countries. In fact, in 1991, a national S&T cooperative agreement was signed that became the foundation for several high-level meetings, institutional-level agreements, research partnerships, and projects (see Fink et al., 2012; Fink, 2013). Both countries were seen as equal in terms of economic development in the 1980s. However, Korea has moved much more rapidly, from a mostly agriculture-based country in the 1950s to an internationally high-tech competitor in the 2000s. As a result, the bilateral relationship between Brazil and Korea has been inversely specialized. Whereas Korea is now on the edge of nanoscience and technology as well as engineering, computer and material sciences, Brazil's attractiveness to Korea has involved the market potential for Korean manufacturers (see also Fink et al., 2012; Fink, 2013).

The collaboration between Sinos Valley and Korean partners began in 2010 when the HT Micron Joint Venture was launched at TECNOSINOS between the Korean firm HANA Micron and the Brazilian group PARIT. Today, this collaboration involves activities at multiple levels,

including firms, universities and governments. These activities include institutional missions and business matchmaking (promoted by governments); business development, transfer technology, and joint projects (promoted by firms); and institutional missions, business development, exchange programs (both undergraduate and graduate), and scientific forums (promoted by universities). All of these activities attempt to build a strategic alliance between these three sectors at the local and global levels in an attempt to overcome prior mistakes in the development of local capabilities as the president of UNISINOS points.

Firstly, we need to become aware of our local incompetence in terms of technological innovation and thus develop the competences needed to promote a high tech cluster in Sinos Valley. Secondly, try to understand how South Korea has inserted itself in major global production arrangements in order to understand the strategic mistakes made by Brazil that have excluded it from these arrangements and consequently take positive action to overcome those mistakes. Thirdly, to be known and to know leaders who can build good partnerships with us. [Brazilian, President of UNISINOS]

The first meetings began in 2009 when the CEOs of PARIT and HANA Micron collaborated to start a business project to realize market opportunities in the semiconductor industry in Brazil. Based on the technological experience of the Korean CEO (first generation of the semiconductor industry in Korea with a Samsung background) and the market and business experiences of the Brazilian CEO (senior businessman in the IT and automation industries), they decided to start a ‘fifty-fifty’ joint venture. At that time, each visited the home country of the other to start the business development plan of the Brazilian joint venture. This led to several personal interactions that planted the seeds of a trust relationship, as the CEO of HT Micron notes:

The great decision to go further in developing an integrated circuits business was taken during my first trip to South Korea, when I met a person who was new in my network. His company was a source of knowledge, and he was willing to be a partner in the Brazilian project. From then, several business trips increased the range of relations and created a network which allowed the development of the project. [Brazilian, CEO of HT Micron]

After a national bidding process, in early 2010, a memorandum of understanding (MoU) was signed between the company (HT Micron), TECNOSINOS (Tech Park), UNISINOS (university), and municipality (government). The MoU included placing a semiconductor manufacturing plant in TECNOSINOS that was supported by special incentives from the municipality and the state (such as local tax incentives) and a differentiating business model with UNISINOS. This model was based on the PADIS policy (federal level), in which UNISINOS would build clean room facilities to host the company's manufacturing line (in a rental contract) and to support the company's R&D investment in the long term (in an R&D contract). R&D investment would be made in a training program, applied research, and technology service and development.

Later in 2010, UNISINOS decided to further promote collaboration through an S&T plan with Korean universities. The idea was to foster the university's internationalization plans through student and faculty exchange programs, joint research and business projects. To promote this, the university president and board members met with several representatives of Korean universities, such as KAIST (Korean Advanced Institute of Technology), SKKU (Sungkyunkwan University), SOGANG University, KIST (Korean Institute of Science and Technology), and Hongik University. Furthermore, in this year, it was decided to transfer the clean room technology from Korea to Brazil to build the HT Micron manufacturing plant. The Brazilian and Korean embassies played an important facilitating role in this process, not least by helping the partners understand each other's language, cultural norms and institutional protocols.

In 2011, a group of six of UNISINOS' leading faculty members spent one semester at SKKU and SOGANG universities. Based on this and related experienced, they decided to host an international science forum and develop a dual master's degree program in electrical engineering in semiconductors (packaging and testing) and a technological institute of semiconductors (ITT

Chip). The master's degree has a dual degree program in partnership with SKKU in Korea, and ITT Chip has strong federal support (investment of approximately 8 million USD by a non-refunded fund of the Ministry of Science, Technology and Innovation). The dean of Engineering School of UNISINOS offered his perception of the challenges to the university and the region in this particular high-tech knowledge area. He stated that it was possible to develop a minimum level of trust during these interactions to further develop the region:

It is important to note that being a new knowledge field for UNISINOS and extremely developed in countries like Korea and the US, our efforts to create this area of knowledge have been very big ... there is a local lack of human resources at the master's and doctoral levels ... a lack of infrastructure, which is extremely expensive to be sustained ... but, after 5 years, we have two masters who graduated in this area already acting as researchers in ITT Chip, maintaining partnership with Korea, opportunities to send master's students, faculty and graduate students to top universities there, and even participation in events of the semiconductor packaging area as speakers. Thus, winning the trust of the international partners also involves a slow conquest, and let's say this trust relationship has advanced enough until this moment. There is a long way to go; it requires a lot of effort, focus, and patience from the university to the maturation of human resources in this area. [Brazilian, Dean of Engineering School of UNISINOS]

In late 2011, the state's governor led a parallel mission to promote new investments, establish institutional contacts, and learn about Korean industrial and technological policies. A record number of 74 representatives spent ten days in Korea, which was an important stepping stone in the further development of the semiconductor industry. Some key policy makers of the RS state were part of this mission and later exchanged information with Korean policy makers regarding semiconductor policies. In addition, HT Micron started transferring technology from HANA Micron to a pre-operation plant at UNISINOS. This pre-operation plant was housed in a building located in the technological institute area at UNISINOS and aimed to start the operation of smart chip products (low technology). The CFO of HANA Micron was expatriated to Brazil, and a Korean management company was hired to manage the clean room construction.

In 2012, the Brazilian federal government launched the Science without Borders program (SwB). This program aims to strengthen the national innovation system by promoting the international exchange and mobility of talented students. Since the program was launched, it has supported more than 75,000 students (SwB website, 2014). Although most of these students went to US and UK universities, 450 went to Korean universities (2012 - 2014). Most of the students who went to Korea combined both academic and work experiences. HANA Micron, for instance, opened its doors to the Brazilian students for an internship experience, including the packaging and testing of semiconductors. Other Korean companies followed suit, such as Hyundai Motors, Samsung Electronics, POSCO Steel and Hyundai Elevators. The association between academic and internship experiences has been referred to by the students as 'added value' in their careers. Both of these opportunities involved tremendous engagement with the Brazilian Embassy in Seoul, as the former head of S&T division of Brazilian embassy in Seoul noted:

The connection between the business and the academic environment seems to be a motivating factor in the mobility of students (still very absent in Brazil). Undoubtedly, it favors the company with more access to well-skilled professionals. *A relevant point was the partnerships with the Brazilian Embassy in South Korea, which has been very engaged in the organization of the internships in South Korean companies for all the students during the periods of academic summer and winter vacations.* [former head of S&T division of Brazilian embassy in Korea]

This model was adopted by HT Micron and UNISINOS and combined academic and internship experience locally and internationally. Hence, a student from UNISINOS could apply to a scholarship (through an internal call) to have an academic experience in Korea followed by an internship experience in Korea (for a total of one semester) and could have an internship or advanced career opportunity when he/she returned to Brazil at HT Micron. The student could replace his/her curriculum grades with academic and internship activities. This program (called

the ‘HT scholarship’) is supported by private R&D funds at both the undergraduate and graduate (master’s) levels. One student shared his international experiences in this program:

The experiences I have gained in Korea contributed directly to my career because during the period in that country, I had the opportunity to have an internship at *Hana Micron ... They showed me the entire semiconductor packaging process, the technologies employed in a hands-on experience.* In addition, the Samsung company also contributed to show the exchange students its semiconductor manufacturing plant. After this international experience, I became an employee in the new products and semiconductor packaging technologies division at the local company. [Brazilian, exchange Student]

Based on these initiatives, Sinos Valley has been able to attract more Korean firms and professionals. The construction of HT Micron’s manufacturing plant was completed in late 2013. The Korean managing firm, along with a local partner, transferred the clean room technology with an international quality standard at competitive costs. HT Micron also started technology transfer for other products, such as DRAM memory and NAND flash memory with SiP (System in Package) high technology. A large team of highly qualified engineers was involved. Korean engineers came to Brazil to set up equipment, transfer tacit knowledge, and train local engineers, and Brazilian engineers went to Korea to get a hands-on experience. These exchange activities facilitated the transfer of knowledge, not least because language barriers would have constrained formal transfer. Engineers, CEOs and companies were embedded in a learning process and began to build pipelines between both countries through regular meetings and through the exchange of both codified and tacit knowledge. Although this first stage of the business and partnerships were successful, there were some local constraints to attracting senior professionals to further develop the business as well as the cluster.

Interactions at the university and government level also increased during these years. For example, there have been other faculty and student exchanges. Students received support from the SwB program, the HT scholarship program, and summer programs. Additional international

scientific forums occurred at which several Koreans met their Brazilian counterparts to exchange knowledge and develop joint research projects. At these forums, Korean and Brazilian government members also became involved. The UNISINOS president led yearly institutional missions to Korea, and the SKKU president, in return, launched an institutional mission to Sinos Valley for the first time in 2014. UNISINOS opened a Korean language course in 2012 led by a native teacher supported by the Korean government, and more than two hundred students applied for the first course. UFRGS also offered a language course to teach Portuguese to Koreans. The government's activities included institutional meetings in both countries to promote new S&T opportunities and matchmaking between Korean and Brazilian entrepreneurs, some of which resulted in the start-up of new companies. The former CEO of Development Bank of RS State summarized the main outcomes of all of these interactions over this period (2010 – 2014):

The fact that HT Micron enhances the interaction with South Korea - one of the most important countries in the high-tech industries – stimulates this cluster in technological upgrading, both from a personal and an organizational point of view—in *technological transfer, mainly due to UNISINOS' prominent role, the flow* in both directions of executives and academics who participate in several activities, and including the region in the minds of Korean entrepreneurs as a natural candidate for new Korean investments in Brazil. [Brazilian, Former CEO of Development Bank of RS State]

The success of the still rather young IBC initiative in Sinos Valley is also reflected in numbers. Over the last five years (2010 – 2014), 393 highly qualified people benefited from various exchange programs between Sinos Valley and Korea. Of these, 57% traveled from Brazil to Korea, and 43% traveled from Korea to Brazil. Most of them came from the university (56%), followed by company staff (22%) and government representatives (21%). Initially, in 2010, HT Micron and the first UNISINOS mission supported the exchange of only 17 high administrative members between both countries. In 2011, this number rose to 123 thanks to the development of the RS mission in Korea. Most exchanges occurred in 2012 (156) and 2013 (137), including student and

faculty programs, forums, business activities, cleanroom construction, the establishment of line production equipment, and institutional meetings.

All exchanges stimulated technology transfer, knowledge creation, and the development of domestic capabilities in the semiconductor cluster. The emergent relationship between Brazilian and Korean CEOs (corporate level) as well as university presidents have been an important seed of this process. HT Micron has already hired approximately 200 employees, 25% of whom came from the UNISINOS partnership (HT Micron data, 2014). Eight of these employees had internship experience at HANA Micron and academic experience at SKKU or Hongik universities. Many of these people are now employed in the R&D department of the Brazilian company. In the near future, approximately 500 more hires are expected. From the Korean perspective, this partnership supported the internationalization of HANA Micron. From the university perspective, this partnership has upgraded UNISINOS' research capacity through international exchange and mobility programs, joint research projects, international scientific and institutional forums, and business collaboration. Ten agreements were established with Korean universities to support these activities, and an S&T agreement was established with Georgia Institute of Technology in Atlanta in which a full professor from that university joined UNISINOS' master's program and the technology institute. The state government has supported this emergent cluster by means of special policies and funds and the promotion of new business initiatives (mainly SME). The federal government has promoted the international exchange and mobility of faculty and students through the SwB program and has supported innovation projects through its S&T agencies (see FINEP, CAPES, and CNPQ) and special funds from its development bank (see BNDES).

In sum, these activities have stimulated a GBC process that is much more coordinated at multiple levels than 'organic' GBC as experienced between established clusters such as Bangalore

and Silicon Valley. As part of the coordination effort, various otherwise unconnected cluster resources, such as internship and employment opportunities at local firms, training and research programs at universities, and exchange programs at the government level, could be combined and leveraged as a package that compensates for the perhaps limited market attractiveness of each individual resource. Arguably, local and international linkages across sectors (firm, university, government) would not have been established organically, but took deliberate, collective efforts of participating parties. Figure 1 illustrates the operation of linkages across levels.

INSERT Figure 1 HERE.

Through this effort, ‘mistakes’ of prior clustering processes in the region could be prevented. On the one hand, multi-level strategic coordination has established a rather idiosyncratic bond between cluster participants in Sinos Valley and Korea, which has made cluster growth less contingent on global competitive dynamics. Whereas in the shoe industry, for example, switching costs for multinationals are relatively low due to few location-specific investments, this is not the case for semiconductors. Both Brazilian and Korean partners have a joint interest in continuing and even extending this collaboration in the long term. Also, the cross-sector approach helps to manage the risk of brain drain to other locations. As illustrated above, both local and global linkages between universities and firms are in line with the potential career paths of professionals, from basic and advanced education to internships and full employment. Unlike the case of the IT industry, where many graduates seek career opportunities abroad or in larger cities, the rather elaborate system of cross-sector linkages in semiconductors provides longer-term career incentives in the region.

Implications for Future Research

Our study confirms and extends prior research on brain circulation and its effects on cluster development, in particular in emerging economies (Saxenian, 2005; Bresnahan et al., 2001; Saxenian and Hsu, 2001). Both our cases suggest that dynamics of GBC and cluster growth are mutually reinforcing. Yet, diaspora is not merely an antecedent of cluster attractiveness, or a consequence of cluster growth (see for this discussion Zaheer et al., 2009; Lorenzen and Mudambi, 2013). By contrast, our study suggests that a dynamic, co-evolutionary perspective needs to be taken to understand the interdependent effects of GBC and local cluster development.

Based on our two cases – Bangalore and Sinos Valley – we can further differentiate two generic types of GBC: organic and coordinated. Organic BC describes a rather market-driven process by which ‘reversed brain drain’ is stimulated by the increasing attractiveness of particular clusters, e.g. due to foreign direct investment, improved infrastructure, employment and career opportunities. Governance plays only a minor role in this type of GBC. Both organizational and individual, local and inter-cluster ties driving GBC thus develop rather sporadically by means of positive feedback loops. The example of Bangalore and its emerging connection with Silicon Valley, in terms of talent movement, knowledge and practice exchange, and professional development, illustrates this dynamic process (see also Lorenzen and Mudambi, 2013; Bresnahan et al., 2001; Saxenian, 2005). By contrast, coordinated BC describes a process of individual movement and exchange and resulting knowledge transfer between clusters that is deliberately designed and governed through cluster policies and a strategic alliance of organizational actors, e.g. firms, universities, and governments. The case of Sinos Valley illustrated this process. Tie formation – both within and between clusters – in the case of coordinated BC is stimulated through

resources – labor pool, education system, employment opportunities – through cross-sector ties between firms and universities – both locally and between clusters. As noted by others, coordinated cluster approaches may help manage a greater complexity of transactions and interchanges (see also Schuessler et al., 2013; Sydow et al., 2011). Also, they help develop a certain level of idiosyncrasy that prevents both individuals and firms to easily switch locations. However, prior research also suggests that any more advanced coordination effect within clusters is constrained by the number of participants. The more people, firms and institutions need to be coordinated, the more difficult it becomes to align incentive systems, prevent free-riding, and administer processes. The study by Manning et al. (2012) illustrates that problem by comparing the effectiveness of non-poaching agreements between foreign multinational enterprises in a small location in Romania (effective) vs. in Shanghai, China (ineffective).

Along with prior research, our study also shows how important both local and global linkages are for clusters to emerge and grow (see e.g. Bathelt et al., 2004; Lorenzen and Mudambi, 2013; Feldman, 2001). In both our empirical cases, such ties have emerged, in particular locally. However, only in the Sinos Valley case, organizational and individual ties have developed across sector boundaries, e.g. between firms and universities, both locally and between clusters. As a result, Sinos Valley has established multi-level linkages with Korean partner firms and schools. We argue that the complex undertaking of developing those linkages is facilitated through coordinated rather than organic approaches.

Finally, our study addresses the ambiguous role of employee turnover and talent migration for cluster growth. Whereas in established clusters, talent movement between firms happens within cluster boundaries, thus promoting learning and innovation among firms (see e.g. Song et al., 2003; Almeida and Kogut, 1999), in less developed clusters, brain drain (to more established locations)

can be a serious threat. In particular the second case indicated that this problem can be in part mitigated when both local and transnational cluster linkages are in line with individual career progression paths. Having the opportunity to get a basic degree, take advanced courses in a foreign country, do an internship and get follow-up employment locally gives a longer-term career perspective that may prevent talent from leaving the emerging cluster (in favor of more established ones). Arguably, this high level of alignment between organizational ties and individual career progression can be reached more affectively through coordinated rather than organic BC.

Our findings have thus important implications for future research. First, we build on prior research that has shown the importance of different types of ties for cluster growth: individual and organizational ties (Lorenzen and Mudambi, 2013), local and global ties (Bathelt et al., 2004), as well as cross-sector ties, in particular between firms and universities (see also Feldman, 2001; Manning et al., 2012). In addition to that research, our study suggests that not just the ‘co-existence’ of these ties but the way they are interconnected plays an important role for BC and cluster growth. Going further, these ties can develop and interact in a more or less ‘organic’ or ‘coordinated’ fashion. Future research needs to thus take the role of governance and coordination in establishing such ties more seriously (see also Schuessler et al., 2013). However, in addition to that, we encourage future studies to bring back in some of the key structural features of these tie configurations, include the portfolio of ‘weak’ vs. ‘strong’, as well as ‘central’ and ‘marginal’ ties. Grabher (1993) for example suggested that strong ties between firms and local institutions may stabilize growth but also hinder change. For example, could the rather strong tie between Sinos Valley and Korea turn into a weakness? What if Korea loses their competitive edge in semiconductors, and how will Sinos Valley respond to that? Similar, prior studies inform about the role of centrality in global networks (Owen-Smith and Powell, 2004; Lorenzen and Mudambi,

2013). What difference does it make for Sinos Valley to what extent they have become a central or peripheral hub within global production networks in the semiconductors industry? Will a high degree of coordination compensate for weak structural positioning?

Second, our study needs to be seen in line with a growing interest of cluster scholars in the role of governance and leadership, in particular at an early stage of cluster development (Schuessler et al., 2013; Sydow et al., 2010). Rather than attributing early cluster growth to ‘luck’ (Pouder and St John, 1996) or ‘chance’ (Porter, 2000), this study suggests that in fact a series of deliberative governance efforts may reduce the role of ‘luck’ quite significantly. This is also because certain facilitating conditions that apply to organic BC and that are partly based on ‘luck’, such as prior foreign MNC investment, do not apply as much to cases where coordinated BC is successfully implemented. In this regard, our study also suggests that the notion of ‘anchor firms or institutions’ as magnet for outside talent and investments (Foster et al., 2015; Porter et al., 2012), should be complemented with the idea of ‘anchor alliances’ between firms and local institutions, which not serve to attract talent but also help ‘cross-boundary transposition’ of ideas and knowledge (Powell et al., 2012). Beside these elements of governance, future research should also pay attention to potential transitions between different levels, modes and intensities of governance. Clearly, our distinction between ‘organic’ and ‘coordinated’ is only a first step toward categorizing various modes. Also we need to be better understand how coordinated modes of BC (and other cluster stimulating dynamics) turn into more organic ones, and vice versa.

Third, our study takes part in a longer-term quest towards understanding effective catch-up strategies of developing countries (see Humphrey and Schmitz, 2002; Lorenzen and Mudambi, 2013). Our study suggests that in particular in the absence of prior related technologies and capabilities, coordinated ‘leveraging’ strategies may add the catch-up process. In particular

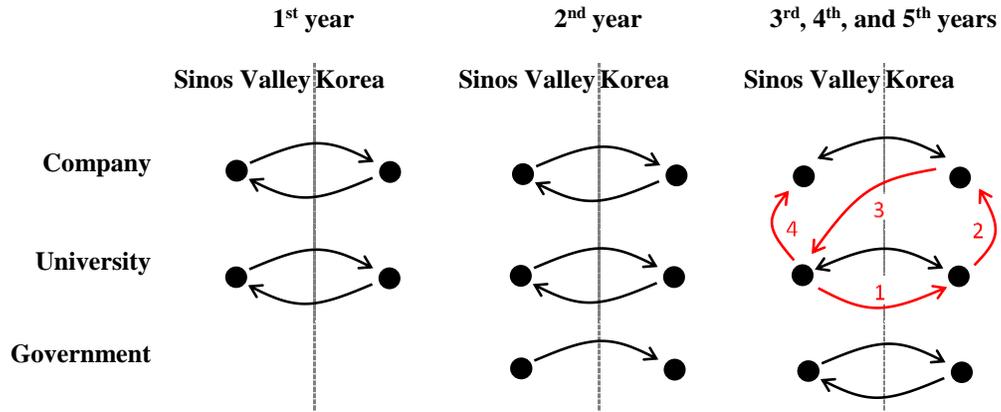
alliances with ‘aspiring peers’ (here: Korea for Brazil) seem an interesting means of learning and accelerating the catch-up process. Our study also brings smaller, less metropolitan locations back into the discussion. Despite size and development disadvantages, ‘smart governance’ may help these second-tier locations build local and global alliances to ‘leap-frog’ development. This strategy parallels the business world where strategic alliances can help firms’ diversity, gain market share and accelerate innovation (Gulati, 1998). Similarly, in our case an alliance architecture between/across firms and universities may add the ‘market development’ of catching up economies. Of course, future research needs to also investigate how ‘inclusive’ such coordinated strategies are. Who benefits from these efforts, who is left behind?

In conclusion, our study brings governance back into the discussion of cluster growth and economic development. Combined with the notion of increased global connectivity and the importance of diaspora networks, a governance perspective helps understand how even those locations that are disadvantaged in terms of size or development can benefit from what we call ‘global brain circulation’ when coordinated efforts are taken to stimulate the process.

REFERENCES ON DEMAND

FIGURES AND TABLES

Figure 1. Global brain circulation architecture and its relational effects



- (i) Circles mean talent people who have been moving from one to another country.
- (ii) Arrows indicate the talent people directions across national boundaries and over different levels.

Table 1: Comparison of Brain Circulation as Organic vs. Coordinated Process

	BC as Organic Process	BC as Coordinated Process
Cluster attractiveness	Market driven: Size and Branding effects	Governance driven: Resource bundling across sectors
Interplay individual and organizational ties	Sporadic, entrepreneurial	Part of governance architecture
Interplay local and global ties	Sporadic, independent, e.g. transnational VCs	Part of governance architecture
Facilitating conditions	Many (e.g. prior MNCs, infrastructure, talent pool)	Strategic consensus of multiple stakeholders
Cross-sector linkages	Sporadic	Intentionally promoted
Stage when approach is effective	Growth stage	Embryonic stage
Facilitating cluster size	Medium to large	Small
Magnitude of effect	Unlimited (limited only by agglomeration diseconomies)	Limited (cohorts of students, limitations of coordination)
Role of governance	Limited to tax incentives; VC firms; associations spanning clusters;	Multi-level governance: building linkages, setting up exchange programs