Part II

Case Studies: Entrepreneurs, Scientists, Students, Health Professionals, and Cultural Workers

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The International Mobility of Entrepreneurs and Regional Upgrading in India and China

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5.1 Introduction

By 2000, over one-third of Silicon Valley's high skilled workers were foreign-born, and overwhelmingly from Asia. These US educated engineers are transforming developmental opportunities for formerly peripheral regions as they build professional and business connections to their home countries. In a process more akin to 'brain circulation' than 'brain drain' these engineers and entrepreneurs, aided by the lowered transaction costs associated with digitization, are transferring technical and institutional know-how between distant regional economies faster and more flexibly than most large corporations. This chapter examines how Chinese- and Indian-born engineers are contributing to highly localized processes of entrepreneurial experimentation in their home countries, while maintaining close ties to the technology and markets in Silicon Valley.

Global labour markets are being transformed as the falling costs of transportation and communications facilitate greater mobility and as digital technologies support the formalization and long distance exchange of large amounts of information. International migration, historically a one-way process, has become a reversible choice, particularly for those with scarce technical skills, and it is now possible to collaborate in real time, even on complex tasks, with counterparts located at great distances. US educated scientists and engineers from developing countries—once

forced to choose between settling abroad and returning home to far less attractive professional opportunities—are now contributing to their home economies while maintaining professional and economic ties in more technologically advanced economies. Many travel regularly between the US and their home country; some become 'transnational' as they work, and even maintain residences and citizenship in more than one nation.

The migration of talented youth from developing to advanced countries was viewed by most economists in the post-war decades as a brain drain that exacerbated international inequality by enriching already wealthy economies at the expense of their poor counterparts (Bhagwati 1985). According to a classic textbook on economic development

> The people who migrate legally from poorer to richer lands are the very ones that Third World countries can least afford to lose, the highly educated and skilled. Since the great majority of these migrants move on a permanent basis, this perverse brain drain not only represents a loss of valuable human resources but could also prove to be a serious constraint on the future economic progress of Third World nations. (Todaro 1985)

Data on these trends are hard to find, but the UN has estimated a total of three hundred thousand highly skilled emigrants from all developing countries to the West during the 1960s (Rapaport 2002); the 1990 US Census showed 2.5 million highly skilled immigrants, excluding students.

Much of the movement of talented individuals from developing to advanced countries during the latter part of the twentieth century involved migration to the US, specifically to Silicon Valley. The region's technology producers grew very rapidly from the 1970s through the 1990s, absorbing scientists and engineers voraciously and irrespective of national origin. Tens of thousands of immigrants from developing countries, who had initially come to the US for graduate engineering education, accepted jobs in Silicon Valley rather than return to their home countries where professional opportunities were far more limited.[1] By 2000, over half (53 per cent) of Silicon Valley's scientists and engineers were foreign-born. Indian and Chinese immigrants alone accounted for over one-quarter of the region's scientists and engineers, or some 20,000 Indian and 20,000 Chinese (5,000 Taiwan- and 15,000 mainland-born) engineers.[2]

[1] NSF data shows that over 95 per cent of foreign-born engineering and science doctorate holders from India and China planned to stay in the US after graduation.

[2] Indians accounted for 13 per cent and Chinese for 14 per cent of the region's engineers and scientists. This data is from the 5 per cent Microdata Sample, 2000 US Census.

This chapter argues that the same individuals who left their home countries for better lifestyles abroad are now reversing the brain drain, transforming it into brain circulation as they return home to work, establish partnerships, or start new companies, while maintaining business and professional ties with the US.

The spread of venture capital financing provides a window into this process. In the early 1980s, returning migrants from Taiwan and Israel began to transfer the Silicon Valley model of early stage high-risk investing to their home countries, locations that US venture capitalists typically had neither interest in nor the ability to serve. These native-born investors provided the cultural and linguistic know-how needed to operate profitably in these markets. In addition to capital, they brought technical and operating experience, knowledge of new business models, and networks of contacts in the US. Israel and Taiwan today boast the largest venture capital industries outside North America, and both have high rates of new firm formation and growth. Israel is now known for software and Internet firms like Mirablis (an instant messaging program developer) and Checkpoint (security software); Taiwan has become a center of leading edge personal computer (PC) and integrated circuit (IC) manufacturing with firms like Acer Technology Ventures (PCs and components) and TSMC (semiconductor foundry.) All have relied on the skills and contacts of returning scientists and engineers as well as cross-regional investors and other service providers.[3]

Long distance migrations have shaped the contours of the world economy throughout history (Piore 1979). The transfers of skill and know-how that accompany the movement of individuals and groups within and between nations can have an enduring impact on patterns of economic development, as with the modernization of Japan during the Meiji restoration in the nineteenth century, and the transfer of British textile and German steel technology to the US during the nineteenth century. Economic historians have documented the contributions of personnel recruitment to knowledge transfer, and they have demonstrated that the experience, relationships, and tacit knowledge that reside in individuals and their communities play a central role in long-distance transfers of technology and economic institutions (Brenner 1994; Sowell 1996; Bordo et al. 2003).

[3] For details on the process of brain circulation and its impacts on Taiwan and Israel, see Saxenian (2006).

Today's returning entrepreneurs have dramatically accelerated the adaptation of technology and institutions to local circumstances that are invariably different from those in the US. Transferring production to a new environment requires deep knowledge of the local context—the subtle as well as more apparent differences in social, cultural, and institutional settings. And there are few substitutes for native experience. Nor is this is a one-way process. The fragmentation of production and the dramatic reductions in the cost of transportation and communication allow these highly mobile entrepreneurs to build and maintain long distance partnerships to tap overseas expertise, cost savings, and markets.

The chapter focuses on the creation of venture capital industries with close links to Silicon Valley—a process that entails extensive institutional change, particularly in domestic capital markets, and in turn can have important consequences for the pattern of economic development. Not surprisingly, this process was faster in small countries like Israel and Taiwan than in the complex political economies of China and India. Nonetheless, by 2004 venture capital and private equity firms were investing more than US$1 billion annually in enterprises located in China and a comparable amount in India. While this is a fraction of the venture capital invested annually in the US or even the amount of foreign direct investment in these economies, it supports indigenous entrepreneurship and has created an alternative, increasingly competitive, trajectory to the development opportunities provided by both established domestic firms and multinational corporations in these nations.

At the outset the chapter discusses the limits of traditional core–periphery understandings of the relation between developed and developing economies in an era of global labour mobility and brain circulation, particularly the failure to anticipate the development of independent technological capabilities in the periphery. Then we trace the transfer of the Silicon Valley model of venture capital to Taiwan during the 1980s by networks of US educated Chinese engineers. In this case the transfer of institutional and policy know-how was arguably as important as the subsequent transfer of skills and technical knowledge. Then we take a detailed look at more recent processes of policy reform and institutional adaptation in China and India. The venture capital industries in these two countries have grown rapidly, with close connections to their Silicon Valley and US counterparts, and in both countries, economic development in certain regions is characterized by high rates of entrepreneurship and experimentation. The chapter concludes with thoughts about the

extent to which it is possible to generalize from these cases of peripheral entrepreneurship to other late developing economies.

5.2 Economic Development in an Era of Global Labour Mobility

Traditional accounts of economic development assume that new products and technologies emerge in industrialized nations that combine sophisticated skill and research capabilities with large, high income markets—and that mass manufacturing is shifted to less costly locations once the product is standardized and the process stabilized. Success in this view builds on success in advanced economies, while peripheral economies remain followers. This divide is perpetuated by both the strategies of multinational corporations and the tendencies toward agglomeration created by the economics of increasing returns. This model leaves little room for the development of independent technological capabilities in the periphery. At best, foreign investment from the core might contribute to the incremental mastery of manufacturing techniques and upgrading of local suppliers. Even the most successful newly industrializing countries are destined to remain imitators as long as leading edge skill and technology reside in the corporate research labs and universities in the core. The primary route to development in the periphery, in this view, is the mobilization by the state, in conjunction with local banks and industry, of the resources to either develop or import the mass manufacturing capabilities that were perfected in the core.

Transformations in the world economy have undermined the power of this core–periphery model, however. The increasing mobility of highly skilled workers and information on the one hand, and the fragmentation of production in information and communication technology sectors on the other, provide unprecedented opportunities for formerly peripheral economies. Regions that missed the post-war economic boom, in particular, have provided fertile environments for a decentralized growth based on entrepreneurship. The key actors in this process are neither policymakers nor multinational corporations in isolation, although both certainly play a role, but rather communities of technically skilled immigrants with work experience and connections to Silicon Valley and related technology centres.

US educated and trained engineers are increasingly transferring up-to-date technology and market information and helping to jump start

local entrepreneurship, allowing their home economies to participate in the information technology revolution. Because of their experience and professional networks, these cross-regional entrepreneurs can quickly identify promising new market opportunities, raise capital, build management teams, and establish partnerships with other specialist producers—even those located far away. The ease of communication and information exchange within ethnic professional networks accelerates learning about new sources of skill, technology, and capital as well as about potential collaborators. It also facilitates the timely responses that are essential in a highly competitive environment. This decentralized responsiveness is an advantage that few multinationals can claim. The scarce resource in this environment is the ability to locate foreign partners quickly and to manage complex business relationships and teamwork across cultural and linguistic barriers. This is particularly challenging in high-tech industries in which products, markets, and technologies are continually redefined—and where product cycles are often nine months or less. First generation immigrants like the Chinese and Indian engineers in Silicon Valley who have the language, cultural, and technical skill to function well in the US as well as in their home markets have a commanding advantage. They have created institutions and social structures that enable even the smallest producers to locate and maintain mutually beneficial collaborations across long distances and that facilitate access to distant sources of capital, skill, and markets.

Late developing economies typically face two major disadvantages: they are remote from the sources of leading edge technology, and they are distant from developed markets and the interactions with users that are crucial for innovation (Hobday 1995). Firms in peripheral locations use a variety of mechanisms to overcome these disadvantages, from joint ventures and technology licensing to foreign investment and overseas acquisitions. However, a network of technologists with strong ties to global markets and the linguistic and cultural skills to work in their home country is arguably the most efficient and compelling way to overcome these limitations. Cross-regional entrepreneurs and their communities can facilitate the diffusion of technical and institutional know-how, provide access to potential customers and partners, and help to overcome reputational as well as informational trade barriers for isolated economies.

The increasing sophistication of information and communication technologies and the liberalization of global markets have accelerated this process. It is now quick, simple, and inexpensive to communicate internationally and to transfer information between distant locations.

Information systems that facilitate the formalization of knowledge are dramatically expanding the volume as well as the variety of possible forms of information exchange. However, information technology alone cannot ensure successful co-ordination or efficient transfers of technical and institutional knowledge. Long distance collaborations still depend heavily upon a shared social context and language that ensures mutual intelligibility between partners, particularly as speed and responsiveness are essential in today's technology competition.

Market liberalization has been equally important to the economic transformation of China and India. But the reduction of trade barriers and bureaucratic intervention alone does not create the institutional and social context, let alone the domain knowledge, required to insure sustained competitive success in global industries. Technology entrepreneurship remains highly localized even in the most advanced economies and it cannot be created by fiat, as evidenced by decades of failed attempts to 'grow the next Silicon Valley'. Efforts to jump-start entrepreneurship by mobilizing researchers, capital, and a modern infrastructure cannot replicate the shared language and trust of a technical community that permits open information exchange, collaboration, and learning (often by failure) alongside competition in places like Silicon Valley. Returning entrepreneurs are ideally positioned to collaborate with domestic policymakers and businesses to identify appropriate market niches, mobilize domestic skill and knowledge, connect to international markets, and identify and devise strategies to overcome obstacles to further growth. In the 1970s and 1980s US educated Israeli and Taiwanese engineers and entrepreneurs returned to their home countries by the thousands and successfully transferred both US style venture capital and the Silicon Valley model of business focus and partnering. These regions have now completed several cycles of reinvestment by successful entrepreneurs who also serve as role models and contribute accumulated know-how and contacts to a subsequent generation of technology ventures. By contrast, the entrepreneurial ecosystem is still in its formative stages in the technology regions of India and China. These regions have seen important early entrepreneurial successes, and both have sizable technically skilled workforces willing to work very hard for relatively low wages. While few US educated emigrants returned to either India or China during the 1980s and 1990s, the post-2001 technology recession triggered an upsurge in cross-regional and returnees that has continued to the present.

The contributions of an international technical community in transferring the institutions of technology entrepreneurship should not

be confused with the broader role of a diaspora in the home country. The aggregate remittances, investments, or demonstration effects of a diaspora can affect an economy in a variety of different but largely limited ways. These cross-regional networks, however, are created by a small subset of highly educated professionals whose potential contributions to economic development are disproportionately significant. They are not typically drawn from the traditional economic or political elites of their home countries. Rather, most are the top engineering students from middle class households whose access to education in the US has landed them in a very different technological and institutional environment—one that they initially master and later transfer to their home countries. Returning migrant communities are not replicating Silicon Valley around the world. Wide variations in national economic and political institutions, themselves the products of enormously varied histories and cultures, ensure distinctive and divergent economic trajectories. It is more appropriate to see the emerging regions as hybrids, combining elements of the Silicon Valley industrial system with inherited local institutions and resources. Returning entrepreneurs typically seek (with varying success) to transfer venture capital finance, merit-based advancement, and corporate transparency to economies with traditions of elite privilege, government control, and corruption. They seek to reproduce the team-based firm with minimal hierarchy and horizontal information flows in an environment dominated by family run businesses or state owned enterprises. Moreover the national institutions that support the Silicon Valley system—efficient and well developed capital markets, property rights, an independent judiciary, regulatory oversight, and sophisticated education systems, research institutions, and physical infrastructure—are rarely present in these peripheral economies.

A regional economic trajectory is shaped both by local institutions and by the range of technological and market opportunities available at the time it enters global markets (Bresnahan and Gambardella 2004). The fast growing market for wireless communication in Asia has, for example, created opportunities for firms in China and India to contribute to the direction of the technology and its applications—even if they do not define the technical forefront. Entrepreneurship led growth, with competitive small and medium sized technology producers in high skill regions connecting to and collaborating with counterparts elsewhere, is only one possible future for these formerly peripheral regions. They could forgo the opportunity to upgrade local skills and capabilities, and instead remain suppliers of low cost labour to global (or domestic) corporations. China

and India have the labour supply to do this for a relatively long time. However, many transnational entrepreneurs have maintained close ties to the technology and markets of Silicon Valley, and are constructing firms committed to an alternative, high value-added trajectory.

5.3 Taiwan: Transferring the Silicon Valley Model

Taiwan's venture capital industry was modelled after that in Silicon Valley—and with time fostered mutually beneficial economic ties between high-tech industries in the two regions. Dr Kuo-Ting Li, a former economic affairs minister who is widely regarded as the architect of Taiwan's technology strategy, was the original champion of venture capital in Taiwan. Li visited Silicon Valley regularly during the 1970s and 1980s to meet with US educated Chinese engineers and seek their advice on strategies to make Taiwanese industry more globally competitive. He was especially impressed with the local venture capital industry and the institutional supports that it created for entrepreneurship. In the early 1980s—long before it was fashionable elsewhere—Dr Li convinced the finance ministry of the need to provide funding for research intensive production and promote the development of a public capital market. In 1982 he introduced legislation to create, develop, and regulate venture capital in Taiwan, including comprehensive tax incentives and financial assistance. While such policy may seem uncontroversial today, the concept of venture capital was foreign to Taiwanese practice, in which family members closely controlled all of the financial affairs of a business. Dr Li also faced significant resistance from senior policymakers like Dr Ramo, a technological consultant of Executive Yuan, who argued that Taiwan lacked the capabilities to develop a venture capital industry (Saxenian and Li 2003).[4]

The policy measures and regulations that Taiwan ultimately adopted were greatly shaped by the large community of overseas Taiwanese engineers, many of whom were based in Silicon Valley. The finance ministry, for example, hired US educated engineers to develop a plan for the creation and organization of private industrial investment companies in Taiwan. They concluded that Taiwan should import the venture capital model from the US. At the same time Taiwan's economic affairs minister, Li-Te Hsu, and the CEO of Acer, Stan Shih, also visited the US to learn about the institutions and systems of venture capital.

[4] The data in this section is drawn heavily from Saxenian and Li (2003).

Overseas Chinese engineers also played a crucial role in the mobilization of a political consensus to support the government promotion of a venture capital industry. An IBM executive based in Silicon Valley, Ta-Lin Hsu, used his status as an outside expert—in Chinese terminology, a 'foreign monk'—to actively promote the new policy measures among different governmental decision making units in Taiwan. In the eyes of its domestic and overseas promoters, the justifications for the introduction of the venture capital mechanism to Taiwan were fourfold. The supporters of Li argued, first, that rather than trying to replicate the high level technological innovation of places like Silicon Valley, Taiwan should exploit its own strengths—its supply of relatively low cost, highly skilled engineers. In this view, Taiwan would position itself to develop commercial applications based innovations from the US. Lower skill, mass production could be carried out elsewhere. Li envisioned the Hsinchu Science-based Industrial Park (HSIP), which was created in 1980, as the place for Taiwanese entrepreneurs to undertake this commercialization and as the place to develop a bridge between domestic and foreign companies. The availability of venture capital would be the key determinant of success in this strategy. Policymakers also recognized that the conservatism of Taiwan's established financial institutions was a major hindrance to the incubation of high-tech ventures. Most financial institutions at that time were commercial banks, which provided only mortgage or debt financing. In addition, the risk-averse attitude of the government officials who managed the 'development fund' and other financial incentive programmes limited the ability of these capital sources to spawn risky technology enterprises. A private venture capital industry would provide an important capital source for such high-risk but potentially high-reward ventures. In addition, Taiwan's businesses were overwhelmingly (95 per cent) small and medium sized enterprises and most were family run businesses that lacked incentives to adopt modern management techniques. Policymakers believed that a venture capital industry could help promote the introduction of modern financial and management skills by institutionalizing the separation of ownership and control. Finally, they recognized that the introduction of the venture capital mechanism would entail the development of a public capital market that provided an exit option for venture capital investments.

Recognizing that Taiwan lacked the relevant institutional know-how to start a venture capital industry, in the early 1980s domestic policymakers organized collaborations with large US financial institutions to facilitate the transfer of relevant financial and managerial expertise. They also

sent individuals to the US to be trained in managing a venture capital business and introduced a series of initiatives to encourage domestic firms to enter the industry. Under Li's guidance, the finance ministry created significant tax incentives to encourage the establishment of a venture capital industry—20 per cent of the capital invested in strategic (technology intensive) ventures by individual or corporate investors was tax deductible for up to five years. The ministry also offered substantial matching funds through a 'seed fund' with NT$800 million from the Executive Yuan Development Fund. In addition regulation governing security and exchange was modified to support the development of a public capital market.

The domestic computer company Acer founded Taiwan's first venture capital firm in 1984 as a joint venture with the old-line Continental Engineering Group. However there were initially no followers. Faced with the challenge of raising capital from Taiwan's risk-averse financial and industrial communities, Li invited the overseas Chinese community to establish venture capital businesses in Taiwan. Ta-Lin Hsu, who had been a key senior policy adviser and STAG member since the 1970s, set up Hambrecht & Quist Asia Pacific in 1986. Hsu reports that it was not easy to raise the initial US$50 million fund. In particular Li 'twisted lots of arms' to raise US$21 million (51 per cent) from leading Taiwanese industrial groups such as Far East Textile, President Enterprises, and Mitac. The balance (49 per cent) came from the government.[5] The first general manager in H&Q Asia Pacific's Taipei office, Ding-Hua Hu, was a classic returnee to Taiwan. After earning a PhD in engineering at Princeton, Hu returned in the 1970s to play a leading role in building Taiwan's semiconductor industry as the first general director of the Electronics Research and Service Organization and as a professor of electrical engineering at the elite Chiao Tung University.

In 1987, two other overseas Chinese engineers, Peter Liu and Lip-Bu Tan, responded to Li's invitation as well, establishing Taiwan's second US style venture fund, the Walden International Investment Group (WIIG) as a branch of the San Francisco-based Walden Group. Both H&Q Asia Pacific and WIIG (along with Peter Liu's spin off firm, WI Harper) were able to raise capital for Taiwanese funds with relative ease from the networks of overseas Chinese in Silicon Valley who were familiar with venture capital. All three remain leading investors in Silicon Valley and Taiwan's technology industries, and increasingly in mainland China as well. It was

[5] Interview with Ta-lin Hsu, San Francisco, US, 1 June 1997.

only after these investments showed returns—after companies like Acer and the returnee company, Microtek, were publicly listed on the Taiwan Stock Exchange in the late 1980s—that that the venture capital industry in Taiwan took off. The seed fund with matching grants for venture investments was depleted and the Executive Yuan committed a second fund of NT$1.6 billion that was also allocated quickly. Domestic IT firms began to create their own venture funds, including D-Link, Macronix, Mosel, Taiwan Semiconductor Manufacturing Company (TSMC), Silicon-Ware, UMAX Data Systems, UMC, and Winbond. Old-line firms in traditional industries like petrochemicals that had been reluctant earlier to get involved in the 'new economy' also began investing in technology related venture funds and businesses.

The emergence of Taiwan's venture capital industry and the early successes of venture backed start-ups attracted growing numbers of overseas Chinese to return from the US to start businesses. Miin Wu—a Stanford graduate who worked in Silicon Valley for over a decade before returning in 1988 to start Macronix International, one of Taiwan's first semiconductor companies, in Hsinchu Science Park with funding from H & Q Asia Pacific—is a well known example. The availability of venture capital arguably transformed the Hsinchu Science Park from its original role as an export processing zone into a fertile environment for the growth of indigenous technology firms. By 1996 over 2,500 engineers and scientists had returned to work in the Hsinchu Science Park and 40 per cent of the 203 companies based in the park were started by returnees (Saxenian 2006). The availability of venture capital distinguished Taiwan from the rest of Asia at a time when capital was available in the region only to large corporations with ties to governments or to wealthy families. One measure of the success of Taiwan's venture capital industry is the impressive performance of venture funded firms in public capital markets. Ten of the 32 new ventures started in the Hsinchu Science Park in 1996 received funding from local venture funds. By 1998, over 130 venture funded companies were listed on the Taiwan Stock Exchange and some 40 were listed on NASDAQ in the US.

Taiwan's technology sector emerged in the 1970s as a source of low cost skill for labour intensive calculator and electronic component manufacturing. The networks of US educated engineers who worked with policy-makers to develop local institutions like venture capital, helped transform the local environment, creating conditions for entrepreneurial experimentation. In the early 1990s—with the growth of entrepreneurship and accumulated production experience—local firms began differentiating

their products on the basis of innovation and quality rather than simply low cost. Entrepreneurs and established firms defined specialized niches that allow them to focus and shift to higher value-added activities without competing head on with industry leaders in the US and elsewhere. By the end of the decade, Taiwan had established a position as the world's most flexible and cost effective center for IT manufacturing.

5.4 Building China's Venture Capital Industry

The Chinese government initiated creation of domestic venture capital in the 1980s, but in contrast with Taiwan, where a dynamic private sector venture capital industry took off in the 1990s, the industry in China was constrained by a financial system and capital markets inherited from the planned economy. The China New Technology Venture Investment Corporation, which was established as a limited corporation in 1985 by the State Science and Technology Council and the finance ministry as the country's first experiment with venture capital, was declared bankrupt and closed by the People's Bank of China in 1997. This and several other early failures were an indication of structural problems, but did not stop local governments, universities and state owned companies, and other organizations from setting up venture capital funds. Notably missing, however, were commitments of capital to these venture funds by private sources.

In 2000, some 160 domestic venture capital firms were in operation in China, primarily located in Beijing, Shanghai, and Shenzhen. The government remained the primary source of capital, either directly or indirectly through university or state owned firms—thus compromising the incentive for fund managers to make high-risk investments, particularly in private enterprises (White et al. 2002). Investments in government owned companies, by contrast, carried little risk. Julie Yu Li, a partner in a venture capital firm started by a government owned trading company in Shenzhen, summarized the challenge: 'I am supposed to invest in high-technology businesses, but my director once asked me if I could "reduce the risk to zero"!' And she points out other limits of the current system:

> I never expected my job would be this difficult. We have no way to identify entrepreneurs or to evaluate risks and returns and we must get approval from the president to make any investments, which takes forever because it is so hard to get access to senior management.[6]

[6] Interview with Julie Yu Li, Shenzhen, China, 11 January 2001.

A Silicon Valley based entrepreneur who has advised the Chinese government on reforming the industry notes: 'Venture capital fund managers in China have little at stake in the success of their ventures. If they are honest they will take no risk at all; if not they take advantage of the opportunity to make under-the-table deals with entrepreneurs'.

The regulatory framework for venture capital investing in China remains weak—it is unnecessarily restrictive in some ways, overly lax in others, and the rules are often overlooked in practice (Xiao 2002). China's company law, for example, historically limited the number of shareholders and set a minimum level of investment that was not only high in the Chinese context but also exceeded the practice in the typical Western venture capital firm. It also limited the contribution of intangible technology to the valuation of an enterprise to 20 per cent—unrealistic for technology businesses.

Reform of the system has been continuous in recent years, and shaped by extensive input from returning Chinese entrepreneurs and professionals. Carmen Chang, a Taiwan born, US educated partner at Wilson Sonsini Goodrich & Rosati, one of Silicon Valley's leading law firms, has served Silicon Valley's leading Taiwanese and mainland Chinese entrepreneurs since the 1980s. Chang has been recruited to advise on major investments as well as policy and regulatory reform in China. She led the legal team for the high profile semiconductor foundry in Shanghai, SMIC, a more than US$2 billion deal that involved major US, Taiwanese, and Chinese investors. She helped establish a joint venture between Silicon Valley-based 3Com and China's Huawei; and she has served as an adviser to the Chinese Securities and Regulatory Commission as they planned for a NASDAQ type market in Shenzhen.

China's venture capital industry faces other challenges related to the limited government oversight, including the information asymmetries between investors and fund managers, and between venture capital firms and the companies they finance. In both cases the lack of transparency, reporting standards, performance measures, and external oversight creates strong incentives for corruption and for concealing or falsifying information (Xiao 2002). It is therefore no surprise that while the China's venture capital firms have financed thousands of high-tech enterprises, these investments have generated minimal returns to date.[7]

Along with its banks, China's capital markets are the weakest link in its economy. While the Taiwan stock exchange played a vital role in

[7] Interview with Tang Hui-hao, 10 September 2004.

providing liquidity for venture capital financed start-ups, the Chinese stock market was organized in the 1980s to provide capital for the expansion of state controlled companies, a bias against private enterprise that continued throughout the 1990s as the Chinese exchanges were used to prop up failing state owned enterprises. Even today, in spite of many efforts at reform, the market remains poorly regulated and subject to price manipulation. The old governmental quota system, which gave each province an annual initial public offering (IPO) quota and ensured that state companies dominated the market listings regardless of their profitability, is being phased out. However the top regulators at the China Securities and Regulatory Commission are government appointees and management of the exchange remains highly political. The onerous listing requirements and regulatory procedures for approving public share offers on the main stock exchanges still favour state backed firms. In 2000 only a handful of the more than 1,000 companies listed on the Shanghai and Shenzhen stock exchanges were from the private sector.

In the late 1990s the China Securities and Regulatory Commission planned a second board in Shenzhen modelled after NASDAQ for high risk, high-return companies. However the anticipated opening was delayed following the US technology stock collapse in early 2001. An initial step toward setting up the second trading board was taken in 2004 when small and medium sized firms were allowed to list on the Shenzhen exchange for the first time, and the expectation was that a second step would be taken in 2005 with a lowering of the listing requirements for these smaller capitalized companies. On the other hand, when a local government issues a list of the industries that venture capital will focus on in the coming years, it suggests that China is often still trying to 'grow the new economy using the tools of the planned economy' (Xiao 2002).

The only genuine high-risk technology investors in China are the approximately 50 foreign venture capital funds with a presence in the country, many from Taiwan and Silicon Valley. These firms—including Japan's Softbank, Warburg Pincus, Intel VC, WI Harper, WIIG, H&Q Asia Pacific, Acer Technology Ventures, V2V, IDG, and Vertex—invest in China very cautiously. Their investors typically bring knowledge not only of technology and management but also understanding of and experience in doing business in the Chinese market. Acer Technology Ventures, for example, has offices in Silicon Valley, Taipei, and Shanghai and plays a central role in promoting cross-Pacific start-ups. The limited partners include Acer affiliate companies (32 per cent), Acer top management (6 per cent), and institutional investors.

A series of high profile IPOs including SMIC, 51job Inc (an on-line human resource services company) and China's largest on-line game company, Shanda Interactive Entertainment, fuelled a rush of new investors into the China market in 2004, boosting venture capital investment to just over US$1 billion, or double the amount a year earlier. While this is not a large amount compared to the total foreign direct investment in China of approximately US$62 billion in 2004, many observers worry about a 'mini bubble' with too much risk capital chasing too few high quality start-ups alongside the already excessive valuations of Chinese technology stocks.[8,9]

Longer term investors have learned from hard experience the challenges of doing business in China. The chairman of WIIG, Lip-Bu Tan, recalls that when he first went to China in the early 1990s he intended to invest in state owned enterprises, but soon realized how difficult it would be to overcome their inefficient management, obsolete equipment, and limited understandings of market economies. He then sought to create joint ventures between US start-ups and local Chinese companies, but concluded that the challenge of bridging the conflicting goals and approaches of two management cultures was insurmountable. According to Tan, the experience with Howard Yang's New Wave Silicon taught him that the best strategy in China is to invest in US educated students who want to return home to start firms. New Wave Silicon was acquired in 2002 by Silicon Valley-based semiconductor company, Integrated Device Technology, for US$85 million, earning money (and US dollars) both for WIIG as well as for China's Hua Hong Microelectronics. The key, says Tan, is to find US university graduates who have stayed and worked in companies in a place like Silicon Valley for many years, 'You have to be reasonably brain-washed in the US to succeed in a western-style technology venture in China'. As the mainland Chinese community in the US matured in the first decade of the twenty-first century such seasoned start-ups seem increasingly plausible. Tan's vision of the model returnee firm includes headquarters and R&D capability in Silicon Valley, incorporation in the Caribbean, manufacturing and/or development in China, and higher

[8] Overseas Chinese venture capitalist David Chao, who is based in Silicon Valley but regularly travels to China, observes,

I think of China as the wild, wild West. Business law has only been in practice for the last 10 years. There are fundamental issues that still have to be addressed. What rights does a shareholder have in China? There's also this significant cultural gap . . . There's definitely a lemming effect going on here. A lot of these guys will get burned.

[9] Gary Rivlin 'Talk of a Bubble as Venture Capitalists Flock to China' in *The New York Times*, 6 December 2004: C10.

level design or logistics capability in Taiwan, led by entrepreneurs who understand Chinese language, culture, and institutions.

The cross-Pacific venture capital firm Authosis specializes in early stage fabless IC design companies, particularly those focusing on the China market. The firm is headquartered in Hong Kong and has operations in Shanghai and Shenzhen as well as in Silicon Valley. Authosis founder and CEO Danny Liu has extensive experience working for China's Legend Group (now Lenovo), which provides invaluable relationships in domestic technology and business circles, as well as experience investing in Silicon Valley start-ups. The advisory board includes the former CEO of the Silicon Valley Bank, a former Dean of Engineering at UC Berkeley, the CTO of Taiwan Semiconductor Manufacturing Co. (and also a professor at UC Berkeley), and computer science and engineering professors from MIT, Tsinghua University, and Peking University. One of the firm's earliest and most successful investments was the electronic design automation company Celestry Design Technologies, started by Wayne Wei-Ming Dai.

These cross-regional venture capital investors have financed some of China's most promising new technology enterprises. The most successful firms have experienced Chinese senior management teams who return from the US to start technology businesses. These returnees are advantaged by networks of former classmates, friends, and family they can tap as they undertake the challenges of growing a firm in an environment that requires personal connections to get things done. The standard cross-regional start-up combines the new product and business vision, technology architecture, product marketing, and R&D oversight from Silicon Valley with China's R&D implementation, manufacturing and production logistics, and field engineering and local sales support. Their leverages are the management experience of Silicon Valley's overseas Chinese, China's low cost engineering resources, standard and commercially available development tools, and the supply chain manufacturing infrastructure of greater China (Taiwan and mainland). In this vision, products like mobile appliances or new semiconductor designs can rely on the US market as an early driver and then be commercialized in both China and US markets.

There remain substantial challenges to these cross-regional start-ups. Venture investment in China is still in its early stages; there has not yet been a complete cycle of investments and reinvestments in a second generation of entrepreneurs. Cross-regional firms also face significant difficulties coordinating distant activities, particularly in developing organizational synergy and persistent, consistent communication. Finally, they face the challenge that all technology firms in China face, of controlling

and protecting their intellectual property (Chwang 2003). Finally, they lack viable exit options since private enterprises have virtually no access to China's public capital markets (the two main trading boards, in Shanghai and Shenzhen, are dominated by former state owned enterprises). Equally important for foreign investors, the Chinese yuan (CNY) is not convertible, so there is no legal way to get earnings out of the country.

The power of the overseas community is most evident in the semiconductor industry, which originated in Silicon Valley and has been transferred by Chinese entrepreneurs first to Taiwan and then from Taiwan and Silicon Valley to China. In the words of WebEx CEO Min Zhu,

> Silicon Valley is the technology leader and the center for real innovation because it supports the growth of start-ups. New firms cannot grow this fast in China or India. The most powerful model is a truly international company that combines the creative ideas and architectures that are developed in the United States with the ability to quickly implement them where skill is less expensive: both need to be scaleable.[10]

5.5 Venture Capital and Entrepreneurship in India

Veteran Silicon Valley venture capitalist William H. Draper III took US style early stage venture investing to India in 1995. Soon after establishing a US$55 million fund, Draper International, with a colleague in San Francisco and local partners in Bangalore and Bombay, he realized the many obstacles involved in working with entrepreneurs in India. The concept of venture capital was new in India, where the closely held family centred business model dominated both small firms and the large groups like Birla and Tata. It was very difficult to coordinate activities between India and Silicon Valley, and start-ups—with far more limited resources—faced all the same frustrations experienced by multinational investors, from the frequently corrupt and restrictive bureaucracy, to the lack of Western-style stock option plans, to retain key personnel to the limits of basic infrastructure such as power and water and the very high cost of connectivity. In the words of Draper's partner, Robin Richards, in 1997:

> From a venture capitalist's perspective, it is 5–10 times slower to start-up a company in India than in the US, mostly due to the difficulty of getting the correct infrastructure in place for production. And since most of the technology market

[10] Interview with Min Zhu, San Jose, US, 16 April 2001.

is focused in the West, it is difficult for an India-based entrepreneur to form the necessary business partnerships, and find the right management, marketing and sales talent to join his or her company. (Kurian 1997)

Within two years, Draper and Richards had reoriented the strategy for the fund to focus primarily on investments in US-based firms with a large proportion of their activities in India. When the fund closed in 2000, only one of the India-based companies that had received funding was successful (Rediff Communications), whereas a majority of the US-based firms in the portfolio had found liquidity. The timing was fortuitous, to be sure, but Draper attributes the successes as well to the combination of technology development in India and business, marketing, and sales operations 'near the action' in the US. Some of the firms in the fund were in the US to start, but others were in India and Draper brought them to Silicon Valley. According to Richards, they learned about some of their best US-based deals in India: 'You could be sitting in Bangalore and hear about 10 great deals in Santa Clara that you could be a venture capital investor in, but you'd hear about them first in Bangalore' (Schram 2001: 66).

Draper International discovered that the ecosystem for Silicon Valley style entrepreneurship was absent in India in the 1990s. Successful Indian and multinational software services and business process firms had created facilities that allowed them to draw on local skill, but they remained externally oriented and isolated from the local environment. Labour mobility in regions like Bangalore was 20–30 per cent in the 1990s as workers sought to maximize their earnings in a tight market, but it was not associated with the experimentation of a technical community as in Silicon Valley or Hsinchu. As a result, it simply contributed to annual wage increases on the order of 25–40 per cent, as well as the increasing tendency for firms to expand to other areas (Parthasarathy 2000).

A domestic venture capital industry emerged in India in the 1990s, but much of it was large public sector funds or banks and multilateral institutions. Organizations like Union Trust of India Ventures or Small Industries Development Bank of India Venture Capital lacked domain knowledge or experience in software or technology related industries. The funds, typically run by conservative financiers concerned with tangible assets and unwilling to take risks, were overwhelmingly late stage investors in software services. In the words of A.V. Sridhar, former senior manager at Wipro, 'The Indian venture capitalist will not take risks in new areas, as opposed to a risk-free definitive software services market, where he is assured of quick returns and profits' (Biswas 1998). The supply of

venture capital in India remained very small by international standards, in part because of a multiplicity of conflicting, often cumbersome and anachronistic regulations and a variety of other forms of discrimination against the industry. In 1998 only 21 companies were registered with the Indian Venture Capital Industry Association, and they had approximately US$700 million available for investment. This compared to Israel's 100 funds with US$4 billion available for investment in 1999 and Taiwan's 110 funds with US$1.32 billion investments.

A few domestic technology start-ups survived the environment of the 1990s, as well, but none experienced the successes of start-ups in Taiwan or Israel at the time, although most were started by returnees from the US (Desai 2003). For example, Silicon Automation Systems (SAS) was started in Silicon Valley in 1989 by four Indian engineers educated in the US. They bootstrapped the venture, and in 1991 they moved part of the operation to Bangalore while seeking to maintain a strong research and software and hardware design (as opposed to software services) orientation. In 1997 SAS was a small, privately held firm with about three hundred employees and US$10 million in exports. Another returnee, Pradeep Singh, started the software services firm Aditi in Bangalore in 1994, after nine years at Microsoft. With headquarters in Seattle, Aditi relied on Microsoft as a stable client while also seeking to grow the business. During the 1990s most of the other returnee start-ups in Bangalore and elsewhere in India—a small number, to be sure—either failed or stagnated.

The boom in the US technology sector in the late 1990s had contradictory consequences for India. Labour shortages resulted in an increase in the quota for temporary visas granted on the basis of skill, with 124,697 Indian nationals gaining approvals of H1-B status in 2000 alone, representing nearly half (48 per cent) of all visa approvals. The next largest sending country was China, accounting for only 9 per cent of H-1B recipients (22,570). Desai (2003) estimates that at least half a million Indian programmers received visas (of all sorts) for the US between 1996 and 2001. Labour shortages also contributed to the growing numbers of cross-regional start-ups between Silicon Valley and India. Rakesh Mathur, who worked for Intel in Silicon Valley for many years before starting three successive successful technology companies—Armedia, Junglee, and Stratify—explains,

> 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)

Mathur made six trips to India in 1999, and in 2000 his firm Stratify established a 100 person operation in Bangalore. Mahesh Veerina, who started self-financed Internet technology firm Ramp Networks in 1993 with two friends, reports that they were quickly running out of money and could not afford to pay for local engineers, so they hired programmers in India for one-quarter of the Silicon Valley rate. The firm's engineers reported that they were able to cut development time in half because Indian team worked while the US team slept. By 1998 the firm had 65 employees in Santa Clara and 25 in India—and required that every engineer spend at least a couple of weeks working in the other country (Thurm 1998). While data are not available, it appears that this cross-regional business model was increasingly common in the late 1990s.

While firms like Ramp Networks and Stratify represent the standard model for building a cross-regional company, starting in the US and tapping talent in India, Draper International pioneered the reverse strategy. In 1997 the venture capital firm identified and recruited A.V. Sridhar, a senior manager at Wipro who had never worked outside India, to Silicon Valley to start a company in the data mining field. Sridhar quickly identified a marketing team, including Sanjay Anandaram, who was already working for Wipro in Silicon Valley, and senior managers with experience at Oracle India and IBM Research. The start-up, Neta Inc., developed Internet personalization software and was acquired two years later by Internet portal Infoseek (now Go.com). Sridhar explains why he moved to Silicon Valley to start the business, 'To create a successful company, one has to be real close to the market. One has to be in a place which supports the creation of new technologies as a daily affair' (Biswas 1998). Permanent returnees to India from Silicon Valley remained few and far between throughout the 1990s, but the professional and personal networks linking Indians in Silicon Valley to family members, friends, and colleagues at home combined with access to email and low cost travel and phones to generate an unprecedented rate of information exchange between the United States and India. In the words of a Silicon Valley engineer

> I go back to India two or three times a year because of my work and there are parts of India where you take a train and go over there and they don't even have a rickshaw or a cab to take you to your destination. You have to walk. But everybody in the small town knows exactly what the job situation is in Silicon Valley. They know the H-1B quota level, when it is filled, when it is open again. They know exactly what kinds of skills are required in Silicon Valley, not even in California, just Silicon Valley. (Santa Clara County Office of Human Relations 2000)

Websites like Non-Resident Indians Online (www.nriol.com), www.return2india.com, and www.siliconindia.com became increasingly popular among US educated Indians. They travel home frequently, some returning home to get married (often following the traditional practice of arranged marriage), and seemed torn between the familial and cultural pull of home and what they regarded as superior professional and economic opportunities in the US.

The potential for substantial returns attracted a new generation of venture capitalists. A group of new US$50–100 million funds, typically from established markets such as Walden International and E-Ventures (Softbank), targeted early stage investments in India. Corporate venture capital also became active in Indian technology regions. Intel Capital committed to invest US$100 million in Indian IT start-ups during 2000, and Computer Associates began investing actively as well. Traditional sectors that had earlier shunned the software industry became interested in investing because of the high valuations. Fund managers began to tap India's high net worth individuals and family firms for capital. Total venture capital investments in India reached US$1,160 million in 2000. The level declined to US$937 million in 2001, and dropped off further in 2002 and 2003.

A new generation of cross-border investors with accumulated experience in both India and Silicon Valley has emerged as well. The JumpStartUp Venture Fund was established in Bangalore in July 2000 by three veterans of the IT industry: Kiran Nadkarni had 14 years of experience with venture capital in India, serving most recently as the Draper International partner in Bangalore; K. Ganapathy Subramanian came from ICICI Venture, a leading venture capital firm in India; and Sanjay Anandaram, who had worked at Wipro in both Bangalore and Silicon Valley and then at start-up Neta Inc. The US$45 million fund was targeted at early stage information technology start-ups and had funding from both institutional investors (including Silicon Valley Bank) and individuals, including Bill Draper and successful Indian executives in the US (contributing 20 per cent of the fund).

In 2002, JumpStartUp moved its headquarters from Bangalore to Santa Clara, California, in order to shift its investment strategy from an India focused fund toward US–India cross-border investments. The partners realized that their small fund was not sufficient to support early stage start-ups from the ground up in the environment of the early 2000s, when outside investors were reluctant to contribute to cash poor companies. The new strategy recognizes that Silicon Valley's cash strapped

new ventures must increasingly set up engineering centres in India. Jump-StartUp envisions a role as co-investor with established venture capital firms in order to help portfolio companies set up engineering teams as well as design, deployment, and support functions in India. In the worlds of Nadkarni,

> It is very hard for companies started by non-Indians to think of working out of India, unless they have done it in the past. Unless the founders have intent to do things out of India . . . When a start-up decides to establish a development center in India, invariably you will see that one of the founders is an Indian. (Shankar and Sundaram 2003)

Most venture capital in India remains focused on later stage investments in software services firms, but venture capital firms with Indian fund managers who bring technology investment and entrepreneurial expertise have targeted the early stage US–India connection as well, including WestBridge Capital Partners and Artiman Ventures. The economic logic for this structure appears compelling: a company that would need US$10–15 million in its first round of funding in Silicon Valley might hire a comparable engineering workforce in India for only US$2–3 million.

5.6 Conclusion

As highly skilled engineers and entrepreneurs become increasingly mobile, the old pattern of one-way flows of technology and capital from the core to the periphery is being replaced by a more complex and decentralized two-way flow of skill, capital, and technology between differently specialized regional economies. Silicon Valley is now at the core of this rapidly diversifying network of economies because it is the largest and most sophisticated market as well as a leading source of new technologies. Emerging technology regions like Hsinchu, Bangalore, and Shanghai are not replicas of Silicon Valley—rather these new regional economies are like extensions of Silicon Valley and they have co-evolved with the Silicon Valley economy. While producers in these regions initially entered global markets by providing low cost skill, each has developed specializations that add distinctive value to electronic products and systems by transforming activities once regarded as mundane and low-tech into more efficient and dynamic processes. Israel was a low cost location for research and development labs in the 1980s; today entrepreneurs are pioneering sophisticated internet and security technologies. Taiwan was known in

the 1980s for its cheap PC clones and components; today it is recognized for the flexibility and efficiency of its semiconductor and electronic systems producers. Beijing and Shanghai were known in the 1990s for 'me too' Internet ventures; today Chinese producers are poised to play a lead role in developing wireless technology. Bangalore provided labour intensive software coding and maintenance in the 1980s and 1990s; today local companies are managing large scale consulting and software services projects for leading global corporations.

The new technology regions have all become high wage, high cost locations in their national economies, yet they continue to spawn start-ups and attract new firms, and most existing producers continue expanding locally. This growth is reminiscent of the continued clustering of computer and communications related firms in Silicon Valley during the 1980s and 1990s; these areas now boast a regional advantage that compensates for their high costs. Silicon Valley producers no longer view locating or sourcing from India or China as an efficient way to reduce costs; rather, they argue that the only reason to work with producers in those locations is to gain access to the talent. These developments explain why Silicon Valley-based firms are active participants in all of these regions as investors and as partners, not simply as competitors. A firm like Cisco designs and sources critical parts of its operating system software from India and application specific integrated circuits from Israel for its high-end routers, and the manufacturing of most of its hardware from Taiwan and China. It also invests in start-ups with promising technologies in these locations. On the other hand, a start-up like July Systems obtained venture capital from firms based in the US, Taiwan and China, and India, and its products will likely incorporate components from all these locations as well as being targeted at all their markets.

US technology producers benefit directly from the development of these specialized technology regions. They now look to their counterparts in Taiwan and China, India, and Israel not simply for low level implementation but increasingly for co-development and co-architecting of products and components. In addition, firms in the new technology regions are increasingly partnering with one another as well as with firms from Silicon Valley, as when a Taiwanese semiconductor firm invests in Israeli start-ups specialized in digital speech processing chips, or when an Israeli company contributes intellectual property components to a chip design firm based in India. These collaborations deepen the capabilities of each of

the partners and over time can support a process of reciprocal innovation and upgrading in the respective regions.

5.6.1 *A Model for Others?*

This is not to suggest that all developing economies are positioned to reap the benefits of brain circulation and peripheral entrepreneurship. This opportunity is benefiting countries that have invested heavily in higher education, typically technical education, and are politically and economically stable enough that immigrants will consider returning home. Some of the largest technically skilled immigrant groups in Silicon Valley have not built business or professional connections to their home countries for political reasons. Most of the region's Iranian and Vietnamese immigrants, for example, are political refugees and hence not inclined to return to countries that, in any case, lack the economic stability needed for technology investment or entrepreneurship. This criterion applies in varying degrees to many of the developing economies that have technically skilled communities in the US and at home, including Russia, parts of Eastern Europe, and Latin America. It is possible that urban areas like St Petersburg or Buenos Aires will become more attractive to returning entrepreneurs in the future as their economies develop and eventually provide greater professional opportunities for returnees. However, large parts of Africa and Latin America lack the skill base or political openness to become attractive environments for technology entrepreneurship.

In many Asian countries, government support for large scale, capital intensive investments in the 1970s and 1980s, either by domestic corporations (Korea) or by multinationals (Singapore), have created inhospitable environments for entrepreneurial experimentation. One indication of this is data on the sources of innovation. South Korea's *chaebol*, or large business groups, accounted for 81 per cent of all US patents earned in Korea in the 1990s compared to only 3.5 per cent earned by business groups in Taiwan (Trajtenberg 2000). Likewise, in South Korea the top 50 assignees accounted for 85 per cent of all US patents, with Samsung alone accounting for 30 per cent, while Taiwan's top 50 assignees accounted for only 26 per cent of all US patents. This decentralization of innovative capabilities was reflected in a substantially higher rate of patenting in the late 1990s, with Taiwan earning 17.7 patents per US$ billion exports compared to 11.6 in Korea (Mahmood and Singh 2003).

Evidence from the Korean and Japanese communities in Silicon Valley suggests that even when entrepreneurs are successful in the US, they often lack opportunities for alliances and partnerships at home. It is very difficult for these small firms to collaborate on equal terms with the giant *chaebol* and *keiretsu* (industrial groupings in Japan). This contrasts to the Taiwanese technology entrepreneurs in Silicon Valley whose firms have grown up through partnerships with their counterparts, often also entrepreneurs, at home.

The creation of a transnational community is a two-way process. While policymakers and planners can encourage cross-regional connections, they cannot create or substitute for transnational entrepreneurs and their decentralized networks. Government agencies from Singapore, Hong Kong, and Japan regularly sponsor networking events for their expatriates in the Bay Area as a way to recruit return entrepreneurs and investments. However, the absence of entrepreneurial collaborators at home means that these agencies can provide incentives and information but not access to partners with an interest in jointly transforming the home environment. Governments cannot by themselves insure the preconditions for return entrepreneurship; this is inherently a process of collaborative institution building that takes both local knowledge and understanding of global technology markets and networks.

Cross-regional networks develop only when skilled immigrants are both willing and able to return to their home countries for business in large enough numbers to create close links to the technical community in the home country. The receptiveness of the home country depends upon factors such as political stability, economic openness, and level of economic development. It often builds on multinational investments in research and development that have contributed to a developing local skill base and infrastructure that supports entrepreneurship. A critical variable is political leaders willing to collaborate with returning entrepreneurs to develop a shared vision and remove institutional and political obstacles to entrepreneurship led technology growth.

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