The new Argonauts

Forget the brain drain – today's highly skilled migrants circulate between the US and developing countries, creating new technology businesses and spreading prosperity along the way.

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July Systems, which develops technology for selling content such as games and ring-tones on mobile phones, was founded by two Indian-born repeat entrepreneurs. While its headquarters are in California's Silicon Valley, near game developers and mobile-content firms, it develops its products in the Indian city of Bangalore, where the founders have good business connections. In its first five years, July Systems has raised $28m from top US, Indian and Taiwanese investors.

Verisilicon Holdings, which designs semiconductors, was started by a graduate of the University of California at Berkeley from mainland China. Based in Shanghai, at the heart of China's fast growing integrated-circuit (IC) market, it has development teams in Silicon Valley and Taipei, the leading centres of IC-design talent. Since it was founded in 2001, VeriSilicon has raised $20m from Chinese and US venture-capital firms.

Like the Argonauts of Greek mythology who ventured with Jason centuries ago, these US-educated but foreign-born entrepreneurs are embarking on risky foreign adventures in pursuit of wealth. Armed with their knowledge of technology markets and their global contact-books, the new Argonauts are in a strong position to mobilise the expertise and capital needed to start successful global ventures. Their success also forces us to think afresh about how countries and regions grow.

In the late 1990s, nearly three in ten Silicon Valley start-ups were run by immigrants, mostly from developing economies such as India and China. Since then, these immigrants have become global entrepreneurs. Some remain based in Silicon Valley, while tapping low-cost technical talent and financing in their home countries. Others return home to start businesses but continue working with customers and partners in Silicon Valley. As these cross-regional collaborations multiply and deepen, both the US and developing economies benefit.

Entrepreneurs and their far-flung networks now play a vital role in the technology industries' global expansion – and make an increasingly important contribution to economic growth and development more broadly. Ventures such as July Systems and Verisilicon are among the thousands of start-ups that have helped create dynamic technology clusters in countries such as Israel, Taiwan, India and China. These investments may be small by comparison ➤

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➢ to total foreign direct investment, but by boosting indigenous entrepreneurship, they create a huge potential for future growth.

This globalisation of entrepreneurial networks reflects dramatic changes in global labour markets. Falling transport and communication costs allow high-skilled workers to work in several countries at once, while digital technologies make it possible to exchange vast amounts of information across long distances cheaply and instantly. International migration, traditionally a one-way process, has become a reversible choice, particularly for those with scarce technical skills, while people can now collaborate in real time, even on complex tasks, with counterparts far away. Scientists and engineers from developing countries, who were once forced to choose between settling abroad and returning home to far less attractive professional opportunities, can now contribute to their home economies while maintaining professional and business ties in more technologically advanced countries.

This is most evident in Silicon Valley, where networks of foreign-born engineers and entrepreneurs transfer technical and institutional know-how between distant regional economies faster and more flexibly than most multinationals. The protagonists in this process are not large

corporations but the new Argonauts: the foreign-born engineers, entrepreneurs, managers, lawyers and bankers who have the linguistic and cultural abilities as well as the institutional knowledge to collaborate with their home-country counterparts. While systematic data on these highly decentralised two-way flows of skill, technology and capital is scarce, their impacts are arguably as important as more easily measured multinational investments.

From brain drain to brain circulation

The migration of talented youth from developing to advanced countries has traditionally been seen as a "brain drain"

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which exacerbates international inequality by enriching already wealthy economies at the expense of their poor counterparts. According to the 2000 Census, 2.5m highly skilled immigrants (not including students) resided in the United States.

Silicon Valley has greatly benefited from this foreign brainpower. Tens of thousands of talented immigrants from developing countries, who initially came to the US to earn a graduate degree in engineering, accepted jobs in Silicon Valley rather than return home, where professional opportunities were limited. By the end of the 1990s, over half of Silicon Valley's 200,000 scientists and engineers were foreign-born, primarily in Asia, and only a small proportion planned to return home. These immigrants, who were often excluded from established networks, nonetheless quickly created ethnic social and professional networks which have supported their career advancement and entrepreneurial success. High-profile start-ups such as Sabeer Bathia's Hotmail, Jerry Yang's Yahoo and Min Zhu's Webex are only the most visible reflections of the extent to which Silicon Valley's immigrant engineers have mastered the region's entrepreneurial business system.

But these highly skilled emigrants are now increasingly transforming the brain drain into "brain circulation" by returning home to establish business relationships or start new companies while maintaining their social and professional ties to the US. ➢

"Because of their experience and professional networks, these cross-regional entrepreneurs can quickly identify promising new market opportunities."

- Foreign-educated engineers turned venture capitalists often take the lead by investing in their home countries. As experienced engineers, managers and investors return home, either temporarily or permanently, they export first-hand knowledge of US capital markets and business models to peripheral regions.

In the early 1980s, foreign-born engineers transferred the Silicon Valley model of early-stage high-risk investing to Taiwan and Israel, which US venture capitalists were typically neither interested in nor able to serve. Native-born investors provided the cultural and linguistic know-how needed to operate profitably in these markets. As well as capital, they brought technical and operating experience, knowledge of new business models and networks of contacts in the US. Israel and Taiwan now boast the largest venture-capital industries outside North America ($4bn is invested annually in Israel and $1.3bn in Taiwan.) Both have high rates of new firm formation, innovation and growth. Israel is now known for software and internet firms such as Mirablis (a developer of instant-messaging programs) and Checkpoint (security software); firms such as Acer (personal computers and components) and TSMC (a semiconductor foundry) have transformed Taiwan into a centre of leading-edge PC and IC manufacturing.

Immigrants from India and China with experience in Silicon Valley have also started to influence economic development back home, both directly, by transferring technology and know-how when they return home to work or start businesses, and indirectly, by influencing policy formation and other aspects of the institutional environment. By 2004, venture-capital and private-equity firms were investing more than $1bn annually in China, and a similar amount in India. While this is only a fraction of the venture capital invested annually in the US or, indeed, of total FDI in these economies, it is fostering local ecosystems which support indigenous entrepreneurship and which are an increasingly viable alternative to the development opportunities provided by established domestic firms and multinational corporations.

No longer on the sidelines

Traditional accounts of economic development assume that new products and technologies emerge in advanced economies, which have sophisticated skill and research capabilities as well as large and wealthy domestic markets, with mass manufacturing shifting to less costly locations once a product is standardised and mature. Development, in this view, builds on success in advanced economies, while peripheral economies remain followers. Both the strategies of multinational corporations and the clustering effects created by economies of scale perpetuate this divide.

This leaves little scope for the periphery to develop independent technological capabilities. At best, foreign investment from the core might contribute to the incremental mastery of foreign manufacturing techniques and the upgrading of local suppliers. Even the most successful newly industrialising countries are destined to remain imitators, because leading-edge skill and technology

reside in the corporate research labs and universities in the core.

But changes in the world economy have undermined this core-periphery model. The increasing mobility of high-skilled workers and information, combined with the fragmentation of production in the information and communication technology sectors, provide unprecedented opportunities for formerly peripheral economies to benefit from decentralised growth based on entrepreneurship and experimentation. While policymakers and multinational corporations have a role to play, central to this are communities of technically skilled immigrants with experience in, and connections to, Silicon Valley and other technology centres.

As foreign-born, but US-trained engineers transfer know-how and market information to their countries of origin, and help jump-start local entrepreneurship, they are 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. This decentralised responsiveness is a vitally important advantage which few multinationals have.

As recently as the 1970s, only large, established companies could grow internationally, primarily by establishing marketing offices or factories overseas. Today, the fragmentation of production and the falling costs of transport and communication allow even small firms to build partnerships with foreign producers to tap overseas expertise, cost savings and markets. Start-ups in Silicon Valley are often global actors from day one; many raise capital, subcontract manufacturing or software development, and market their products or services outside the US.

The scarce resource is no longer size but the ability to locate foreign partners quickly, and then to manage complex business relationships and teamwork across cultural and linguistic barriers. This is particularly challenging in high-tech industries where products, markets, and technologies are continually redefined – and where product cycles are often shorter than nine months. First-generation immigrants have a commanding advantage. ➢

Thousands of start-ups have helped create dynamic technology clusters such as The Cyber Gateway in Hyderabad.

Building new technologies: female workers at the construction site for an IT company, Bangalore.

➢ Developing economies typically have two major handicaps: they are remote from the sources of leading-edge technology and distant from developed markets and the interactions with users that are crucial for innovation. Firms in peripheral locations can try to overcome these disadvantages through joint ventures, technology licensing, foreign investment, overseas acquisitions, and so on. But 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 best 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 overcome isolated economies' reputational and informational trade barriers.

While new technologies and more open global markets make this possible, long-distance collaborations still depend heavily on a shared social context and language, which ensure partners understand each other well, which is vital in rapidly evolving markets. Nor can new technological clusters be created simply by mobilising researchers, capital and a modern infrastructure: they also require the shared language and trust of a technical community, which permits open information exchange, collaboration and learning (often by failure) along with intense competition.

The new technology centres differ in their specialities and level of technological sophistication. Cross-regional entrepreneurs rarely compete head-on with established US producers; instead they build on the skills and the technical and economic resources of their home countries. In the 1980s, Taiwan was known for its cheap PC clones and components; today, it is recognised for the flexibility and efficiency of its IC and electronic-systems producers. In the 1990s, China was known for me-too internet ventures; now, Chinese producers are poised to play a lead role in developing wireless technology. In the 1990s, India was a provider of labour-intensive software coding and maintenance; today, local companies are mobilising the thousands of underemployed English-speaking Indian engineers to manage large-scale software services projects for leading global companies. Whereas in the 1980s, Israel was a low-cost research location, since then, local entrepreneurs have applied the fruits of the country's advanced military research to pioneer sophisticated internet and security technologies.

A new generation of cross-regional start-ups combine Silicon Valley's new product vision, technology architecture, marketing, and research-and-development coordination with the technical capabilities of distant regions. The emerging regions are hybrids, which marry elements of the Silicon Valley industrial system with ➢

Fragmentation of production in the information and communication technology sectors provides unprecedented opportunities to benefit from decentralised growth.

- inherited local institutions and resources. Returning entrepreneurs typically seek (with varying success) to transfer venture capital, merit-based advancement and corporate transparency to economies with traditions of elite privilege, government control, and corruption. They seek to reproduce team-based firms with limited hierarchy in an environment dominated by family-run businesses or state-owned enterprises. And they seek to influence policy because the national institutions that support the Silicon Valley system – efficient capital markets, an independent judiciary, regulatory oversight, sophisticated education systems, research institutions, and physical infrastructure – are rarely present in these peripheral economies.

Returning entrepreneurs have found different ways to overcome the weaknesses of their home countries. In India, entrepreneurs rely on private telecoms facilities and power supplies rather than on the country's costly and unreliable infrastructure, while in China returning entrepreneurs have learned to negotiate the complex bureaucratic rules and politics which regulate private companies. They also rely on US institutions: in addition to receiving graduate training in the US, many establish headquarters or research labs in Silicon Valley, harness venture capital, professional services, and managerial and technical talent from the US, and even raise funds on US capital markets.

These cross-regional start-ups still face significant challenges. Venture-capital investment is still in its infancy in most of the world. There are shortages of experienced managerial talent and ongoing difficulties coordinating distant activities, particularly in developing organisational synergy and persistent, consistent communication. Entrepreneur-led growth, with highly competitive, specialised technology producers in high-skill regions connecting to, and collaborating with, counterparts elsewhere, is only one possible future for these regions. If they are not careful, they may miss 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 a big enough labour supply to do this for a relatively long time. However, many cross-regional entrepreneurs are

- constructing firms committed to an alternative, high-value-added trajectory.

The world isn't flat

Is brain circulation between technology regions making the world "flat", as Thomas Friedman of the *New York Times* suggests? Hardly. The new Argonauts cluster tenaciously in the leading technology centres, which is why Palo Alto now has more in common with Taipei and Tel Aviv than with Fresno, a three-hour drive away. Residents of Bangalore enjoy Western standards of living, while those in nearby rural areas remain mired in poverty. Economic geographers have documented this phenomenon of increasing returns in specific locations – where the advantages of locating in a crowded and costly place outweigh the increasing costs, resulting in a pronounced clustering process. The rise of entrepreneurship-led growth suggests that the regional cluster may be replacing the national economy as the locus of economic growth.

Overseas technology investments are not motivated solely by low labour costs, as critics suggest. The leading destinations for cross-border technology investment are regions such as Bangalore and Shanghai, where wages and other costs are significantly higher than in their surrounding economies, and rising rapidly. Even when

Companies such as this American-owned manufacturer of flexible printed circuits has established itself in China to take advantage of the lower labour costs.

low wages attract initial investments, local enterprises distinguish themselves from other low-cost regions by collaborating with Silicon Valley-based partners. This allows local producers to develop specialised skills, expertise and relationships which ensure a regional advantage that compensates for their high costs: Israel in sophisticated internet and security technologies, Taiwan in global logistics and design, China in efficient IT manufacturing, and India in managing complex software services and consulting projects.

The old pattern of one-way flows of technology and capital from the core to the periphery is being replaced by a far more complex and decentralised two-way flow of skill, capital and technology between regional economies with different specialities. Silicon Valley is 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. But this may change, as new relationships emerge and new markets open up. The fast-growing Asian market for wireless communication, for example, has enabled firms in China and India to contribute to how the technology and its applications are developed – even though they do not yet define its leading edge. Over time, producers in developing regions may be able to build independent capabilities and define entirely new specialisations and markets.

Even the largest Silicon Valley companies participate in all these regions not simply as competitors but also as investors and partners. An established firm such as Cisco designs and sources critical parts of its operating-system software from India; buys application-specific ICs for its high-end routers from Israel; and has most of its hardware manufactured in Taiwan and China. Like Intel and Acer, it also invests in foreign start-ups with promising technologies. A start-up such as July Systems obtained venture capital from the US, Taiwan, China and India, and its products will likely incorporate components from all these locations, as well as being targeted at all their markets.

> **"Palo Alto now has more in common with Taipei than with Fresno, a three-hour drive away."**

US technology producers now look to their counterparts in Taiwan, China, India and Israel not simply for low-level implementation but increasingly to co-develop products and components. Firms in the new technology regions are increasingly partnering with one another, as well as with firms from Silicon Valley. A Taiwanese semiconductor firm invests in Israeli start-ups specialising in digital-speech-processing chips, while an Israeli company contributes intellectual-property components to a chip-design firm in India. These collaborations deepen both partners' capabilities and over time can support a process of reciprocal innovation and upgrading.

A model for others?

Not all developing economies can reap the benefits of brain circulation and peripheral entrepreneurship. For political reasons, some of the largest technically-skilled immigrant groups in Silicon Valley have not built business or professional connections to their home countries. Most of the Iranian ➢

and Vietnamese immigrants, for example, are political refugees and so not inclined to return to countries which, in any case, lack the economic stability needed for technology investment or entrepreneurship. This is also true to varying degrees for immigrants from Russia, parts of Eastern Europe and Latin America. Saint Petersburg or Buenos Aires may one day become more attractive to returning entrepreneurs, but large parts of Africa and Latin America lack the skill base or political openness to foster technology entrepreneurship.

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 decentralised networks. Foreign governments regularly sponsor networking events for their expatriates in the Bay Area in order to recruit return entrepreneurs and investments, but without entrepreneurial collaborators at home, these agencies will have little success.

Silicon Valley's role as the dominant technology centre will most likely continue to diminish.

Cross-regional networks develop only when skilled immigrants are both willing and able to return to their home countries to do business in large enough numbers to create close links to the technical community in the home country. This requires political stability, economic openness and a certain level of economic development, notably a high level of technical education. It often builds on multinational companies' investments in research and development which have helped develop a local skill base as well as an infrastructure which supports entrepreneurship. Political leaders must also be committed to removing institutional obstacles to entrepreneurship-led growth.

Technology markets are shifting quickly, with demand from outside the US growing rapidly. While North America, Europe and Japan account for less than 15% of the world's population, they produce more than half of global output. This is set to change decisively, with Goldman Sachs, the US investment bank, predicting that customer demand from India and China will dominate global markets within a decade and that these two economies will be larger than the US by 2050. Producers in other peripheral economies will surely develop the capabilities to participate in global networks too. They will likely share with their predecessors a history of investments in education and research, as well as an institutional openness that ensures both competitive intensity and long-distance collaborations. Silicon Valley's role as the dominant technology centre will most likely continue to diminish. This does not imply decline, rather that it will become one of many nodes in a more open and distributed global network of differently specialised and complementary regional economies. ■