Silicon Valley's New Immigrant Entrepreneurs

By AnnaLee Saxenian
University of California, Santa Cruz

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Debates over the immigration of scientists and engineers to the United States focus primarily on the extent to which foreign-born professionals displace native workers, or on the existence of invisible barriers to mobility, or "glass ceilings," experienced by non-native professionals. Both approaches assume that the primary economic contribution of immigrants is as a source of relatively low-cost labor, even in the most technologically advanced sectors of the economy (McCarthy and Vernez, 1997). The view from sending countries, by contrast, has historically been that the emigration of highly skilled personnel to the United States represents a significant economic loss, or "brain drain," which deprives their economies of their best and brightest.

Neither of these views is adequate in today's increasingly global economy. Debates over the extent to which immigrants displace native workers overlook evidence that foreign-born scientists and engineers are starting new businesses and generating jobs and wealth for the state economy at least as fast as their native counterparts (Borjas, 1994, 1995; Smith and Edmondston, 1997). Similarly, the dynamism of emerging regions in Asia and elsewhere means that it is no longer valid to assume that skilled immigrants will stay permanently in the United States. Recent research suggests that the "brain drain" may be giving way to a process of "brain circulation," as talented immigrants who study and work in the United States return to their home countries to take advantage of promising opportunities there. [1] And advances in transportation and communications technologies mean that even when these skilled immigrants choose not to return home, they still play a critical role as middlemen linking businesses in the United States to those in geographically distant regions.

There is widespread recognition of the significance of immigrant entrepreneurship in traditional industries ranging from small-scale retail to garment manufacturing (Waldinger et al., 1990). Yet we have only anecdotal evidence of a parallel process in the newer, knowledge-based sectors of the economy (Hing and Lee, 1996). It is in these dynamic new industries that immigrants with technical skills and

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[1] See Jean M. Johnson and Mark C. Regets, "International Mobility of Scientists and Engineeers to the United States--Brain Drain or Brain Circulation?" *National Science Foundation Issue Brief,* NSF 98-316, June 22, 1998

strong connections to fast-growing overseas markets have the potential to make significant economic contributions. Not only are skilled immigrants highly mobile, but the technology industries in which they are concentrated are largest and fastest-growing exporters and leading contributors to the nation's economic growth.

This study examines the entrepreneurial contribution of highly skilled immigrants--in this case immigrant scientists and engineers--to the Silicon Valley economy. It has four goals. First, it quantifies immigrant engineers' and entrepreneurs' presence in and contribution to the Silicon Valley economy. Second, the study examines the extent to which foreign-born engineers are organizing ethnic networks in the region like those found in traditional immigrant enterprises to support the often risky process of starting new technology businesses. Third, it analyzes how these skilled immigrants build long-distance social and economic networks back to their home countries that further enhance entrepreneurial opportunities within Silicon Valley. Finally, it explores the implications of this new model of immigrant-led globalization for public policy.

This is a descriptive and exploratory study that employs a mix of research methods and strategies. It relies on three primary sources. Data on immigrants' education, occupations, and earnings are drawn from the Public Use Microdata Sample (PUMS) of the 1990 census. The decennial census provides the only comprehensive data on immigrants by industry and occupation in the United States. Ample evidence suggests that the Asian presence in Silicon Valley increased significantly during the 1990s, but industrial and occupational detail is not available. As a result, the data on the quantitative significance of immigrant engineers presented here almost certainly represent a significant undercount which can only be corrected with data from the 2000 census.

This study relies on immigrant-run businesses as a proxy for immigrant-founded businesses. Data on immigrant-run businesses were drawn from a customized Dun & Bradstreet database of 11,443 high-technology firms founded in Silicon Valley between 1980 and 1998. Immigrant-run businesses are defined as companies with chief executive officers (CEOs) with Chinese and Indian surnames. This sample may understate the scale of immigrant entrepreneurship in the region because firms that were started by Chinese or Indians but have hired non-Asian outsiders as CEOs are not counted. While the sample also includes Chinese and Indians born in the United States, it appears unlikely that this is a large source of bias because the great majority of Asian engineers in the region are foreign-born. Appendix A provides lists 59 public technology firms in Silicon Valley that were founded by or are were run by Chinese or Indians at the end of 1998.

The findings reported in the balance of this study are based on original data from more than 100 in-depth interviews with engineers, entrepreneurs, venture capitalists, policymakers, and other key actors in Silicon Valley. These interviews typically lasted at least one hour and were conducted between January 1997 and January 1998. An additional 67 interviews were conducted in the Taipei and Hsinchu regions of Taiwan (25) during May 1997 and the Bangalore, Bombay, and Delhi regions of India (42) during December 1997. The interviews in Asia included national and local policymakers as well as representatives of technology businesses. Although all the interviews were conducted in English, a Mandarin- or Hindi-speaking research assistant participated in the Chinese and Indian interviews, respectively, to assist with language and cultural clarification or translation.

Immigration and Entrepreneurship in Silicon Valley

Skilled immigrants are a growing presence in Silicon Valley, accounting for one-third of the engineering workforce in most technology firms and emerging as visible entrepreneurs in the 1980s and 1990s. This study documents the growing contribution of skilled Chinese and Indians to the Silicon Valley economy as entrepreneurs as well as engineers. The data presented here suggest that well known

technology companies like Yahoo! and Hotmail, which have immigrant founders, represent the tip of a significantly larger iceberg.

The New Asian Immigrants

Asian immigration to California began in the 18th century, but its modern history can be dated to the Immigration Act of 1965, often referred to as the Hart-Celler Act. Before 1965, the U.S. immigration system limited foreign entry by mandating extremely small quotas according to nation of origin. Hart-Celler, by contrast, allowed immigration based on both the possession of scarce skills and on family ties to citizens or permanent residents. It also significantly increased the total number of immigrants allowed into the United States. For example, Taiwan, like most other Asian countries, was historically limited to a maximum of 100 immigrant visas per year. As a result, only 47 scientists and engineers emigrated to the United States from Taiwan in 1965. Two years later, the number had increased to 1,321 (Chang, 1992).

The Hart-Celler Act thus created significant new opportunities for foreign-born engineers and other highly educated professionals whose skills were in short supply, as well as for their families and relatives. The great majority of these new skilled immigrants were of Asian origin, and they settled disproportionately on the West Coast of the United States. By 1990, one-quarter of the engineers and scientists employed in California's technology industries were foreign-born--more than twice that of other highly industrialized states such as Massachusetts and Texas (Alarcon, 1998). The Immigration and Nationality Act of 1990 further favored the immigration of engineers by almost tripling the number of visas granted on the basis of occupational skills from 54,000 to 140,000 annually.

These changes in the immigration system coincided with the growth of a new generation of high-technology industries in Silicon Valley and in turn transformed the regional workforce. As the demand for skilled labor in the region's emerging electronics industry exploded during the 1970s and 1980s, so too did immigration to the region. Between 1975 and 1990, Silicon Valley's technology companies created more than 150,000 jobs--and the foreign-born population in the region more than doubled to almost 350,000 (Saxenian, 1994). By 1990, 23 percent of the population of Santa Clara County (at the heart of Silicon Valley) was foreign-born, surpassing San Francisco County as the largest absolute concentration of immigrants in the Bay Area

Census data confirm the presence of a large technically skilled, foreign-born workforce in Silicon Valley. Although one-quarter of the total Silicon Valley workforce in 1990 was foreign-born, 30 percent of the high-technology workforce was foreign-born. These immigrants were concentrated in professional occupations: One-third of all scientists and engineers in Silicon Valley's technology industries in 1990 were foreign-born. Of those, almost two-thirds were Asians--and the majority were of Chinese and Indian descent. In fact, according to the 1990 census 5 percent PUMS, more than half of the Asian-born engineers in the region were of Chinese (51 percent) or Indian (23 percent) origin, and the balance included relatively small numbers of Vietnamese (13 percent), Filipinos (6 percent), Japanese (4 percent), and Koreans (3 percent).

The disproportionate representation of Chinese and Indian engineers in Silicon Valley's technology workforce explains the focus on these two groups in the balance of this study. This reflects broader national trends: Foreign-born engineers and computer scientists in the United States are significantly more likely to come from India, Taiwan, or China than from other Asian nations. The presence of large numbers of Chinese and Indians in Silicon Valley is a recent phenomenon, mirroring the timing of the changes in U.S. immigration legislation.: 71 percent of the Chinese and 87 percent of the Indians working in Silicon Valley high-technology industries in 1990 arrived in the United States after 1970, and 41 percent of the Chinese and 60 percent of the Indians arrived after 1980. Although we must

await the 2000 census data for confirmation, Asian immigration to the region almost certainly accelerated during the 1990s, particularly among highly educated professionals, as a result of the higher limits established by the Immigration Act of 1990.

The Chinese engineering workforce in Silicon Valley was dominated by Taiwanese immigrants in the 1970s and 1980s. In the 1960s, there were very few Chinese technology workers in the region prior to 1970. In the two subsequent decades more than one-third of the region's Chinese immigrant engineers were from Taiwan. Immigrants from Mainland China are a growing presence in the regional workforce. The University of California at Berkeley, for example, granted graduate degrees in science and engineering to a fast-growing proportion of students from Mainland China between1980 and 1997, whereas the proportion granted to students from Taiwan declined correspondingly during the same period. By the mid-1990s, over half of the degrees (53 percent) were granted to students from China, compared to 35 percent in the late 1980s and only 10 percent in the early 1980s. The number of graduate degrees granted can be seen as a leading indicator of labor supply in Silicon Valley, as most graduates find jobs in the region's technology companies.

National trends in graduate science and engineering education mirror these trends closely and provide insights into the changing composition of the Silicon Valley workforce. Between1990 and 1996, the number of doctorates in science and engineering granted annually by U.S. universities to immigrants from China more than tripled (from 477 to 1,680), and those to Indian immigrants doubled (to 692), whereas those to Taiwanese remained stable (at about 300). These three immigrant groups alone accounted for 81 percent of the doctorates granted to Asians and 62 percent of all foreign doctorates in science and engineering granted in the United States between 1985 and 1996. (Johnson, 1998) Moreover, California's universities grant engineering degrees to Asian students at more than twice the rate of universities in the rest of the nation (American Association of Engineering Societies, 1995). In short, we can expect the 2000 census to show a dramatic increase in the number of Mainland Chinese and Indian engineers in the Silicon Valley workforce.

Not surprisingly, Silicon Valley's Indian and Chinese workforce is highly educated. In 1990, they earned graduate degrees at significantly greater rates than their white counterparts: 32 percent of the Indian and 23 percent of the Chinese employed in Silicon Valley in 1990 had advanced degrees, compared to only 11 percent for the white population. Their superior educational attainment is even more pronounced in technology industries: 55 percent of Indian and 40 percent of Chinese technology workers held graduate degrees, compared to 18 percent of whites.

This educational attainment is only partially reflected in occupational status. Indians and Chinese working in the region's technology sector were better represented in professional and managerial occupations than their white counterparts, with 60 percent of Indians and 57 percent of Chinese employed as professionals and managers, compared to 53 percent of whites. However, these groups were significantly more concentrated in professional than managerial occupations: 45 percent of the Indians, 41 percent of the Chinese, and 27 percent of the whites were in professional occupations, but only 15 percent of the Indians and 16 percent of the Chinese were managers, compared to 26 percent of the whites. In other words, although Indians and Chinese accounted for 2 percent and 6 percent of Silicon Valley's technology professionals, respectively, they represented less than 1 percent and 4 percent of the managers.[2]

The relatively lower representation of Chinese and Indians in managerial positions could be due to several factors: biases favoring technical, as opposed to business, education, or to the linguistic and

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[2] The CorpTech Directory lists the names and titles of all the executives in public technology firms in the region. These data show Chinese and Indians in significantly greater numbers in R&D than other functions such as CEO, finance, marketing, or sales

cultural difficulties of many new immigrants. It could also be a reflection of more subtle forms of discrimination or institutional barriers to mobility based on race--or the "glass ceiling". However, income data provide little support for the glass ceiling hypothesis. Our analysis documents that there is no statistically significant difference between the earnings of Chinese and Indians in managerial, professional, and technical occupations and their white counterparts (Saxenian, 1999). This is consistent with the findings of other researchers who document greater disparities in managerial representation and upward mobility than in wage levels between Asian and white engineers with comparable skills and education (Fernandez, 1998; Tang, 1993).

Whatever the data show, many Chinese and Indians in Silicon Valley believe that there is a glass ceiling inhibiting their professional advancement. A 1991 survey of Asian professionals in the region found that two-thirds of those working in the private sector believed that advancement to managerial positions was limited by race. Moreover, these concerns increased significantly with the age and experience of the respondents. This perception is consistent with the finding that in technology industry at least, Chinese and Indians remain concentrated in professional rather than managerial positions, despite superior levels of educational attainment. It is notable, however, that those surveyed attributed these limitations less to "racial prejudice and stereotypes" than to the perception of an "old boys' network that excludes Asians" and the "lack of role models." (AACI, 1993)

Lester Lee, a native of Szechuan, China, who moved to Silicon Valley in 1958, describes the feeling of being an outsider that was common for Asian immigrants in that period. "When I first came to Silicon Valley," he remembers, "there were so few of us that if I saw another Chinese on the street I'd go over and shake his hand." This sense of being an outsider was reinforced in many ways. Lee notes, for example, that "nobody wanted to sell us [Chinese] houses in the 1960s." Although immigrants like Lee typically held graduate degrees in engineering from U.S. universities and worked for mainstream technology companies, they often felt personally and professionally isolated in a world dominated by white men.

Immigrant engineers like Lester Lee responded to the sense of exclusion from established business and social structures in two ways. Many responded individually by starting their own businesses. Lee became the region's first Chinese entrepreneur when he left Ampex in 1970 to start a company called Recortec. Other early Chinese engineers report that they felt as if they were seen as "good work horses, and not race horses" or "good technicians, rather than managers." David Lee, for example, left Xerox in 1973 to start Qume after a less-experienced outsider was hired as his boss. Lee was able to raise startup capital from the mainstream venture capital community, but only on the condition that he hire a non-Asian president for his company. David Lam similarly left Hewlett-Packard in 1979 after being passed over for a promotion and started a semiconductor equipment manufacturing business called Lam Research, which is now a publicly traded company with $1.3 billion in sales. Not surprisingly, these three have become community leaders and role models for subsequent generations of Chinese entrepreneurs.

The New Immigrant Entrepreneurs

During the 1980s and 1990s, Silicon Valley's immigrant engineers increasingly followed the career trajectories of native engineers by starting technology businesses. In contrast to traditional immigrant entrepreneurs who are concentrated in low-technology services and manufacturing sectors, these new immigrant entrepreneurs are a growing presence in the most technologically dynamic and globally competitive sectors of the Silicon Valley economy. At least 37 public technology companies in the region were started by Chinese immigrants; another 22 were started by Indians (see Appendix A). The existence of so many immigrant-run publicly traded companies suggests a significant population of

private, immigrant-founded companies. Unfortunately, it is difficult to get accurate estimates of ethnic or immigrant entrepreneurship in technology industries. The standard way to measure immigrant entrepreneurship is by examining the "self-employed" category in the U.S. census. Although this may be a good approximation for owner-run businesses in traditional industries, it almost certainly leads to a significant undercount in technology sectors because so many companies are funded with outside funds or venture capital--and hence are not owned by the founding entrepreneur.

A higher and probably more accurate estimate of ethnic entrepreneurship in Silicon Valley was obtained by identifying all businesses with CEOs having Chinese and Indian surnames in a Dun & Bradstreet database of technology firms started since 1980. According to this count, close to one-quarter (24 percent) of Silicon Valley's technology firms in 1998 had Chinese or Indian executives and they created both jobs and wealth in the region. Of the 11,443 high-technology firms started during this period, 2,001 (17 percent) were run by Chinese and 774 (7 percent) by Indians. In 1998, these companies collectively accounted for over $16.8 billion in sales and 58,282 jobs (see Table 1). These numbers may still understate the scale of immigrant entrepreneurship in the region because firms started by Chinese or Indians with non-Asian CEOs are not counted. Our interviews suggest that this has frequently been the case in Silicon Valley, where venture capital financing has often been tied to the requirement that non-Asian senior executives be hired. This seems a more likely source of bias than the opposite scenario, i.e., firms started by non-Asians that hire a Chinese or Indian CEO.

Table 1. 1998 Sales and Employment of Silicon Valley High-Technology Firms Led by a Chinese or Indian CEO

	No. of Firms	Total Sales ($ M)	Total Employment
Indian	774	3,588	16,598
Chinese	2,001	13,237	41,684
Total	**2,775**	**16,825**	**58,282**
Share of Silicon Valley high-technology firms, %	24	17	14

Source: Dun & Bradstreet database, 1998. Note: Statistics are for firms started by Chinese or Indians between 1980 and 1998.

These data also indicate that the rate of Chinese and Indian entrepreneurship in Silicon Valley increased significantly over time. Chinese and Indians were at the helm of 13 percent of Silicon Valley's technology companies between 1980 and 1984, but they were running 29 percent of the region's high-technology companies started between 1995 and 1998 (see Table2). The following sections suggest that this growth has been fueled both by the emergence of role models and by supportive networks within the ethnic communities in the region, as well as by growing ties to Asian markets and sources of capital and manufacturing capabilities.

Table 2. Chinese- and Indian-Run Companies as Share of Total Silicon Valley High-Technology Start-Ups, 1980-1998

	1980-1984		1985-1989		1990-1994		1995-1998	
	No.	%	No.	%	No.	%	No.	%
Indian	47	3	90	4	252	7	385	9
Chinese	121	9	347	15	724	19	809	20
White	1,181	88	1,827	81	2,787	74	2,869	71
Total	1,349	100	2,264	100	3,763	100	4,063	100

Source: Dun & Bradstreet database, 1998.

Chinese and Indian firms remain small relative to the technology sector as a whole, with an average of 21 employees per firm compared to 37 employees per firm for all firms. Although these immigrant-run firms employ fewer people, they appear to be at least as productive: Chinese-run firms have sales of $317,555 per employee and Indian-run firms have sales of $216,110 per employee compared to $242,105 sales per employee for all technology firms in the Dun & Bradstreet database. It is impossible to identify and precisely track the progress of the technology companies started by immigrants, in part because so many have passed managerial responsibility to their native counterparts. However, the technology companies listed in Appendix A, which were either founded by or are currently run by Chinese or Indian and are publicly traded, have average sales and employment that are much closer to the regional average.

There is an interesting sectoral division among these businesses. Chinese-run firms are more concentrated than Indian-run firms in computer and electronic hardware manufacturing and trade, whereas Indian-run companies are disproportionately in software and business services. This difference is likely due to the differences in language skills between the two groups. Indian immigrants tend to be proficient in English, but most first-generation Chinese immigrants are not. This means that Indians can move more easily into software development whereas Chinese immigrants gravitate toward sectors where language skills are less important. It is worth noting, however, that this appears to be changing. Two well known public technology companies started by Taiwanese immigrants--Broadvision and AboveNet--are in the software and Internet sectors, respectively. Moreover, in absolute terms, there are more Chinese-run than Indian-run software and service companies.

There is also a large number of Chinese firms in the wholesale sector, reflecting a distinctive, lower-skill segment of the Taiwanese technology community. These firms, which are on average quite small, specialize in selling computers and computer components that are manufactured in Taiwan. They appear to have some ties to the more technically sophisticated sector of the Chinese community through their association, the Chinese American Computer Corporation, as well as through personal and alumni networks. These ties allow the wholesale and retail communities to learn quickly about technology trends as well as to provide market feedback.

The Origins of Silicon Valley's Ethnic Networks

The previous section portrays Chinese and Indian entrepreneurs as individuals or as collections of unrelated individuals. This conforms to the popular image of the entrepreneur as a lone pioneer. In reality, however, Silicon Valley's immigrant entrepreneurs--like their mainstream counterparts--rely on a diverse range of informal social structures and institutions to support their entrepreneurial activities.

Unlike traditional ethnic entrepreneurs who remain isolated in low wage, low skill industries (Waldinger et al, 1990). Silicon Valley's new immigrant entrepreneurs, are professionals who are active in dynamic and technologically sophisticated industries. Yet like their less educated predecessors, the region's Chinese and Indian engineering communities rely on ethnic strategies to enhance their own entrepreneurial opportunities. Seeing themselves as outsiders to the mainstream technology community, Silicon Valley's immigrant engineers created local social and professional networks to mobilize the information, know-how, skill, and capital needed to start technology firms. This is reflected in a proliferation of ethnic professional associations.

Table 3 lists the professional and technical associations organized by Silicon Valley's Chinese and Indian immigrant engineers.[3] These organizations are among the vibrant and active professional associations in the region, with memberships ranging from several hundred in the newer associations to over one thousand in the established organizations.

Table 3. Indian and Chinese Professional Associations in Silicon Valley

Name	Year Founded	Membership	Brief Description

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[3] This list includes only professional associations whose focus is technology industry and whose primary membership base is in Silicon Valley. It does not include the numerous Chinese and Indian political, social, and cultural organizations in the region; nor does it include ethnic business or trade associations for traditional, non-technology industries

Indian			
Silicon Valley Indian Professionals Association (SIPA)	1991	1,000	Forum for expatriate Indians to contribute to cooperation between United States and India. Web site: www.sipa.org
The Indus Entrepreneur (TiE)	1992	560	Fosters entrepreneurship by providing mentorship and resources. Web site: www.tie.org
Chinese			
Chinese Institute of Engineers (CIE/USA)	1979	1,000	Promotes communication and interchange of information among Chinese engineers and scientists. Web site: www.cie-sf.org
Asian American Manufacturers Association (AAMA)	1980	> 700	Promotes the growth and success of U.S. technology enterprises throughout the Pacific Rim. Web site: www.aamasv.com
Chinese Software Professionals Association (CSPA)	1988	1,400	Promotes technology collaboration and facilitates information exchange in the software profession. Web site: www.cspa.com
Chinese American Computer Corporation (NBI)	1988	270 corporations	Mid-technology cluster of PC clone system sellers, majority from Taiwan. Web site: www.killerapp.com/nbi
Monte Jade Science and Technology Association (MJSTA)	1989	150 corp. 300 ind. (West Coast)	Promotes the cooperation and mutual flow of technology and investment between Taiwan and the United States. Web site: www.montejade.org
Silicon Valley Chinese Engineers Association (SCEA)	1989	400	Network of Mainland Chinese engineers to promote entrepreneurship and professionalism among members and establish ties to China. Web site: www.scea.org
Chinese American Semiconductor Professionals Association (CASPA)	1991	40 corporations, 1,600 individuals	Promotes technical, communication, information exchange, and collaboration among semiconductor professionals. Web site: www.caspa.com
North America Taiwanese Engineers Association (NATEA)	1991	400	Promotes exchange of scientific and technical information. Web site: http://natea.org
Chinese Information and Networking Association (CINA)	1992	700	Chinese professionals who advocate technologies and business opportunities in information industries. Web site: www.cina.org
Chinese Internet Technology Association (CITA)	1996	600	Forum and network for Chinese Internet professionals and entrepreneurs to incubate ideas, learn from each other, and form potential partnerships. Web site: www.cita.net
North America Chinese Semiconductor Association (NACSA)	1996	600	Professional advancement in semiconductor sector, interaction between the United States and China. Web site: www.nacsa.com

SOURCE: Interviews.

The organizations combine elements of traditional immigrant culture with distinctly high-technology practices: They simultaneously create ethnic identities within the region and facilitate the professional networking and information exchange that aid success in the highly mobile Silicon Valley economy. They are not traditional political or lobbying organizations. With the exception of the Asian American Manufacturers Association (AAMA), the activities of these groups are oriented exclusively to fostering the professional and technical advancement of their members.

It is notable that the region's Chinese and Indian immigrants have organized separately from one another--as well as from Silicon Valley's mainstream professional and technical associations, such as the American Electronics Association, the Institute of Electrical and Electronic Engineers, or the Software Entrepreneurs Forum. They also join the mainstream organizations, to be sure, but most are less active in these than they are in the ethnic associations. There is virtually no overlap in the membership of Indian

and Chinese professional associations, although there appears to be considerable overlap within the separate communities, particularly the Chinese, with its multiplicity of differently specialized associations. There are also ethnic distinctions within the Chinese technology community. The Monte Jade Science and Technology Association and the North American Taiwanese Engineers Association, for example, use Mandarin (Chinese) at many meetings and social events--which excludes not only non-Chinese members, but even Chinese from Hong Kong or Southeast Asia who speak Cantonese.

In spite of the distinct ethnic subcultures and the greater number and specialization of the Chinese associations, these associations share important functions as well. All mix socializing--over Chinese banquets, Indian dinners, or family-centered social events--with support for professional and technical advancement. Each organization, either explicitly or informally, provides first-generation immigrants with a source of professional contacts and networks within the local technology community: They serve as important sources of labor market information and recruitment channels and they provide role models of successful immigrant entrepreneurs and managers. In addition, the associations sponsor regular speakers and conferences that provide forums for sharing specialized technical and market information as well as basic information about the nuts and bolts of entrepreneurship and management for engineers with limited business experience. In addition to providing sessions on how to write a business plan or manage a business, some of the Chinese associations give seminars on English communication, negotiation skills, and stress management.

Many of these associations have become important forums for cross-generational investment and mentoring as well. An older generation of successful immigrant engineers and entrepreneurs in both the Chinese and the Indian communities now plays an active role in financing and mentoring younger generations of co-ethnic entrepreneurs. Individuals within these networks often invest individually or jointly in promising new ventures, acting as "angel" investors who are more accessible to immigrants than the mainstream venture capital community and who are also willing to invest smaller amounts of money. The goal of the Indus Entrepreneur (TiE), for example, is to "foster entrepreneurship by providing mentorship and resources" within the South Asian technology community. Similarly, both the AAMA and the Monte Jade Science and Technology Association sponsor annual investment conferences aimed at matching potential investors (often from Asia as well as Silicon Valley) with promising Chinese entrepreneurs.

This is not to suggest that these associations create self-contained ethnic businesses or communities. Many Chinese and Indian immigrants socialize primarily within the ethnic networks, but they routinely work with native engineers and native-run businesses. In fact, there is growing recognition within these communities that although a start-up might be spawned with the support of the ethnic networks, it needs to become part of the mainstream to grow. It appears that the most successful immigrant entrepreneurs in Silicon Valley today are those who have drawn on ethnic resources while simultaneously integrating into mainstream technology and business networks.[4]

The remainder of this section traces the evolution of some of the region's leading Chinese and Indian professional associations to illuminate their origins and activities in more detail. Although this study focuses on Chinese and Indians, the phenomenon of ethnic networking and mutual support among skilled immigrants in Silicon Valley now extends to the region's Iranian, Korean, Japanese, Israeli, French, Filipino, and Singaporean immigrant engineers.

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[4] This parallels Granovetter's (1995) notion of balancing coupling and decoupling in the case of overseas Chinese entrepreneurs.

The Chinese Institute of Engineers: The "Grandfather" of the Chinese Associations

A handful of Chinese engineers--including Lester Lee, David Lee, and David Lam--started a local branch of the Chinese Institute of Engineers (CIE) in 1979 to promote better communication and organization among the region's Chinese engineers. The Bay Area chapter of CIE quickly became the largest in the country: Today CIE has some 1,000 members in the Bay Area and is regarded by old timers as the "grandfather" of Silicon Valley's Chinese organizations.

The organization was dominated initially by Taiwanese immigrants, reflecting the composition of the Chinese technology community in Silicon Valley at the time. Its early dynamism built on pre-existing professional and social ties among these engineers, a majority of whom were graduates of Taiwan's elite engineering universities. Most Taiwanese engineers report that by the mid-1980s they had dozens of classmates in Silicon Valley. The National Taiwan University Alumni Association, for example, has 1,500 members in the Bay Area alone. These alumni relations--which seemed more important to many Taiwanese immigrants when living abroad than they had at home—have become an important basis for the solidarity within the Chinese engineering community in Silicon Valley.

The CIE is primarily a technical organization. However, the initial meetings of the Bay Area chapter focused heavily on teaching members the mechanics of starting a business, getting legal and financial help, and providing basic management training to engineers who had only technical education. Over time, CIE became an important source of role models and mentors for recently arrived immigrants. Gerry Liu, who co-founded Knights Technology in 1987 with four Chinese friends, reports:

> When I was thinking of starting my own business, I went around to call on a few senior, established Chinese businessmen to seek their advice. I called David Lee . . . I contacted David Lam and Winston Chen. I called up Ta-ling Hsu. They did not know me, but they took my calls. I went to their offices or their homes, they spent time with me telling me what I should or shouldn't be doing.

Not surprisingly, immigrants like Liu began starting businesses at an increasing rate in the late 1980s and 1990s.

The CIE remains the most technical of the region's ethnic associations, and its goal is "to foster friendship, provide a forum for technical exchange and promote cooperation among Chinese-American engineers to enhance their image and influence." It also plays a central role in promoting collaboration between Chinese-American engineers and their counterparts in Asia. In 1989, CIE initiates- an annual week-long technical seminar with the parallel organization in Taiwan, and this was extended to include engineers from Mainland China during 1990s. In addition, when the Taiwanese government initiates major engineering projects, from a transit system to a power station, they consult the Silicon Valley chapter of CIE. These forums not only transfer technical know-how but also create professional and social ties among Chinese engineers living on both sides of the Pacific.

Although CIE was the first organization of Chinese engineers in the Bay Area, there was already a well developed infrastructure of Chinese associations in the region. San Francisco's Chinatown--historically the center of Chinese immigration to the area--was the home of hundreds of traditional Chinese ethnic associations, including regional and district hometown associations, kinship (clan, family, or multi-family), and dialect associations. There were also business and trade associations that supported the thousands of traditional ethnic businesses located in the city, including apparel contractors, jewelry and gift shops, neighborhood grocers, Chinese laundries, and restaurants (Wong, 1998).

The CIE was distinguished from these established ethnic associations by both the social and economic background of its members and by geography. CIE members were highly educated professionals who had immigrated in recent decades from Taiwan or China and who lived and worked in the South Bay. They had little in common with the older generations of less-skilled farmers and manual workers who had immigrated from Hong Kong and southern China (Guangdong and Fujian provinces) and who lived and worked in San Francisco. The early gatherings of Silicon Valley's Chinese engineers centered in the city because of its concentration of Chinese restaurants. By the mid-1980s, as the area's Chinese population increased significantly (and with it the number of Chinese restaurants suitable for holding meetings!), the center of gravity for socializing had shifted decisively to the Peninsula. Our interviews confirm that these two communities of Chinese immigrants coexist today in the Bay Area with limited social or professional interaction.

Into the Mainstream: The Asian American Manufacturers Association

The Asian American Manufacturers Association (AAMA) was founded in 1980 by a group of eight Chinese engineers at Lester Lee's company, Recortec. Motivated by the desire to be seen as professionals rather than simply as good engineers and to participate more directly in the political process, the founding members envisioned an institution that would help Asians join mainstream American society. There were only 21 members at the founding meeting, but they quickly achieved their vision of positioning the AAMA as a high-profile, high-caliber association with broad appeal to Asian professionals in the area.

The goals of the AAMA were broader and more political than those of CIE. The original objectives were: "(1.) To obtain resources from federal, state, and local governments, and private sectors to assist in the development, growth, and success of the organization; (2.) To benefit individual members of the association through mutual support and sharing of resources, information and individual talents; and (3.) To address issues that affect the welfare of the members of the association and the Asian Pacific American business community" (Gong, 1996).

In spite of a significantly broader agenda, the early AAMA meetings, like those of the CIE, focused primarily on teaching first-time entrepreneurs the nuts and bolts of starting and managing a technology business. These meetings also showcased role models of successful Asian Americans in the industry and provided a mutual support and networking forum for members. Such forums were intended to help their members advance professionally, but they also helped promote the adoption of American management models--rather than traditional Chinese business models based on family ties and obligations--in immigrant-run technology companies.

The AAMA now has more than 700 members and is the most visible voice of the Asian community in Silicon Valley. Its goal is now more global, to "promote the growth and success of U.S. technology enterprises throughout the Pacific Rim." But the organization's objectives still include fostering business growth and networking, facilitating management and leadership development (including providing "management development training, opportunities, and managerial/executive role models and contacts that will help members break through the glass ceiling"), recognizing and publicizing the achievements of Asian Americans, and supporting equal opportunity.

The AAMA has the broadest potential membership base and agenda of the ethnic associations in Silicon Valley. All of its meetings are conducted in English and its membership, which is open to all professionals, includes large numbers of investment bankers, consultants, lawyers, and accountants as well as engineers. In spite of this umbrella-like character, three-quarters of AAMA members are Chinese.

These early professional associations had overlapping memberships and boards reflecting in part the small scale of the Chinese technology community in Silicon Valley. Members describe both CIE and AAMA--and the social networks they support--as providing helpful job search networks and as sources of reliable information, advice and mentoring, seed capital, and trusted business partners. A former president of the AAMA describes these advantages: "Doing business is about building relationships, it's people betting on people, so you still want to trust the people you're dealing with. A lot of trust is developed through friendship and professional networks like school alumni relations, business associations, and industry ties." David Lam similarly describes the advantages of the ethnic networks:

> If there is someone that I know . . . if we have some mutual business interest, then the
> deal can come together rather fast. And if we have known each other for some years and
> a certain level of mutual trust has already been established, it is much easier to go
> forward from there. In other situations I may not have known the person directly, but
> through some introduction I talked to them, and things also went along very well. So I
> think the connections play a very important role.

The Proliferation of Chinese Professional and Technical Associations

The growing scale and diversity of the Chinese engineering community in Silicon Valley during the 1980s and early 1990s generated a proliferation of professional and technical associations. As Table 3 shows, at least nine more Chinese technology-related associations--
or more than one per year--were started in Silicon Valley between 1988 and 1996. The new generation of Mainland Chinese have in turn created still more associations since that time, often parallel to comparable Taiwanese organizations. All of these associations bring together the Chinese members of a given industry and all are dedicated broadly to promoting the professional advancement of individuals and member firms. Collectively, the Chinese associations, represent nearly 6,000 members in Silicon Valley-- although this number undoubtedly double-counts individuals who belong to multiple associations.

Breaking the Glass Ceiling: The Silicon Valley Indian Professionals Association

A young Intel engineer and his three Indian roommates started the Silicon Valley Indian Professionals Association (SIPA) in 1987 to provide a meeting place for Indian professionals to share their common concerns. In spite of their superior mastery of the English language, which distinguished them from most of their Chinese counterparts, they too were concerned about limits on the opportunities for professional advancement in technology industry. According to SIPA founder, Prakash Chandra, "many Indians didn't see a career path beyond what they were doing." Many of the early SIPA meetings were thus focused on individual career strategies as well as on the nuts and bolts of the technology industry.

Silicon Valley's Indian immigrants did not mobilize collectively until a decade later than their Chinese counterparts, in part because they were later in achieving a critical mass in the region. Many Indian engineers complained about a glass ceiling in the region's established companies, and responded by starting their own businesses: "Why do you think there are so many Indian entrepreneurs in Silicon Valley? Because they know that sooner or later they will be held back." When they organized collectively, however, they created new associations such as SIPA rather than joining existing groups such as the AAMA. This no doubt reflects the greater comfort they felt in being with other Indians, in spite of the fact that they were often from different regions of the country and spoke different dialects. In

fact, a sizable subset of these engineers grew up in Africa and had never lived in India. But like their Chinese counterparts, their backgrounds were often similar--many were graduates of the prestigious Indian Institutes of Technology (IITs) or Indian Institutes of Science (IISs)--and hence were unified by common professional identities along with the pull of shared ethnic ties.

Like its Chinese counterparts, SIPA's vision gradually expanded beyond the focus on individual professional advancement. In this case, largely in response to visits by Indian government delegations in the early 1990s seeking to build business ties in the United States, SIPA redefined its role to include attempting to "fill the information gap" between the United States and India. The association began sponsoring regular seminars and workshops that would allow U.S.-based Indian professionals to help their employers gain a better understanding of the recently opened Indian market and business environment, and simultaneously to explore professional opportunities for themselves in India. Today, SIPA has about 1,000 members, virtually all Indians, and holds regular seminars to disseminate information of interest and strengthen ties with business and government officials in India.

Cross-Generational Mentoring: The Indus Entrepreneur

SIPA lost some of its momentum when its founder returned to India in 1992, but in the same year, an older generation of Indian immigrants started The Indus Entrepreneur. TiE's goal was to nurture entrepreneurs from South Asia. Its founding members included three of the region's most successful Indian entrepreneurs: Suhas Patil, former MIT professor and founder of Cirrus Logic, Prabhu Goel, founder of Gateway Design Automation, and Kanwal Rekhi, who started and ran Excelan until it merged with Novell. This core group came together in response to a visit from India's Secretary of Electronics to Silicon Valley in 1992, but when the minister's flight was delayed they began to informally share complaints about the difficulties of running a business. In the words of another local entrepreneur who subsequently organized the first meeting of TiE: "I realized that we all had the same problems, but that we don't work together. That as individuals we are brilliant, but collectively we amounted to nothing." TiE began its monthly meetings with the intent of creating a forum for networking among themselves as well as for assisting younger South Asians to start their own businesses.

Like the first-generation of Chinese immigrant entrepreneurs, Indians such as Patil and Goel had succeeded in spite of their lack of contacts or community support. In the words of another early TiE member, Satish Gupta:

> When some of us started our businesses we had nobody we could turn to for help. We literally had to scrounge and do it on our own. What we see in Silicon Valley, especially with the new start-up businesses, is that contacts are everything. All of us have struggled through developing contacts, so our business is to give the new person a little bit of a better start than we had.

This goal of mentoring and assisting entrepreneurs remains central to TiE's agenda and is achieved through monthly meetings and presentations, the annual conference, and extensive informal networking and mentoring. Even TiE founders were amazed by the popularity of the first annual conference in 1994, which attracted over 500 people. Today it draws close to 1,000.

TiE founders call themselves Indus (rather than Indian) entrepreneurs to include other South Asians such as Pakistanis, Bangladeshis, and Nepalese. However, the organization's Bay Area members are almost all Indian. Forty charter members form the core of the organization. Charter membership is by invitation only and includes successful entrepreneurs, corporate executives, and senior professionals with

roots in or an interest in the Indus region who support the organization with annual dues of $1,000. TiE has U.S. chapters in Southern California, Boston, and Austin as well, but the center of gravity remains in Silicon Valley. In 1999, TiE chapters were established in Bangalore, Bombay, and Delhi, India.

TiE's most distinctive contribution is its model of cross-generational investing and mentoring. Because of their earlier business successes, TiE's founders are able to provide start-up capital, business and financial advice, and professional contacts to a younger generation of Indian entrepreneurs. These engineers claim that one of the biggest obstacles to their own advancement has been the bias on the part of mainstream financial organizations, and in particular, the difficulties faced by non-native applicants in raising venture capital. Like their Chinese counterparts, they felt like outsiders to the mainstream, primarily white and native, venture capital community.

TiE members often take on the roles of mentors, advisors, board members, and angel investors in new Indian companies. One early recipient of TiE funding, Naren Bakshi, presented the business plan for a company called Vision Software in 1995. Within months, TiE members had raised $1.7 million for Bakshi's company. Today, Vision Software has 60 employees and has raised additional funding--in fact Bakshi was approached by more venture capitalists than he could use. This fits the vision of TiE founders of supporting "diamonds in the rough" and encouraging them to expand by diversifying their funding and integrating into the mainstream technology community.

Chandra Shekar, founder of Exodus Corporation, reports that the help from TiE members extends beyond providing capital and sitting on the board of directors to serving as a "trusted friend" or even the "brain behind moving the company where it is today." One of the most important contributions these experienced entrepreneurs and executives provide is access to "entry points" with potential customers or business alliances. According to Shekar,

> The Indian network works well, especially because the larger companies like Sun, Oracle and HP have a large number of Indians . . . you gain credibility through your association with a TiE member . . . for example, if HP wants to do business with you, they see that you are a credible party to do business with. This is very important.

Vinod Khosla, a co-founder of Sun Microsystems and now a partner at venture capital firm Kleiner, Perkins summarizes: "the ethnic networks clearly play a role here: people talk to each other, they test their ideas, they suggest other people they know, who are likely to be of the same ethnicity. There is more trust because the language and cultural approach are so similar." Of course once successful Indian entrepreneurs invest in a company, they provide the legitimacy that allows the entrepreneur to get a hearing from the region's more established venture capital funds. Satish Gupta of Cirrus Logic similarly notes that:

> networks work primarily with trust elements of trust are not something that people develop in any kind of formal manner .trust has to do with the believability of the person, body language, mannerisms, behavior, cultural background, all these things become important for building trust caste may play a role, financial status may play a role . . . .

But he adds that although organizations like TiE are instrumental in creating trust in the community, they also create a set of duties and sanctions:

> if you don't fulfill your obligations, you could be an outcast the pressure of, hey, you better not do this because I'm going to see you at the temple or sitting around the same coffee table at the TiE meeting and I know another five guys that you have to work with, so you better not do anything wrong.

Groups like SIPA and TiE create common identities among an otherwise fragmented nationality. Indians historically are deeply divided and typically segregate themselves by regional and linguistic differences: the Bengalis, Punjabis, Tamil, and Gujaratis tend to stick together. But in Silicon Valley it seems that the Indian identity has become more powerful than these regional distinctions. As the author V. S. Naipaul wrote of his own upbringing in Trinidad: "In these special circumstances overseas Indians developed something they would have never known in India: a sense of belonging to an Indian community. This feeling of community could override religion and caste." As with the overseas Chinese community, there are of course subgroups with varied amounts of familiarity and trust, but the shared experience of immigration appears to strengthen rather than undermine ethnic identities.

There is always a danger of insularity in these ethnic communities. Some suggest that the TiE network remains so closed that it prevents outsiders from participating. According to a charter member of TiE, there is little desire in the organization to connect to the outside: "This network just does not connect to the mainstream. If you look at the social gatherings that the TiE members go to, it's all Indians. There's nothing wrong with it . . . but I think if you don't integrate as much, you don't leverage the benefit that much." The challenge for Silicon Valley's immigrant entrepreneurs will continue to be to balance reliance on ethnic networks with integration into the mainstream technology community.

The Benefits of Local Ethnic Networks

We cannot definitively demonstrate the economic benefits of these immigrant networks. However the proliferation of ethnic professional associations in Silicon Valley during the 1980s and 1990s corresponded with the growing visibility and success of Chinese- and Indian-run businesses. The entrepreneurs themselves give the networks much credit. According to Mohan Trika, a CEO of an internal Xerox venture called inXight:

> . . . organizations like TiE create self-confidence in the community. This confidence is very important . . . it provides a safety net around you, the feeling that you can approach somebody to get some help. It's all about managing risk. Your ability to manage risk is improved by these networks. If there are no role models, confidence builders to look at, then the chances of taking risk are not there. That's what we are saying: "come on with me, I'll help you." This quickly becomes a self-reinforcing process: you create 5 or 10 entrepreneurs and those 10 create another 10 . . . I can approach literally any big company, or any company in the Bay Area, and find two or three contacts . . . through the TiE network I know so-and-so in Oracle, etc.

This networking creates value, he says:

> . . . because we are a technology selling company for the next generation of user interface, every major software company or any software company must have at least two or three Indians or Chinese in there . . . And because they are there, it is very easy for me, or my technical officer, to create that bond, to pick up the phone and say: Swaminathan, can you help me, can you tell me what's going on . . . he'll say don't quote me but the decision is because of this, this and this. Based on this you can reformulate your strategy, your pricing, or your offer . . . Such contacts are critical for startups.

The increased visibility of successful Chinese and Indian entrepreneurs and executives in Silicon Valley in the 1990s has transformed their image in the mainstream community as well. Some Asians

today suggest that although the "glass ceiling" may remain a problem in traditional industries, or in old-line technology companies, it is diminishing as a problem in Silicon Valley.

Sources of capital for Asian entrepreneurs are proliferating, in part because of growing flows of capital from Taiwan, Hong Kong, and Singapore in the 1990s. Several new venture capital firms dedicated primarily to funding Asian immigrants were started in the region as well during the 1990s: Alpine Technology Ventures, for example, has focused on Chinese companies, whereas the Draper International Fund specializes in financing Indian technology ventures. Other firms such as Walden International Investment Group and Advent International explicitly link Silicon Valley-based entrepreneurs to Asian sources of funding. Some of the major venture capital firms are even said to be hiring Asian-American partners to avoid losing out on deals going to foreign-born entrepreneurs. In addition, Silicon Valley's immigrant entrepreneurs may now be advantaged relative to their mainstream counterparts by their privileged ties to Asian sources of capital, markets, and manufacturing capabilities.

Globalization of Silicon Valley's Ethnic Networks: Two Cases

At the same time that Silicon Valley's immigrant entrepreneurs organized local professional networks, they were also building ties back to their home countries. The region's Chinese engineers constructed a vibrant two-way bridge connecting the technology communities in Silicon Valley and Taiwan; their Indian counterparts became key middlemen linking U.S. businesses to low-cost software expertise in India. These cross-Pacific networks represent more than an additional "ethnic resource" that supports entrepreneurial success; rather, they provide the region's skilled immigrants with an important advantage over their mainstream competitors who often lack the language skills, cultural know-how, and contacts to build business relationships in Asia.

The traditional image of the immigrant economy is the isolated Chinatown or "ethnic enclave" with limited ties to the outside economy. Silicon Valley's new immigrant entrepreneurs, by contrast, are increasingly building professional and social networks that span national boundaries and facilitate flows of capital, skill, and technology. In so doing, they are creating transnational communities that provide the shared information, contacts, and trust that allow local producers to participate in an increasingly global economy (Portes, 1996).

As recently as the 1970s, only very large corporations had the resources and capabilities to grow internationally, and they did so primarily by establishing marketing offices or manufacturing plants overseas. Today, by contrast, new transportation and communications technologies allow even the smallest firms to build partnerships with foreign producers to tap overseas expertise, cost-savings, and markets. Start-ups in Silicon Valley today are often global actors from the day they begin operations: Many raise capital from Asian sources, others subcontract manufacturing to Taiwan or rely on software development in India, and virtually all sell their products in Asian markets.

The scarce resource in this new environment is the ability to locate foreign partners quickly and to manage complex business relationships across cultural and linguistic boundaries. This is particularly a challenge in high-technology industries in which products, markets, and technologies are continually being redefined--and where product cycles are routinely shorter than nine months. First-generation immigrants, like the Chinese and Indian engineers of Silicon Valley, who have the language, cultural, and technical skills to function well in both the United States and foreign markets are distinctly positioned to play a central role in this environment. They are creating social structures that enable even the smallest

producers to locate and maintain mutually beneficial collaborations across long distances and that facilitate access to Asian sources of capital, manufacturing capabilities, skills, and markets.

These ties have measurable economic benefits. Research at the University of California at Berkeley has documented a significant correlation between the presence of first-generation immigrants from a given country and exports from California. For example, every 1 percent increase in the number of first-generation immigrants from a given country, exports from California go up nearly 0.5 percent. Moreover, this effect is especially pronounced in the Asia-Pacific region where, all other things being equal, California exports nearly four times more than it exports to comparable countries in other parts of the world (Bardhan and Howe, 1998).

This section presents cases of immigrant entrepreneurs in Silicon Valley who have helped to construct the new transnational (and typically trans-local) networks. The region's Taiwanese engineers have forged close social and economic ties to their counterparts in the Hsinchu region of Taiwan--the area, comparable in size to Silicon Valley, that extends from Taipei to the Hsinchu Science-Based Industrial Park. They have created a rich fabric of professional and business relationships that supports a two-way process of reciprocal industrial upgrading. Silicon Valley's Indian engineers, by contrast, play a more arm's-length role as middlemen linking U.S.-based companies with low-cost software expertise in localities like Bangalore and Hyderabad. In both cases, the immigrant engineers provide the critical contacts, information, and cultural know-how that link dynamic--but distant--regions in the global economy.

The Hsinchu, Taiwan, Region and Silicon Valley

In the 1960s and 1970s, the relationship between Taiwan and the United States was a textbook First to Third-World relationship. American businesses invested in Taiwan primarily to take advantage of its low-wage manufacturing labor. Meanwhile, Taiwan's best and the brightest engineering students came to the United States for graduate education and created a classic "brain drain" when they remained in the US for professional opportunities. Many ended up in Silicon Valley.

This relationship has changed significantly during the past decade. By the late 1980s, engineers began returning to Taiwan in large numbers, drawn by active government recruitment and the opportunities created by rapid economic development (Lin, 1998). At the same time, a growing cohort of highly mobile engineers began to work in both the United States and Taiwan, commuting across the Pacific regularly. Typically Taiwan-born, U.S.-educated engineers, they have the professional contacts and language skills to function fluently in both the Silicon Valley and Taiwanese business cultures and to draw on the complementary strengths of the two regional economies.

K. Y. Han is typical. After graduating from National Taiwan University in the 1970s, Han completed a master's in solid state physics at the University of California, Santa Barbara. Like many Taiwanese engineers, Han was drawn to Silicon Valley in the early 1980s and worked for nearly a decade at a series of semiconductor companies before joining his college classmate and friend, Jimmy Lee, to start Integrated Silicon Solutions, Inc. (ISSI). After bootstrapping the initial start-up with their own funds and those of other Taiwanese colleagues, they raised more than $9 million in venture capital. Their lack of managerial experience meant that Lee and Han were unable to raise funds from Silicon Valley's mainstream venture capital community. The early rounds of funding were thus exclusively from Asian sources, including the Walden International Investment Group, a San Francisco-based venture fund that specializes in Asian investments, as well as from large industrial conglomerates based in Singapore and Taiwan.

Han and Lee mobilized their professional and personal networks in both Taiwan and the United States to expand ISSI. They recruited engineers (many of whom were Chinese) in their Silicon Valley headquarters to focus on R&D, product design, development, and sales of their high-speed static random access memory chips (SRAMs). They targeted their products at the personal computer market, and many of their initial customers were Taiwanese motherboard producers, which allowed them to grow very rapidly in the first several years. And, with the assistance of the Taiwanese government, they established manufacturing partnerships with Taiwan's state-of-the-art semiconductor foundries and incorporated in the Hsinchu Science-Based Industrial Park to oversee assembly, packaging, and testing.

By 1995, when ISSI was listed on NASDAQ, Han was visiting Taiwan at least monthly to monitor the firm's manufacturing operations and to work with newly formed subsidiaries in Hong Kong and Mainland China. Finally, he joined thousands of other Silicon Valley "returnees" and moved his family back to Taiwan. This allowed Han to strengthen the already close relationship with their main foundry, the Taiwan Semiconductor Manufacturing Corporation, as well as to coordinate the logistics and production control process on a daily basis. The presence of a senior manager like Han also turned out to be an advantage for developing local customers. Han still spends an hour each day on the phone with Jimmy Lee and he returns to Silicon Valley as often as ten times a year. Today ISSI has $110 million in sales and 500 employees worldwide, including 350 in Silicon Valley.

A closely knit community of Taiwanese returnees, and U.S.-based engineers and entrepreneurs like Jimmy Lee and K. Y. Han has become the bridge between Silicon Valley and Hsinchu. These social ties, which often build on pre-existing alumni relationships among graduates of Taiwan's elite engineering universities, were institutionalized in 1989 with the formation of the Monte Jade Science and Technology Association. Monte Jade's goal is the promotion of business cooperation, investment, and technology transfer between Chinese engineers in the Bay Area and Taiwan. Although the organization remains private, it works closely with local representatives of the Taiwanese government to encourage mutually beneficial investments and business collaborations. Like Silicon Valley's other ethnic associations, Monte Jade's social activities are often as important as its professional activities. In spite of the fact that the organization's official language is Mandarin (Chinese), the annual conference typically draws over 1,000 attendees for a day of technical and business analysis as well as a gala banquet.

This transnational community has accelerated the upgrading of Taiwan's technological infrastructure by transferring technical know-how and organizational models as well as by forging closer ties with Silicon Valley. Observers note, for example, that management practices in Hsinchu companies are more like those of Silicon Valley than of the traditional family-firm model that dominates older industries in Taiwan. As a result, Taiwan is now the world's largest producer of notebook computers and a range of related PC components including motherboards, monitors, scanners, power supplies, and keyboards. (IIIC-MIC, 1997) In addition, Taiwan's semiconductor and integrated circuit manufacturing capabilities are said to be on a par with the leading Japanese and U.S. producers; and its flexible and efficient networks of specialized small and medium-sized enterprises coordinate the diverse components of this sophisticated infrastructure (Hsu, 1997; Mathews, 1997).

Taiwan has also become an important source of capital for Silicon Valley start-ups--particularly those started by immigrant entrepreneurs. It is impossible to accurately estimate the total flow of capital from Taiwan to Silicon Valley because so much of it is invested informally by individual angel investors, but there is no doubt that it increased dramatically in the 1990s. Formal investments from Asia (not including Japan) were more than $500 million in 1997 (Miller, 1997). This includes investments by funds based in Taiwan, Hong Kong, and Singapore as well as U.S.-based venture groups such as Walden International and Advent International that raise capital primarily from Asian sources. These investors often provide more than capital. According to Ken Tai, a founder of Acer and now head of venture fund, InveStar Capital: "When we invest we are also helping bring entrepreneurs back to Taiwan. It is

relationship building . . . we help them get high level introductions to foundries (for manufacturing) and we help establish strategic opportunities and relationships with customers."

The growing integration of the technological communities of Silicon Valley and Hsinchu offers substantial benefits to both economies. Silicon Valley remains the center of new product definition and design and development of leading-edge technologies, whereas Taiwan offers world-class manufacturing, flexible development and integration, and access to key customers and markets in China and Southeast Asia (Naughton, 1997). This appears a classic case of the economic benefits of comparative advantage. However, these economic gains from specialization and trade would not be possible without the underlying social structures and institutions provided by the community of Taiwanese engineers, which insures continuous flows of information between the two regions. Some say that Taiwan is like an extension of Silicon Valley, or that there is a "very small world" between Silicon Valley and Taiwan.

The reciprocal and decentralized nature of these relationships is distinctive. The ties between Japan and the United States in the 1980s were typically arm's-length, and technology transfers between large firms were managed from the top down. The Silicon Valley-Hsinchu relationship, by contrast, consists of formal and informal collaborations between individual investors and entrepreneurs, small and medium-sized firms, as well as divisions of larger companies located on both sides of the Pacific. In this complex mix, the rich social and professional ties among Taiwanese engineers and their U.S. counterparts are as important as the more formal corporate alliances and partnerships.

The Bangalore, India, Region and Silicon Valley

Radha Basu left her conservative South Indian family to pursue graduate studies in computer science at the University of Southern California in the early 1970s. Like many other skilled immigrants, she was subsequently drawn into the fast-growing Silicon Valley labor market where she began a long career at Hewlett-Packard (HP). When Basu returned to India to participate in an electronics industry task force in the mid-1980s, the government invited her to set up one of the country's first foreign subsidiaries. She spent four years establishing HP's software center in Bangalore--pioneering the trend among foreign companies of tapping India's highly skilled, but relatively low-cost software talent. When Basu returned to Silicon Valley in 1989 the HP office in India employed 400 people, and it has since grown to become one of HP's most successful foreign subsidiaries.

Radha Basu was uniquely positioned to negotiate the complex and often bewildering bureaucracy and the backward infrastructure of her home country. She explains that it takes both patience and cultural understanding do business in India: "You can't just fly in and out and stay in a five-star hotel and expect to get things done like you can elsewhere. You have to understand India and its development needs and adapt to them." Many Indian engineers followed Basu's lead in the early 1990s: They exploited their cultural and linguistic capabilities and their contacts to help build software operations in their home country. Indians educated in the United States have been pivotal in setting up the Indian software facilities for Oracle, Novell, Bay Networks, and other Silicon Valley companies.

However, few Indian engineers choose to live and work permanently in India. Unlike the Taiwanese immigrants who have increasingly returned home to start businesses or to work in established companies, Indian engineers--if they return at all--typically do so on a temporary basis. This is due in part to the difference in standards of living, but most observers agree that the frustrations associated with doing business in India are equally important. Radha Basu explains that the first HP office in India consisted of a telex machine on her dining room table, and that for many years she had to produce physical evidence of software exports for customs officials who did not understand how the satellite

datalink worked. She adds that when the Indian government talked about a "single window of clearance" to facilitate foreign trade, she would joke "where is the window?

Business conditions have improved dramatically in India since Basu arrived. The establishment of the Software Technology Parks (STPs) scheme in the late 1980s gave export-oriented software firms in designated zones tax exemptions for five years and guaranteed access to high-speed satellite links and reliable electricity. The national economic liberalization that began in 1991 greatly improved the climate for the software industry as well. Yet even today, expatriates complain bitterly about complex bureaucratic restrictions, corrupt and unresponsive officials, and an infrastructure that causes massive daily frustrations--from unreliable power supplies, water shortages, and backward and extremely costly telecommunications facilities to dangerous and congested highways.

Moreover, many overseas Indians, often referred to as non-resident Indians (NRIs) feel out of place in India. NRIs often face resentment when they return to India--a resentment that is not unrelated to India's long-standing hostility to foreign corporations. In contrast to the close collaboration between Taiwan's policymakers and U.S.-based engineers, there has been almost no communication at all between the Silicon Valley engineering community and India's policymakers--even those concerned directly with technology policy. Moreover, young engineers in India prefer to work for U.S. multinationals because they are seen as a ticket to Silicon Valley: Software companies in Bangalore report turnovers of 20-30 percent per year, primarily because so many workers jump at the first opportunity to emigrate. Of course, some U.S.-educated Indians return home and stay, but, on balance, the "brain drain" of skilled Indian workers to the United States continued unabated throughout the 1990s.

Silicon Valley's Indian engineers thus play an important, but largely arm's-length, role connecting U.S. firms with India's low-cost, high-quality skill. Although some, like Basu, have returned to establish subsidiaries, most do little more than promote India as a viable location for software development. As they became more visible in U.S. companies during the 1990s, NRIs were increasingly instrumental in convincing senior management in their firms to source software or establish operations in India. The cost differential remains a motivating factor for such moves: Wages for software programmers and systems analysts are ten times lower in India, and the cost of an engineer is 35-40 percent what it is in the United States. The availability of skill is, of course, the essential precondition for considering India; and it is of growing importance for Silicon Valley firms facing shortages of skilled labor. The low wages provide a viable tradeoff to working in an environment plagued by chronic infrastructural problems.

The Indian software industry has boomed in recent years, but most of the growth is still driven by low-value added services (Parthasarathy, 1999; Lateef, 1997; Heeks, 1996). Throughout the 1980s and early 1990s, India was confined almost exclusively to low-value segments of software production such as coding, testing, and maintenance. A majority of this activity was in the form of on-site services overseas-- or "body-shopping"--which proved to be extremely lucrative, given the size of the wage gap.[5] Although more of the work is now being done offshore (in India) and a handful of large Indian firms and American multinationals have started to provide higher value-added design services, much of the software development in India today differs little from body-shopping. The time difference makes it possible to work around the clock with programmers in India logging on to a customer's computers to perform relatively routine testing, coding, or programming tasks once a U.S.-based team has left for the day.

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[5] Body-shopping is defined narrowly: it refers to offering on-site programming services (in the United States, for example) on the basis of "time and material" contracts. Onsite services accounted for approximately 90 percent of the value of Indian software exports in 1990, and for 61 percent in 1995.

The climate for entrepreneurship in India is not hospitable, and it remained one of the main constraints on the upgrading of the Indian software industry in the 1990s. India lacks a venture capital industry and the domestic market for information technology is very small. As a result, the software industry is dominated by a small number of large export-oriented domestic and foreign corporations that have minimal ties with each other, local entrepreneurs, or the Indian engineering community in Silicon Valley. These companies have been so profitable exploiting the wage gap that they have had few incentives to address higher value-added segments of the market--or to nurture entrepreneurial companies that might do so.

As a result, most economic relations between Silicon Valley and regions like Bangalore are still conducted primarily by individuals within the large American or Indian corporations. There are few U.S.-educated engineers who have their feet sufficiently in both worlds to transfer the information and know-how about new markets and technologies or to build the long-term relationships that would contribute to the upgrading of India's technological infrastructure. And there are no institutionalized mechanisms--either public or private--that would both facilitate and reinforce the creation of more broad-based interactions between the two regions.

However, communications between the engineering communities in India and the United States are growing fast, especially among the younger generation. Alumni associations from the elite Indian Institutes of Technology (who have many graduates in Silicon Valley) are starting to play a bridging role by organizing seminars and social events. A new journal, *siliconindia* (www.siliconindia.com), provides up-to-date information on technology businesses in the United States and India and has recruited several of Silicon Valley's most successful engineers onto its editorial board. And a growing number of U.S.-educated Indians report a desire to return home, whereas others have left the large Indian companies to try their hand at entrepreneurship in Silicon Valley. In short, there is a small but growing technical community linking Silicon Valley and Bangalore--one that could play an important role in the upgrading of the Indian software industry in the future.

Taiwan and India Meet in Silicon Valley

Silicon Valley-based firms are now well positioned to exploit both India's software talent and Taiwan's manufacturing capabilities. Mahesh Veerina started Ramp Networks (initially named Trancell Systems) in 1993 with several Indian friends, relatives, and colleagues. Their vision was to develop low-cost devices that speed Internet access for small businesses. By 1994, they were short on money and decided to hire programmers in India for one-quarter of the Silicon Valley rate. One founder spent two years setting up and managing their software development center in the southern city of Hyderabad, which was seen as "a big sacrifice." They followed the current trend of chosing Hyderabad over the increasingly congested Bangalore because business costs and labor turnover were lower. Ramp obtained funding to expand the Indian operation from Draper International--a San Francisco-based venture fund dedicated to financing technology activity in India.

Veerina did not discover Taiwan until 1997 when he was introduced to the principals at the Taiwanese investment fund, InveStar Capital. After investing in Ramp, InveStar partners Ken Tai and Herbert Chang convinced Veerina to visit Taiwan. They set up two days of appointments with high-level executives in Taiwanese technology companies. Veerina, who travels regularly to India but had never visited East Asia, was amazed: "the Taiwanese are a tight community and very receptive to and knowledgeable about new technologies and companies over here. They also do deals very quickly . . . it is incredible the way they operate, the speed with which they move, and the dynamism of the place." He told Tai and Chang that he wanted to return to Taiwan immediately.

In less than three months, Veerina established Original Equipment Manufacturing (OEM) relationships for high-volume manufacture of Ramp's routers with three Taiwanese manufacturers (compared to the nine months it took for them to establish a similar partnership with a U.S. manufacturer). The price per unit quoted by the Taiwanese was almost half what Ramp was paying for manufacturing in the United States, and it was able to increase its output one-hundred-fold because of the relationships that Veerina subsequently built with key customers in the Taiwanese PC industry. Ramp also decided to use the worldwide distribution channels of its Taiwanese partners. Moreover, when Ramp designed a new model, the Taiwanese manufacturer was prepared to ship product in two weeks, compared to the six months it would have taken in the United States.

Veerina says he could never have built these business relationships without the help of InveStar's partners and their network of high-level contacts in Taiwan. In a business where product cycles are often shorter than nine months, the speed as well as cost savings provided by these relationships provides critical competitive advantages to a firm like Ramp. InveStar's Tai and Chang see this as one of their key assets: intimate knowledge of the ins and outs of the business infrastructure in Taiwan's decentralized industrial system. By helping outsiders (Chinese as well as non-Chinese) negotiate these complicated social and business networks to tap into Taiwan's cost-effective and high-quality infrastructure and capability for speedy and flexible integration, they provide their clients with far more than access to capital. In 1999, when Ramp went public on NASDAQ, its software development was in India, its manufacturing in Taiwan, and new product definition and HQ remained in Silicon Valley.

As Silicon Valley's skilled Chinese and Indian immigrants create social and economic links to their home countries, they simultaneously open foreign markets, identify manufacturing options, and technical skills in growing regions of Asia to the broader business community in California. Firms in traditional as well as technology sectors, for example, now increasingly turn to India for software programming talent. Meanwhile, California's complex of technology-related sectors increasingly relies on Taiwan's fast and flexible infrastructure for manufacturing semiconductors and PCs, as well as their growing markets for advanced technology components (Dedrick and Kraemer, 1998). It is particularly striking that these advantages are now equally accessible to entrepreneurs like Ramp's Veerina as well as to more established corporations. In short, although these new international linkages are being forged by a relatively small community of highly skilled immigrants, they are strengthening the economic infrastructure of Silicon Valley as well.

Conclusion

This research underscores important changes in the relationship between immigration, trade, and economic development in the 1990s. In the past, the primary economic linkages created by immigrants to their countries of origin were remittances sent to families left behind. Today, however, a growing numbers of skilled immigrants return to their home countries after studying and working abroad. Those who stay often become part of transnational communities that link the United States to the economies of distant regions. The new immigrant entrepreneurs thus foster economic development directly, by creating new jobs and wealth, as well as indirectly, by coordinating the information flows and providing the linguistic and cultural know-how that promote trade and investment flows with their home countries.

Scholars and policymakers need to recognize the growing interrelationships between immigration, trade, and economic development policy. The economic effect of skilled immigrants, in particular, is not limited to labor supply and wage effects. Some of their economic contributions, such as enhanced trade and investment flows, are difficult to quantify, but they must figure into our debates. The national debate over the increase of H1-B visas for high-skilled immigrants, for example, focused

primarily on the extent to which immigrants displace native workers. Yet we have seen here that these immigrants also create new jobs and economic linkages in their role as entrepreneurs. Economic openness has its costs, to be sure, but the strength of the California economy has historically derived from its openness and diversity--and this will be increasingly true as the economy becomes more global. The experience of Silicon Valley's new immigrant entrepreneurs suggests that California should resist the view that immigration and trade are zero-sum processes. We need to encourage the immigration of skilled workers, while simultaneously devoting resources to improving the education of native workers.

The fastest growing groups of immigrant engineers in Silicon Valley today are from Mainland China and India. Chinese, in particular, are increasingly visible in the computer science and engineering departments of local universities as well as in the workforces of the region's established companies. Although still relative newcomers to Silicon Valley, they appear poised to follow the trajectory of their Taiwanese predecessors. Several have started their own companies. And they are already building ties back home, encouraged by the active efforts of Chinese bureaucrats and universities--and by the powerful incentive provided by the promise of the China market. Ties between Silicon Valley and India will almost certainly continue to expand as well. Whether the emerging connections between Silicon Valley and regions in China and India generate broader ties that contribute to industrial upgrading in these nations-- as well as creating new markets and partners for Silicon Valley producers--will depend largely on political and economic developments within those nations. Whatever the outcome, the task for policymakers remains to maintain open boundaries so that regions like Silicon Valley continue to both build and benefit from their growing ties to the Asian economy.

Appendix A

Public Immigrant-Founded or -Run Technology Companies Based in Silicon Valley in 1998

Company	Immigrant Name	Position	Sales ($000)	No. of Empl.	Year Founded
Indian (Total Indian Public Firms = 22)					
Accom, Inc.	Junaid Sheikh	Chairman of the Board	17,627	64	1987
Alliance Semiconductor Corp.	N. D. Reddy	Chairman of the Board	118,400	168	1985
Aspect Development, Inc.	Romesh Wadhwani	Chairman of the Board	49,929	536	1991
Asyst Technologies, Inc.	Mihir Parikh	Chairman of the Board	165,463	606	1984
Celeritek, Inc.	Tamer Husseini	Chairman of the Board	56,317	422	1984
Cirrus Logic Corp.	Suhas Patil	Founder	1,146,945	1,857	1984
Digital Link Corp.	Vinita Gupta	Chairman of the Board	66,008	281	1985
Excelan	Kanwal Rekhi	Founder	Sold to Novell		1981
Exodus Communications	K. B. Chandrashekar	Founder	12,408	93	1992
Gateway Automation Design	Prabhu Goel	Founder	Sold to Cadence		1982
Integrated Device Technology	Norman Godinho	Founder	587,136	4,979	1980
Integrated Process Eqp Corp.	Sanjeev Chitre	Chairman of the Board	189,012	1,100	1989
Integrated Systems	Naren Gupta	Founder	120,469	584	1980
Micronics Computers, Inc.	Shanker Munshani	President	99,276	122	1986
NeoMagic Corp.	Prakash Agarwal	President	124,654	162	1993
Nuko Information Systems, Inc.	Pratap K. Kondamoori	Chairman of the Board	11,082	96	1994
Oryx Technology Corp.	Arvind Patel	President	16,000	17	1990
Pinnacle Systems	Ajay Chopra	Founder	105,296	323	1986
Quality Semiconductor, Inc.	R. P. Gupta	President	62,691	206	1988
Raster Graphics, Inc.	Rak Kumar	President	48,928	140	1987
SMART Modular Technologies	Ajay Shah	Chairman of the Board	694,675	636	1988
Sun Microsystems, Inc.	Vinod Khosla	Founder	9,791,000	26,300	1982

Chinese (Total Chinese Public Firms = 36)					
Above Net Communications, Inc.	Sherman Tuan	CEO, Founder	3,436	71	1995
Asante Technologies, Inc.	Jeff Y. Lin	Chairman of the Board	83,279	190	1988
Avant Corp.	Gerald C. Hsu	Chairman of the Board	38,004	701	1986
Award Software International	George Huang	President	23,367	163	1993
Broadvision, Inc.	Pehong Chen	President	27,105	188	1993
C Cube Microsystems, Inc.	Yen-Sheng Sun	Founder	33,712	750	1988
Communcation Intelligence Corp.	James Dao	Chairman of the Board	5,516	88	1981
Compression Labs	Wen Chen	Founder	87,882	317	1976
Digital Video Systems, Inc.	Edmund Y. Sun	Chairman of the Board	3,521	563	1992
Documentum	Howard Shao	Founder	75,635	388	1990
ECAD	Paul Huang	Founder	Sold to Cadence		1982
Epic Technology Group	Sang S. Wang	Chairman of the Board	Sold to Synopsis		1986
ESS Technology, Inc.	Fred S. Chen	Chairman of the Board	249,517	447	1992
E-Tek Dynamics	Ming Shih	Founder	106,924	657	1983
Everex Systems, Inc.	Cher Wang	Chairman	125,000	190	1993
Genelabs Technologies, Inc.	Frank Kung	Founder	12,790	147	1984
Infinity Financial Technology	Roger Lang	President	Sold to SunGuard		1989
Insignia Solutions, Inc.	Robert P. Lee	Chairman of the Board	55,095	167	1987
Integrated Device Technology	Chun Chiu Tsu-Wei Lee Fu Huang	Founder Founder Founder	587,136	4,979	1980
Integrated Silicon Solution, Inc.	Jimmy Lee	President	108,261	450	1988
Komag, Inc.	Tu Chen	Founder	631,082	4,738	1983
Lam Research Corp.	David Lam	Founder	1,052,586	3,300	1980
NVidia Corp.	Jen-Hsun Huang	CEO	32,421	115	1993
Oak Technology, Inc.	David D. Tsang	Chairman of the Board	157,106	511	1987
Opti, Inc.	Jerry Chang Kenny Liu Fong-Lu Lin	Chairman Founder Founder	67,842	133	1989
Pericom Semiconductor Corp.	Alex C. Hui	President	49,198	172	1990

Premisys Communications, Inc.	Raymond C. Lin	President	102,298	331	1990
Quality Semiconductor, Inc.	Chun P. Chiu	Chairman of the Board	62,691	206	1988
Qume Corp.	David Lee	Founder	Sold to Wyse		1973
Sigma Designs, Inc.	Jimmy Chan Jason Chen	Founder Founder	36,982	71	1982
Silicon Storage Technology	Bing Yeh	President	75,322	184	1989
Solectron Corp.	Winston Chen	Founder	3,694,385	18,215	1977
Trident Microsystems, Inc.	Frank Lin	President	113,002	439	1987
Vitelic Corp.	Alex Au	Founder	Merged with Mosel (TW)		1982
Weitek	Chi-Shin Wang Edmund Sun Godfrey Fang	Founder Founder Founder	7,972	27	1981
Yahoo! Inc.	Jerry Yang	Founder	67,411	386	1995

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