

The Economic Impact of Knowledge Workers from India and China

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INTRODUCTION

Immigration is a contentious issue in the United States. Most of the debate over the costs and benefits of immigration focuses on less-educated immigrants, who comprise the majority of new arrivals. Less attention has been paid to the smaller, but sizeable number of immigrants and temporary workers who come to the U.S. with considerable skills. While roughly half of recent arrivals never completed high school, one in five have at least a college degree, and 8 percent have a master's, professional, or Ph.D. degree.²

A substantial share of the highly educated migrants to the U.S. come from China and India. Though only about one in 10 new arrivals is from one of these countries, they make up 28 percent of college-educated new arrivals. Almost half of these migrants arrived in the last decade, and one in four came in just the last five years.³

One interesting aspect of immigration is that, while admissions policy is set nationally, its impacts are felt locally, with some regions receiving many more immigrants than others.

One-quarter of Chinese and Indian migrants in the U.S. live in the area of New York, New Jersey, and Pennsylvania (with a roughly equal number residing in California).⁴ This is almost double the region's share of the overall U.S. population. Still, Chinese and Indians comprise just 3 percent of the labor force in the region, and only 5 percent of its college-educated labor force.

Nonetheless, the effects of these workers can be quite large, as they are a disproportionately high share of employment in certain sectors. For example, 12 percent of the region's workers with a Ph.D. are Chinese or Indian. A quarter of the region's medical scientists and 22 percent of its computer software engineers are Chinese or Indian. Among computer hardware engineers and chemical and physical scientists, the proportion is between 15 percent and 20 percent.

What is the impact of these Chinese and Indian knowledge workers on the economy? How do they affect industrial performance? Do they displace native-born workers or fill a "talent crunch"? What effect do they have on prevailing wages? On innovation? On fiscal conditions?

The key conclusion of this paper is that Chinese and Indian knowledge workers are

good for the regional economy. Industries that face competition from firms in other parts of the country benefit from having more of the available knowledge workers locate in this region, rather than elsewhere—most notably California. Furthermore, if the U.S. were to put tighter restrictions on the number of knowledge workers allowed to enter the country, the jobs they currently fill would more than likely migrate to where those workers are—places like Shanghai and Bangalore. Outsourcing would benefit fewer people in the region than the kind of “insourcing” these knowledge workers represent. Evidence suggests that the cost to native-born workers who are in the same fields as the migrants is probably small, relative to the overall benefit to other workers, employers, stockholders, and taxpayers in the region.

CHARACTERISTICS OF THE KNOWLEDGE WORKERS

Chinese and Indian immigration into New Jersey, New York, and Pennsylvania has grown dramatically in recent decades. In 2005, there were 436,000 Chinese-born and 498,000 Indian-born people living in the region. This represents an 80 percent increase in the Chinese population and a 167 percent increase in the Indian population in the region in just 15 years. Table I shows in detail how the population has varied across states and over time.

EDUCATION

Many Chinese and Indian migrants to the region initially came as university students or as temporary workers through the H-1B visa program. Some attended graduate school here, returned to their home countries, and subsequently returned to the U.S. for work.

TABLE I
Chinese and Indians living in New York, New Jersey, and Pennsylvania

State	Year	Chinese	Indians	Chinese and Indians
New Jersey	1990	35,089	62,378	97,467
	2000	65,519	143,970	209,489
	2005	80,491	178,685	259,176
New York	1990	190,794	102,707	293,501
	2000	301,577	220,824	522,401
	2005	310,071	253,317	563,388
Pennsylvania	1990	16,943	21,478	38,421
	2000	30,634	42,663	73,297
	2005	45,694	65,928	111,622
NJ–NY–PA Region	1990	242,826	186,563	429,389
	2000	397,730	407,457	805,187
	2005	436,256	497,930	934,186

Source: Microdata of the U.S. census of population 1990 and 2000 and the American Communities Survey of 2005.

TABLE 2
Education of the region's labor force

	Natives	Chinese	Indians
Bachelor's degree or higher	32.8%	45.8%	65.6%
Bachelor's degree	20.3%	19.0%	33.3%
Master's degree	8.6%	16.3%	22.2%
Professional degree	2.7%	3.3%	6.4%
Doctoral degree	1.2%	7.3%	3.8%

Note: Source is the American Communities Survey, 2005. Numbers are the percentage of each national-origin group which has the specified level of education.

TABLE 3
School enrollment among those with a bachelor's degree

Natives	9.4%
Chinese	11.5%
Recent Chinese	44.1%
Indians	9.0%
Recent Indians	13.9%

Source: American Communities Survey, 2005. "Recent" refers to those who arrived in the United States in the last five years. Numbers are the percentage of the people with a bachelor's degree in each national-origin group in the region who are currently enrolled in school.

Though the U.S. census of population does not report the source of an individual's education, it is generally believed that most of the Chinese and Indians with doctorates working in the U.S. attended graduate school here.

The Chinese and Indians who have settled in the New Jersey, New York, and Pennsylvania region are highly educated, compared to the rest of the region's population. This can be seen in Table 2. While one third of the native-born labor force has a bachelor's degree or higher, close to half (46 percent) of Chinese-born workers in the region do, and the proportion among Indians is two-thirds.

Very few native-born workers in the region have doctorates—just over 1 percent. Among the Chinese-born, the share is six times as high (7.3 percent), and among Indians, it is more than three times as high. Moreover, as Table 3 shows, among those with a bachelor's degree, Chinese and Indians are much more likely than natives to be pursuing higher degrees. Less than 10 percent of natives with a bachelor's degree are currently enrolled in school. Among Chinese who have been in the country for a decade or less, close to half (44 percent) are currently continuing their education. Among Indians, the proportion is more than one in eight.

TABLE 4

Top industries of Chinese college graduates

<i>Industry</i>	<i>Share (%)</i>
Universities	9.7
Finance	6.2
Hospitals	5.2
Computer systems design	4.9
Banking	4.2
Pharmaceuticals	4.0
Schools	2.7
Insurance	2.4
Nondepository credit	2.3
Scientific R&D	2.3
Wired telecom	2.0
Doctors' offices	1.9
Engineering services	1.9
Technical consulting	1.7
Restaurants	1.7
Bookkeeping/payroll	1.5

Source: American Communities Survey, 2005. Numbers are the percentage of Chinese college graduates in the region who are employed in each industry.

TABLE 5

Top industries of Indian college graduates

<i>Industry</i>	<i>Share (%)</i>
Computer systems design	9.4
Hospitals	8.6
Universities	4.9
Finance	4.8
Doctors' offices	3.8
Banking	3.7
Restaurants	2.5
Insurance	2.2
Pharmaceuticals	2.1
Technical consulting	2.1
Schools	2.0
Engineering services	1.9
Groceries	1.7
Taxis	1.6
Real estate	1.5

Source: American Communities Survey, 2005. Numbers are the percentage of Indian college graduates in the region who are employed in each industry.

OTHER CHARACTERISTICS

In terms of language fluency, 60 percent of Chinese workers with at least a bachelor's degree speak English fluently. Among Indians, that share is 80 percent. The fraction of migrants who are fluent obviously rises as they spend more time in the U.S.

In terms of age, Chinese and Indian workers as a whole are no younger than native-born workers (for whom the average age is 41). However, those who arrived in the U.S. in just the last five years are six years younger, on average.

EMPLOYMENT

Chinese and Indian workers are concentrated in certain industries and occupations. Table 4 shows the share of Chinese college graduates in the region who are employed in different industries, while Table 5 shows the same data for Indians. One out of 10 Chinese workers is employed at a university (9.7 percent), while roughly the same share of Indians (9.4 percent) is employed in computer systems design. In both cases, the share of the other nationality employed in the industry is 4.9 percent. Apart from universities and computer systems design, the most common industries for both

TABLE 6
Top occupations of Chinese college graduates

<i>Occupation</i>	<i>Share (%)</i>
Accountant	6.5
Postsecondary teacher	5.7
Computer software engineer	5.3
Manager	4.4
Computer scientist and systems analyst	4.4
Physician	3.1
Medical scientist	3.1
Computer programmer	3.1
Designer	2.4
Physical scientist	2.4
Financial manager	2.2
Office manager	2.0
Engineer (misc.)	2.0
Chemist and materials scientist	1.6
School teacher	1.5
Marketing and sales manager	1.3
Secretary	1.1
Retail manager	1.1
Database administrator	1.1
CEO	1.1

Source: American Communities Survey, 2005. Numbers are the percentage of Chinese college graduates in the region who are employed in each occupation.

TABLE 7
Top occupations of Indian college graduates

<i>Occupation</i>	<i>Share (%)</i>
Computer software engineer	7.6
Physician	6.9
Computer scientist and systems analyst	5.2
Computer programmer	4.3
Retail manager	3.7
Accountant	3.4
Postsecondary teacher	3.3
Cashier	3.3
Manager	2.8
Registered nurse	2.2
Retail sales	1.6
Computer and info systems manager	1.6
Engineer (misc.)	1.5
Taxi	1.5
Financial manager	1.4
CEO	1.4
Clinical lab technicians	1.2

Source: American Communities Survey, 2005. Numbers are the percentage of Indian college graduates in the region who are employed in each occupation.

groups are hospitals (8.6 percent of Indians and 5.2 percent of Chinese) and finance (6.2 percent of Chinese and 4.8 percent of Indians).

In terms of occupations, Tables 6 and 7 show that the most common ones for Chinese college graduates in the region are accountant (6.5 percent), postsecondary teacher (5.7 percent), computer software engineer (5.3 percent), and computer scientist and systems analyst (4.4 percent). Among Indians, the most common occupations are computer software engineer (7.6 percent), physician (6.9 percent), computer scientist or systems analyst (5.2 percent), and programmer (4.3 percent).

TOP INDUSTRIES AND OCCUPATIONS

In order to assess which industries and occupations have been most affected by the entry of Chinese and Indian knowledge workers, it is instructive to look at the share of total employment in each sector that is comprised of Chinese and Indian workers. Note that this is different than the numbers calculated in the previous section: the share of Chinese and Indians who have entered each sector.

Table 8 shows the share of employment in each industry in the region which is made up of Chinese and Indian workers who hold at least a bachelor's degree. The most affected industries by far are software publishing and

TABLE 8

Chinese and Indian college graduates as a share of employment in the region (by industry)

<i>Industry</i>	<i>Chinese (%)</i>	<i>Indian (%)</i>	<i>Chinese or Indian (%)</i>
Software publishing	3.0	9.1	12.1
Computer systems design	3.0	9.1	12.1
Pharmaceutical	3.9	3.5	7.4
Apparel and fabric	3.1	4.2	7.3
Computer equipment	3.8	3.5	7.2
Scientific R&D	3.9	2.1	6.0
Finance	2.7	2.7	5.5
Taxi	0.2	5.0	5.2
Information service	1.2	3.6	4.8
Credit	2.2	2.1	4.3
Technical consulting	1.6	2.7	4.3
Universities	2.4	1.8	4.2
Durables (misc.)	1.6	2.6	4.2
Wired telecom	2.1	2.0	4.1
Electronic components	1.5	2.4	3.9
Banking	1.8	2.1	3.9
Specialty food stores	0.9	3.0	3.9

Source: American Communities Survey, 2005. Numbers are the percentage of employees in the industry who are of the specified national origin.

computer systems design, in which one out of every eight workers is Indian or Chinese (with three-fourths of those being Indian).⁵ Just over 7 percent of workers in pharmaceuticals are Chinese (3.9 percent) or Indian (3.5 percent). Other industries with similar shares of Chinese and Indian workers include apparel and fabric (7.3 percent), computer equipment (7.2 percent), scientific research and development (6 percent), and finance (5.5 percent).⁶

Table 9 shows similar numbers for employment by occupation. More than one out of four medical scientists in the region is Chinese or Indian (19.0 percent and 7.4 percent). The share is close to that for computer software engineers, among whom 7.2 percent are

Chinese and 15.0 percent are Indian. Between 15–20 percent of health diagnosing and treating professionals, mathematical scientists, chemists and material scientists, physical scientists, database administrators, and computer hardware engineers are Chinese or Indian. Among computer scientists and physicians, the share is over 13 percent.

To put these numbers into perspective, consider that just 5.1 percent of college-graduate workers in the region is Chinese or Indian (1.9 percent and 3.2 percent, respectively). Clearly, the presence of Chinese and Indian knowledge workers is concentrated in specific scientific and technical sectors of the regional economy.

TABLE 9

Chinese and Indian college graduates as a share of employment in the region (by occupation)

<i>Occupation</i>	<i>Chinese (%)</i>	<i>Indian (%)</i>	<i>Chinese or Indian (%)</i>
Medical scientist	19.0	7.4	26.5
Computer software engineer	7.2	15.0	22.2
Health diagnosing and treating	14.8	3.7	18.5
Mathematical scientist	16.7	1.5	18.2
Chemist and materials scientist	9.3	8.4	17.7
Physical scientist	12.6	4.3	16.9
Database administrator	6.6	9.2	15.8
Computer hardware engineer	8.0	6.9	14.9
Computer scientist	4.0	9.4	13.4
Physician	3.1	10.0	13.2
Natural sciences manager	5.9	5.9	11.8
Biology technician	5.9	5.9	11.8
Computer programmer	4.4	6.1	10.5
Chemical engineer	5.3	3.1	8.4
Engineer (misc.)	4.1	4.3	8.4
Credit analyst	8.2	na	8.2
Biologist	4.8	3.2	8.1
Network systems analyst	3.0	4.3	7.3
Clinical lab technician	1.5	5.4	6.9
Computer systems technician	2.7	4.1	6.8
<i>All workers</i>	<i>1.4</i>	<i>1.7</i>	<i>3.1</i>
<i>All college-graduate workers</i>	<i>1.9</i>	<i>3.2</i>	<i>5.1</i>

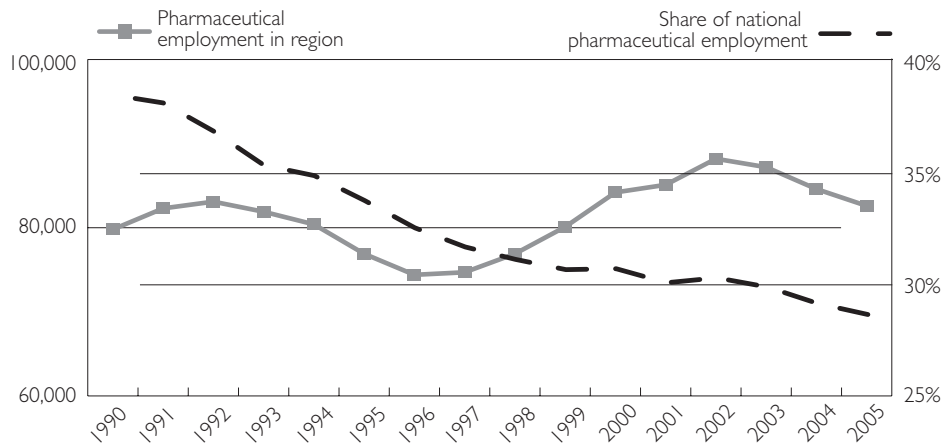
Source: American Communities Survey, 2005. Numbers are the percentage of employees in the occupation who are of the specified national origin.

EFFECT ON FIRMS

One way in which local firms hire foreign knowledge workers is through the H-1B visa program. H-1Bs are temporary employer-sponsored visas for workers in "specialty occupations." These visas permit a foreigner to work for the sponsor company for three years, renewable for another three years. Workers on H-1Bs can also be sponsored for Legal Permanent Residence (i.e., a green card) by their employers.

Perhaps the best way to gauge whether foreign knowledge workers are good for U.S. firms is the fact that the full annual quota of H-1B visas is usually snapped up almost immediately after employers are able to apply for them. Companies spend a great deal of money lobbying Congress to raise the cap on the number of such visas made available to them. Even the casual reader of the *New York Times* will have noticed ads on the op-ed page, sponsored by technology companies advocating increases the H-1B cap.

FIGURE I
Pharmaceutical employment

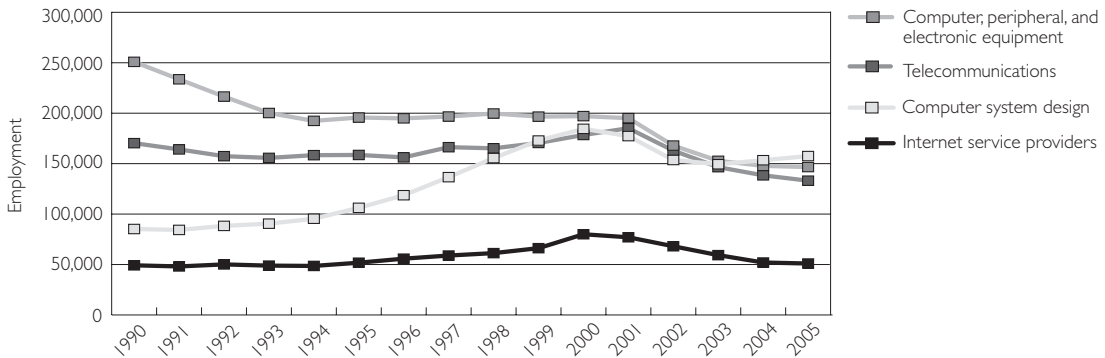


Clearly, companies believe that knowledge workers are good for them. Some argue that the supply of qualified native-born workers is simply insufficient to meet companies' demand in certain scientific and technical fields. Economists often reject this argument, on the grounds that if the pay were high enough, more native-born workers would enter the field, and the shortage would disappear. However, in the short-run, there may be a relatively fixed supply of native workers with a given set of skills, and industry may wish to expand faster than the educational system can produce new graduates.

It also makes sense to look one link up on the supply chain, to the supply of natives to U.S. graduate programs. Graduate schools are full of foreign-born students.⁷ Half of the doctorates graduated in engineering are now foreign-born. Some of this is because natives have opportunities that foreign-born workers

do not. For example, a U.S. computer science graduate may well prefer to take a high-paying job on Wall Street, rather than go on to graduate school in computer science. The supply of native-born graduate students might therefore not rise unless salaries in the two fields became comparable (as they once were, during the high-tech boom). On the other hand, a computer science graduate from the Indian Institute of Technology might be eager to attend to a computer science graduate program in the U.S. Furthermore, the Indian graduate might be much more interested in a job as a computer programmer than a U.S.-born graduate, first because his outside opportunities are so much more limited, and second, because for him it could be a stepping stone to a career in the U.S. Firms may perceive that the same salary will buy a higher quality foreign computer programmer than native-born one.

FIGURE 2
IT employment in the region



Ironically, another reason U.S. students may avoid entering fields in which there is currently a perceived shortage is that they believe that the jobs in these fields will soon be outsourced.

In addition to the firms that benefit directly from hiring Chinese and Indian knowledge workers, other firms may profit as well. To the extent that their employment increases economic activity in certain sectors, benefits will also accrue to the industries which supply

the equipment and supplies needed by those sectors.

Figures 1–3 show the number of people employed in two key affected sectors in the region, namely pharmaceuticals and IT. The first figure shows that since 1990—the year in which the H-1B visa program was initiated—pharmaceutical employment in the industry has cycled up and down. Some of this appears to be due to national conditions, and over

FIGURE 3
IT employment share of national employment

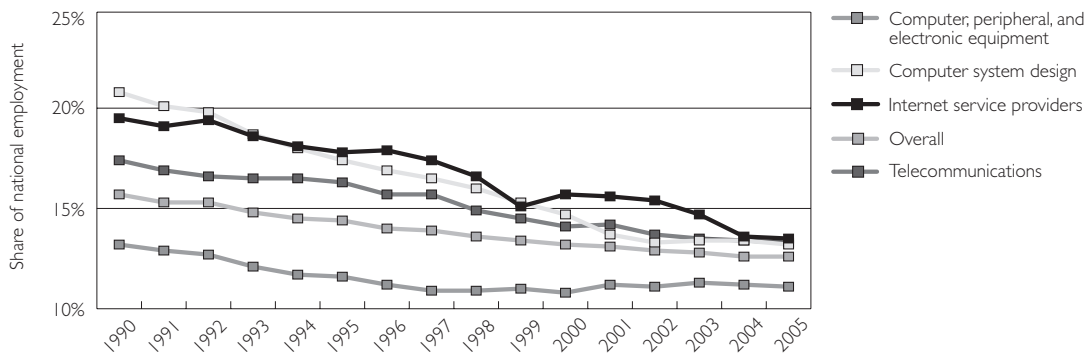
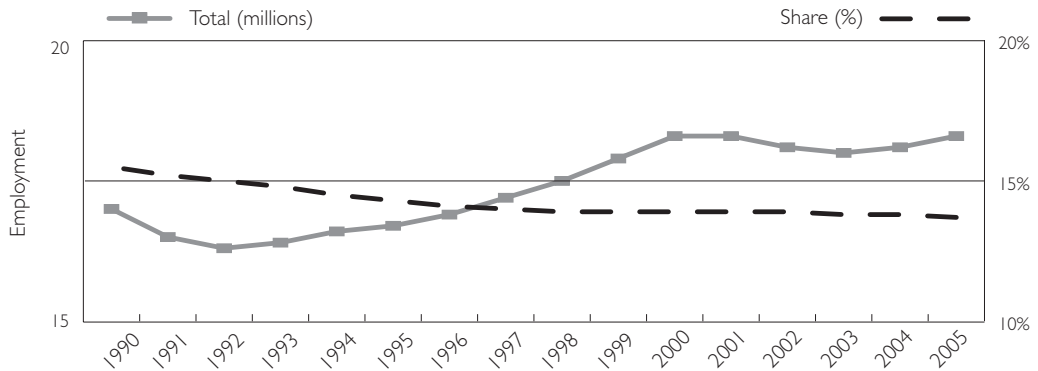


FIGURE 4
Total employment in the region



the period as whole, the region's share of the nation's pharmaceutical employment has fallen by about ten percentage points, from roughly 38 percent to 28 percent.

Figures 2 and 3 show comparable numbers for IT, first in absolute terms, and then as a share of U.S. IT employment. There was a decline in the number of people employed in computer, peripheral, and electronic equipment, and an increase in the number working in computer systems design. Still, as in the case of pharmaceuticals, there has been a decline over time in the region's share of national employment in all these fields, though the absolute scale of the decline has been much smaller.

Finally, Figure 4 shows that while total employment of all kinds in the region has, for the most part, risen over time, the region's share of national employment has fallen from about 16 percent to about 14 percent. Put in this perspective, the relative decline in pharmaceutical employment has been large, compared to the region as a whole.

EFFECT ON WORKERS

While the impact on firms in the region is unambiguously positive, the effect of Chinese and Indian knowledge workers on native workers is less obvious. On the one hand, there are natives who work in the same occupations and industries where the migrant knowledge workers are concentrated. The standard textbook model of the labor market would suggest that when the supply of workers to a particular sector rises, competition among workers increases, resulting in lower wages and more displacement and unemployment for the workers who were in the field to begin with. In a growing sector, the outcome would be slower wage and employment growth for natives. However, if there was indeed a labor shortage to begin with (i.e., not enough natives to fill those jobs at the prevailing wage), there would be no such displacement or wage effects.

If, on the other hand, there is competition for jobs, foreign-born knowledge workers could have an adverse impact on natives. As discussed above, foreign knowledge workers

may be willing to work for less than native-born ones. Though, at least under the H-1B visa program, the law specifies that firms must pay the foreigners the prevailing U.S. wage, this may be difficult to enforce. Table 10 shows, however, that even within narrowly-defined occupations, Chinese and Indian workers do not systematically earn less than natives. In fact, in most of the occupations in which they are heavily represented, they earn more. On average, the pay of college-graduate Chinese and Indians is just slightly lower (95 percent of natives' pay). Their unemployment rate is higher, on average, than that of native college graduates, which is not suggestive of natives being systematically displaced in

favor of foreign workers. There is, however, great variation by field, so that, for example, the unemployment rate is higher for natives than Chinese- or Indian-born hardware and software engineers, programmers, and computer scientists. This could be consistent with displacement. However, some of this difference may simply be due to the facts of U.S. immigration law: Under the rules of the H-1B visa program, Chinese and Indians who are not employed by a U.S. firm must return to or remain in their home countries, so those "unemployed" workers don't show up in these statistics. Regardless, without knowing the counterfactual—what the region's unemployment rates by occupation would be in the

TABLE 10
Wages and unemployment in the New Jersey, New York, and Pennsylvania region

Occupation	Wages (hourly)			Unemployment rate		
	Natives (\$)	Chinese and Indians (\$)	Ratio CI to natives (%)	Natives (%)	Chinese and Indians (%)	Difference CI-natives (%)
All college graduates	28.78	27.58	95	1.6	2.4	0.8
Medical scientist	30.04	23.95	79	1.7	1.0	-0.7
Software engineer	31.03	35.91	115	1.7	1.2	-0.5
Health diagnosing	21.44	37.24	173	1.4	3.8	2.4
Math scientist	23.64	35.43	149	3.7	n/a	n/a
Chemist	27.77	24.76	89	1.1	3.5	2.4
Physical scientist	27.99	24.30	86	1.3	0.8	-0.5
Database administrator	26.61	33.99	127	2.0	2.7	0.7
Hardware engineer	25.67	34.15	133	3.5	2.4	-1.1
Computer scientist	28.52	32.77	114	2.9	1.8	-1.1
Physician	56.88	44.02	77	0.5	1.9	1.4
Natural science mgr.	39.27	46.52	118	1.9	n/a	n/a
Biology technician	14.18	17.85	126	2.9	n/a	n/a
Programmer	28.31	30.77	108	2.3	1.6	-0.7
Chemical engineer	29.68	35.84	121	2.2	1.6	-0.6
Engineer (misc.)	29.85	30.41	102	1.1	2.6	1.5

Source: U.S. census of population, 2000. Missing cells are occupations in which the sample sizes were too small to make an accurate calculation.

absence of the Chinese and Indian workers—it is not possible to infer their impact. An alternative approach to assessing this will be discussed below.

One case study that may shed some light on the likely impact of highly skilled migrant workers is the influx of an enormous number of engineers and physicians into the Israeli labor market after the collapse of the Soviet Union. Despite the proportionately enormous increase in labor supply to certain fields, native-born workers in those fields did not experience employment or wage losses.⁸ It is hypothesized that firms in these sectors expanded enough to absorb the influx, suggesting that the same could potentially occur in the New Jersey, New York, and Pennsylvania region. The lack of an adverse effect on native-born workers suggests the possibility of complementarities, in addition to competition, between workers in the same occupation at high levels of skill. For example, chemists working on developing a new drug may benefit from the contribution and expertise of a foreign chemist on their team, and this boost to productivity can create more jobs. Furthermore, within that set of new jobs, native-born workers in Israel—who had country-specific skills and experience that the immigrants lacked—appear to have been pushed up the ladder within their field, into more supervisory, higher-ranking positions, with the lower-ranking routine jobs in their fields filled by the new immigrants.

A second category of native workers is those with whom the foreign-born knowledge workers do not compete, but for whom they are

complementary. In other words, rather than substituting for each other, they work together and make each other more productive. Consider, for example, U.S.-born pharmaceutical scientists whose research labs are staffed by Chinese lab technicians; high-tech innovators who employ Indian software engineers to implement their ideas; and managers who are supported by foreign-born database administrators. Economic theory predicts that native workers who are complemented by Chinese and Indian knowledge workers will see their productivity, wages, and employment rates rise when more of these workers are employed in the region.

Do workers in the New Jersey, New York, and Pennsylvania region who are in fields that have absorbed many Chinese and Indian workers earn less or have higher unemployment rates than those in other parts of the country? Table II considers the hourly wages and unemployment rates of natives in a set of occupations heavily populated by migrant knowledge workers. It compares these outcomes for natives in the region who are in those sectors to the outcomes of native college graduates overall in the region, and to the outcomes of similar workers in the rest of the country.

These comparisons should, however, be taken with a grain of salt. There are several challenges in trying to empirically estimate the impact of migrants on native workers. For example, does it make sense to think of the presence of migrant workers in a sector as influencing wage and unemployment conditions in the sector, but not the other way around? Perhaps firms are more likely to hire these workers in fields

TABLE 11

Native labor market conditions in the region compared to the rest of the U.S.

Occupation	Native wages (hourly)			Native unemployment rate		
	U.S. (\$)	Region (\$)	Region/U.S. (%)	U.S. (%)	Region (%)	Region-U.S. (%)
All college graduates	25.86	28.78	113	1.5	1.6	0.1
Medical scientist	27.34	30.04	110	1.4	1.7	0.3
Software engineer	29.76	31.03	104	1.7	1.7	0.0
Health diagnosing	21.76	21.44	99	0.7	1.4	0.7
Math scientist	25.43	23.64	93	1.5	3.7	2.2
Chemist	25.36	27.77	110	1.7	1.1	-0.6
Physical scientist	24.28	27.99	115	1.4	1.3	-0.1
Database administrator	25.12	26.61	106	1.6	2.0	0.4
Hardware engineer	26.78	25.67	96	2.2	3.5	1.3
Computer scientist	25.83	28.52	104	2.2	2.9	0.7
Physician	56.54	56.88	101	0.5	0.5	0.0
Natural science mgr.	34.68	39.27	132	1.9	1.9	0.0
Biology technician	15.89	14.18	89	5.7	2.9	-2.8
Programmer	25.76	28.31	110	2.5	2.3	-0.2
Chemical Engineer	30.40	29.68	98	1.6	2.2	0.6
Engineer (misc.)	28.47	29.85	105	1.2	1.1	-0.1

Source: U.S. census of population, 2000.

where native wages are particularly high. Or, to the contrary, maybe firms are more likely to hire Asian workers in areas where it is harder to recruit natives, due to lower prevailing wage rates. At least in the case of H-1B's, it seems fair to assume that the distribution of Chinese and Indian immigrants is determined primarily by the distribution of demand for them by firms. In the case of migrants who originally come as students, it is less clear whether it is legitimate to consider their presence as unrelated to prevailing wage and employment conditions in a field and region.

With these caveats in mind, the numbers in Table 11 suggest that native workers do tend to earn somewhat less in occupations with high shares of Chinese and Indian workers,

compared to other college-graduate natives in the region, or to natives in those occupations in other parts of the country. The third column of the top row of numbers in the table shows that, among all college graduates, natives in the region earn 13 percent more than natives in the rest of the country. Looking down the rows shows how earnings in the region compare to earnings in the nation for each of the listed occupations. In most cases, the ratio is somewhat smaller than the 13 percent college graduates overall. In some cases—for example, hardware engineers—native workers in the region actually earn less than those elsewhere. However, in other fields with very high proportions of Indian and Chinese workers, such as medical scientists or computer programmers, the ratio of regional to national

wages is reasonably close to what is observed for college-educated workers as a whole.

Similarly, natives in the region who work in sectors with a strong presence of Chinese and Indian knowledge workers do not have uniformly higher unemployment rates than native college graduates who work in other sectors in the region, or who work in the same sector outside of the region. For college graduates overall, the native unemployment rate in the region is 0.1 percent higher than in the rest of the country. Again, the differential is wider in some occupations with high proportions of Chinese and Indians, while in others it is lower. It is again difficult to infer causality, since unemployed native workers may migrate to different parts of the country in search of work.

Overall, these results do not provide strong evidence in support of the hypothesis that native-born workers in the region have significantly lower pay or fewer jobs because of the presence of Chinese and Indian knowledge workers.

EFFECT ON INNOVATION

Chinese and Indian knowledge workers are heavily concentrated in innovative industries and occupations. One way of measuring the extent of innovation is by the number of U.S. patents issued in these sectors. Patent activity benefits not only the firm which registers the patent, but also the rest of society, which benefits from the existence of the patented hardware technology, pharmaceuticals, software, and so on. By broadening the network over which information and expertise is shared, the migration of knowledge workers

certainly increases the rate of innovation at the global level. Even at the regional level, the flow of knowledge workers facilitates the exchange of ideas.

It would be interesting to gauge how much patenting activity is directly due to the work of Chinese and Indians in the region. However, there are two difficulties with measuring this. First, innovation is usually a team effort. Though much of the work that leads to a particular patent may have been done by Chinese or Indian employees, they may not be the lead scientist whose name appears on the patent. Second, the Patent and Trademark Office of the U.S. Department of Commerce does not record country of birth in the available patent records, only country of residence at the time of the patent. Apart from going through the patent records one by one and attempting to identify Chinese and Indian names, it is not possible to gauge the direct patenting work done by these nationality groups in the U.S.⁹

One way of approximating innovation due to Chinese and Indian knowledge workers is to look at the rate of patenting by the industries (or companies) that employ large numbers of them. However, even if there is a positive correlation, there is again the problem of disentangling the direction of causation: does hiring more Chinese and Indians lead to more patenting, or are industries with more patenting activity more likely to hire Chinese and Indian workers?

Figure 5 shows the number patents issued to the pharmaceutical industry in the New Jersey, New York, and Pennsylvania region over

FIGURE 5
Pharmaceutical patents in the region

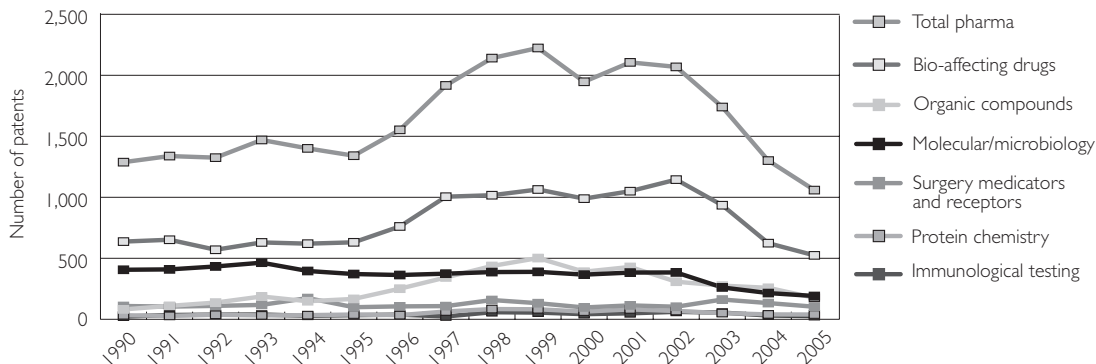
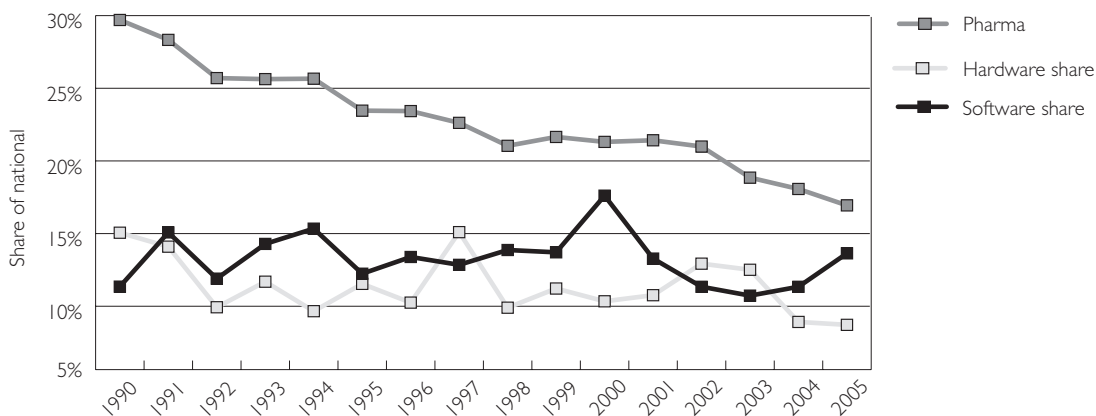


FIGURE 6
Region's share of national patents



time.¹⁰ Though the number of patents grew significantly in the late 1990s, it has declined somewhat since then. Furthermore, Figure 6 shows that pharmaceutical patents in the region have declined as a share of all pharmaceutical patents registered in the U.S. over the period. Given firms' high demand for them, it seems more likely that Chinese and Indian migrants contributed to the initial rise in patenting, rather than the subsequent decline. Still, looking at these figures, it is impossible to know

what the counterfactual trend would have looked like in the absence of these workers.

Figures 7 and 8 show the number of patents issued in computer software and hardware, respectively. Both fields showed healthy growth through 2000, with hardware continuing to grow for a few more years, and software declining and then recovering somewhat. The region's share of patenting in IT has held more or less constant over the period.

FIGURE 7
Software patents in the region

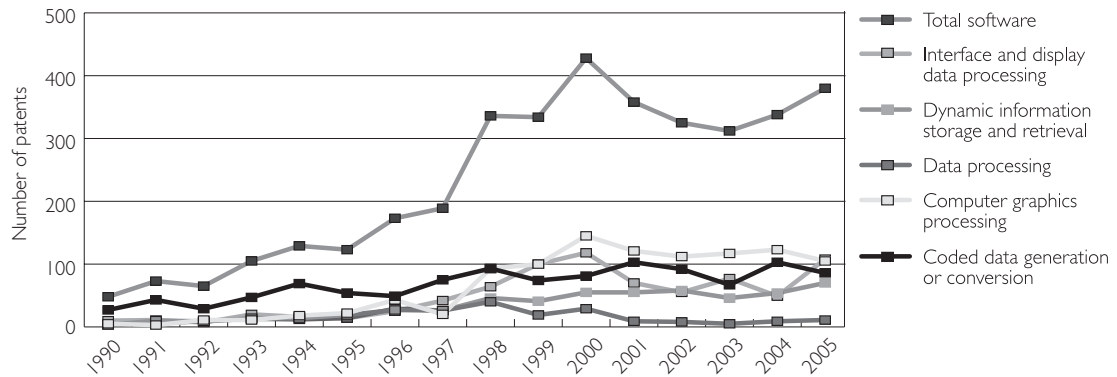
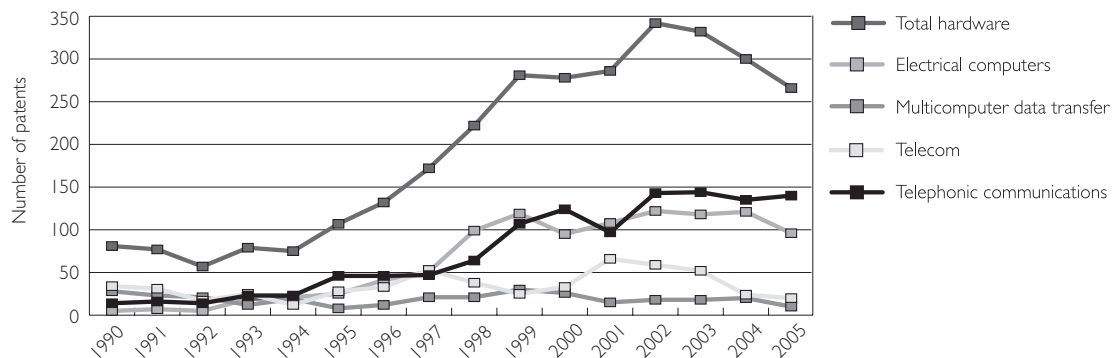


FIGURE 8
Hardware patents in the region



Without data from specific companies on patent activity and the number of Chinese and Indian workers they employ, it is hard to disentangle the effects of these knowledge workers on innovation in the region. Still, given their level of training in scientific and technical fields, as well as the eagerness of firms in innovative industries to hire them, it seems likely that they benefit the region in this way as well.

EFFECT ON TAXPAYERS AND LOCAL BUSINESSES

High-skilled Chinese and Indian workers pay income taxes, even those who are on temporary work visas like the H-1B. They also pay all the other taxes that people living in the U.S. do—property taxes, sales taxes, and so on. As well educated professionals, their incomes tend to be much higher than the average in the region, so the amount they pay in taxes

is greater than the amount they cost in public services or transfer payments.

Finally, even if some Chinese and Indian knowledge workers remit a portion of their income back to their home country, they still spend a significant share of it in the region—on housing, food, and other living expenses. This spending contributes to demand in a variety of sectors of the economy, and though they are only a small share of the region's population, this additional consumer spending is another benefit that would not be enjoyed by the region if these workers (or their jobs) were located elsewhere.

CONCLUSION

Chinese and Indian knowledge workers provide a variety of economic benefits to the New Jersey, New York, and Pennsylvania regional economy. They provide a highly-skilled workforce which enables firms in the region to grow

and innovate, giving them an edge over firms in other parts of the country which do not employ these workers. While they may present competition to some groups of workers living in the region, they provide benefits to other workers through complementarities. Employing Chinese and Indian knowledge workers helps to keep jobs in the region, as opposed to other parts of the United State or abroad. The economic activity they generate benefits many groups in the region. It benefits the workers whose jobs are not eliminated by their firm moving operations elsewhere. It benefits the local firms that supply the equipment and materials required for the work they do, as well as the goods and services they purchase when they are not at work. Evidence suggests that the cost to local workers who are in the same field as the migrants is probably quite small, relative to the overall benefit to other workers, firms, and taxpayers in the region.

Notes

1. The author is grateful to Spencer Amdur for excellent research assistance.

2. Unless otherwise attributed, the statistics in this paper were derived from the microdata of the American Communities Survey of 2005, a 1 percent sample of the U.S. population. Data for earlier years were drawn from the U.S. census of population of 1990 and 2000, 5 percent samples.

3. There are approximately 1.8 million Chinese and 1.9 million Indians in the U.S., comprising 1.3 percent of the population. Including all those who report Chinese or Indian ancestry brings the numbers to 2.9 million and 2.3 million, respectively.

4. The highest concentration of Indian Americans in the U.S. is in Edison, New Jersey, where 18 percent of the population is of Indian descent.

5. Large IT companies in the region include IBM, Accenture, AOL Time Warner, Bell Labs, AT&T, Comcast, and D.E. Shaw.

6. The financial industry in the region is most heavily concentrated in New York City, though some firms, such as Lehman Brothers and Goldman Sachs, have back-office operations in New Jersey.

Other large financial firms in the region include Citigroup, Deutsche Bank, J.P. Morgan Chase, Merrill Lynch, and Prudential.

7. For detailed statistics, see *Open Doors*, published by the Institute for International Education, 2006.

8. See "The Impact of Mass Migration on the Israeli Labor Market" by Rachel M. Friedberg, published in the *Quarterly Journal of Economics*, 2001.

9. A paper that does just this for Indian names is "Birds of a Feather—Better Together? Exploring the Optimal Spatial Distribution of Ethnic Inventors From a Knowledge Flow Perspective," by Ajay Agrawal, Devesh Kapur, and John McHale, <http://ssrn.com/abstract=920908>, 2006.

10. Pharmaceuticals are a major industry in the region, particularly in New Jersey. Two of the largest firms are Bristol-Meyers-Squibb and Merck. Other large firms with operations in the region include Pfizer, Johnson & Johnson, Wyeth, Schering-Plough, Advaxis, and Ortho-McNeil.

