Intercontinental Coding: Offshore and Migrant Programmers

by Alexandra Samuel
Presented at Ethicomp '98

America's 1995 debate over the Immigration Reform Act drew the most attention for the attacks on illegal Mexican immigrants. In the midst of that debate a different discussion unfolded: a discussion focused on Indian software programmers who legally immigrate to the United States. American engineers and software professionals argued that immigrant programmers were taking U.S. jobs and depressing U.S. wages. American software companies argued that immigrant programmers were needed to address shortages of skilled labor in the United States, and that closing the door to immigrant programmers would merely force companies to move production overseas in order to meet their labor requirements.

The debate was puzzling, however, in that it addressed only part of the big picture. Even though there are clearly large numbers of Indian programmers working in the U.S. software industry, there are still more employed by U.S. software operations in India. If the alternative to the immigration of Indian programmers into the U.S. was the exodus of U.S. software jobs to India, why would American computer professionals try to restrict immigration? And if software firms could so readily operate in India, why lobby heavily against the proposed immigration restrictions?

The answer to both questions lies in the often misrepresented relationship between Indian programmer immigration, and offshore software production. These are not two distinct phenomena, operating as mutual substitutes; rather, they are mutual complements, functioning as a coherent whole. Recognizing this fact, U.S. professionals had relatively little to fear from employers' threats to move more of their operations offshore; and the software industry was just as keen to maintain a system of relatively generous immigration policies, which allowed them to

use Indian programmers in the U.S. as part of a larger system of intercontinental coding.[1]

This paper will demonstrate that programmer immigration and offshore coding constitute a coherent, intercontinental coding system, despite the general division of immigration and investment flows into separate fields of study and debate. The first section will establish the U.S. demand for programmers and provide an overview of how intercontinental coding satisfies that demand. The second section will examine offshore programming in India, in order to show how Indian government policy encouraged a technical labor supply, and how technological developments made this labor source a feasible and increasingly attractive option for U.S. industry by effectively compressing the distance between the U.S. and India. The disadvantages of offshore programming will also be discussed, in order to show why offshore programming is not in itself sufficient to meet the needs of the software industry. The third section of the paper will look at Indian programmers in the U.S., starting with the specifics of the H1B visa program that brings many Indian programmers into the country. This will be followed by evidence on how U.S. firms use the H1B program in conjunction with offshore programming, as reflected in debates over the 1995 Immigration Reform Act. The concluding section of the paper will suggest directions for further reflection and research.

[1] This term comes from **Duffy, Tom, "Intercontinental Coding," Computerworld .August 1 (1996).**

I. U.S. Software and Intercontinental Coding

> " Poor or not, life has become coding madness all over again....And once again, work is providing us with a comforting sense of normalcy, living and working inside of code's predictably segmented time/space. Simply grinding away at something makes life feel stable, even though the external particulars of life (like our paychecks, our office, and so forth) are, at best, random." [2]
> -- Douglas Coupland, microserfs.

The intercontinental coding system has been part of the continued rise of the American computer industry, already apparent in the rapid gains of the NASDAQ and other technology stock indices. Within this broader growth trend, the software industry has done better still. Where the 1972 ratio of software to hardware sales was 7¢ to every dollar, the ratio is now $1 to $1.[3] The expansion of consumer and corporate demand for software, combined with the Year 2000 problem[4], have seen the U.S. software industry growing at 2.5 times the pace of the economy as a whole.[5] Worldwide, the U.S. commands about 75% of the software market.[6]

At the heart of this expansion is one precious commodity: code. "Code" is the term for the commands that make up computer programs, and "coders" are the educated and well-remunerated workers who can create thousands of command lines in order to assemble computer applications. Knowing how to code -- in C++, Java, Cobol, or another programming language -- virtually guarantees a well-paying, if stressful, job. Software development companies like Microsoft and IBM, financial services companies like Citibank and Fidelity, and information

---

[2] Coupland, Douglas, microserfs, (New York: Regan Books, 1995), p. 135.

[3] Business Software Alliance, "Building an Information Economy: Software Industry Positions U.S. for New, Digital Era," 1997, p. 3.

[4] The Year 2000 (Y2K) problem refers to a bug that pervades many mainframe and PC systems. These systems use two-digit year dates (as in 12/1/97); this means that they are unable to distinguish between the year 1900 (00) and the year 2000 (ditto). Left unresolved, this problem will lead to a variety of potentially serious malfunctions in everything from credit card transactions to transportation networks. There is no global solution to the problem; programs have to be individually, and painstakingly, rewritten.

[5] Business Software Alliance, "Building an Information Economy" 1997, p. 3.

[6] Correa, C. M, "Strategies for Software Exports from Developing-Countries," World Development 24.1 (1996): 171-182, p. 174.

services companies like Tata and Keane all require coders to write and maintain the programs that are sold as retail software or customized corporate applications.

In the search for coders, U.S. companies employ a variety of recruiting techniques. Stealing coders from the competition, advertising job openings on the Internet, recruiting on college campuses, and more recently, among high school students, all help to meet the industry's labor needs. These techniques have generated a spiral of inter-company competition for coders; the result is upward wage drift, difficulty retaining workers, and trouble putting teams of workers together for urgent projects.

No surprise, then, that US software companies have increasingly turned to a relatively abundant source of technically proficient, English-speaking, lower-wage coders: India. American companies largely use programming shops in India for producing business-oriented (non-retail) applications. Offshore production takes the form of outsourcing (subcontracting) to Indian software companies, or establishing proprietary (fully- or partially-owned) plants in India. The difference between outsourcing and proprietary production is minimized by the low cost of setting up an "independent" shop in the software industry, where a shop can be as simple as a single worker and one computer terminal. Companies ranging from Intel to Microsoft to Citibank either operate their own programming shops in India, or contract for offshore programming services. In 1994-95, India exported $274 million in software to the US[7]; since almost none of this consisted of packaged software, it can virtually all be considered as contract services provided to US firms or private clients.

U.S. firms also use immigration policies to bring or keep Indian coders in the U.S., usually through H1B temporary "nonimmigrant" visas. On the immigration side, about 40,000 immigrant workers have been added each year to America's work force of 1.5 million programmers;[8] of these, Indian immigrants clearly constitute the largest group, and possibly a majority. The practice of bringing programmers, rather than programs, into the U.S. is sometimes criticized as "body shopping," and raises concerns about a potential "brain drain" from India to the U.S.

---

[7] **Heeks, Richard, India's Software Industry: State Policy, Liberalisation and Industrial Development, (New Delhi: Sage Publications, 1996), p. 74.**

[8] **Stern, Marcus, "High-tech companies pose immigration reform threat," San Diego Union-Tribune 1995: Page A1.**

In fact, the presence of Indian programmers in the United States appears to operate as a complement to, rather than substitute for, offshore programming; the value of one option is actually enhanced by the availability of the other. American firms use Indian programmers on-site as a way of checking out prospective subcontractors, or use temporary visas to train Indian workers before establishing or expanding offshore operations. Indian contractors serve as sources for on-site labor as well as offshore; workers used in offshore projects may be brought into the US for future projects.

The combination of immigration and offshore coding also allows firms to address the limitations of each option. T1 line not available? Video conferencing inadequate for this particular project? Ship the worker instead of the software. Need a lot of workers fast, more than the number of visas you have available? Want to use your mainframe capacity more than 12 hours a day? Call an Indian firm, or set up your own shop, and you can quickly assemble an offshore team. Location is no longer about where or who, it is about when and how. India is not "offshore", it is nighttime, cheaper and faster; the U.S. is not "on-site," it is daytime, face-to-face and with greater managerial control.

This approach to the choice of production location has developed from U.S. companies' experience with the advantages and disadvantages of coding shops in India. While the growth of these shops has received several technological boosts, it has also benefitted from policy decisions by the Indian government. Sometimes inadvertently, sometimes with extreme foresight, the Indian government has fostered a software industry that now provides both offshore and immigrant workers for the U.S.-based coding system.

II. India: Offshore and Overnight

> "The flexibility given to us is unique to this ...In the past, joining the IAS or becoming a doctor was considered prestigious. Now, it is the turn of software."
>
> -- Narendra Kumar, Infosys Technologies Ltd., Bangalore.[9]

The rise in outsourced and proprietary forms of offshore programming traces back to the industrial policy of the Indian government, which served as the catalyst for computer industry development in India. In the mid-1960s, the government established the goal that

---

[9] **Vijayan, Jaikumar, "Look out, here comes India. (US companies looking to India for software development)," Computerworld Feb 26 1996 30,.9, (1996): 100(4).**

the Indian computer industry

> was to become autonomous and technically sophisticated in the shortest time possible. This general goal was operationalized by the government through the enunciation of three specific objectives: Indians should participate in the ownership and control of any units established in the country by foreign computer firms; wholly Indian firms should emerge quickly and satisfy the bulk of the nation's computer requirements; and Indians should have access to the most advanced computers and computer fabrication technologies available internationally.[10]

As part of this plan, the government signed a 1966 accord with IBM geared towards expanding the company's Indian manufacturing operation.[11] At the same time, "the government expressed a desire that IBM allow Indian participation in the ownership and control of what at that time was one of a very few 100 percent foreign-owned subsidiaries in India."[12] As part of government policy requiring shared ownership of India-based production, in 1968 the government again requested local equity in the IBM project, only to be told that IBM would withdraw rather than lose its central control over manufacturing.[13] While the British International Computers and Tabulators Limited formed a 1968 partnership with India's Tata Enterprises in order to meet the local equity requirement[14], during the 1960s and 1970s India remained "entirely dependent on multinational corporations for IT equipment and software]."[15]

---

[10] **Grieco, Joseph M., Between Dependency and Autonomy: India's Experience with the International Computer Industry, (Berkeley, CA: University of California Press, 1984), p. 9.**

[11] **Grieco., Between Dependency and Autonomy, 1984, p. 24.**

[12] **Grieco., Between Dependency and Autonomy, 1984, pp. 24-25.**

[13] **Grieco., Between Dependency and Autonomy, 1984, p. 25.**

[14] **Grieco, Joseph M., "Between Dependency and Autonomy: India's Experience with the International Computer Industry," Multinational Corporations: The Political Economy of Foreign Direct Investment, ed. Theodore Moran, (Lexington, MA: Lexingon Books, 1985), p. 59.**

[15] Harindranath, G, and Jonathan Liebenau, "The Impact of Globalisation on India's Information Technology

The government took up the gauntlet of domestic control once again in 1977, and this time accepted no alternative to local participation in the ownership of IBM's main operations in India.[16] IBM announced its withdrawal, and in June 1978 ceased its Indian operations. [17] What might have been a disaster for India's computer industry instead became a decisively positive turning point. Local industry stepped in to

> fill the void left by IBM...the public sector company, Computer Maintenance Corporation (CMC), took over the task of servicing IBM equipment and software. Subsequently, CMC has emerged as one of the most successful Indian computer firms that has distinguished itself in software development for both the local and overseas markets. Further, many of the Indian professionals previously employed and trained by IBM set up small software businesses that generated entrepreneurship within the local software industry.[18]

The legacy of IBM's departure thus formed a crucial part of the growth in domestic technology firms. As important as this decision to emphasize local equity in technology production was the government's role in producing a technical labor force. India has "the world's second largest pool of English-speaking scientific and technical labor",[19] with computer courses being introduced in an additional hundred institutions every year.[20] While many companies are still working on conforming to the international "ISO 9000" technical standard for quality

---

Industry," Information Technology for Development (1995), p. 74.

[16] **Grieco, Between Dependency and Autonomy: 1984, p. 31.**

[17] **Grieco, Between Dependency and Autonomy: 1984, p. 31.**

[18] **Lakha, Salim, "The new international division of labour and the Indian computer software industry," Modern Asian Studies May 1994 28,.2, (1994): 381(28), p. 391.**

[19] **Evans, Peter B, Embedded autonomy: states and industrial transformation, (Princeton, N.J.: Princeton University Press, 1995), p. 151.**

[20] **Lakha, "The new international division of labour," 1994, p. 394.**

management,[21] the sheer number of proficient coders produced by India's education system has been enough to draw many software production operations. This was one of the factors Bill Gates cited in Microsoft's anticipation of Indian production, when he noted that, "India has a great reputation for having world-class universities, particularly the IITs (Indian Institute of Technology) for companies like Microsoft which has sourced a lot of really great engineers [from there]" [22]

The government's emphasis on technical education has helped to a large, computer-literate labor supply. The abundance of skilled workers on the Indian market makes Indian programmers significantly less expensive: Indian programmers' wages are variously pegged at one-tenth[23] to one-quarter[24] of US programmer salaries. Rising demand for programmers, especially due to the Y2K problem, has caused Indian programmers' wages to increase "by an average of 20% to 30% over the past two years"[25], but wage savings are still by far the most-cited reason for offshore development.

Matching this abundant labor supply with American industry demand required several technological developments, however. The first of these was inadvertent:

> India does not have a mainframe-dominated computing legacy as in the West. There is a lower concentration of large mainframes per square kilometre and compared to the size of the IT population. This is partly due to the price of previous generations of mainframe environments and

---

[21] **LaMonica, Martin, and Elizabeth Heichler, "Operation offshore. (US corporations use Indian software companies to meet the demand for new software applications) (includes related article on the need to have detailed, well-defined specifications for offshore programmers)," Computerworld August 8 1994 28,.32, (1994): 73(3).**

[22] **"Gates has plans for India," Reuters; reprinted on CNET March 4 1997.**

[23] **Correa, "Strategies for Software Exports from Developing-Countries," 1996, p. 180 note 37.**

[24] **Vijayan, "Look out, here comes India." 1996.**

[25] **King, Julia, "Staffing woes deepen: offshore talent pool costly, dwindling. (year 2000 programmers) (Industry Trend or Event)," Computerworld May 19 1997 31,.20, (1997): 1(2).**

> also due to some of the past policies of the Indian government. These prevented Western companies from establishing wholly-owned subsidiaries and restricted foreign ownership of Indian companies. This means that Indian universities have been training graduates in Unix and PC systems a long time before those skills came into vogue in Western corporations.[26]

Given the American computer industry's shift away from mainframe work and toward network (PC-based) systems, this has proven to be a significant advantage in terms of the types of programming expertise that are widely available in India.

There are further ways in which the American shift toward networking laid the groundwork for the growth of Indian software by making offshore coding relatively more attractive. Client-server architecture (a.k.a. "distributed architecture"), in which "the data is either physically or conceptually separated from the interface" allows software to be written "without knowing the location of the data"[27]. More recently, the shift toward object-oriented programming, which involves assembling programs from reusable blocks of code ("objects") [28] also makes offshore coding more feasible, insofar as some portions of the overall application can be designed independent of the data source (and therefore in a different location from the collected data).[29] By allowing programming to take place in a separate location from the collected data, client-server architecture and object-oriented programming both reduce the need for on-site programming. This has opened the door to wider use of long-distance, offshore programmers. Changes in the process of coding made Indian workers and offshore programming relatively more attractive, but communications advances have brought long-distance programming virtually next-door. Software code can now be transported via the Internet, CompuServe, FedEx, or a leased T1 line for major projects [30]; in fact, T1 and satellite connections are now fast enough

---

[26] Melvyn Burgoyne, UK sales director of Information Management Resources (IMR), quoted in Gandy, Tony, "Switch on to India," The Banker .June (1995).

[27] Rubel, Malcolm C., "The Impact of the Internet on Programming Practices," Data Based Advisor .April (1996).. Distributed computing involves using a network of smaller computers, which run applications collaboratively across a network, rather than one or two large-scale mainframe computers. (From Williams, Robin, Jargon: An Informal Dictionary of Computer Terms, (Berkeley, CA: Peachpit Press, 1993), p. 162.)

[28] Williams, Jargon, 1993, pp. 378-9.

[29] Rubel, "The Impact of the Internet on Programming Practices," 1996.

[30] Rubel, "The Impact of the Internet on Programming Practices,"1996. A T1 line is a high-speed data line, which allows data to move faster than on traditional phone

that the code written by programmers sitting at a terminal in India is often fed directly to mainframe computers located in the United States. While these connections are much more expensive than domestic lines -- T1 connections to India cost $130,000 to $140,000 a year, compared with about $9,600 in the US[31] -- on all but the smallest projects the cost is more than offset by the lower wages of Indian workers. Finally, on a much more prosaic level, the process of long-distance application development is facilitated by technologies like faxes, video conferencing, the Internet, and the good old-fashioned telephone, which help keep offshore programmers in sync with the home company or client.

Faster connections, combined with the shift to networking, have thus made large-scale offshore coding possible and increasingly attractive. This development has effectively dovetailed with the Indian government's turn to a more liberal policy on multinational investments. From its earlier policies of equity-sharing requirements, the Indian government has jumped on the international bandwagon of competition for foreign investment. The government's software development policy, announced in 1986, removed the requirement of domestic equity participation for 100% export-oriented projects; this decision to permit 100% foreign-owned production fit with the Indian government's mid-1980s shift to economic liberalization.[32]

The Indian government has helped to realize the technological possibilities of offshore coding by sponsoring industrial parks that serve as hubs for offshore software development. In 1990, the government announced the development of a series of "Software Technology Parks" (STPs), which now offer satellite links and T1 connections that are accessible to smaller companies on a shared basis.[33] The STPs also provide special access to hardware and software imports, and tax exemptions.[34] STPs in Bombay, Bangalore, Calcutta, Delhi, and elsewhere[35] are now home to at

---

lines.

[31] Vijayan, "Look out, here comes India," 1996.

[32] Lakha, "The new international division of labour" 1994, p. 387-88.

[33] Harindranath and Liebenau, "The Impact of Globalisation" 1995, p. 79.

[34] Harindranath and Liebenau, "The Impact of Globalisation" 1995, p. 79.

least 225 software companies.[36]

The time difference is a further source of competitive advantage for Indian programmers. Particularly in the packaged (retail) software industry, delivery time is crucial to an application's success. Late arrival on the market or long delays between version updates can lead to the erosion of market share. Speeding up the coding process is therefore crucial to product success; the premium that software companies put on quick delivery is the main reason that "0" version applications (as in version 1.0, 2.0, etc.) are frequently full of bugs that are resolved only after the product appears on store shelves. While this strategy reflects consumer/client emphasis on fast delivery over bug-free programs,[37] it does not eliminate the pressure on coders. Offshore programming helps to resolve the time crunch by allowing a second shift of programmers; while programmers sleep in Silicon Valley, their counterparts in Bangalore complete more hours of coding. Round-the-clock programming puts software in the hands of clients and consumers that much sooner.

The time zone advantage has a couple of additional appeals. For projects using high-speed connections to link offshore workers to US-based mainframes, the time difference allows mainframes to be used during off-peak hours[38]; while U.S. workers sleep, Indian workers use American mainframes from their terminals in India. Another appeal is communication efficiency. Applications consultant Malcom Rubel recounts the sales pitch of Saurabh Mehta, a contract programmer based in Abmedabad, India:

> We have a geographical advantage you won't find with other firms. When we finish our work day and send the results to you, it's waiting for you when you get into your office. When you look at it

---

[35] **LaMonica and Heichler, "Operation offshore," 1994.**

[36] **Harindranath and Liebenau, "The Impact of Globalisation" 1995, p. 79.**

[37] **See Ed Yourdon, as quoted in Bellinger, Robert, "He wrote them off in a book four years ago, but new book is 'cautiously optimistic' -- Author recants: programmers no dodos," Electronic Engineering Times .April 15 (1996).**

[38] **Anthes, Gary H., "Not made in USA," Computerworld .December 6 (1993)..**

> and communicate with us, your changes are waiting for us when we get to work the following day. The process is actually quicker than if your programmers lived on the other side of town.[39]

The combination of a skilled work force, high-speed connections, and the time-zone advantage has allowed offshore programming to blossom in a variety of forms. For example, in one of its Indian projects, IBM (back in India under the government's liberalized regime) uses its Indian team as part of a larger project with workers in Seattle, China, Latvia, and Belarus. In the IBM process,

> The Seattle workers first set a daily work specification for a particular application, and assign the work to one of the offshore teams. The offshore team turns that specification into code later that day, working while the Americans sleep. The offshore development team sends the code back to Seattle overnight. It is then reviewed and tested during United States working hours, while the European and Asians, in turn, catch up on their sleep. After reviewing and testing the code, the Seattle team specifies new changes, sends the code back for more work, and the daily iterative cycle begins all over again.[40]

More straightforward projects include those of a Texas mobile communications software company, which outsourced the entire development process of a new telephony product to an Indian contract programmer[41]; a US retail chain that subcontracted the development of a warehouse application to the Indian operations of Information Management Resources Inc., for a cost of $500,000 as opposed to $1 million for in-house development or $1.5 million for a US-based contract[42]; and Citicorp's wholly-owned Madras subsidiary, used for consumer banking

---

[39] **Rubel, "The Impact of the Internet on Programming Practices," 1996.**

[40] **Hayward, Douglas, "Offshore Programmers Save IBM Millions," TechWire .February 18 (1997).**

[41] **Vijayan, "Look out, here comes India," 1996.**

[42] **Anthes, "Not made in USA," 1993.**

software development[43]. More recently, Microsoft announced that it would build its first offshore software development center in India, initially planned on a small scale but with expectations of further expansion.[44] Offshore work in projects such as these can be complemented by occassional face-to-face meetings; for example, Texas Instruments held a joint meeting of the Dallas and New Delhi programmers who were long-distant collaborators on a new application tool.[45] India's software industry has thus benefitted from government policies, technological developments, and a degree of a serendipity. Government policies have nourished a large, computer-literate labor supply, whose low wages are the primary attraction for U.S. firms. Technological developments and a time-zone advantage have allowed U.S. firms to use offshore programmers in India effectively, either through outsourcing or the establishment of proprietary programming shops. While India-based programming is thus a widely used option for many U.S. software projects, it also has certain disadvantages; disadvantages that may prompt the use of Indian programmers in the U.S., rather than offshore.

A 1994 survey of forty firms found that managers hesitated before outsourcing due to issues such as "loss of IT control" (54%); "high contract cost" (41%); "contracting difficulties" (13%), as well as less significant concerns about "vendor lock-in," "loss of critical skills," and "inability to reverse the decision." [46] The suvey analysis further argued that certain projects are simply unsuitable for outsourcing, for example those "which provide strategic or competitive

---

[43] **Scheier, Robert L., "Universal code: US firms save costs by tapping programming talent overseas," PC Week .April 3 (1995).**

[44] **"Microsoft to set up India Unit," Reuters on CNET .November 13 (1997).**

[45] **Duffy, "Intercontinental Coding," 1996.**

[46] **Patane, Joseph R., and Jaak Jurison, "Is global outsourcing diminishing the prospects for American programmers?," Journal of Systems Management. June (1994).**

advantage for the firm", as well as applications that are "small, complex, or low in structure...because the cost of setup time and coordination effort may offset any advantages that might accrue from lower labor rates." [47]

Firms have additional, political reasons for hesitation. Some American firms express concern about the loss of employment to India[48], and the reception of American firms in India may not be trouble-free, either. For example, in the case of Bangalore, India's software capital:

> Bangalore's future success as India's 'Silicon City' depends on whether local and national political leaders can meet three challenges: periodic outbursts of public hostility toward multinationals that occasionally result in demonstrations and government actions against these corporations; the need to raise billions of dollars in public and private investment to modernize and expand Bangalore's urban infrastrucutre; and any tensions resulting from the growing disparity between rich and poor.[49]

These political, managerial and technological limitations on offshore programming mean that producing in India is not always an optimal, or even viable, production choice. For projects that are too small, complex, or guarded for offshore production, or for pre- and post-production systems work, on-site programmers are still required. Within the intercontinental coding system, however, India supplies on-site workers, too — as an alternative to relatively scarce, higher-wage U.S. programmers.

III. Immigrant Coding

"We don't join gangs, and we don't cheat on welfare...We are just nerds who like to sit around in front of computers. "
-- Giri Madras, post-doctoral research associate, U.C. Davis.[50]

---

[47] **Patane and Jurison, "Is global outsourcing diminishing the prospects for American programmers?," 1994.**

[48] **For example, Jim Quinlan of Data Solutions, as quoted in Tristram, Claire, "Offshore Rescue? -- Cobol programmers abroad are great for coding, but testing is another story," InformationWeek .October 27 (1997)..**

[49] **Stremlau, John, "Dateline Bangalore: third world technopolis. (India)," Foreign Policy Spring 17 (1996): 17, p. 162.**

[50] **McGraw,"Boon or boondoggle?" 1995.**

The technological and policy developments that have spurred the growth of offshore programming have also driven programmer migration. According to Peter Evans,

> The graduates of...elite Indian Insitutes of Technology (IIT) were so well trained that there was a brisk demand for their services in the United States. Indeed, a large proportion of IIT graduates emigrated, allowing the United States to reap the social return from India's extraordinary investment in their education. Investment in human capital without equal attention to generating firms that will utilize it produces perverse results. [51]

Good or bad for India, tens of thousands of Indian workers nonetheless come to the U.S. every year to work as coders or systems analysts. This practice is often referred to derogatorily as "body shopping," usually in reference to short-term contracts which see Indian programmers, rather than programs, "exported" to the United States. Many, if not most, Indian programmers come into the U.S. (at least initially) on an "H1B" nonimmigrant visa. The extent of the immigration phenomenon makes Indian programmers a noted part of the U.S. software industry; the way these visas are used shows how immigrant coders and offshore programmers fit into one intercontinental coding system.

H1B nonimmigrant visas for temporary workers with "specialty occupations" are approved by a Department of Labor/Immigration and Naturalization Service program that allows up to 65,000 professionals into the US each year to fill positions in fields that the Department of Labor certifies as "labor shortage" areas. The program was created in response to research group predictions that the US would face a shortage of scientists and engineers.[52] Under the program's provisions, a firm that wishes to hire workers from abroad initiates the process with a Labor Condition Application (LCA) to the Department of Labor, specifying the geographical area in which the worker is needed. One LCA application can cover anywhere from a single programming position to a hundred or more. The Department of Labor then uses metropolitan area statistics in order to determine whether there is indeed a shortage of programmers in the

---

[51] Evans, Embedded autonomy, 1995, p. 151.

[52] McGraw, "Boon or boondoggle?" 1995.

city/county in question. In the computer industry, the job market is virtually always wide open, so Labor generally certifies the application. At that point, the employer can sponsor a programmer to enter the U.S. on an H1B application, and the I.N.S. will approve such applications (conditional on proof of LCA certification) until it reaches the annual ceiling of 65,000 immigrants allowed in under the H1B program for all "shortage" fields combined. Officially, the H1B program allows professionals in these fields to remain in the United States for up to three years, although visas can be extended for an additional three to four years; workers entering on an H1B are also allowed to apply for permanent visas while they are in the US on an H1B. [53]

The difficulty of obtaining accurate figures on the number of software programmers admitted under the H1B program suggests that the Department of Labor - I.N.S. cooperation required in administering this program may not be operating effectively. Under the terms of the program, the number of H1B workers allowed into the country is subject to an annual cap of 65,000; once this ceiling is reached, no further applications are accepted. In 1997, this ceiling was for the first time reached before the end of the fiscal year, so that the I.N.S. suspended processing of applications as of September. Despite this cap, the I.N.S.'s Statistical Yearbook table on "nonimmigrants admitted by class of admission, selected fiscal years 1981-96" records a total of 100,446 H1B entries in 1990; 110,223 in 1992; 92, 795 in 1993; 105,899 in 1994; 117, 574 in 1995; and 144,458[54] -- figures clearly in excess of the program's stated cap, and likely reflecting record-

---

[53] **Details on the H1B visa program come from a series of telephone conversations with staff of the Department of Labor and the Immigration and Naturalization Service, December 1997.**

[54] **U.S. Immigration and Naturalization Service, Statistical Yearbook of the Immigration and Naturalization Service, 1996, (Washington, DC: U.S. Government Printing Office, 1997), Table 39, p. 120. Supported by U.S. Immigration and Naturalization Service, Statistical Yearbook of the Immigration and Naturalization Service, 1995, (Washington, DC: U.S. Government Printing Office, 1997), Table 39, p. 114, and I.N.S. Table 614, "Temporary Workers Admitted by Occupation Fiscal Year 1995", December 17, 1997 fax.**

keeping trouble at the I.N.S.[55] Indeed, administrative incompetence was one of the central charges of anti-H1B forces in the 1995 debate.

Despite the tricky figures, there are indications that Indian programmers constitute one of the largest categories of workers admitted under the H1B program (and likely, the largest). First, figures on the number of positions certified show the prominence of computer industry jobs within the H1B program. In 1996, the Department of Labor certified approximately 98,000 Labor Condition Applications from employers claiming shortages of qualified computer workers in their county, more than for any other field. Of these, 84,000 certified shortages of systems analysts and programmers, and another 9,500 certified shortages of software and systems engineers. This was increase over the 80,000 computer industry LCAs certified in 1995, and looks even more dramatic in comparison with the 17,000 computer-related LCAs certified in 1992. This growth reflects overall growth in the H1B/LCA program; the cross-industry total of 180,000 LCAs approved in 1996 is up from 30,000 in 1991.[56]

These numbers still do not give us the total number of workers entering on H1B visas, since the 98,000 computer industry certifications in 1996 were part of a total of 180,000 certified LCAs (which, due to multiple positions per application, actually represents 600,000 certified "shortage" positions), compared to only 65,000 total visas available. The large number of LCAs relative to visas is a function of the H1B process, which requires employers to seek certification of a labour shortage before sponsoring particular worker's visas; many positions are therefore certified as

---

[55] **Record-keeping trouble is further suggested by the fact that I.N.S. Table 614, "Temporary Workers Admitted by Occupation Fiscal Year 1995" lists 87,421 of the admitted workers as "Occupation unknown or not reported." This appears to be a nonsensical category for a visa that is by definition occupation-specific. In addition, two telephone conversations with a staff member in the I.N.S. Adjudications office discovered that the I.N.S. is currently undertaking a major systems overhaul in ordr to be able to provide more accurate statistical tracking, as mandated by Congress in order to provide immigration status checks to private sector employers.**

[56] **These figures from Patrick Stange, Department of Labor, December 17, 1997.**

suffering from labour market shortages, even though no worker is admitted to the US in order to fill them. Indeed, companies will sometimes file LCAs in anticipation of future hiring, so that they are ready in case they wish to hire from abroad; a Department of Labor official gave the example of a computer services company filing LCAs in every county in Texas, so that they could pursue contracts to provide immigrant programmers' services to companies in any one of those counties.[57]

The second type of evidence supporting the significance of Indian programmer immigration comes from country-by-country (rather than occupational) data. I.N.S. country-by-country figures show that with a little over 20% of the H1B visas granted in fiscal year 1996, Indian citizens received the largest national share of H1B visas that year, as in 1995 (19%) and 1994 (24%).[58] Furthermore, although there is no direct relationship between the number of LCAs certified for computer-related positions, and the number of programmers actually entering the country, one Department of Labor official confirmed that Indian programmers are one of the largest groups of H1B recipients.

While it is therefore clear that the immigration of Indian programmers into the U.S. is a sizeable phenomenon, it is the way that visas and immigrant programmers are used by U.S. firms

---

[57] **Conversation with Department of Labor official, December 17, 1997.**

[58] **Calculated from I.N.S. table of "Nonimmigrants admitted as temporary workers, exchange visitors, and intracopmany transferres by region and selected country of citizenship," U.S. Immigration and Naturalization Service, Statistical Yearbook of the Immigration and Naturalization Service, 1994, (Washington, DC: U.S. Government Printing Office, 1996; Statistical Yearbook of the Immigration and Naturalization Service, 1995, Statistical Yearbook of the Immigration and Naturalization Service, 1996. For all three years, the second-largest share of H1B visas went to the United Kingdom, with between 12.6 and 13% of the total allotment. Note that some Canadian workers who might otherwise qualify for H1B visas may in some cases enter under TN visas for North American Free Trade Agreement workers, and that the combined figures for Canadians receiving TN and H1B visas are larger than those for Indian workers on H1B visas.**

that (along with offshore programming) constitutes an international coding system. Immigrant Indian programmers (and the H1B visa system) fit into this system in several ways: first, immigrant programmers provide a lower-wage alternative to the use of U.S. programmers for on-site work; second, visas constitute a type of non-wage premium that U.S. firms can use to attract scarce workers; third, immigrant programmers allow firms to provide integrated offshore and on-site programming services; and fourth, visas provide a way of training workers for further work offshore.

The use of immigrant programmers as a low-wage alternative was at the center of the 1995 debate over the H1B program, but before the Simpson bill surfaced, the Commission on Immigration Reform had already found problems in the H1B system.[59] A report by the Department of Labor's inspector general found that H1B visas were often used to hire lower wage foreign workers, even when U.S. workers were available.[60] In his statement to the Senate Judiciary Committee Subcommittee on Immigration, Labor secretary Robert Reich described the H1B program as "seriously flawed in its current form."[61] Simpson's own argument on behalf of the H1B cutback was that "[w]e want to be sure that...we do not give rise to seeing wages and working conditions that cause many of the best and brightest Americans to forsake science and engineering for other, more lucrative fields."[62]

---

[59] **LaGesse, David, "Immigrant Advocates Worried," Arizona Republic March 18 1996..**

[60] **Ladendorf, Kirk, "Foreign labor a high-tech bargain," Austin American-Statesman April 21 1996.**

[61] **Reich, Robert B., "Statement before the Senate Judiciary Committee Subcommittee on Immigration," , 1995.**

[62] **Leopold, George, "Reich backs tighter rules for temp visas," Electronic Engineering Times .October 9 (1995).**

In practice, the H1B program not only allows lower-wage workers into the U.S.; it constitutes its own brand of non-wage premium. Keane Inc., a major provider of software services within the U.S., has its own full-time immigration specialist. H1Bs are part of Keane's stock in trade; the firm recruits programmers from the foreign students on US college campuses, procures H1Bs for their new recruits while they start working, and sweetens the deal by helping them obtain permanent visas.[63] Keane is not alone in using this technique: "of the 1,400 workers Intel recruited directly off campuses [in 1994], about 250 were hired using H1Bs as a stopgap visa until permanent immigration visas could be obtained from the Immigration and Naturalization Service."[64] As an additional form of compensation, procuring H1Bs for foreign students and prospective immigrants can serve as a top-up to the lower wages of immigrant programmers.

The lower wages of immigrant programmers, complemented by the use of H1Bs as a non-wage premium, constitute the primary incentive for bringing Indian software programmers to the United States. What makes this practice part of an intercontinental coding system is the extent to which employment of immigrant Indian programmers is intertwined with offshore production in India. This relationship is reflected in the business practices of software firms employing Indian programmers in the United States, whose U.S.-based operations often complement offshore operations in India. Tata Consultancy, a firm providing on-site software services to U.S. firms, employed about 350 H1-B workers in 1993; the firm is a branch of India's leading software firm.[65] In a similar vein Keane Inc., a major provider of on-site services to U.S.

---

[63] **Conversation with Tim Rempe, Immigration consultant for Keane Inc. Boston, December 17, 1997.**

[64] **Stern, "High-tech companies pose immigration reform threat," 1995.**

[65] **Stewart, Janet Kidd, "Do they threaten US jobs? Some say foreigners are being exploited," Chicago Sun-Times May 16 1993.**

firms, formed a partnership with CBSI, an offshore developer; this partnership reflected the needs of clients who want both on-site and offshore development options.[66] The H1B program allows software services companies to meet this demand for one-stop shopping.

The H1B program plays the further role of allowing firms to conduct U.S.-based training for the workers who will then be employed in India.:[67] This practice was discussed during the 1995 Immigration Reform Act debate:

> Clint Eisenhauer, spokesman for Charlotte, N.C.-based Sea-Land, confirmed that the big shipping company dismissed almost 100 IS employees this year and transferred the work to offshore programming shops in India and the Philippines. During the transition, foreign programmers came to the U.S. for training under "guest worker" visas.[68]

> A similar story was told byLinda Kilcrease, a former programmer at American International Group, Inc. (AIG), an insurance company that replaced 250 IS employees with foreign workers. "Adding insult to injury, displaced employees were forced to train their replacements in the computer systems they had built and successfully run for years," she said....In a statement from New York, AIG officials said it was more cost-effective to outsource its software maintenance work because the staffing needs are variable.[69]

The two witnesses above came before the Simpson committee under the auspices of Softpac. Their testimony, like much of the debate over the Immigration Reform Act, attested to the intertwined nature of immigrant and offshore programming. The extent of programmer immigration, the wage effects of immigration and the H1B visa program, and the use of immigrant programmers as part of an intercontinental coding system were all well-evidenced by the way the debate unfolded. While the debate thus revolved around the isolated issue of

---

[66] **"Keane Announces Partnership with CBSI to Offer Offshore Programming Services to Clients," PR Newswire July 17 1996.**

[67] **Siegemann, Ken, "HP, India Firm Sued Over Hiring Programmers," San Francisco Chronicle October 7 1993.**

[68] **Betts, Mitch, "Programmers to Senate: Preserve American dream," Computerworld .December 4 (1995).**

[69] **Betts, "Programmers to Senate: Preserve American dream," 1995.**

immigration, the positions taken by software professionals and industry representatives reflected the way in which programmer immigration is actually inextricable from offshore programming.

The Immigration Reform Act initially proposed a couple of changes to the H1B system in which many programmers enter the U.S. One provision of the Act would have scaled back the number of workers allowed into the U.S. under the H1B program. The initial version of the Simpson bill also called for a tax to be levied on H1B hires, in order to subsidize training for American workers, and required that H1B workers be hired at slightly *above* prevailing U.S. wages.[70] The H1B reduction was supported by the Software Professionals' Political Action Committee (Softpac), and by the Institute of Electrical and Electronics Engineers (IEEE) in the hope of protecting U.S. programmers' employment and earnings. The virtually universal opposition of the computer industry to the proposed H1B reduction was organized by the Business Software Alliance, a computer industry group consisting of Intel, Microsoft, Apple, and other firms.

The Business Software Alliance, and the firms it represented, essentially presented evidence for the existence of an intercontinental coding system, in which restrictions on programmer immigration hurt U.S. industry and thus, U.S. workers. At the heart of its stand on the Simpson bill, the computer industry laid one simple fact: "National borders are becoming less relevant, thanks to network technology. People like Sen. Simpson should stop their jabbering and let the electronics industry -- by far the nation's largest gainful employer -- get on with its work."[71]

In asserting the global nature of the coding system, the software industry also managed to separate the issue of H1Bs from the broader immigration debate. For example, the V.P. of

---

[70] **Buerger, David J., "Networking industry could be gagged by anti-immigration bogey," Network World .November 6 (1995); Stern, Marcus, "High-tech companies pose immigration reform threat," San Diego Union-Tribune 1995: Page A1.**

[71] **Buerger, David J., "Networking industry could be gagged by anti-immigration bogey," Network World .November 6 (1995).**

Intel on the one hand conceded the need for immigration reform:

> Americans are understandably alarmed by the annual rate of illegal immigration...Compounding the situation are maladies seen as exacerbated by immigration: violent crime, challenges to the English language, a flawed welfare system and stagnating wages.[72]

And on the other hand, argued the important of visas for skilled workers:

> Talent from abroad is vital to high-tech companies, each assembling the world's best minds to win in global markets. And if you can't compete globally these days, you just can't compete...It's far more expensive to hire foreigners; we do so because they have the skills we need.[73]

Similarly, in a letter opposing the Simpson bill, the CEO of Cypress Semiconductor explicitly juxtaposed the H1B issue with the broader tone of the anti-immigration debate:

> Pat Buchanan has taken up 'Jose' as a euphemism for immigrants. I would like Mr. Buchanan to meet our 'Jose,' Dr. Jose Arreola, the Mexican immigrant with a Ph.D. in transistor physics. Jose is our top scientist, the one whose responsibility is to manage a group of 30 people - 80 percent with advanced degrees - to produce our most advanced semiconductor technology for the future.[74]

The point of differentiating legal high-skill immigration was to show that the H1B program was crucial to industry competitiveness, and thus, to the well-being of the U.S. economy.

As one commentator put it:

> Preventing employers from hiring foreign professionals would hurt the economy more than help. That's because employers who can't use imported labor to lower costs will be more lively to ship work overseas. Instead of moving to the United States -- where they pay taxes, build homes and buy goods -- the high-skill workers will stay in India or Ireland or wherever and work by telecommuting.[75]

The computer industry thus used the intertwined nature of immigrant and offshore coding to argue that immigration restrictions would force companies towards higher levels of offshore production. In a letter to Senator Dianne Feinstein, 150 California high-tech companies argued

---

[72] **Maibach, Michael C., "Immigration in the Information Age," Upside .March (1996).**

[73] **Maibach, "Immigration in the Information Age," 1996.**

[74] **T. J. Rodgers, quoted in Glassmann, James K., "Barring Immigrants Will Cost Jobs in U.S.," The Arizona Republic .March 15 (1996)..**

[75] **Geewax, Marilyn, "Editorial: Tough Trade-Off -- Jobs Foreigners Fill Cheaply Stay in US," Phoenix Gazette November 1 1995: B5.**

that

> the Simpson bill is severely flawed. The legal immigration system in America works reasonably well, although we recognize that uneven enforcement by the federal government is a concern. Our industry is global in nature. After exhausting the supply of qualified U.S. workers, we sometimes need to hire non-U.S. workers with specialized technical skills. And we need to be able to transfer key employees in our overseas subsidiaries back to the U.S. Some view legal immigration as displacing American jobs. The reality is the opposite; in the high-tech electronics industry, legal immigration creates American jobs and it creates jobs here in California.
>
> ...[The Simpson Bill] would make it extremely difficult to hire qualified, high-skilled immigrant workers and to obtain visas for employment-based workers. It would also impose new taxes and increase governmental red tape, contrary to the thrust of this Congress. While its supporters argue that the legal provisions of the Simpson bill will promote employment in the U.S. in fact they will compel some companies to transfer high wage engineering and research jobs overseas and deprive our employment base of the dynamism provided by key foreign workers.[76]

The latter argument was based on the contention that visa restrictions would actually force companies to expand their offshore operations in order to have access to talent that would be unable to enter the US.[77]

Despite the industry's "my way or the highway" argument, the software professionals' lobby worked hard for H1B restrictions. Indeed, IEEE and Softpac largely ignored the overseas alternative, and pitched their support of the Simpson bill in terms of the ineffectiveness of the current system. For example, Softpac's executive director submitted LCA applications to the Department of Labor to check their certification process; the result was an approval, even though his proposed $5 per hour wage was well below the prevailing programming wage.[78] This example reflected IEEE and Softpac's emphasis on the wage-depressing effects of immigration; wage effects, rather than overall employment numbers, were the focus of employees' anti-H1B

---

[76] **"Over 150 CA High-Tech Executives in Opposition to Legal Immigration Legislation," PR Newswire February 28 1996.**

[77] **Gembrowski, Susan, "Technology firms fear GOP efforts to reduce U.S. legal immigration," San Diego Daily Transcript 1996.**

[78] **"SoftPac: Feds 'rubber-stamp' H1B visas," Electronic Engineering Times .June 12 (1995).**

efforts, an emphasis that fit with the reality of a strong (generally excess) demand for U.S. software programmers. Particularly with Year 2000 conversion work, immigrant programmers are no more likely than offshore shops to replace American software engineers; but a large enough influx could depress engineers's wages. Based on strong demand for engineers, IEEE refuted the industry's overseas alternative by arguing that "employers are not seeking a technical workforce in the Third World. They want a high-tech workforce in the United States that will accept Third World wages and working conditions."[79] IEEE Chairman Joel Snyder further argued "that the Simpson bill will safeguard wages and working conditions for US labor and help protect foreign workers from exploitation."[80]

Yet even as it focused on the wage effects of immigration, the IEEE acknowledged the overseas alternative; IEEE itself argued that preventing firms from laying off U.S. programmers in order to hire immigrant workers was no replacement for overall restrictions, precisely because "[e]mployers do not usually lay off Americans just prior to hiring foreign temporaries...Instead, they outsource work to third parties...then furlough Americans."[81] Similarly, one IEEE member wrote that "[t]he problem is not the use of immigrant labor in the United States, but rather the use of high-tech labor overseas, where the wages are even lower."[82]

The computer industry's H1B battle thus came down to a simple clash of interests: on the one side, companies sought continued access to a cheaper and/or more abundant supply of labour for

---

[79] **IEEE Chairman Joel B. Snyder, quoted in Institute of Electrical and Electronics Engineers, "Balance employers' hiring needs, employees' job opportunities..," 1995.**

[80] **"Electronic Engineers Back High-Tech Immigration Limits," Newsbytes News Network November 27 1995.**

[81] **Bellinger, Robert, "'Disappointment' on immigration," Electronic Engineering Times .March 18 (1996).**

[82] **Matchett, John, "Immigrants not the issue; job export is," Electronic Engineering Times January 2 1996.**

on-site projects; on the other side, professional associations sought to product wages (and possibly employment levels) by limiting that supply. Ultimately, the business side won: the Senate Judiciary Committee voted to separate the provisions of the Simpson bill dealing with legal immigration from those dealing with illegal immigration, largely due to business pressure.[83] A political defeat for software professionals, but likely not a costly one: a year after the H1B debate, industry analyst Ed Yourdon reported Indian wages were rising rapidly[84] (reducing U.S.-India wage differentials); and the Bureau of Labor statistics predicted a decade of 6.4% annual job growth for systems analysts.[85]

Victories and defeats aside, the debate over the Simpson bill confirmed through rhetoric what U.S. industry had already demonstrated in practice: the immigration of Indian programmers is inextricable from offshore programming in India. In the offerings of firms with both U.S. and Indian divisions, in the use of H1B visas to train offshore workers and compensate immigrant coders, and in the balancing of domestic, immigrant, and offshore wages, the U.S. software industry has elaborated an intercontinental coding system. The relationship between immigrant and offshore programming within this system explains the positions taken during the 1995 Immigration Reform Act debate; but it also raises further questions about significance of intercontinental coding, and its implications for the Indian programmers who live within the system.

---

[83] **LaGesse, David, "Immigrant Advocates Worried," Arizona Republic March 18 1996.**

[84] **Bellinger, Robert, "He wrote them off in a book four years ago, but new book is 'cautiously optimistic' -- Author recants: programmers no dodos," Electronic Engineering Times .April 15 (1996).**

[85] **Rebello, Kathy, "We humbly beg you to take this job. Please," Business Week .June 17 (1996).**

Conclusion: The Future of Intercontinental Coding

> Silicon Valley....They dont actually MANUFACTURE much by way of silicon here anymore...The silicon chip factories are mostly a thing of the past. Chips are printed and and etched here but the DIRTY STUFF is offshored. *CLEAN* Intellectual properties are created here now, insted. (sic)
>
> -- Douglas Coupland, microserfs.[86]

The work of Indian programmers in the U.S. and India is clearly better understood as a whole than as discrete phenomena. U.S. software firms structure their production systems in order to take advantage of the highly skilled Indian labor force wherever possible. This system has on the one hand been facilitated by the government policies, technological developments, and time-zone advantage that have made offshore programming in India attractive to U.S. firms; and on the other hand been encouraged by the disadvantages of offshore programming and the advantages of using immigrant workers through the U.S. H1B visa program. As is clear from the practices of U.S. firms and from the 1995 Immigration Reform Act debate, the employment of Indian programmers in both the U.S. and India now functions as one intercontinental coding system.

The binational employment of Indian programmers is itself part of a larger system of intercontinental coding that also embraces Ireland, China, Israel, and Russia as key software producers. Each country has its particular asset: for India, it is the combination of native English and labor abundance; for Ireland, English and low staff turnover[87]; for Russian programmers, knowledge of relatively recent software.[88] These crossnational motivations form the basis for projects like IBM's around-the-clock example, in an international division of labor reminiscent of the initial outsourcing of silicon chip production in the 1970s and criticized by some

---

[86] Coupland, microserfs, 1995, p. 129.

[87] Charlton, John, "Ireland hits jackpot as off-shore DP site," Computer Talk .September 9 (1991).

[88] Davis, Fred, "Electronic immigrants: cheap labor without green cards," PC Week .June 3 (1991).

scholars.[89]

What makes intercontinental coding different from the previous generation of intercontinental production is the difference between virtual and physical products. The production process for tangible goods may be divided between classes, countries, or even continents; but it is possible to specify where, when, and by whom a component is produced. Not so for software: when a program is being written by a programmer in India, using a mainframe located in the United States, where is production actually located?

The intangibility of software production makes distinguishing between immigrant and offshore programmers not only difficult, but ultimately nonsensical. The same individuals work in offshore and on-site projects, depending on the month; and much of the same work is done between sites. The interchangeability of electronic and geographical migration flies in the face of efforts to divide immigration debates from discussion of investment flows. It may therefore be that what is ultimately significant about the mutual inextricability of programmer immigration and offshore production is the way this double-edged phenomenon refutes the significance of national borders.

The technology that makes borders invisible to programmers also makes programmers less visible to borders, however. In the rush to cover the alternatives of immigrant and offshore programming, nationally-oriented media outlets have little explored the experiences of India's transnational software workers.. The extent to which programmers have embraced the erosion of physical space, and the financial, social, and political consequences of that choice, form the most interesting questions in this entire situation. Given the lack of information on the opinions and experiences of Indian programmers themselves, the answers to these questions will have to await further research. It is only through this further research that programmers will become the subjects, rather than the objects, of this story.

---

[89] **See, for example, Snow, Robert T., "The New International Division of Labor and the U.S. Work Force: The Case of the Electronics Industry," Women, Men, and the International Division of Labor, ed. June Nash, and Maria Patricia Fernandez-Kelly, (Albany, NY: SUNY Press, 1983).**

Bibliography

"Electronic Engineers Back High-Tech Immigration Limits," Newsbytes News Network November 27 1995.

"SoftPac: Feds 'rubber-stamp' H1B visas," Electronic Engineering Times .June 12 (1995).

"Keane Announces Partnership with CBSI to Offer Offshore Programming Services to Clients," PR Newswire July 17 1996.

"Over 150 CA High-Tech Executives in Opposition to Legal Immigration Legislation," PR Newswire February 28 1996.

"Gates has plans for India," Reuters; reprinted on CNET March 4 1997.

"Microsoft to set up India Unit," Reuters on CNET .November 13 (1997).

Anthes, Gary H., "Not made in USA," Computerworld .December 6 (1993).

Bellinger, Robert, "'Disappointment' on immigration," Electronic Engineering Times .March 18 (1996).

Bellinger, Robert, "He wrote them off in a book four years ago, but new book is 'cautiously optimistic' -- Author recants: programmers no dodos," Electronic Engineering Times .April 15 (1996).

Betts, Mitch, "Programmers to Senate: Preserve American dream," Computerworld .December 4 (1995).

Buerger, David J., "Networking industry could be gagged by anti-immigration bogey," Network World .November 6 (1995).

Business Software Alliance, "Building an Information Economy: Software Industry Positions U.S. for New, Digital Era," , 1997.

Charlton, John, "Ireland hits jackpot as off-shore DP site," Computer Talk .September 9 (1991).

Correa, C. M., "Strategies for Software Exports from Developing-Countries," World Development 24.1 (1996): 171-182.

Coupland, Douglas, microserfs, (New York: Regan Books, 1995).

Davis, Fred, "Electronic immigrants: cheap labor without green cards," PC Week .June 3 (1991).

Donoghue, Keith, "Labor Storm Brewing Over Silicon Valley," The Recorder .November 27 (1995).

Duffy, Tom, “Intercontinental Coding,” Computerworld .August 1 (1996).

Evans, Peter B., Embedded autonomy: states and industrial transformation, (Princeton, N.J.: Princeton University Press, 1995).

Gandy, Tony, “Switch on to India,” The Banker .June (1995).

Geewax, Marilyn, “Editorial: Tough Trade-Off -- Jobs Foreigners Fill Cheaply Stay in US,” Phoenix Gazette November 1 1995: B5.

Gembrowski, Susan, “Technology firms fear GOP efforts to reduce U.S. legal immigration,” San Diego Daily Transcript 1996.

Glassmann, James K., “Barring Immigrants Will Cost Jobs in U.S.,” The Arizona Republic .March 15 (1996).

Grieco, Joseph M., Between Dependency and Autonomy: India's Experience with the International Computer Industry, (Berkeley, CA: University of California Press, 1984).

Grieco, Joseph M., “Between Dependency and Autonomy: India's Experience with the International Computer Industry,” Multinational Corporations: The Political Economy of Foreign Direct Investment, ed. Theodore Moran, (Lexington, MA: Lexingon Books, 1985): 55-84.

Harindranath, G., and Jonathan Liebenau, “The Impact of Globalisation on India's Information Technology Industry,” Information Technology for Development (1995).

Hayward, Douglas, “Offshore Programmers Save IBM Millions,” TechWire .February 18 (1997).

Heeks, Richard, India's Software Industry: State Policy, Liberalisation and Industrial Development, (New Delhi: Sage Publications, 1996).

Institute of Electrical and Electronics Engineers, “Balance employers' hiring needs, employees' job opportunities...,” , 1995.

Jacobs, Jeffrey W., et al., “Mekong Committee history and lessons for river basin development,” The Geographical Journal July 1995 161,.2, (1995): 135(14).

King, Julia, “Staffing woes deepen: offshore talent pool costly, dwindling. (year 2000 programmers) (Industry Trend or Event),” Computerworld May 19 1997 31,.20, (1997): 1(2).

Ladendorf, Kirk, “Foreign labor a high-tech bargain,” Austin American-Statesman April 21 1996.

LaGesse, David, “Immigrant Advocates Worried,” Arizona Republic March 18 1996.

Lakha, Salim, “The new international division of labour and the Indian computer software industry,” Modern Asian Studies May 1994 28,.2, (1994): 381(28).

LaMonica, Martin, and Elizabeth Heichler, “Operation offshore. (US corporations use Indian software companies to meet the demand for new software applications) (includes related article on the need to have detailed, well-defined specifications for offshore programmers),” Computerworld August 8 1994 28,.32, (1994): 73(3).

Leopold, George, “Reich backs tighter rules for temp visas,” Electronic Engineering Times .October 9 (1995).

Maibach, Michael C., “Immigration in the Information Age,” Upside .March (1996).

Matchett, John, “Immigrants not the issue; job export is,” Electronic Engineering Times January 2 1996.

McGraw, Mike, “Boon or boondoggle? Visa programs hurt US workers, foster abuse,” Kansas City Star July 16 1995.

Patane, Joseph R., and Jaak Jurison, “Is global outsourcing diminishing the prospects for American programmers?,” Journal of Systems Management .June (1994).

Rebello, Kathy, “We humbly beg you to take this job. Please.,” Business Week .June 17 (1996).

Reich, Robert B., “Statement before the Senate Judiciary Committee Subcommittee on Immigration,” , 1995.

Rubel, Malcolm C., “The Impact of the Internet on Programming Practices,” Data Based Advisor .April (1996).

Scheier, Robert L., “Universal code: US firms save costs by tapping programming talent overseas,” PC Week .April 3 (1995).

Siegemann, Ken, “HP, India Firm Sued Over Hiring Programmers,” San Francisco Chronicle October 7 1993.

Snow, Robert T., “The New International Division of Labor and the U.S. Work Force: The Case of the Electronics Industry,” Women, Men, and the International Division of Labor, ed. June Nash, and Maria Patricia Fernandez-Kelly, (Albany, NY: SUNY Press, 1983).

Stern, Marcus, “High-tech companies pose immigration reform threat,” San Diego Union-Tribune 1995: Page A1.

Stewart, Janet Kidd, “Do they threaten US jobs? Some say foreigners are being exploited,” Chicago Sun-Times May 16 1993.

Stremlau, John, “Dateline Bangalore: third world technopolis. (India),” Foreign Policy Spring 17 (1996): 17.

Tristram, Claire, “Offshore Rescue? -- Cobol programmers abroad are great for coding, but testing is another story,” InformationWeek .October 27 (1997).

U.S. Immigration and Naturalization Service, Statistical Yearbook of the Immigration and Naturalization Service, 1994, (Washington, DC: U.S. Government Printing Office, 1996).

U.S. Immigration and Naturalization Service, Statistical Yearbook of the Immigration and Naturalization Service, 1995, (Washington, DC: U.S. Government Printing Office, 1997).

U.S. Immigration and Naturalization Service, Statistical Yearbook of the Immigration and Naturalization Service, 1996, (Washington, DC: U.S. Government Printing Office, 1997).

Vijayan, Jaikumar, “Look out, here comes India. (US companies looking to India for software development) (includes related articles on an Indian programmer and how Indian companies are cost-effective) (Industry Trend or Event),” Computerworld Feb 26 1996 30,.9, (1996): 100(4).

Williams, Robin, Jargon: An Informal Dictionary of Computer Terms, (Berkeley, CA: Peachpit Press, 1993).

S