

***The Internationalization of Science & Engineering:
Issues of Work, Education, and Security***

**The Science & Engineering Workforce Project
of the National Bureau of Economic Research**

Sponsored by the Sloan Foundation

**Conference of 15-16 May 2003
The Earth Institute, Columbia University, New York, NY**

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6. "Education, still in demand: Arabs don't like American policy but do like its education," *The Economist*, October 26, 2002 [page 110]
7. Simon London, "The networked world changes everything: The Silicon Valley visionary [Greg Papadopoulos] says the internet will continue to bring rapid and fundamental changes in centres of research and learning," *Financial Times*, 24 March 2003 [page 112]

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2. Rafael Alarcon, "Migrants of the Information Age: Indian and Mexican Engineers and Regional Development in Silicon Valley," Center for Comparative Immigration Studies, University of California-San Diego, Working Paper No. 16, May 2000 [page 126]
3. Rafiq Dossani, "Chinese and Indian Networks in Silicon Valley," a summary of a May-June 2001 survey of over 10,000 members of Silicon Valley engineering associations (2272 responses) [page 145]
4. Stuart Anderson, "Foreign-Born Engineers and Scientists Don't Undercut Wages: They Earn More," commentary for the Cato Institute (www.cato.org), 25 October 1996 [page 149]
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6. Rashmee Z. Ahmed, "Britain closes door on Indian IT professionals," *Sunday Times of India* (Mumbai), 1 September 2002 [page 151]
7. Professional Contractors Group (U.K.), "Review of Work Permit Policy on Recruitment and Employment Agencies and Contractors" (a report compiled by Philip Ross, Stephen Hunter, and Gurdial Rai), June 2002 [page 152]

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3. Jean M. Johnson and Mark C. Regets, "International Mobility of Scientists and Engineers in the United States – Brain Drain or Brain Circulation?," *Issue Brief* [Division of Science Resources Studies, National Science Foundation], NSF 98-316, 22 June 1998 [page 172]
4. William J. Carrington and Enrica Detragiache, "How Extensive is the Brain Drain?," *Finance & Development*, June 1999 [page 175]
5. Mario Cervantes and Dominique Guellec, "The brain drain: Old myths, new realities," *Observer*, no. 230, January 2002 [page 179]
6. Hyaeweol Choi, "Reverse Brain Drain: Who Gains or Loses?," *International Higher Education*, Winter 2000 [page 182]
7. Sharon G. Levin and Paula E. Stephan, "Are the Foreign Born a Source of Strength for U.S. Science?," *Science's Compass*, 20 August 1998 [page 184]
8. David Cyranoski, "Plugging the brain drain: China produces fine scientists, but too many go abroad for training and do not return," *Nature*, vol. 417, 13 June 2002 [page 190]
9. David Cyranoski, "Independent' biology institute targets China's exiles," *Nature*, 21 November 2002 [page 191]
10. Zhang Guochu and Li Wenjun, "International Mobility of China's Resources in Science and Technology and its Impact" from *International Mobility of the Highly Skilled* (Paris: OECD, 2001) [page 192]
11. Timothy Roberts, "Asian techies and entrepreneurs pursue new opportunities far from Silicon Valley," *Silicon Valley/San Jose Business Journal*, 7 April 2003 [page 198]
12. "Reversing the brain drain," *The Hindu* [online edition of the national newspaper/ India], 20 June 2001 [page 200]
13. "Brain drain costs Asia billions," BBC News online, 10 July 2001 [page 201]
14. "Brain drain costs developing countries billions" from CNN.com, 10 July 2001 [page 203]
15. "Vajpayee calls for reversing brain drain, cutting red tape," *Business Line* [*The Hindu* financial daily], 4 January 2003 [page 204]
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18. "Investing in People, Sharing Skills, and Knowledge," chapter three of *Eliminating World Poverty: Making Globalisation Work for the Poor – White Paper on International Development* (Cm. 5006, Presented to Parliament by the Secretary of State for International Development by Command of Her Majesty, December 2000) [page 217]
19. Uwe Hunger, "The 'Brain Gain' Hypothesis: Third World Elites in Industrialized Countries and Socioeconomic Development in their Home Country," from Center for Comparative Immigration Studies, University of California-San Diego, Working Paper No. 47, January 2002 [page 232]
20. "Silicon Valley Immigrants Forging Local and Transnational Networks," *Research Brief*:

Public Policy Institute of California, issue #58, April 2002 [page 255]

21. Mihir A. Desai, Devesh Kapur, and John McHale, “The Fiscal Impact of High Skilled Emigration: Flows of Indians to the U.S.,” working paper of November 2002 [page 257]
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3. Jeffrey Sachs, “Weapons of mass salvation,” *The Economist*, 26 October 2002 [page 311]
4. Jeffrey D. Sachs, “A New Global Effort to Control Malaria,” *Science*, vol. 298, 4 October 2002 [page 313]
5. Harold Varmus, “Squeeze on Science,” *Washington Post*, 4 October 2000 [page 316]
6. Harold Varmus, Harvard University Commencement address, 6 June 1996 [page 317]
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3. David Cyranoski, “Chinese plan pins big hopes on small science,” *Nature*, vol. 414, 15 November 2001 [page 333]
4. Jia Hepeng, “China plans \$600 million boost for high-tech projects” from SciDev.Net (11 January 2002) [page 334]
5. K.S. Jayaraman, “Indian science gets major budget boost” and T.V. Jayan, “Indian science research: in the doldrums?” from SciDev.Net (7 March 2002 and 30 December 2002) [page 335]
6. K.S. Jayaraman, “India’s scientists agonize over fall in publication rate,” *Nature*, vol. 419, 12 September 2002 [page 336]
7. K.S. Jayaraman, “Indian prime minister pledges to revamp science,” *Nature*, vol. 421, 9 January 2003 [page 337]
8. Ashok Parthasarathi, “A champion of new technologies: Despite its strengths, India needs to invest far more to retain its lead,” *Nature*, vol. 422, 6 March 2003 [page 338]
9. Amol Sharma, “Hard drives make inroads into rural India,” *Christian Science Monitor*, 1 May 2003 [page 340]
10. Jacques Gaillard, Mohamad Hassan, and Roland Waast in collaboration with Daniel Schaffer, “Africa” for the *UNESCO Science Report 2002* [page 341]

11. Lee Branstetter and Yoshiaki Nakamura, "Is Japan's Innovative Capacity in Decline?," National Bureau of Economic Research Working Paper 9438, January 2003 [page 362]
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13. Raymond Feddema, "South Korea plans its biotechnology future," *Biotechnology and Development Monitor*, no. 50, March 2003 [page 388]
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16. Servio P. Ribeiro, et. al., "Brazil has the talent: just let us get on with the job," letter to *Nature*, vol. 413, 6 September 2001 [page 398]
17. Hebe Vessuri, "Mobility Programs for Scientists and Engineers in Latin America" from National Science Foundation, Division of Science Resources Studies, *Graduate Education Reform in Europe, Asia, and the Americas and International Mobility of Scientists and Engineers: Proceedings of an NSF Workshop*, NSF 00-318, Project Officer, Jean M. Johnson (Arlington, VA: NSF, 2000) [page 399]
18. Valeria Roman, "Argentina drops scheme for young researchers" and "Argentina's scientists want more expatriate support" from SciDev.Net (9 March 2002 and 15 January 2003) [page 402]
19. Hector Ciapuscio, "What does the future hold for Argentine science?" and Esther Orozco, "The self-help challenges for Mexican science" from SciDev.Net (13 January 2002 and 22 April 2002) [page 403]
20. Jose Goldemberg, "What is the Role of Science in Developing Countries" from *Science* magazine online [page 404]

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3. Marjorie Valbrun, "U.S. Web System Unveiled to Track Foreign Students," *Wall Street Journal*, 13 May 2002 [page 413]
4. Ronald M. Atlas, "National Security and the Biological Research Community," *Science*, vol. 298, 25 October 2002 [page 414]
5. Geoff Brumfield, "Researchers rage at tightened restrictions on U.S. immigration," *Nature*, vol. 422, 3 April 2003 [page 416]
6. "Scientists criticise research restrictions," BBC News online, 18 February 2002 [page 418]
7. Martin Enserink, "USDA Closes Lab Doors to Foreign Scientists," *Science*, vol. 296, 10 May 2002 [page 420]
8. Richard Stone, "U.S. Visa Crackdown Disrupts Meetings," *Science*, vol. 297, 23 August 2002 [page 421]
9. "Visa restrictions hamper research," *San Jose Mercury* online, posted at www.bayarea.com, 10 March 2003 [page 422]
10. *Chronicle of Higher Education*, special supplements on homeland security and U.S. universities, 11 April 2003 [page 423]

11. Amitai Etzioni, "Patriot Act is needed, but so are revisions," *Christian Science Monitor*, 2 May 2003 [page 444]
12. Mark Clayton, "Higher Espionage: The CIA finds a warmer welcome on campus since 9/11....," *Christian Science Monitor*, 29 April 2003 [page 445]
13. Alice P. Gast, "The Impact of Restricting information Access on Science and Technology," statement and policy recommendations of 2003 [page 448]
14. Charles M. Vest, "Response and Responsibility: Balancing Security and Openness in Research and Education," statement of September 2002 for the *Massachusetts Institute of Technology Report of the President for the Academic Year 2001-2002* [page 455]
15. Haim Baruh, "Terrorism Hysteria Blocks Foreign Students' Entry," letter to the *Wall Street Journal*, 28 January 2003 [page 463]
16. Scott Atran, "Who Wants to be a Martyr?," *New York Times*, 5 May 2003 [page 464]
17. David S. Cloud and Jacob M. Schlesinger, "U.S. Pursues Leads Recovered in Capture of al Qaeda Official," *Wall Street Journal*, 4 March 2003 [page 466]
18. Kelly Greene and Chad Terhune, "Before al Qaeda, Studies in the U.S.," *Wall Street Journal*, 4 March 2003 [page 467]
19. R. Adam Moody, "Reexamining Brain Drain from the former Soviet Union," *The Nonproliferation Review*, Spring-Summer 1996 [page 468]
20. Paula E. Stephan, Grant C. Black, James D. Adams, and Sharon G. Levin, "Survey of Foreign Recipients of U.S. Ph.D.'s," *Science*, vol. 295, 22 March 2002 [page 474]
21. Ann Davis, "Plan to Fingerprint Visitors to U.S. Raises Many Doubts," *Wall Street Journal*, 31 July 2002 [page 477]
22. Betty Liu, "War turns employers against foreign workers," *Financial Times*, 12 December 2001 [page 478]
23. Norihiko Shirouzu, "Signs of an Ethnic Backlash Put Arab Americans on Defensive," *Wall Street Journal*, 14 September 2001 [page 479]
24. Michael Barbaro, "Biodefense Plan Greeted with Caution: Drug Firms Want Better Guarantees," *Washington Post*, 2 May 2003 [page 480]
25. Cory F. Coll, "Why Los Alamos and Lawrence Livermore Require Foreign National Participation in their Research and Development Programs," paper of March 2003 [page 482]