REMARKS OF

Michael S. Teitelbaum
Alfred P. Sloan Foundation
New York

at the roundtable convened by Members of the House Science Committee
on the U.S. Science and Engineering Workforce
Rayburn House Office Building 2318
June 23, 2005

Congressmen Gordon and Costello, other members of the Committee, Committee staff, ladies and gentlemen:

Thank you for inviting me to share with you my thoughts on the fascinating questions you have raised concerning the current and prospective circumstances of the U.S. science and engineering workforce as it relates to recent and prospective trends in offshore outsourcing of professional services.

By way of introduction, I should say that I am by background a demographer who has spent a good deal of time examining some of the issues you are raising. As one example, I attach a paper on the "shortages" question that I published in 2003. I serve as Program Director of the Alfred P. Sloan Foundation in New York, a philanthropic foundation has long focused its attention on the health of U.S. science, engineering, and economic performance. Over the past few years, Sloan has supported a good deal of the still-small volume of research and analysis that addresses your questions. I should add, however, that I appear before you in my personal professional capacity; the Sloan Foundation as an institution takes no positions on these issues.

You have posed a series of questions to me, and I respond to these below.

- ***<u>What is known about the current and future demand in the S&T job market?</u>***

<u>As to the present</u>: overall U.S. labor market conditions for scientists and engineers are relatively weak. Market demand for such professionals has shown relatively sluggish growth during the recent recovery from the sharp declines of several years ago, although there have been some employment increases in a few industries that experienced dramatic employment declines from their peaks around 2000 (e.g., software, IT).

Overall, the available data suggest ample or surplus numbers of highly qualified candidates with extensive postgraduate education. This is true of information technology, telecommunications, computing, and software. It is especially so for academe, which has become risk-averse about replacing departing tenured faculty with tenure-track junior positions, preferring instead to fill open slots with temporary and part-time appointees they can easily recruit from an ample pool of applicants. (Advertisements for tenure-track assistant professorships often attract hundreds of applications from recent

PhDs.) As is always the case, there are some fields and subfields that represent exceptions to this general picture.

As to the future: There is a broad expert consensus that efforts to forecast future demand in the S&T job market are "notoriously difficult" and that "accurate forecasts have not been produced."[1] U.S. science and engineering labor markets are "notoriously difficult" to forecast for a number of reasons. First, many of these labor markets are heavily influenced, directly or indirectly, by U.S. Government decisions based on hard-to-anticipate political decisions. This is the case for both supply and demand.[2] On the supply side, the numbers of U.S. students pursuing degrees in science and engineering fields has been affected by Federal funding. Meanwhile, the supply of foreign scientists and engineers in the U.S. has been affected by shifts in Federal immigration policy, most recently in the tripling for three years (2001,2002,2003) of the number of H-1B visas.

On the demand side, too, Federal decisions about procurement (especially defense, space and homeland security) and about research funding have had major impacts over the past several decades, both upward and downward, on labor market demand for scientists and engineers in diverse specialties. Many of these public policy decisions have been taken without enough attention to the shocks they might cause in science and engineering labor markets. Examples include:

- Policy responses to Sputnik: +80% in Federal R&D during the 1960s
- Sharp upward and downward shifts in DoD and NASA budgets.
- Rapid doubling of the NIH research budget, 1998-2003, from $13.6B to $27.3B, followed by far lower growth rates
- Recent declines, at least in real dollars, in NSF budgets.
- BioShield Initiative, 2003, +$5.6 billion
- Nanotech Initiative: +$2.4 billion

The private sector has also been a source of numerous labor market shocks. During the late 1990s, many firms made large investments to prevent software crises resulting from the so-called "Y2K" problem. With the passage of the year 2000, most such efforts were summarily terminated. During the same period, there were private sector investment booms in at least three high-tech domains: internet commerce (the "dot-com bubble"); telecommunications, and biotech. Most of these were financed initially by venture capital, then by the "irrational exuberance" that prevailed in the financial markets until around 2001. All subsequently ended with wrenching convulsions (and not a few visible criminal fraud prosecutions) over the past few years.

The truth here can be stated succinctly: <u>no person or organization known to me has any credible way of forecasting what science and engineering sectors of the U.S. economy will look like in 2010 or 2012. Certainly there are no credible projections of future demand growth on which sensible policy responses on supply might be based.</u>

---

[1] National Research Council, <u>Forecasting Demand and Supply of Doctoral Scientists and Engineers: Report of a Workshop on Methodology</u>, Washington*:* National Academy Press, 2000.
[2] Richard Freeman, Olin Lectures, Yale University, 2003. To be published by Yale University Press.

- ***<u>How has increased productivity of scientists and engineers over the past two decades affected employment levels of scientists and engineers?</u>***

I do not think we know much about this question. I wonder if there really is much in the way of clear evidence about increased productivity among scientists and engineers over the past two decades.

- ***<u>Are there well documented shortages of workers in particular fields?</u>***

Regarding current labor markets for scientists and engineers overall, there are few if any of the market signals that such any such "shortages" would produce. Such signals would include evidence of strong upward pressures on real wages, or unemployment rates that are very low compared with those of other highly-educated workers.

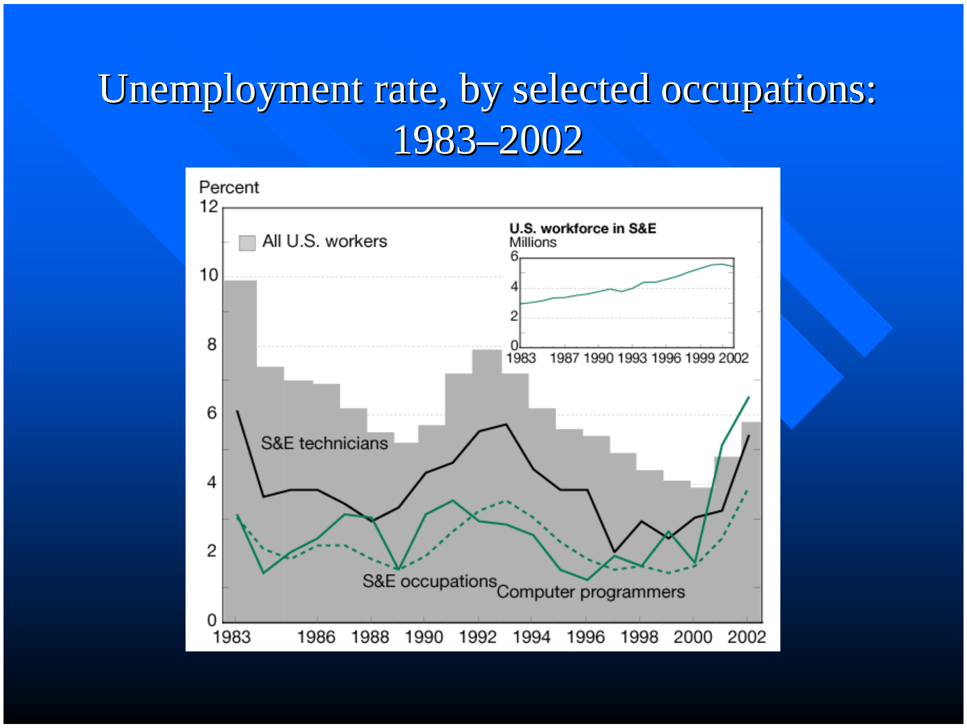
While overall labor market conditions in science and engineering may be "soft" and hence unattractive to prospective new entrants, there can be very "tight" labor markets in some very specific subfields or niches. For example, all employers expect to face strong hiring competition in "hot" fields that are very new or growing rapidly, and for truly exceptional scientists and engineers ("superstars") who will always be small in number. Moreover, some employers whose past hiring of younger scientists and engineers has been constrained by freezes or business cycles (e.g. some Federal technical agencies) now realize that their workforces have been aging in place and that increasing proportions are becoming eligible for retirement.

Consider, if you will, the 2003 Issue Paper by RAND, in which the RAND analysts sought to assemble then-available data from the National Science Foundation (NSF), the Census Bureau, Bureau of Labor Statistics, the National Research Council, and several scientific associations. The paper was published two years after the onset of the high-tech bust in 2001, but RAND noted that the available data were well out of date: "That data more recent than 1999 or 2000 are generally not yet published is especially unfortunate, as the S&E workforce situation has arguably changed significantly since then." However, RAND's analysis of even these data, from the peak years of the dot-com and IT booms that subsequently became busts, showed that

> neither earnings patterns nor unemployment patterns indicate an S&E shortage in the data we were able to find. Altogether, the data…do not portray the kind of vigorous employment and earnings prospects that would be expected to draw increasing numbers of bright and informed young people into S&E fields.[3]

Data compiled by the National Science Board (see Figure) indicate that unemployment rates for science and engineering occupations have long been much lower than unemployment rates for all U.S. workers. This is no surprise, of course: unemployment is nearly always lower among highly-skilled workers. What is perhaps more surprising is the apparent narrowing of the gap since 2000, with overall

[3] William P. Butz, et al., "Is There a Shortage of Scientists and Engineers? How Would We Know?" <u>RAND Science and Technology Issue Paper</u>, 2003, p. 4.



Source: National Science Board, Science and Engineering Indicators, 2004.

employment in science and engineering occupations rising toward the level of overall unemployment in recent years, while that among computer programmers and science/engineering technicians seemingly coming to equal or exceed the average rate.

It is worth noting that such unemployment rates, while certainly worthy of our attention, have some real limitations is assessing career prospects and experiences in science and engineering occupations. For example: consider an aeronautical engineer who is laid off due to cutbacks by Boeing, and while seeking a new engineering position takes a job as an insurance agent. If this person becomes unemployed again, the Bureau of Labor Statistics would count him/her as an unemployed insurance agent, rather than as an unemployed engineer.

In natural science disciplines (with smaller employment than engineering), numerous reports by leading scientists have been pointing to increasingly unattractive career prospects for newly-minted PhDs. One symptom has been the rapid increase in the pool of “postdocs”, recent PhDs who seek or accept temporary and usually low-paid research positions in research universities financed mainly by Federal research grant funds to senior scientists. A 1998 National Academy of Sciences committee report on careers in the life sciences (by far the largest natural science field) concluded that “recent trends in employment opportunities suggest that the attractiveness to young people of careers in the life-science research is declining"[4] and later data from 2002 were described by the committee's chair as "appalling." [5]

Such career problems being faced by recent PhD's in the life sciences suggest that the oft-advised solution of more Federal research funding may not improve career attractiveness as promised: the life sciences in particular has experienced very rapid increases in Federal research funding in recent years, with the doubling of the NIH research budget between 1998 and 2003.

Finally, I note that in discussing trends in the supply of graduates in science and engineering fields, it is easy for even sophisticated people to get their facts quite wrong. In a much-quoted comment at a recent forum on innovation and education at the Library of Congress, Bill Gates asserted that "there just aren't as many [U.S.] graduates with computer science background", which "creates a dilemma for us, in terms of how we get our work done." This is not correct; the number of B.S. degrees in computer science has been rising for nearly a decade now.[6] More generally, the computer field is one that has experienced dramatic fluctuations in the past, and hence due caution should be exercised in any responses to short-term ups and downs.

- ***What is the extent of off-shoring of S&T jobs now and what are the trends?***

Studies of services offshoring are literally in their infancy. Most policy pronouncements are based upon anecdotal reports, drawn from out-of-date data from several years ago, or on theoretical or ideological perspectives largely uninformed by data.

The Sloan Foundation has made some recent grants to encourage serious and objective research on this topic. One such study currently underway, by Drs. Rafiq Dossani of Stanford and Martin Kenney of UC-Davis, delves more deeply than earlier studies into the case of India. India is the largest destination country to which services are being offshored (as China is the largest destination of manufacturing offshoring). Dossani and Kenney recently have produced a paper entitled "The Next Wave of Globalization? Exploring the Relocation of Service Provision to India." This paper is currently under review for journal publication, and hence cannot yet be quoted. An earlier paper by the same authors was published in 2004, but was based on data collected in 2003.[7] Given the apparently rapid changes underway in this area, such 2-year-old data may not represent an accurate portrayal of the current situation.

However, Dr. Dossani has kindly provided me with one table in which they seek to summarize their estimates of trends in growth of Indian exports of software and of "IT-enabled services" (ITES) from 1999-2000 to 2004-05. Most of their data come from Nasscom, India's National Association of Software & Service Companies (www.nasscom.org)

---

[4] National Research Council, Committee on Dimensions, Causes, and Implications of Recent Trends in the Careers of Life Scientists, Trends in the Early Careers of Life Scientists (Washington: National Academy Press, 1998), p. 1.

[5] Erica Goldman and Eliot Marshall, "NIH Grantees: Where Have All The Young Ones Gone?" *Science, 298*, 4 October 2002, p. 40.

[6] "Counting by Gates," Science magazine, 13 May 2005, Volume 308, p. 948

[7] Rafiq Dossani and Martin Kenney, "'Lift and Shift': Moving the back office to India," Information Technologies and International Development, 1 (2), Winter 2003, pp. 21-37.

The data compiled by Dossani and Kenney estimate that Indian employment in software exports tripled between 1999-2000 and 2004-05, from 110,000 to 345,000. Similarly, Indian employment in export of IT-enabled services increased more than 8-fold over the same six-year period, from 42,000 to 348,000.

Indian revenues from software export grew from $3.4 billion to $12.2 billion, and from IT-enabled services from $0.6 billion to $5.1 billion over the same period. I will attach a copy of this table to my submission to this roundtable.

Table: The growth of Indian exports in the software (SW) and IT-enabled services (ITES) sectors [revenue in $billion]

	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05E	2005-2010 Growth rate (%)	2010 Forecast
Employment – SW exports	110,000	162,000	170,000	205,000	270,000	345,000	20	850,000
Employment – ITES	42,000	70,000	106,000	180,000	253,500	348,000	30	1,300,000
Export revenue – SW	3.4	5.3	6.2	7.1	9.2	12.2	20	30.4
Export revenue – ITES	0.6	0.9	1.5	2.5	3.6	5.1	35	22.9

Source of table: Rafiq Dossani, personal communication, June 2005. dossani@stanford.edu Source of data: Nasscom (2005), p. 28 and 156 for first 7 columns. Dossani estimates for last two columns.

I am not aware of any reliable official US data as yet regarding services offshoring to other countries, although there are efforts underway to develop such data. The data collected by Dossani and Kenney do suggest that there has been a very rapid rate of increase in export of such services by India over the past few years, and that the volumes of both employment and export revenues involved have already become quite significant.

I also wish to draw your attention to the recent (May 2005) Brookings Trade Forum, also partially supported under a Sloan Foundation grant, which brought together many of the leading analysts for an intensive discussion of the issues and implications of recent trends in the offshoring of white-collar work. The Forum papers are to be published by Brookings; some may be available upon request, though in draft form. I will attach a copy of the agenda of this Forum to these remarks.

- ***What are the main causes of off-shoring and is the net effect on the U.S. positive or negative? What are the appropriate public policy options?***

  There has been extensive discussion as to causes. Among these are:

- substantially lower costs (lower employee wages, lower benefits costs);
- substantial financial and capital advantages arising from incentives and subsidies offered overseas governments seeking to attract offshoring, and from use for investment purposes of companies' retained earnings held overseas to avoid US taxation;
- hoped-for access to future markets in which economic growth is accelerating, markets that require custom-tailoring in linguistic, cultural or other terms;
- time zone differences that allow round-the-clock activities to be undertaken in an asynchronous manner;
- price competition from US companies that lower costs via offshoring, and from from overseas companies that have made use of temporary visa programs in the US to import lower-paid workers so as to underbid US providers;
- active promotion of offshoring by numerous service providers and business consulting firms offering current and prospective clients assistance in moving work abroad.
- rapid cost declines of international telecommunication (approaching zero?), due both to technological advances and to over-investment during late 1990s in fiber networks by now-bankrupt companies such as Worldcom and Global Crossing.

There are also many potential risks involved, including:

- Loss to international competitors of firms' key intellectual property
- Unintended enhancement of the capabilities of overseas companies that may become competitors in the future;
- Risks of vulnerability to external political threats, e.g. tensions between India and Pakistan, or China and Taiwan.
- Loss of political and public support in the U.S.

The actual magnitudes of these causes and risks are not established. Such matters cannot be answered in the abstract, and at present there is only anecdotal information as to what the real causes might be. Nor ought we to assume that managers of companies engaged in offshoring will see it to be in their interests to provide honest and clear statements as to their rationales.

- ***As the U.S. manufacturing infrastructure continues to migrate off-shore, how does this impact the job market (both present and future) for people graduating with science and engineering degrees?***

Manufacturing cannot be done well in a vacuum. It requires not only assembly-line workers, but substantial numbers of engineers, managers, accountants, and other professionals. While some of these functions now can be done "remotely", the bulk can best be achieved locally. Hence when large proportions of manufacturing moves off-shore, a penumbra of science and engineering functions seems likely to migrate with it.

I thank for your invitation and for your attention, and stand ready to respond to the best of my ability to any requests for additional information.

Contact information:

Michael S. Teitelbaum
Alfred P. Sloan Foundation
New York
212 649 1649
teitelbaum@sloan.org

Attachments:

1. Michael S. Teitelbaum, "Do we need more scientists"", The Public Interest, 153, Fall 2003, pp. 40-53.
2. Agenda, Brookings Trade Forum "Offshoring White-Collar Work—the Issues and the Implications". May 2005.
3. Terrence K. Kelly, et al., The U.S. Scientific and Technical Workforce: Improving Data for Decisionmaking, RAND Science and Technology, Rand Corporation, 2004.