

# **Can Foreign Talent Fill Gaps In the U.S. Labor Force?**

The Contributions of Recent Literature

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## INTRODUCTION

For nearly two decades, analysts and policymakers have debated the existence, causes, and implications of shortages of skilled workers in the U.S. labor force. Lately, simplistic generalizations about “skill gaps” or “labor shortages” are giving way to deeper understanding of particular segments of the workforce, differentiated by geography, industry or occupation. This update focuses explicitly on high-skill / highly educated occupations - the “talent force” seen as critical to keeping the U.S. globally competitive in high-value and high-margin products and services. It looks at structural forces that are contributing to persistent and chronic shortages as well as the temporary shortage situations routinely experienced as the U.S. economy adapts to rapid change. We pay particular attention to the role of temporary highly-educated foreign workers through the widely used H-1B visa program as one approach to address talent shortages in the U.S., both temporary and structural in nature.

H-1B visas allow for temporary (maximum of six year) entry and employment of highly-educated foreign nationals who hold at least a bachelor’s degree or the equivalent work experience in positions called “specialty occupations” that require a degree for entry. H-1B professionals include scientific researchers, engineers, architects, lawyers, accountants, marketing experts, physicians, physical therapists, other medical professionals, and teachers.

The H-1B visa program has always generated controversy, but the debate has grown more intense in the past three or four years as technology workers have competed in a slower growing technology job market. Coincidental with these economic changes, U.S. policy has reduced the annual H-1B visa limits from 195,000 to 65,000 in 2003.

**What light do recent research and independent studies shed on the topic? Are we any closer to knowing the contributions and impacts of highly-educated foreign workers?**

This overview of the topic is an update of mainstream literature, primarily since 2000. Heavy reliance is placed on academic research and agency statistics, as well as reports from government and third sector sources. **The primary audience of this commentary is those who do not follow this issue on a day-to-day basis. It looks for a consensus among analysts, while pointing out needs for further research.** It does not

come up with new analyses or solutions; instead, it is an attempt to understand what has been learned of late about this topic.

The first section of this paper deals with current and anticipated gaps between the supply and demand of highly-educated workers in the U.S. It addresses the dynamics of the labor market, which occupations are most likely to experience shortage situations, and the role implied for temporary highly-educated foreign workers. The second part deals with the specific impact of temporary highly-educated foreign workers on the U.S. labor market and economy in order to assess the costs and benefits of a program such as the H-1B visa. A concluding section offers a checklist of practical questions that, if answered, would shed needed light on the ongoing policy debate regarding the role of the H-1B visa system and the foreign-born workforce in the United States.

## **PART 1**

### **DOES THE U.S. FACE A SHORTAGE OF HIGHLY-EDUCATED WORKERS?**

National discussion about shortages of skilled workers heated up in the 1980s. Much of the early debate centered on studies by Hudson Institute and others exploring the likely effects of demographic changes on the labor force.<sup>1</sup> The consensus at that time was that the U.S. would soon face worker and skills shortages. In 1990, the National Center on Education and the Economy's report, "America's Choice: High Skills or Low Wages,"<sup>2</sup> predicted that America's future economic prosperity lay in higher value-added economic activity, which would require more sophisticated products and services, and would demand better skilled workers. By the late 1990s, the skills gap was even worse than had been forecasted. The American economy experienced a "perfect storm," a convergence of several not entirely related events and trends. The anticipated economic and demographic structural changes coincided with an economy that boomed throughout the decade coupled with an extraordinary growth in the information technology sector throughout the 1990s. On top of this was a one-time spike in the need for information technology experts in the late 1990s caused by Y2K fears. Firms quickly needed programmers who could ensure that their systems would make it safely to January 1, 2000; they also used this opportunity to make large investments in new software and hardware.

After the bursting of the high tech bubble and the economy's sputtering in 2001-2003, it may seem strange to talk about a shortage of talent. Tens of thousands of IT workers remain unemployed or under employed, after all. But it seems clear that many of the factors identified two decades ago as contributing to a shortage of highly educated workers have not changed ... many have gotten worse. Globalization is forcing even more economic reorganization, intensifying pressures on companies that are unable to adapt and innovate. The Baby Boomers' approach toward retirement age is an inescapable fact of demographic life. Moreover, unanticipated factors comparable to the

Y2K anxiety could lead to sharp unanticipated increases in demands for educated workers.

Some analysts, such as Peter Cappelli of the Wharton School, argue that fears of worker and skill shortages are somewhat overstated: the U.S. labor market has always been remarkably dynamic and in the long run adjusts to mismatches of supply and demand.<sup>3</sup> Even if the domestic supply of highly educated workers does not increase quickly enough, this view holds, the U.S. has always been able to accommodate adjustment through immigration, by bringing the best and brightest from around the world to the United States. It will be a serious problem for the economy, then, if our immigration policy prevents this mechanism from working properly. To decide whether and how immigration policy ought to be reformed, we first must know how serious the gap between the demand and supply of adequately skilled workers is. **Are current or pending mismatches by occupation, industry, or region of substantial consequence to warrant an immigration policy focused on filling the gaps?** One occupational category deserving close watch is that of highly-educated workers. Generalized findings of recent research and statistical reports on this subject include:

- **Fundamental economic forces continue to increase the importance of high-skill occupations**
- **Enrollment and interest in critical engineering and science occupations has noticeably slowed**
- **International student enrollment, historically an important source of educated workers, has slowed recently**
- **The National Science Board sums up the situation as “an emerging and critical problem”**

These findings point toward a “policy crunch point” for the U.S.: how can flexible policy tools correct current or pending specific talent shortages? Although we are not yet at a crisis, changes must be made soon. Without immediate action, it may be difficult for the U.S. to catch up with other countries that **are** making the necessary reform.

## ***Fundamental economic forces continue to increase the importance of high-skill occupations***

There is no reason to expect the economic, technological, and demographic forces that have reshaped the U.S. workforce in recent decades to diminish. Communication technology and globalization have refashioned the ways companies organize themselves and carry out business, and continue to increase the demand for vital occupations and specialized skills. This doesn't mean that everyone in the future will need advanced degrees to get jobs: according to the Bureau of Labor Statistics, four of the ten fastest growing jobs in the future require no post-secondary education. But for American workers, globalization means competing in a world labor market in which numerous unskilled jobs can be performed in many other countries as well. This means wages for these jobs will probably never be sufficient to provide future American workers a chance for the sort of prosperity previous generations took for granted.<sup>4</sup> For American companies, globalization means competing against firms from around the world. Many studies have demonstrated that maintaining a technological lead over the rest of world requires an adequate supply of workers able to develop, use, and maintain next generations of technology.<sup>5</sup> This "skill-biased technological change" is a trend that (in addition to factors such as tax regimes or labor cost developments)<sup>6</sup> influences demand for highly educated labor in all industries, not only IT. Carnevale makes the case that skill requirements have increased overall in the economy.<sup>7</sup> This will continue into the future: according to Hecker, jobs that require a bachelor's degree are expected to increase by 24 percent through 2010.<sup>8</sup>

Directly measuring shortages of workers is difficult, and requires more than simply looking at rates of unemployment. Rather than indicating too many workers, for instance, high unemployment rates could be a sign of a mismatch of skills in a rapidly changing economy, or a lack of workforce mobility. Moreover, the 1990s was a time of unusually low unemployment for the U.S. labor force as a whole, around five percent in the 1990s compared to about seven percent in the 1980s. A generally tight labor market makes it hard to discern exceptional shortages for particular types of skills. Nonetheless, multiple indirect indicators such as employment and unemployment, wage growth, and required training time, as well as anecdotal evidence and supply side factors, conclusively

show that by the second half of the 1990s, shortages of workers were acute in professional occupations, especially in computing, education, and healthcare. The U.S. more specifically also faced a tight labor market for archivists, librarians, related information professionals, and teaching professionals (except secondary).<sup>9</sup> Companies routinely reported information technology (IT) worker shortages in the 1990s, which include many computer-related occupations. Evidence from secondary data sources such as labor surveys also indicated a tight labor market in specific information technology niches<sup>10</sup> especially in jobs requiring higher skill sets.<sup>11</sup>

Although all of these occupations tend to require post-secondary education,<sup>12</sup> the underlying causes driving these shortages differ. Shortages of computer-related and education workers can be interpreted as a direct reflection of the trend towards technology-driven occupations and the associated need for a highly trained workforce; shortages in healthcare professionals reflect the new demands from an aging U.S. population.<sup>13</sup> By 2001, the American economy slipped into recession as the boom of the 1990s faded and as the world economy was rocked by 9/11. Overall unemployment rates had started to rise in 2000.<sup>14</sup> While the need for technology workers abated in the early 2000s, healthcare job demand grew dramatically. According to Paral, 35 million Americans live in areas with too few doctors to adequately serve their medical needs; nearly 16,000 doctors would be needed to alleviate this shortage.<sup>15</sup> Nursing is similarly experiencing a current national shortage of 126,000 workers.<sup>16</sup> This might lead one to conclude that in the 1990s shortages of skilled workers in healthcare were structural (a product, for instance, of fundamental demographic shifts), while shortages of skilled workers in computing were cyclical (a product of the economy itself booming rather than busting). But making such an unambiguous distinction is problematic. Cyclical and structural factors combine in unique ways, specific to occupation. But the combined effect appears to be lower unemployment rates for many categories of highly educated workers. Although unemployment in some industries rose as the booming 1990s came to an end, in the education and healthcare sector, for example, unemployment in 2003 was 3.6 percent, substantially below the national average of six percent.<sup>17</sup> Professional and related occupations in general saw an unemployment rate of only 2.9 percent in 2003.

The labor market today as a whole is less taut than it was in the 1990s, but for high skill jobs in fields such as computing and education it is less slack than for most others.

The acute need for highly educated workers should continue for years to come. The Bureau of Labor Statistics projections of labor demand from 2002 to 2012 point to continuing high demand for broad occupational categories including doctors, registered nurses, post-secondary teachers, and computer scientists and engineers. In the healthcare industry, the demand for physicians and surgeons is expected to grow by 13.2 percent due to replacement needs alone.<sup>18</sup> Furthermore, by 2020 a deficit in physicians of more than 20 percent of projected demand is expected, which is greater than the shortages that existed during the 1960s.<sup>19</sup> Employment growth for teachers is expected to be over 27 percent between 2002 and 2012, higher than the 16 percent increase projected for all industries combined.<sup>20</sup> In addition, a greater-than-average number of workers are over the age of 45 in nearly all the major occupations in the education sector. Retirements in the this sector are therefore expected to create large numbers of job openings in addition to those due to employment growth.<sup>21</sup>

Looking solely at the future need to replace existing workers due to retirement, occupational projections for computer scientists between 2002 and 2012, for example, show a 17.4 percent net replacement growth.<sup>22</sup> But pressures in this field are more than demographic. The latest projections make clear that the U.S. will have to assure an adequate supply of IT workers in the long run if it wants to either retain its world lead in the IT sector or to remain competitive in other industry sectors that rely on information technology.<sup>23</sup> This will be made more difficult by the slowing growth of the American labor supply. According to Tossi, between 2002 and 2012, the labor force is estimated to grow no more than 1.1 percent annually,<sup>24</sup> with the 55-and-older group growing at nearly four times the rate of growth of the overall labor force. During this time, the median age of the population is expected to rise by 5.0 years, while the median age of the labor force is projected to increase by 1.4 years, leaving a much smaller group of prime-age workers relative to the total labor force.<sup>25</sup>

The Aspen Institute points out that for the native-born share of the workforce, the age group of 25 to 54 will stagnate between 2000 and 2020 with a zero percent growth rate. In contrast, between 1980 and 2000, the native-born workforce aged 25 to 54 surged

44 percent.<sup>26</sup> Hence, given current labor force participation rates and retirement patterns, the U.S. will experience a substantial reduction in its prime-age native workforce in the next 20 years. Jobs with a larger share of workers aged 45 and older will be disproportionately hit by this trend in the next decade or two. Teachers and nurse educators, for example, fall into this category.

Although demographic trends are deeply rooted, society's responses are more flexible. Cappelli cautions that it is premature to focus attention purely on the slowdown of labor supply since these forecasts expect specific retirement patterns that could change over time, and do not account for the possibility that an increasingly educated workforce could creatively alleviate the kind of skill-focused shortages that are expected.<sup>27</sup> Horrigan and others point out that productivity growth<sup>28</sup> and various innovative responses by firms to cope with these trends could also influence the final impact of the demographic developments.<sup>29</sup> Firms may also choose to deal with shortages through offshore outsourcing. These trends are not unique to the U.S., and with much lower birthrates Europe and Japan are being hammered even harder by demographic changes. The Organization for Economic Co-operation and Development (OECD) is studying what policies can help to counteract this trend, e.g., encouraging delayed retirement, ensuring that a variety of job opportunities are available for older workers and that they are equipped with the required skills, and drawing homemakers and others into the workforce.<sup>30</sup> Countries will adapt, some better than others.

While analysts disagree about whether impending labor shortages are unavoidable or whether innovations and productivity increases can compensate, both sides agree that American workers must be better educated and more highly skilled. Also, all sides appear to agree that U.S. skill issues will not go away soon. At a recent forum of national leaders and experts on the dynamics of the U.S. workforce convened by the U.S. General Accounting Office, participants agreed that the gap between skills needed by employers and the skill level of U.S. workers - - both those entering the labor market and those already employed - - "poses a major challenge for the U.S. labor market."<sup>31</sup> Educational attainment trends will help determine whether skill shortages will be met with U.S. workers who convert higher education levels into increased productivity or whether labor needs must be met with an increased supply of new workers, possibly from abroad.

Unlike skill shortages, which can be measured only indirectly, domestic educational attainment can be analyzed in detail since data and projections on student enrollment and degree awards are readily available. Unfortunately, the latest data on science and engineering degree attainment do not indicate that skill shortages can be met with domestic workers alone.

### ***Enrollment and interest in critical engineering and science occupations has noticeably slowed***

Though there is no conclusive evidence that wide-ranging labor shortages will occur in the next ten years, the story for specific occupations is quite different. Consider, for example, occupations in engineering and sciences. A smaller share of prime age workers in the new economy will be a more critical problem if the new entrants to the workforce are not sufficiently educated to fill the high-skill jobs opened by retirement and created by new technologies. Tabulations of U.S. Census data for the period between 1980 and 2000 by the National Science Foundation's Division of Science Resource Statistics show that although science and engineering occupations experienced a job growth of close to five percent during the last two decades, production of science and engineering Bachelor's, Master's, or Doctoral degrees in these disciplines has grown not more than two percent.<sup>32</sup>

Interest in pursuing engineering degrees has shown a continued decline. Between 1993 and 2002, the number of students who selected a four-year college major and planned to major in engineering fell by more than 20 percent.<sup>33</sup> The representation of potential engineering majors among ACT test takers similarly decreased by more than 3 percentage points since 1992. Over the past 12 years, the share of potential engineering majors in college preparatory programs and in the top quarter of their high school graduating class has also decreased.

According to the 2004 Science and Engineering Indicators by the National Science Foundation, graduate enrollment in specific fields by citizens and permanent residents in science and engineering increased on average by almost two percent annually between 1983 and 1993, but between 1993 and 2001 it declined 1.3 percent annually. Declines were most notable in mathematics, engineering and physical sciences.<sup>34</sup> Citizen

and permanent resident enrollment between 1993 and 2001 in computer sciences increased by about one percent annually, significantly lower than the previous decade's growth of three percent per year.<sup>35</sup>

Enrollment alone does not necessarily imply graduation in that field or eventual participation in the workforce in that field. In 2000, approximately 25 to 30 percent of students entering college in the U.S. intended to major in science and engineering fields,<sup>36</sup> but a considerable gap exists between freshman intentions and successful completion of science and engineering degrees. Studies of first-year science and engineering students in 1990 found that fewer than 50 percent had completed science or engineering degrees within five years.<sup>37</sup> Students intending to major in these disciplines in their freshman year explore and switch to other academic departments in undergraduate education, and approximately 20 percent drop out of college.<sup>38</sup>

This is not good news. Even accounting for moderate temporary and permanent immigration based on current trends, the National Center for Education Statistics predicts awards of bachelor's degrees in all fields to increase by an average of only around 1.3 percent annually between 2000 and 2012, master's degrees by 0.8 percent and doctoral degrees by 0.4 percent.<sup>39</sup> In the long run, the Aspen Institute expects the share of 25-year-olds and older in the labor force with some college degree between 2000 and 2020 to grow by about eight percent *less* than in the previous two decades.<sup>40</sup> Finally, the National Science and Technology Council predicts that by 2050 the number of 22-year-olds that are expected to earn a Science and Engineering bachelor's degree will actually decline by nine percent.<sup>41</sup>

***International student enrollment, historically an important source of highly-educated workers, has slowed recently***

At the same time that the U.S. production of a highly-educated workforce is slowing down, American companies must compete against firms from countries that are rapidly increasing their own pools of highly educated workers. In 1975, the U.S. ranked third among countries in the proportion of 18-24 year old population earning natural science and engineering degrees. Within the same group of countries, in 2000 it ranked

only 15th.<sup>42</sup> Most other countries, including China and South Korea have shown above 200 percent growth in the share of college-age youth that earned first university degrees in natural sciences and engineering between 1975 and 2000. During this period, the United States increased its ratio by only 43 percent, reaching a ratio of 5.7 degree holders per 100 inhabitants in 2000.<sup>43</sup> By contrast, Taiwan and South Korea dramatically increased the ratio of first time natural science and engineering degrees in their 24-year-old populations, from 2.6 and 2.1 per 100 in 1975 to 11.1 per 100 in 2000 for Taiwan and 10.9 for South Korea. It isn't only Asia: several European countries have doubled and tripled their ratios, reaching figures between 8 and 11 degrees per 100.<sup>44</sup>

Looking solely at citizen and permanent resident enrollment in sciences and engineering reveals only part of the picture. Even more troubling for American companies is the fact that they may be losing access to one of their most important resources: top students from other countries who have come to the U.S. for higher education. Foreign-born degree-holders now comprise more than 50 percent of engineering and computer science graduate students in the United States.<sup>45</sup> Given the predicted slowdown in domestic educational attainment, international students could help bolster the weakening future talent level among U.S. workers. For example, graduate enrollment in science and engineering witnessed a decline from 1993-1998, but recovered to the 1993 level by 2001.<sup>46</sup> The recovery was driven by increases in the number of foreign graduate students enrolling in computer sciences and engineering. Graduate science and engineering enrollment from 1994 to 2001 reflects a decline of 10 percent in enrollment by U.S. citizens and permanent residents, balanced by an increase of nearly 35 percent in foreign graduate science and engineering enrollment.<sup>47</sup> Foreign students make up a high proportion of science and engineering graduate students, particularly at the doctoral level where they earned more than one third of all degrees in 2001.<sup>48</sup> These degrees are heavily concentrated in mathematics and computer sciences (representing 49 percent of 2001 doctoral degrees awarded in that field) and engineering (56 percent of 2001 doctoral engineering degrees awarded), with even higher shares in more specific fields such as electrical engineering (65 percent of doctoral degree recipients in this field are foreign students).<sup>49</sup> At the master's level, foreign students in mathematics, computer sciences and engineering showed a similar strong presence of over 40 percent in 2000.<sup>50</sup>

Since September 11<sup>th</sup> 2001, however, growth in the number of international students enrolled in graduate programs (including science and engineering) has slowed down dramatically. Recent surveys indicate a declining interest in pursuing degrees in the U.S.. The number of international students attending U.S. colleges and universities increased less than one percent in 2002-03 over the prior year, the smallest increase since 1995-96.<sup>51</sup> The Institute for International Education reported the number of international students studying mathematics and computer sciences at U.S. institutions of higher education in 2002-03 decreased by six percent, although these students still made up twelve percent of total foreign enrollment.<sup>52</sup> More recently, surveys by several educational institutions over the 2003-2004 academic year indicate a decline in international student applications of over 30 percent.<sup>53</sup>

A critical question is whether the slowdown of foreign student enrollment in American colleges and universities is only a result of temporarily heightened security concerns by U.S. immigration officials after 9/11. Another explanation would be that academic institutions in other countries have improved to the level of post-secondary education institutions in the U.S., and thus can attract the homegrown students that a generation ago would have enrolled at MIT or Stanford. If that is the case, it could mean trouble for companies doing business in the U.S.. U.S.-based employers have grown increasingly dependent on the global workforce to meet their needs in particular areas. Science and engineering jobs, for example, experienced very strong growth from 1980-2000, increasing by 159 percent between 1980 and 2000, or an average of 4.9 percent per year (compared with 1.1 percent for the entire labor force).<sup>54</sup> Foreign-born science and engineering trained workers in 1999 at the same time made up 21 percent of the workforce in the field of computer sciences, 12.5 percent of the workforce in the field of mathematics, and close to 20 percent in engineering.<sup>55</sup> Without question, foreign-born science and engineering workers helped make the rising U.S. science and engineering employment over the past several decades possible.

Many of these foreign-born skilled workers came to this country as students. During the fiscal year 2002, for instance, 65 percent of H-1B beneficiaries for new employment were already in the U.S. on a non-immigrant visa.<sup>56</sup> The last official report that breaks out information on the previous immigration status of H-1B workers indicates

that the majority of H1-B recipients between May 1998 and July 1999 entered on an academic student (F) visa.<sup>57</sup> Data from this report points to the importance of international students as contributors to the future supply of highly-educated workers needed to offset shortages in the U.S. workforce and the complementary nature of different temporary skill-related visa programs.

***The National Science Board sums up the situation as “an emerging and critical problem”***

A comment by the National Science Board on the findings of the NSF Science & Engineering Indicators 2004 worries that the trends of declining U.S. citizen enrollment in sciences and engineering coupled with the expected growth in jobs in these fields “threaten the economic welfare and security” of the U.S..<sup>58</sup> While it says the situation is not at crisis level, the National Science Board recently urged a “national policy imperative” to ensure capacity in the face of an increasingly competitive global labor market.<sup>59</sup> Committees to the Board expressed concern if either new science and engineering degree production drops or immigration slows. In its 2003 report, *The Science and Engineering Workforce - Realizing America’s Potential*, the NSB argues for increasing the number of U.S. citizens pursuing science and engineering studies and careers while emphasizing that “this effort should not be a tradeoff for, or at the expense of foreign-born talent that the nation needs, deserves and appreciates.”<sup>60</sup>

Crisis or not, certain occupations clearly are at a “crunch point.” The issue deserves immediate and thoughtful action. Almost universally, analysts acknowledge that labor demand shifts favoring more highly-educated workers are part of ongoing economic and demographic restructuring in the United States. They do not disagree that supply-demand gaps are emerging and in cases, such as physicians and nurses, already exist today. Scholars are wrestling with whether or not higher productivity, workplace innovations, changing retirement patterns and the like will correct for these shortfalls through natural market mechanisms, and whether the adjustment will be timely enough to maintain U.S. economic leadership. If the market mechanisms and other domestic policies cannot adapt quickly or comprehensively, disruptions and deficiencies could be minimized with the help of highly-educated foreign workers. As a result, the policy

question becomes: **How can we facilitate adjustments targeted at particular supply-demand gaps? What existing or modified mechanisms will enable adjustments to the shortage of highly-educated workers with minimal unintended consequences?**

The next section summarizes recent literature, especially since 2000, pertaining to the role of temporary highly-educated workers and the H-1B program as one means to smooth disruptions in the labor supply chain.

## **PART 2**

### **WHAT DIFFERENCE CAN AND DO HIGHLY-EDUCATED FOREIGN WORKERS MAKE?**

As virtually all analysts agree, the rapidly changing economy and demographic shifts require a greater supply of future workers for occupations in computer sciences, healthcare, education, and other fields demanding high skills. Many believe the H-1B visa program could ease current and future shortages of these critical workers. During the booming 1990s, obvious shortages of high-tech talent in the U.S. quieted opponents of an employment-based immigration policy. For example, a report of the Office of Technology in 1997 reported the “emergence of a world-wide shortage of information technology workers.”<sup>61</sup> A 2000 report prepared for the National Association of Counties similarly reported that 80 percent of U.S. counties reported high-skill shortages, with 77 percent characterizing the shortage as serious or very serious.<sup>62</sup> Most agreed that this shortage meant American companies were having trouble competing or seizing opportunities to expand their markets.<sup>63</sup> In 1999 Laura D’Andrea Tyson (former Council of Economic Advisor to President Clinton),<sup>64</sup> Robert McTeer (President and CEO of the Federal Reserve Bank of Dallas),<sup>65</sup> and Federal Reserve Bank Chair Alan Greenspan,<sup>66</sup> agreed in their support for an open U.S. policy that would attract entry by foreign workers to fill growing talent gaps. Less enthusiastic analysts such as Robert Atkinson of the Progressive Policy Institute recognized the need for “high tech visas,” but emphasized a more aggressive approach to educate and train on the home front.<sup>67</sup> Still others criticized particular aspects of the H1-B program, worrying that lower cost foreign workers might push down overall wages, that the “binding” nature of the H-1B employment requirements would amount to exploitation of foreign workers “chained” to particular companies, and that evidence of labor shortages was still inconclusive.<sup>68</sup> Many American workers loudly expressed their unhappiness with the H1-B visa program with the recession in 2001 and the slowdown of the high tech sector between 2000 and 2003.<sup>69</sup> Thus in recent years, the main points of contention concerning the H-1B program can be summarized as:

- *Is the program an adequate remedy to the shortage of talent?*
- *Do temporary foreign workers hurt wages and benefits?*
- *Does foreign talent have any indirect or spill-over benefits for the U.S. economy, beyond the benefits the workers bring their employers?*

While research and statistical computations have not yet caught up with the informational needs of the current debate, several key findings are noteworthy:

- **Temporary foreign workers continue to fill gaps in demand for U.S. highly-educated labor. Many of these workers are graduates of U.S. universities with technical degrees, and are sought as permanent hires by U.S. companies.**
- **Adjustments to permanent resident status by temporary foreign workers alleviate critical labor needs for science and engineering workers.**
- **There is no clear evidence that highly educated foreign workers displace native workers in comparable occupations.**
- **Empirical evidence continues to be mixed or inconclusive about the wage effects of highly-educated foreign workers.**
- **To its advantage, the U.S. does a better job than other developed countries at attracting talent; but this may not continue indefinitely.**
- **Empirical studies and anecdotal evidence point to spill-over benefits such as improved creativity and innovation gained from foreign talent.**

In briefly discussing each of these findings, the focus of this commentary is to update the discussion with findings from the literature since 2000.

### ***Temporary foreign workers continue to fill gaps in demand for highly-educated labor***

Between 1970 and the mid 1990s, the rate of growth in the number of foreign-born workers in life sciences, math, and computer sciences was more than twice that of the native-born.<sup>70</sup> Data from the Current Population Surveys showed that in the January-April period of 2004, 14.9 percent of the civilian labor force was foreign-born, which is a substantial rise from the 2000 results of 13 percent.<sup>71</sup> New foreign-born workers furthermore contributed 47 percent of labor force growth in the 1990s and over 55 percent of the growth between 2000 and the first half of 2004.<sup>72</sup> For all degree levels, the

share of U.S. science and engineering occupations between 1990 and 2000 filled by foreign-born scientists or engineers increased from 14 to 22 percent.<sup>73</sup> At the bachelor's degree level, the share increased from 11 to 17 percent; at the master's level, from 19 to 29 percent; and at the doctorate level, from 24 to 38 percent.<sup>74</sup>

These trends are also evident in the 2004 NSF Science and Engineering Indicators, which provide information on foreign-born scientists and engineers with degrees from U.S. academic institutions. Of all the major disciplines, engineering benefited most from U.S. trained foreign-born doctorates (44.6% in 1999).<sup>75</sup> These data furthermore show a steady increase in reliance on foreign-born faculty (from 11.4% of all academic positions in 1977 to 21% in 2001).<sup>76</sup> “By the end of the 20<sup>th</sup> century, about 35 percent of the computer science and engineering faculties at U.S. universities and colleges were foreign-born, as were nearly 30 percent of the mathematics faculty and about 20 percent of the faculties in physical, life, and social sciences.”<sup>77</sup> Given that the decline in U.S. citizen educational attainment is expected to continue on this path in the years to come and the predicted shortage of science and engineering teachers, the availability of these foreign-born teachers to train the U.S. workforce becomes especially critical.

The H-1B program plays a flexible role in providing needed foreign workers, allowing skills in particularly short supply to be filled relatively quickly, while providing a conduit for temporary foreign workers to adjust to permanent status in response to persistent or structural shortages. Between 1990 and 2000, about 900,000 skilled professionals entered the U.S. labor market under the H-1B visa program.<sup>78</sup> In fiscal years 2001 and 2002, on average, more than 50 percent of approved H-1B petitions were granted to workers with a bachelor's degree, around 30 percent had a master's, and 10 to 17 percent had a PhD or professional degree.<sup>79</sup> In fiscal year 2001, around 42 percent of the new H-1B visas (not continuing employment) were approved for workers already present in the United States on another temporary non-immigrant status, and 58 percent applied from outside the United States. The level of all H-1B applications, and especially for new petitions from outside the U.S., decreased dramatically in fiscal year 2002 due to the economic downturn and new, more stringent security controls and requirements.<sup>80</sup>

New H-1B petitions from outside the U.S. declined to 35 percent, while 65 percent of the new applicants were already in the U.S. on another visa.<sup>81</sup>

In fiscal year 2001, still at the peak of H-1B immigration, individuals working in computer-related positions accounted for more than half (58%) of H-1B admissions, architecture and engineering occupations constituted another 12.2 percent, and workers in education represented 5.3 percent of all H-1B workers.<sup>82</sup> These numbers were similar to the fiscal year 2000 occupational distributions of H-1B workers. In fiscal year 2002, these shares changed to 38 percent, 13 percent, and 10 percent, respectively, the former reflecting the slowdown of the high-tech sectors from 2001.<sup>83</sup> However, occupations in medicine and health increased from 3.4 percent to 6.6 percent, and occupations in both healthcare and education saw increases in absolute numbers of approved H-1B petitions.<sup>84</sup>

### ***Adjustments to permanent resident status by temporary foreign workers alleviate critical labor needs for science and engineering workers***

As demand for their skills has become more acute over the last several years, the length of stay of temporary foreign workers has also been growing.<sup>85</sup> A recent study by Michael Finn of the Oak Ridge Institute for Science and Education reports that 56 percent of 1996 U.S. science and engineering doctoral degree recipients with temporary visas remained in the U.S. in 2001.<sup>86</sup> Approximately 3500 foreign students remain from each annual cohort of new science and engineering doctorates. Stay rates are highest in computer and electrical engineering, physical sciences, computer sciences, and life sciences.

A significant share of H-1B workers are now adjusting to permanent status, permanently raising the skill level of the U.S. labor force. One article estimates that, absent major processing backlogs and given current adjustment rates, more than 50 percent of all H-1B workers would adjust from their present temporary status to permanent status by 2010.<sup>87</sup> This high number might reflect how difficult it is for highly educated foreign nationals - even those with degrees from U.S. universities - to enter the labor market directly through the green card process: processing times for green cards are

getting longer, and there are a few number of slots made available relative to demand.<sup>88</sup> These hurdles force many employers to use the H-1B program rather than go through the green card system.<sup>89</sup> In 1999, all temporary visa holders (of which H-1Bs are the biggest group) constituted about a third of all employed non-citizens in engineering, computer, and mathematical occupations in the U.S. labor market, thus forming a fairly large pool of potentially permanent workers.<sup>90</sup> Fiscal year 2001 counts of permanent visas issued to immigrants in science and engineering show a large increase in permanent visas for science and engineering occupations, dominated by growth in engineering and mathematical/computer sciences. Adjustments from temporary visas (which includes H-1B visas and other cases besides H-1B such as spouses categories) rose from 44,598 in FY 2000 to 85,227 (87,168) in FY 2001 (2002).<sup>91</sup>

Thus, the H1-B visa program shows its flexibility in addressing persistent structural shortages as well as short-term or cyclical gaps. Since the bursting of the tech boom of the 1990s, initial filings of H1-B visas for workers in sciences and engineering are down; but the numbers are increasing for temporary technical workers already in the country on H1-B visas to adjust their status to permanent residence, a response to the structural shortages for skilled workers caused by long-term economic developments and demographic shifts.

Given the positive contributions the H1-B program has made in the past and the potentially challenging times ahead for addressing shortfalls in highly educated workers, constructive policy improvements continue to be offered. In a recent report from the Progressive Policy Institute, Robert Atkinson argues for making it easier for math, science and engineering Ph.D. graduates to become U.S. citizens “. . . by exempting them from the H1-B visa cap and expediting the process by which they can qualify for a green card.”<sup>92</sup> At a recent forum of national leaders and experts on the dynamics of the U.S. workforce convened by the U.S. General Accounting Office,<sup>93</sup> participants pointed out that the H1-B program was developed for different economic times to provide employers with temporary workers but now has become a transitional program enabling many of these workers to become permanent legal residents. Improvements offered include:

- Remove fixed yearly limits on the number of people who may enter the U.S.. Instead, allow visas to fall within ranges that can adjust rapidly to changing economic and workforce circumstances.
- Allow for non-native U.S. college graduates the possibility of green card issuance immediately upon graduation, instead of requiring return to the home country before applying.
- A more flexible U.S. visa program for foreign graduates in math and science.

***There is no clear evidence that foreign talent displaces native workers in equal occupations***

Little broad-based empirical information is available on the employment impact of the highly educated temporary foreign labor force on native-born counterparts. Several studies focus on just one sector or one discipline, without taking into account the movements of labor into and out of any particular sector or job field. The great majority of these studies report that there is no conclusive evidence that foreign nationals, as a whole, force native workers out of jobs.<sup>94</sup> At most, pressure on jobs is exerted only by poorly educated foreign workers<sup>95</sup> and even these effects seem statistically insignificant. This might be even more the case with the H-1B visa because of the nature of the program: participating workers fill needed jobs in rapidly expanding or short-supplied occupations, so the threat to native-born incumbents is generally low.

Another major driver that might be wrongly interpreted as employment displacement is the relative decline of the citizen versus the non-citizen population in advanced degree fields.<sup>96</sup> In several fields of advanced degree studies, foreign nationals are the predominant group of university graduates. In the engineering field, for example, 56 percent of doctoral degrees were awarded to foreign-born students in 2001.<sup>97</sup> With a slowing number of degrees awarded to U.S. citizen, employers are left with little choice but to recruit foreign candidates for jobs. Furthermore, empirical analyses of employment effects of non-citizens on their domestic counterparts cannot distinguish between displacement and upward movement of citizens to better employment opportunities.<sup>98</sup> A 2001 Commission on the IT workforce from the National Research Council concluded

that there was not “sufficient evidence on the magnitude of wage and employment effects to make a judgment about the effects of the program on domestic IT workers.”<sup>99</sup>

***Empirical evidence continues to be mixed about the wage effects of highly-educated foreign workers***

With regard to the impact of foreign workers on the wages of native workers, some research distinguishes between effects at different domestic skill levels. While negative impacts of foreign workers have been observed on the low-skill domestic workforce in some cases, positive relations between foreign and domestic workers in high-skill occupations also seem to occur. Highly-educated workers can, for example, more easily transfer skills acquired in their home country to the U.S. job market and might in that way contribute unique new human capital.<sup>100</sup>

There is no clear consensus about the net wage impact on the overall native workforce. Again, modest evidence supports a negative wage effect of immigration on *low-skill* workers.<sup>101</sup> Various empirical estimates conclude that the elasticity of the native wage with respect to the number of immigrants is *at most* -0.1, which implies that a ten percent increase in the share of immigrants in a region will decrease native wages only by one percent.<sup>102</sup>

There does not seem to be any evidence of adverse wage impacts on highly-educated native workers. In fact, increases in the share of newly arriving immigrant workers within professional and service-related jobs have slightly positive wage effects,<sup>103</sup> suggesting there may be a complementary relationship between native workers and newly arrived immigrants in the top skill categories. This implies that native wages in these occupations might be lower if not for the presence of immigrants.

Although previous studies have separated the effects of total immigration on different skill groups in the U.S., there have been no analyses of the wage effects of immigrants with different skill levels. Only one recent contribution specific to H-1B workers concluded that the number of these highly-educated foreign specialty workers does not appear to depress wages or wage growth in the U.S..<sup>104</sup> It is important to distinguish between the effects of foreign workers with different characteristics, such as

education level, in order to properly assess the economic impact of a program such as the H-1B visa and much more precise empirical research is necessary.

***The U.S. does a better job than other developed countries at attracting highly-educated workers***

Given how important highly-educated foreign workers are for offsetting the decline in the numbers of well educated and highly educated members of the domestic workforce, it's fortunate that the U.S. has done well in attracting and retaining the best and brightest from abroad. A recent Hudson Institute publication<sup>105</sup> highlights the U.S. dominance in attracting highly educated immigrants relative to six other OECD nations.<sup>106</sup> Using 1998 data on immigration to these OECD countries, the U.S. share (temporary and permanent) of the total to these countries was 57 percent of all immigrants; its share of highly educated immigrants was 76 percent. In comparison, Germany and Canada only attracted shares of 16 and 11 percent respectively of all immigrants, and only 7-8 percent of highly-educated foreign entrants.<sup>107</sup> Justin Heet argues that this advantage results from historical U.S. dominance in higher education: Over half the foreign students within OECD countries for which data is available are educated in the U.S.. With relatively high stay rates, as previously mentioned, foreign students add to the highly-educated immigrant labor pool in the U.S., thus partially offsetting domestic declines in this part of the workforce. A key policy question is: How can the U.S. hold onto this competitive advantage to ensure a sufficient educated labor pool for the future?

***Empirical studies and anecdotal evidence point to improved creativity and innovation gained from foreign talent***

It isn't surprising that highly-educated foreign workers have benefited their employers ... otherwise companies would have been unlikely to go through the expense and bureaucratic hurdles of obtaining the visas. Of more interest is whether these workers have provided spill-over or indirect benefits to the U.S. economy as a whole. Have they, for instance, been a source of innovation and creativity? Studies have shown that foreign workers do in fact bring language, cultural, and specialized skills that stimulate

innovation.<sup>108</sup> Their presence helps to promote trade and investment flows with their home countries, thereby improving global economic networks. The economic benefits of highly-educated workers may be significantly understated in conventional economic models. According to a Committee on Economic Development study, highly-educated foreign workers are very productive and can fill critical labor gaps.<sup>109</sup>

Individuals making exceptional contributions to science and engineering in the U.S. are more frequently foreign-born than their share of the overall scientific workforce would predict.<sup>110</sup> Stephan and Levin point out that the U.S. benefits from the educational cost carried by other countries for these highly contributing individuals that received their education abroad.<sup>111</sup> Furthermore, the children of immigrants seem to show a disproportional potential for becoming the future U.S. skilled labor force. According to a study by the National Foundation of American Policy, 60 percent of top science students and 60 percent of top mathematics students in U.S. high schools are children of immigrants.<sup>112</sup> Foreign-born high-school students in addition make up 50 percent of the Mathematics Olympiad and 25 percent of the finalists of the highly regarded Intel Science Talent Search.<sup>113</sup>

Anecdotal evidence of foreign-born contributions in the high-technology sector is striking. Foreign-born employees at Sun Microsystems created both the Java computer language and the SPARC microprocessor, technological innovations that ultimately created thousands of new jobs for the company.<sup>114</sup> In a review of Silicon Valley businesses, Saxenian found that in 1998, Chinese and Indian engineers were running one-quarter of all Silicon Valley high-tech businesses.<sup>115</sup> These firms employed 58,282 workers, and accounted for over \$16 billion in total sales (17% of all firm sales).

However, aside from these isolated studies, no comprehensive reports exist on the substantial overall contributions of foreign scientists, engineers, and entrepreneurs to the U.S. economy. Statistics on patents issued to non-resident U.S. inventors may shed some light on the role of foreign talent in the U.S.. Since the late 1980s, foreign inventors have received between 44 and 48 percent of all U.S. patents.<sup>116</sup> Japan, with the largest share of foreign-owned U.S. patents, has seen that share decline since the early 1990s. The European Union's share of U.S. patents issued to foreign inventors fell from the late 1980s to the early 1990s, and then stabilized at about 35 percent. During this time, the

share of selected Asian economies (China, South Korea, Singapore, Taiwan, and Malaysia) rose steeply, from less than 2 to 12 percent, which is indicative of their rapid technological progress.<sup>117</sup>

Richard Florida furthermore points to the new structural shift of the U.S. economy towards companies, cities and regions following and attracting skilled workers rather than workers moving to where the jobs are.<sup>118</sup> This stresses the increased need to compete even globally for the “creative”, innovative worker, whether through economic development strategies or immigration policies. With the recent declining interest of skilled foreigners in coming to the U.S., Florida fears that the core of the economy is at stake in preserving its lead in innovation and prosperity.

## CONCLUSION

### WHAT ADDITIONAL INFORMATION WOULD HELP INFORM THE POLICY DEBATE?

This review of recent literature, especially since 2000, points to two broad conclusions. First, the widely-held proposition that the U.S. faces shortfalls in the supply of certain highly educated workers to meet rising demand continues to be confirmed. The intensity of this “skills gap” varies by occupation (computer science, engineering, health care, etc.) and industry and over the business cycle. Second, the H1-B program continues to be quite flexible in addressing employer needs of a temporary nature (the original intent of the program) while enabling transition to permanent resident status where labor demand simply cannot be met by the indigenous workforce for a foreseeable future. Recent policy suggestions indicate more flexibility needs to be built into the H1-B program.

Going forward, expanded data and analysis would help inform policy shapers and policy makers:

- To the extent that they exist, for policy purposes, potential occupation-specific negative short-term impacts in the form of employment or wage effects have to be carefully weighed against the positive contributions of these workers to the U.S. economy. Both potential impacts are in need of more detailed empirical analyses. Most of the other developed countries of the world have examined this issue and found in favor of admitting the highly-educated.
- Information about occupation-specific stay rates and the increasing proportion of longer-term foreign-born workers by critical occupations could assist with educational planning and managing the supply of the cadre of knowledgeable and experienced mentors, teachers and professors needed to educate native-born workers.
- A breakout of H-1B employers by size of firm, industry type and geographical location would provide more information on the characteristics of highly-educated worker demand in a rapidly changing economy.

- More information on the academic institutions awarding the first and second degrees of H-1B beneficiaries would shed light on the changing patterns of international flows of talent and provide insight for the development of attraction strategies aimed at filling anticipated shortages in target occupations.

In summary, despite incomplete publicly available data, there remains strong secondary and anecdotal evidence of the positive contributions of a program such as the H-1B visa program to the U.S. economy. The willingness and ability of the U.S. to attract highly trained foreign nationals will be an important tool for the foreseeable future in order to overcome temporary and even more structural shortages in specific high-skill occupations.

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