

# Annotated Research Bibliography: H-1B/Green Card/STEM Labor Shortage Issues

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This document summarizes what I regard as the major research papers on the issues of the H-1B work visa, employer-sponsored green cards and claims of a STEM labor shortage. Here I use the word *major* to mean either that the paper is widely cited or has important findings, not necessarily that I find the analysis to be valid.

Some points to keep in mind:

- **Funding of a research project matters.** Some of the research projects listed below are sponsored by organizations with industry financial ties.<sup>1</sup>
- **Peer review matters.** Generally speaking, research that has been vetted by peer review in a professional journal has much more validity than do unpublished working papers. However, journal papers can be flawed too, and working papers often have valuable, if yet unconfirmed, insights.

The bibliography follows.

1. **Bound (2006):** J. Bound, S. Turner and P. Walsh, Internationalization of U.S. Doctorate Education, in *Science and Engineering Careers in the United States: An Analysis of Markets and Employment*, R. Freeman and D. Goroff (eds.), University of Chicago Press, 2006.

Found that the foreign students doing STEM graduate work at U.S. universities tend to attend weaker, less prestigious institutions:

In physics, biochemistry, and chemistry much of the expansion [from the mid-1980s to mid-90s] in doctorate receipt to foreign students occurs at unranked programs or those ranked outside the top 50; the growth in foreign students in engineering is distributed more evenly among programs. Among students from China, Taiwan, and South Korea growth has been particularly concentrated outside the most highly ranked institutions.

2. **Brown (1998, 2009).** Clair Brown *et al*, 1998, *The Perceived Shortage of High-Tech Workers*, unpublished working paper, 1998, and Clair Brown and Greg Linden, *Chips and Change*, MIT Press, 2009.

This paper explained the link between the foreign student influx in engineering and the stagnant engineering wages. The 2009 book noted, as did the 1989 NSF document (see Weinstein (1998) below), that this is especially true at the graduate level, and that employers welcome the chance to pay lower wages at that level.

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\*Interested readers should read my short synopsis of H-1B issues, at <http://heather.cs.ucdavis.edu/h1b10min.html>, and my collection of quotes of industry people and others on this topic, at <http://heather.cs.ucdavis.edu/h1bquotes.html>.

<sup>1</sup>I have not sought, nor have I received, funding for any of my H-1B research papers.

3. **Costa (2012):** Daniel Costa., *STEM Labor Shortages? Microsoft Report Distorts Reality on Computer Occupations*, EPI, 2012.<sup>2</sup>

Excellent exposure of Microsoft PR claims on H-1B.

4. **Freeman (2005):** Richard Freeman, *Does Globalization of the Scientific/Engineering Workforce Threaten U.S. Leadership?*, unpublished NBER Working Paper No. 11457, June, 2005.

Finds that STEM professionals lost ground in the 1990s relative to those in the law and medicine, due to the foreign STEM influx.

5. **Hanson (2014):** Gordon Hanson and Matthew Slaughter. *Facts and Fallacies about High-Skilled Immigration and the American Economy*, CompeteAmerica report, 2014.

This research is funded by an industry consortium, CompeteAmerica. It has the usual flaws, such as not accounting for skill sets (see Lofstrom (2012) below).

The authors concede the point made by Salzman *et al* (see Salzman (2013) below) that STEM wages have been flat, thus contradicting the claim of a labor shortage. But they contend that the reason wages are flat is that some work is done by foreign workers, abroad or in the U.S. If that were truly the case (I disagree), then why do the authors say we need more H-1Bs? Flat wages would say we have enough already, if not too many.

The authors also state that although STEM wages have remained flat, non-STEM wages have fallen. This is obfuscating the issue; lack of rising wages means lack of a shortage, period.

6. **Hart (2009):** David M. Hart, Zoltan J. Acs, and Spencer L. Tracy, Jr., *High-tech Immigrant Entrepreneurship in the United States*, SBA report, 2009.

Finds a lower rate of immigrant tech entrepreneurship than do other researchers.

Most interesting is the breakdown by national origin. Even though 64% of the tech H-1Bs are from India, only 16% of the important immigrant tech entrepreneurs have come from India. I am not advocating that the H-1B program favor workers from certain countries, but Hart's findings do suggest that current H-1B policy is not generally selecting the most promising workers. This meshes with my own findings (see Matloff (2013b) below).

7. **Hira (2007):** Ronil Hira, *Outsourcing America's Technology and Knowledge Jobs: High-Skills Guest Worker Visas Are Currently Hurting Rather Than Helping Keep Jobs at Home*, EPI, 2007.

Showed that, contrary to the industry threat, "If we can't hire enough H-1Bs, we'll be forced to ship the work abroad," the H-1B and L-1 programs are often used to facilitate sending work abroad.

(I would add, though, that whether a job is sent overseas or a worker is brought here from abroad, that is one fewer job available to Americans. H-1B is not "better" than offshoring in terms of tech jobs for Americans.)

8. **Hunt (2009, 2011)** Jennifer Hunt, *Which Immigrants Are Most Innovative and Entrepreneurial?*, Working Paper 14920, 2009. Cambridge, Mass.: National Bureau of Economic Research, 2009, and same title, *Journal of Labor Economics*, Vol. 29, No. 3, pp. 417457, 2011.

The working paper is the more informative version, as the author was asked to remove H-1Bs from the analysis in the final published version.

The author found that, relative to comparable Americans, the H-1Bs are paid less, and they file fewer patent applications per capita.<sup>3</sup> In the case of patents, the result also is true when restricted to the former foreign students, the industry's prized group.

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<sup>2</sup>Several papers listed here are published by the Economic Policy Institute (EPI), a labor-oriented organization. EPI does not generally fund research other than its own internal projects. As far as I know, none of the works here had EPI funding.

EPI is an interesting special case in another sense. Though EPI does not have a journal, its published papers are peer-reviewed. My own EPI paper, Matloff (2013b), underwent the most rigorous scrutiny I've ever experienced in all my years in academia.

<sup>3</sup>The author published an earlier paper on patenting that was more favorable to H-1Bs, but this was not on a per-capita basis.

9. **ITAA (1997):** Stuart Anderson,<sup>4</sup> *Help Wanted: The IT Workforce Gap At the Dawn of a New Century*, Information Technology Association of American, 1997.

This report by an industry lobbying organization played a key role in Congress' near-doubling of the H-1B cap in 1998. As such, one passage is especially revealing:

Training employees in IT would seem to be a win-win for both worker and employer. And often that is the case. However, extensive training creates other issues. "You take a \$45,000 asset, spend some time and money training him, and suddenly he's turned into an \$80,000 asset," says Mary Kay Cosmetics CIO Trey Bradley. That can lead to another problem. New graduates trained in cutting edge technologies become highly marketable individuals and, therefore, are attractive to other employers.

It is clear that Bradley is not willing to pay the salaries paid by other firms. The ITAA was claiming at the time that qualified IT workers were in short supply, and training in new skills took too long, so that the industry had to resort to hiring H-1Bs. Yet Bradley's remark shows that the main issue is money, not available workers and not time to learn a new tech skill. Note that Matloff (2003) discusses the issue of skill-learning time in depth, showing it is not an important issue with quality workers.

10. **Kerr (2010):** William Kerr and William Lincoln, 2010, The Supply Side of Innovation: H-1B and Ethnic Innovation, *Journal of Labor Economics*, Vol. 28, No. 3.

Finds that the more Chinese and Indian H-1Bs come to the U.S., the larger the number of patent applications filed by ethnic Chinese and Indians. This says little, almost a tautology. The authors also find some evidence of a possible small crowding-in effect on Americans.

11. **Kerr (2014):** Sari Pekkala Kerr, William R. Kerr, and William F. Lincoln, Skilled Immigration and the Employment Structures of U.S. Firms. *Journal of Labor Economics* (forthcoming, 2014).

Takes a firm-level point of view, exploring relations between the numbers of immigrant skilled workers at a firm and various other job numbers at the firm.

From the paper's Conclusion section: "We find consistent evidence linking the hiring of young skilled immigrants to greater employment of skilled workers by the firm, a greater share of the firm's workforce being skilled, a higher share of skilled workers being immigrants, and a lower share of skilled workers being over the age of 40...there is limited evidence connecting actual departures of workers to the hiring of young skilled immigrants...[the analysis here] suggests that departure rates for older STEM occupations may be higher."

Note that this stops short of the "H-1Bs create new jobs" claims made by the industry. And while it does mildly support my own findings that one of the primary uses of the H-1B program is to avoid hiring older Americans, I am very hesitant to embrace this paper.

First, much of the analysis relies on a controversial statistical technique known as *instrumental variables*, which even proponents of the method concede can be difficult to do properly. Second, the analysis concerns only workers who are already at a firm, rather than who is hired from the applicant pool in the first place, and thus is unable to address the question of whether H-1Bs are hired instead of Americans. Third, while it examines the impact of hiring skilled immigrant workers, it does not look at the impact of hiring skilled American workers; my EPI paper on the quality of H-1Bs would suggest that the American impact would be greater than the immigrant impact.

12. **Lofstrom (2012):** Magnus Lofstrom and Joseph Hayes, 2012, *H-1Bs: How Do They Stack Up to U.S. Workers?*, IZA Discussion Paper 6259, December.

Research funded by an industry-related think tank PPIC,<sup>5</sup> presented in a pro-immigration forum (IZA).

Many factual errors, e.g. a statement that employers must give hiring priority to Americans over H-1Bs.

Finds that the H-1Bs are paid at least as much as the Americans, and possibly slightly more.

<sup>4</sup>The report is shown without naming an author, but Anderson's authorship was later reported in the press.

<sup>5</sup>PPIC is funded by the Packard Foundation, which in turn is funded by Hewlett-Packard stock

Major flaws: (a) Does not systematically take geography into account, which matters as wages vary widely by region. (b) Does not take tech skill sets into account; this matters, as the industry claims to hire H-1Bs for their rare skill sets, which typically command around a 20% wage premium. In other words, this paper's wage figures are off by about 20%. (c) They look only at wages at the time of hire, thus failing to sample the H-1Bs at times during which they are most underpaid, since H-1Bs receive smaller raises than comparable Americans.

13. **Matloff (2003):** Norman Matloff, On the Need for Reform of the H-1B Non-immigrant Work Visa in Computer-Related Occupations (invited paper), *University of Michigan Journal of Law Reform*, Fall 2003, Vol. 36, Issue 4, 815-914.

The most extensive peer-reviewed, published general research paper on H-1B and related issues to date (99 pages, 300+ footnotes).

Extensive material on job vacancy rates, tech skill sets, age discrimination in tech, underpayment of H-1Bs, etc.

14. **Matloff (2006):** Norman Matloff, On the Adverse Impact of Work Visa Programs on Older U.S. Engineers and Programmers (invited paper), *California Labor and Employment Law Review* (a publication of the California State Bar Association), August 2006.

Demonstrates how the influx of H-1Bs, who are overwhelmingly young, fuel the rampant age discrimination in the tech fields, starting at the "old" age of 35.

An important facet is specialized skill sets, say Android programming. The industry acknowledges that there are many older programmers available for work, but that they have not updated their skill sets. This paper of mine (and the University of Michigan one cited above, Matloff (2003)) shows this to be a red herring.

Most programmers love learning new technologies, and do so constantly. Of course there are countless different technologies, so no one knows them all, but most older programmers have had the experience of applying for a job for which they have an exact skills match, but then be quickly rejected, without even a phone call. As former CEO (and current promoter of foreign-worker programs) Vivek Wadhwa has stated, "...even if the [older] \$120,000 programmer gets the right skills, companies would rather hire the younger workers. That's really what's behind this."

Again, the training issue is a red herring. Competent programmers can learn a new technology quickly, on the job, without formal training. The industry has always claimed that it can't afford this, as it needs to hire people who can "hit the ground running." Yet this was belied by the *BusinessWeek* report ("Vancouver, the New Tech Hub," May 22, 2014) that Microsoft, Facebook and so on are training foreign programmers who they hire but temporarily "park" in Vancouver, BC while waiting for U.S. visas; see also ITAA (1997) above on this point.

15. **Matloff (2013a):** Norman Matloff, 2013, Immigration and the Tech Industry: As a Labour Shortage Remedy, for Innovation, or for Cost Savings?, *Migration Letters*.

Using a multi-pronged approach, demonstrates that tech industry H-1Bs are on average underpaid relatively to their actual market value.

Note that this underpayment is in almost all cases done in full compliance with the law, exploiting gaping loopholes. See my University of Michigan paper above, Matloff (2003), for details, but I would note here that even Rep. Zoe Lofgren, a strident advocate of expanding the H-1B program, recognizes the problem, as noted in *Computerworld*, March 31, 2011: "Lofgren said that the average wage for computer systems analysts in her district is \$92,000, but the U.S. government prevailing wage rate for H-1B workers in the same job currently stands at \$52,000, or \$40,000 less. 'Small wonder there's a problem here,' said Lofgren. 'We can't have people coming in and undercutting the American educated workforce.'" Unfortunately, none of Lofgren's bills regarding H-1B would even come close to fixing the problem.

Shows the flaws in widely-cited studies that claim the H-1Bs are not underpaid.

Shows that, to many employers, the immobile nature of H-1Bs is even more attractive than saving on salary. See also Mukhopadhyay (2013) below.

Explains how the U.S. tech workers, and the economy in general, are harmed by the H-1B and related programs. This is particularly true for American workers over age 35.

For this reason, proposals in Congress that would grant automatic green cards to new foreign graduates of U.S. universities would be harmful, as the vast majority of the foreign grads would be young, exacerbating the age discrimination problem.

Note carefully that the analysis here excluded the IT outsourcing firms. Thus it showed that the U.S. mainstream firms, i.e. the Intels and the Microsofts, do abuse the H-1B program too, albeit on a higher class of worker. This is important, since the industry claims that the main abuse of H-1B occurs with the outsourcing firms; on the contrary, the abuse occurs throughout the industry. See my Bloomberg View op-ed, “Stop Blaming Indian Companies for Visa Abuse,” <http://www.bloombergvview.com/articles/2013-08-26/stop-blaming-indian-companies-for-visa-abuse> for more on this crucial point.

16. **Matloff (2013b):** Norman Matloff, *Are Foreign Students the Best and Brightest? Data and Implications for Immigration Policy* (invited paper), EPI, 2013.

Analysis of the tech industry’s most prized category of H-1Bs—foreign students who graduated from U.S. universities and who then joined the U.S. workforce, in the fields of computer science and electrical engineering.

Contrary to the industry’s claim (that they never offer statistical evidence to support) that these H-1Bs are “the best and the brightest,” this paper demonstrates that in the computer science field, the H-1Bs are significantly weaker than the Americans, in terms of patenting, research and development work, quality of graduate institution and so on. In the case of electrical engineering, the foreign students are not superior to the Americans in any category, and are weaker in some categories.

Cites other research with similar findings, notably Bound (2000) above and D. Goroff, eds., *The Science and Engineering Workforce in the United States*. Chicago, Ill.: National Bureau of Economic Research/University of Chicago Press, and the work of J. Hunt cited earlier in this document.

As with my *Migration Letters* paper above, Matloff (2013a) the analysis here excluded the IT outsourcing firms.

17. **Mithas (2010):** S. Mithas, and H. Lucas, Are Foreign IT Workers Cheaper? United States Visa Policies and Compensation of Information Technology Professionals, *Management Science*, May, 2010.

Severely handicapped by the nature of its data set, mainly managers, marketers and the like, not mainstream engineers.

The paper finds that H-1Bs are paid 2.6% more than Americans, which the authors ascribe to the H-1Bs having rare skill sets. But those skills command a premium of about 20% on the open market, so that the Mithas and Lucas findings actually show that the H-1Bs are underpaid.

The authors note, correctly, that due to lack of mobility, H-1Bs<sup>6</sup> are underpaid relative to their true market value (consistent with the above), getting much larger salaries after attaining green cards. Attempts to quantify the difference.

18. **Mukhopadhyay (2013):** S. Mukhopadhyay and D. Oxborrow, The Value of an Employment-Based Green Card, *Demography*, February. 2013.

Attempts to measure the underpayment to H-1Bs due to their immobility while waiting for a green card. Some possible methodological issues.

19. **NRC (2001):** National Research Council, *Building a Workforce for the Information Economy*, Washington, D.C.: National Academies Press, 2001.

This study was commissioned by Congress.

In a direct survey of a broad variety of employers, found that they admitted to paying H-1Bs less than comparable Americans. The paper found no evidence of an IT labor shortage, and it found that older workers in IT face major obstacles in the labor market.

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<sup>6</sup>The ones being sponsored for green cards, i.e. those hired by the mainstream U.S. firms such as Intel and Microsoft.

20. **Peri (2008):** Giovanni Peri and Chad Sparber, *Highly-Educated Immigrants and Native Occupational Choice*, working paper, 2008, and Giovanni Peri, *Immigration, Labor Markets and Productivity* (essay), Giovanni Peri, *Cato Journal* (libertarian), Winter 2012.

Unlike later papers by Peri and coauthors that were favorable to the H-1B program and others like it, these two are rather negative. The first paper finds that STEM immigrants displace Americans from the field, in that the STEM immigration results in fewer U.S. natives in STEM:

...we assess whether native-born workers with graduate degrees respond to an increased presence of highly-educated foreign-born workers by choosing new occupations with different skill content.

...we add to evidence from past studies by showing that [U.S.] native occupational adjustment in response to immigration occurs among highly-educated workers and occurs for those already employed.

As the foreign-born share of highly-educated employment rises, native-born employees respond by moving to jobs with less quantitative and more interactive content.

The wage consequences of immigration were not estimated in this paper...If the evidence from the labor market for less-educated workers is an indication, the occupational skill response among highly-educated natives is likely to mitigate their potential wage loss from highly-educated immigration.

In that last paragraph, the authors seem to believe that the natives suffer at least some wage loss due to the displacement. This is consistent with the second paper listed above, in which Peri states that the immigrants make less than natives in the same jobs, and pitches this as a boon to employers. He devotes an entire section of the paper to this point, titled “Lower Wages of Immigrants: an Opportunity for Cost Cutting and Job Creation”:

One common empirical finding in the literature is that immigrants are paid less than natives with similar characteristics and skills. This is in part due to the fact that many immigrants, because of less attractive outside options (such as having to go back to their home country), have lower bargaining power with the firm. In this case firms pay immigrants less than their marginal productivity, increasing the firms’ profits.

21. **Peri (2014):** Giovanni Peri *et al*, 2014a, *STEM Workers, H1B Visas and Productivity in U.S. Cities*, working paper, and 2014, *Closing Economic Windows: How H-1B Visa Denials Cost U.S.-Born Tech Workers Jobs and Wages During the Great Recession*, Partnership for a New American Economy.

Peri’s online CV says that he has received \$50,000 in research support from Microsoft, and the second paper is published by an industry political group, presumably accompanied by funding for Peri’s research. These considerations may explain why there are issues here of lack of balance.

Among other things, these papers violate fundamental academic principles by not citing any research critical of H-1B. Of the 42 references listed in the first paper’s bibliography, there are none whatsoever that are negative about the visa program. One can certainly disagree with contrary findings, but they do have to be cited and explained.

The 2014a paper is too technical to discuss in detail here, but I will summarize by saying that the paper uses controversial methodology (instrumental variables, as with the Kerr papers) and does not present convincing evidence that that methodology accounts for changing economic conditions. It also makes a number of questionable assumptions.

The 2014b paper features a clever approach, but is overly simple. It is not detailed enough to account for the dynamics of the IT labor market. For example, suppose H-1Bs are brought in to replace American IT workers in a certain firm. Typically the American managers remain, and since managers generally have higher salaries, the average salary of the Americans at the firm increases—even though none of them individually gets a raise. The departure of the lower-wage Americans results in a higher mean for those who remain, thus incorrectly making it seem like the influx of H-1Bs causes the Americans’ to rise.

At any rate, the findings of both of the Peri papers are starkly at odds with the broad consensus among economists that the H-1B program suppresses wages, by sheer supply-and-demand considerations. That was the conclusion of the Brown, Freeman, NRC and NSF studies cited above. Former Fed chief Alan Greenspan has stated repeatedly that H-1B suppresses IT wages.

22. **Rothwell (2013):** Jonathan Rothwell and Neil G. Ruiz, *H-1B Visas and the STEM Shortage*, Brookings, 2013.

Brookings has close financial ties to Microsoft and other firms in the industry. According to Brookings' *Annual Report 2013*, they had over \$1,000,000 in donations from Microsoft, over \$1,000,000 from the Bill and Melinda Gates Foundation, over \$1,000,000 from the William and Flora Hewlett Foundation (i.e. HP), over \$500,000 from Qualcomm, over \$250,000 from Google, etc. Brookings has often included a panelist from Microsoft in almost all of their presentations on H-1B, and their research on H-1B is the most cited work in the statements of the industry lobbyists and their allies. The authors make fundamental errors in statistical methodology.<sup>7</sup> But this is rather minor compared to the fundamental flaws, the same as in Lofstrom (2012) above, since they use the same data set: (a) they do not take into account skill sets; (b) they do not account for geography; and (c) they look only at wages at the time of hire, thus failing to sample the H-1Bs at times during which they are most underpaid, since H-1Bs receive smaller raises than comparable Americans.

23. **Salzman (2013):** Hal Salzman, Daniel Kuehn and B. Lindsay Lowell, 2013, *Guestworkers in the High-Skill U.S. Labor Market: an Analysis of Supply, Employment, and Wage Trends*, EPI.

In-depth analysis. Finds no general STEM labor shortage. Lack of a shortage is shown via flat wages.

24. **Teitelbaum (2014):** Michael Teitelbaum, 2014, *Falling Behind?: Boom, Bust, and the Global Race for Scientific Talent*, Princeton University Press.

Shows a long history of false claims of STEM labor shortages in the U.S., and analyzes the motivations for such claims.

25. **Wadhwa (2007):** V. Wadhwa *et al*, 2007, *Intellectual Property, the Immigration Backlog, and a Reverse Brain Drain: America's New Immigrant Entrepreneurs, Part III*, Duke University Fuqua School of Business.

Survey of employers, in which HR departments were asked directly whether they were having difficulty in finding qualified engineers. The answer was that they were not having problems in this regard, and were not having to resort to offering hiring bonuses and so on.

Wadhwa is an outspoken advocate of foreign worker programs, but even he has publicly stated that the H-1B is widely abused, saying for instance, "I know from my experience as a tech CEO that H-1Bs are cheaper than domestic hires. Technically, these workers are supposed to be paid a 'prevailing wage,' but this mechanism is riddled with loopholes."

26. **Weinstein (1998):** Eric Weinstein, *How and Why Government, Universities, and Industry Create Domestic Labor Shortages of Scientists and High-Tech Workers*, Cambridge, Mass.: National Bureau of Economic Research, 1998.

This paper is of major importance, analyzing an internal 1989 document in the National Science Foundation, the main science funding agency in the federal government. The NSF actively promoted the establishment of the H-1B program in 1990.

The NSF document correctly forecast that the large influx of STEM foreign students would suppress wages at the PhD level. It also projected, again correctly, that the stagnant wages would drive American students away from STEM doctoral programs.

In the latter light, note the more recent statement by Cisco Systems Vice President for Research Douglas Comer, "...a Ph.D. in computer science is probably a financial loser in both the short and long terms" (*Science Careers*, April 11, 2008).

Note too the October 5, 2011 testimony to the House Subcommittee on Immigration Policy and Enforcement by Darla Whitaker of Texas Instruments. Ms. Whitaker stated that TI has plenty of engineering applicants with Bachelor's degrees, and thus does not hire foreign workers at that level. She stated TI does hire H-1Bs, and sponsors them for green cards, at the Master's and PhD levels, where she says there is a shortage. When asked why the Americans don't go on to graduate school, Whitaker didn't have much to say, but the answer is clear from the above material.

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<sup>7</sup>For those who know regression analysis, an example is that they treated their Education variable, coded 5/6/7 for Bachelor's/Master's/PhD, rather than setting up two dummy variables.

The NSF document also advocated giving automatic green cards to new foreign grads at U.S. schools, just as in current proposals in Congress. Since NSF also concedes that this would give American students disincentives to study STEM, the autogreen proposal is clearly ill-advised.

27. **M. Zavodny (2011):** M. Zavodny. *Immigration and American Jobs*, American Enterprise Institute for Public Policy Research and the Partnership for a New American Economy, 2011.

Research funded by, and published by, industry organizations.

Does a state-by-state comparison, “In states with more immigrants, are US natives more or less likely to have a job?”, especially with respect to H-1B. This is a highly unreliable approach, as states vary from one another by more than just the numbers of H-1Bs.