

## June 2009; FAQ on H-1B Paper

This note provides answers to frequently asked questions regarding the paper: “The Supply Side of Innovation: H-1B Visa Reforms and US Ethnic Invention” by William Kerr and William Lincoln. We hope to be very clear about what the paper says and does not say. This paper is not a policy piece, but a scientific analysis of the phenomena. The paper should be treated as such. We will continue to update this note with further details.

- *Timing:* Work on this specific paper began in June 2007, although Kerr’s analysis of the probable ethnicities of inventors on US patents dates back to 2003. We began formally presenting our analyses and results in December 2007, and we have continued to present the paper in a variety of forums since then. We appreciate all of the comments collected during these presentations.

HBS Working Paper 09-005 was formally released in December 2008. We requested the HBS working paper number during the summer of 2008, but we continued working on the paper for another six months before releasing it.

- *Purpose of a Working Paper:* A working paper is publicly disseminated for comments and review by an academic journal. A working paper has not yet completed the peer review process. The review and publication process in economics can take several years. It is standard practice to release a working paper when a study is in a form to submit to peer-reviewed journals.

Working papers are sometimes updated by authors as the papers are revised for academic publication. A standard practice regarding whether to update a working paper or not does not exist in economics. We will not be updating HBS Working Paper 09-005, now or in the future. Given the attention and debate placed on this paper, it will be left in its current form for fairness to those citing the work.

We will update this FAQ note with additional information and comments on the paper. This note will also detail any differences between the published version(s) and the working paper as they emerge. The published version(s) of this paper will look different on several dimensions (e.g., length, focus, tests reported).

As an aside, we turned down or delayed a large number of requests for our draft results prior to December 2008. We did this out of concern for multiple copies of the paper circulating, and to finalize our work before releasing it.

- *Funding:* Several observers have suggested or insinuated that funding for this project came from sources with pre-conceived views of what the results should be. This is not true. All funding came via William Kerr’s research grants or from William Lincoln’s graduate fellowship at the University of Michigan. These grants and fellowships are general research grants, without any direction as to what should be studied or how the work should be conducted.

Over 95% of Kerr’s funding came from Harvard Business School, which kindly provides Kerr with annual funding for research efforts. Kerr also received financial assistance from the Innovation Policy and the Economy group at the National Bureau of Economic Research for general research purposes during the period in which this project commenced. Kerr thanked the IPE group for this support in every paper he wrote during this period related to entrepreneurship

and innovation. The IPE group in turn received funding from the Kauffman Foundation, which has never been involved in this work except through this indirect channel.

The listed support by the National Science Foundation and the MIT George Schultz Fund are more dated. These two groups helped fund Kerr's graduate studies at MIT, which ended in 2005. While at MIT, Kerr began the ethnic-name matching work with patents. Kerr continues to cite these two groups in any study that involves the ethnic-name data as thanks for their initial support. Neither institution has been involved in research specific to the H-1B program.

To be very clear, we have never received biased support for this work, from either side. Funding for this effort came exclusively from general research budgets. No direction was given to look at this issue, and the views and conclusions expressed are our own only.

- *The "Inventiveness" of Ethnicities:* We have found that one common mistake that our readers make is to think that our analyses test whether one ethnicity is more or less innovative than another. This is not the case, and the working paper has nothing to say about this topic.

Our analysis measures how the pace and composition of US invention was influenced by the H-1B program. The results find that Indian and Chinese invention grew faster with larger H-1B populations in dependent cities relative to non-dependent cities. Given that a first-order effect of the program is to let more temporary workers from these countries into the US for work in patent-related fields, we should expect to see relatively more inventors with Indian and Chinese names. And that is what the study finds.

One can further wonder whether inventors become more or less productive depending upon the characteristics of other inventors surrounding them. However, it is very hard for us to disentangle this productivity factor from population sizes. The patent data do not contain unique inventor ids, just inventor names. So, we can't separate the extent to which observing more inventors with the "Gupta" surname results from a greater number of distinct inventors with that surname versus higher patenting rates by existing inventors with that surname.

Finally, and most importantly, we could never say with this data whether someone is more or less innovative. Even if we correctly linked unique inventors, we have no data about the inputs and efforts that they make into patenting activities. The best inventor may only have one patent if he or she is working on other fronts simultaneously. A lower productivity inventor may have more patents if that is all he or she does.

Recent papers by Hunt and Gauthier-Loiselle (2008) and Hunt (2009) report that immigrants patent more than natives in the US primarily due to the immigrants being more involved in science and engineering versus an inherent difference in productivity. These papers provide further citations to studies that have examined this issue.

Bottom line, our empirical analyses do not test differences across ethnicities in their "innovativeness." We can only measure how the program influenced the number of patents filed by particular ethnicities. This measured effect will be an aggregate effect that includes both changes in the number of inventors of different ethnicities and changes in patenting rates by individuals. This paper should be solely viewed in terms of this aggregate effect.

- *Marginal Inventions*: In contrast to the above misperception, some readers have alternatively suspected that the observed growth in patenting came from “marginal” inventions – that is, new patents by Indian and Chinese inventors that were not worth as much as previous patents. The values of patents are very difficult to assign. Some researchers use measures like forward citations from other patents or the number of claims granted to the patent as an indicator of economic value. These metrics are far from perfect, but past studies in the patent literature suggest that these proxies work to a first approximation. Using these metrics, we do not find evidence for substantive differences in the quality of patents across ethnicities. This suggests that the reported results are not explained by marginal inventions alone.
- *Short-Run v. Long-Run*: Our analysis only considers the short-run effects of H-1B program changes for US patenting. The empirical framework, timeframes, and data can only support this type of inquiry. In the long-run, the effects may be different than what we estimate for the short-run.

Crowding-in effects or crowding-out effects of native inventors are both possible in the long-run. A possible crowding-out story would focus on native students choosing occupations other than science and engineering due to relative wages. A possible crowding-in story would focus on additional job creation following from more immigrant inventors in an area, perhaps leading to a critical mass of inventors in the city. Other stories and channels are possible, too.

In the introduction of the paper, we direct readers to studies of the long-term effects of immigrants on natives. These are general studies of high-skilled immigration, not specific to the H-1B program, but they are the best evidence available. The H-1B program is too recent to measure accurately its specific long-run effects. We describe the papers with equal emphasis, and we encourage readers to review them closely.

- *Comparisons Across Cities*: It is commonly said that our paper finds that patents increase when the H-1B population increases, and that patents decrease when the H-1B population declines. What our paper finds is that patenting growth in dependent cities increases relative to non-dependent cities with growth in the H-1B population. This comparison across cities is subtle but important. We do not use national-level changes in H-1B admissions and patents to identify our relationship. Such aggregate correlations are very difficult to interpret due to the many other forces operating in the economy (e.g., business cycles).
- *Boom and Bust Cycles*: It has likewise been suggested that our results basically show that more patents are produced during periods when the high-tech sector is expanding (and that the H-1B population is therefore a secondary and correlated issue). This is incorrect. First, we employ very stringent empirical specifications to avoid this problem, as discussed in the paper.

One example is the expected patenting trends. These trends are specific to each city and ethnicity (e.g., Chinese invention in San Francisco). They are based upon the year-by-year national level of patenting in 36 technology groups interacted with technology fields that matter for each city and ethnicity. The increases and decreases in expected patenting for Chinese inventors in San Francisco or Hispanic inventors in San Antonio due to boom and bust cycles are thereby captured. We likewise look at Canadian cities for a counter-factual experiment.

As important, the paper measures effects relative to existing inventor group sizes across ethnicities. Technically, this is where the log specifications with panel effects come in. If the results were merely “more patents,” the effects would be the same for each ethnicity. 10% more patents would result in 10% more Indian invention, 10% more English invention, and so on. The ethnic composition of invention would be unchanged.

Instead, there is an ethnicity-specific component to the measured patent growth in dependent cities. Even if we change the argument to “more high-tech patents,” the relative sizes of the inventor groups still preclude such a simple story. At the end of the sample period, Indian and Chinese inventors account for ~13% of measured patenting activity. The concentrated treatment effects among a group that accounts for ~13% of patents cannot be reconciled in a simple “more patents” story. Any account must be specific to these two groups in terms of first-order effects.

- *Counter-Factual of US Natives on H-1B Visas:* Several readers have asked about the counterfactual of giving H-1Bs to native workers instead of foreign workers. We certainly appreciate the motivation behind this question, but we believe it is the wrong question. In this context, the US government does not direct people to work in one capacity or another. The policy lever is the H-1B worker admissions. Empirical researchers must then look for techniques to discern the impact of the program compared to the counterfactuals of no changes from initial H-1B populations (e.g., the US city analysis, Canadian comparison).

The proposed counterfactual of giving H-1Bs to native workers would be something more like increased support for US citizens to obtain science and engineering educations, or similar policy initiatives. It is well beyond the scope of this study to comment on such alternative initiatives. Some studies of these programs exist in the economics literature and other disciplines, and we believe this is an important topic for additional research.

- *Using Inventor Names to Estimate the Program’s Effects:* It has been suggested that we claim that every inventor with an Indian or Chinese name is working on an H-1B. This is of course not true, and we recognize that there are many inventors with ethnic names in the US that are second or later generations, permanent residents, students, and so on.

Our analysis measures how the pace and ethnic composition of US inventors changed with H-1B population shifts across cities and firms. An observed increase in Indian patenting with higher H-1B population admissions will be a net effect of two factors: 1) changes in the H-1B population of Indian inventors and their patenting activity, and 2) effects on other inventors with Indian names in the US. The latter may be to crowd-in or crowd-out Indian inventors already in the US. Indeed, many immigration studies find the strongest economic effects of new immigrants are on the previous immigrants to the country, rather than the country’s natives.

Our estimated changes in patenting include both factors above, and data limitations preclude us from disaggregating them further for 1995-2006. This is where the econometric specifications are important. The shifts in the H-1B population are sufficiently large to induce the observed changes in Indian and Chinese patenting. There appears to be a crowding-in effect for Chinese inventors not on H-1B visas, so not all growth will be due to H-1B holders only. For Indian inventors, the observed effect could descend from H-1B holders only, or it could have included a crowding-in or crowding-out effect.

Even though our measured outcomes combine both direct and indirect effects, we believe that shifts in the H-1B program are the only factor which can account for this pattern of activity. This is established in the paper through the multiple specification checks like the lag structure analysis, the Canadian analysis, the expected technology trends, and so forth.

Finally, we specifically undertook the analysis using the Current Population Survey (CPS) at the end of the paper to address these concerns in a different way. The CPS allows us to directly identify an individual's citizenship status (but not whether they hold an H-1B). These estimations, despite the CPS's data limitations for this effort, show clear sensitivity for the growth of non-citizen scientists and engineers in dependent states relative to non-dependent states to H-1B population adjustments; this growth does not result in the crowding out of natural-born US citizens and leads to a measureable growth in the total scientific workforce. This analysis is entirely independent of the ethnic patenting data, although we think the patenting data more appropriate.

As an aside, we have received three complaints (out of a substantial number of comments) that using the terms Indian, Chinese, English, and so on is insensitive. In several years of working on this topic, we unfortunately have not been able to devise a better naming convention that portrays the study in an intuitive way. Perhaps the one exception is that we should substitute Anglo-Saxon for English. We hope that readers understand the naming conventions in the context of the paper; any offense is regretted.

- *R2 Value:* The "Overall R2" value reported on page 22 is an adjusted R2 value, although the differences between the two are minor. We are more interested in and wish to emphasize the partial R2 value. In future versions of this paper we won't discuss the overall R2 value.
- *Further Comments:* Please send further comments to [wkerr@hbs.edu](mailto:wkerr@hbs.edu) and [wlincoln@umich.edu](mailto:wlincoln@umich.edu). We will continually update and clarify this note so that our research is accurately portrayed.