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Comment Paula E. Stephan

This chapter addresses an extremely important topic for this conference because of the considerable evidence that the foreign born contribute disproportionately to scientific productivity in the United States. Furthermore, it is assumed, and some anecdotal evidence exists, that if and when individuals return to their home country, the United States continues to benefit scientifically—either because of continued collaboration between the returnees

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and US scientists or because of spillovers from the knowledge produced once the individual has left.

Moreover, it has been widely established that the policies of governments—both the sending governments and the US government—play a large role in determining who comes to the United States and who stays. It is also known that in most fields research requires resources. One reason that scientists working in the United States are arguably more productive than those working in many other countries relates to resources: compared to many other countries the United States provides considerably more resources for doing research.

This chapter matches 244 PhDs who studied in the United States on a Fulbright (FB) with 244 PhDs from foreign countries who came to the United States to study with funding that had "no strings" attached in the sense that there was no requirement that the PhD return to his or her home country for a period of time as there is with the Fulbright program. The match is performed for field, year, institution, mentor (when possible), and country of origin (when possible). The authors build the data set from ProQuest data, search for CVs on the web, and match the names to the ISI *Web of Knowledge.* It is a first-rate database that represents an extraordinary amount of work on the part of the authors. I would urge the authors to put the data in the public domain after they complete their research.

The database is not representative of foreign students in the United States. To be more specific, there are no FBs from China, Korea, Taiwan, or India. Yet these four countries are the largest source of foreign-PhD students in the United States. The authors also have a "Mexican" problem with their data: 90 of the FBs are from Mexico (37 percent); yet only 9 controls are from Mexico.

The database was initially created to study the role that resources play in scientific productivity. While scientists working in rich-resource environments are generally found to be more productive, the question of selection based on quality always haunts researchers who attempt to examine the role that resources play in scientific productivity.[1] That is, to what extent are researchers working in rich resource environments more productive because they are better researchers; to what extent is their higher productivity due to their having access to better resources? In other work Kahn and MacGarvie

1. It is not only that scientists working in rich-resource environments outside the United States have access to better resources; they also have the resources to come back and forth to the United States. The 2006 Survey of Doctorate Recipients (SDR) asked U.S.-based researchers whether they have a foreign collaborator. Conditional upon having a foreign collaborator, the SDR then asked whether the collaborator came to the United States to work with the respondent. The survey found that over 50 percent of those who had a foreign collaborator replied that their foreign collaborator comes to the United States to work with them. Moreover, the respondent was more likely to host the collaborator in the United States than to travel abroad to work with the collaborator (National Science Board, Science and Engineering Indicators 2010, Appendix, Tables 5–22).

argue that this question can be studied by matching Fulbrights, who are required to return home for at least two years, with a sample who do not face the return home requirement. To the degree they are randomly assigned, one should be able to isolate the effects of resources from quality.

It turns out, however, as Kahn and MacGarvie discuss in this chapter, that it does not appear that Fulbrights are randomly assigned. The argument can be made that they are of lower quality than the control group because high quality students decline the Fulbright (or do not apply). They may do so precisely because of the return requirement or the fact that in some countries they have little say regarding their destination university in the United States. On the other hand, the argument can be made that the FBs are better than the controls, being chosen on merit. They may also be underplaced, given the way FBs are assigned, and thus better than the controls they are matched to.

In the chapter prepared for this conference, Kahn and MacGarvie continue to focus on the productivity issue, examining the degree to which the productivity of FB scholars differs from that of controls, both for papers authored while in the United States and for papers authored outside the United States. In an effort to control for quality, they include the number of papers published as an undergraduate as a right-hand-side variable.

In addition to the resource and quality/selection hypotheses, there is an additional reason to hypothesize that Fulbrights might publish less research than the controls. For want of a better word, call this the investment hypothesis. Learning research skills while in graduate school requires an investment on the part of the student. It also requires an investment on the part of the mentor. The student-investment hypothesis is discussed by the authors. The argument is that if students know they have to return after graduate school, they may choose a different type of career path and invest less in building research skills while in graduate school. The faculty-investment hypothesis is not discussed by the authors but it is equally important. To wit, faculty select students to work in their lab, usually supporting them on their grants. If a student has other funding, faculty are less likely to invest in the student and the student may leave graduate school with fewer research skills, fewer publications, less mentoring, and a less extensive long-term network. Either variant of the investment hypothesis means that pregraduation pubs do not necessarily measure quality. Either variant also means that even if one could control for quality, one cannot use the FB program to address the resource hypothesis issue because the FBs may vary systematically from the controls in terms of level of human capital and social capital acquired in graduate school.

Kahn and MacGarvie estimate publishing equations, differentiating between Fulbrights and non-Fulbrights. They then estimate equations differentiating between FBs who are from a country that is in the top quartile of GDP per capita and FBs who are not; in an alternative specification,

they differentiate between whether the FB is from a country that is in the top quartile in terms of the number of scientific articles produced versus in the lower 75 percent. In the revised version of the chapter they draw finer lines, distinguishing between the 25th, 50th, 75th and 90th percentile. They also examine the degree to which the Mexican FBs differ from other FBs and find that for seven of the eight output measures Mexican FBs are not different from other FBs of similar income level.

In future research the authors may wish to test to see if the FB effects are statistically different for those from different levels of GDP. In the conference version of the chapter and the revised version, the authors compare coefficients without testing to see if the coefficients are significantly different from each other.

More importantly, I would urge the authors to consider alternative, nonpublication-based measures of the contribution a PhD makes after graduate school. Which is more valuable in a poor country: publishing four or five articles (which are likely to be in B journals) or contributing to the quality of life in the home country by helping to diffuse knowledge learned in graduate school that can contribute to better health outcomes, greater agricultural productivity, and a more highly educated workforce? The answer, I think, is fairly obvious.

A different measure of contribution would also more accurately reflect the goals of the FB program, which, as stated by the authors, are to "Enable the government of the U.S. to increase mutual understanding between the people of the U.S. and the People of other countries." It is not to enhance scientific productivity of either the United States or of the home country. If it were, there are far better policy levers to use than the FB program.