FREE Policy Brief Series

Does Immigration Help Diffuse Knowledge? Evidence from Russian Scientists

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Immigration is a hotly contested policy issue in many countries. Often, the debate centers on whether immigration is 'good' or 'bad' for the receiving country. A growing literature in economics focuses on understanding whether immigrants can be beneficial for a receiving economy by helping spread knowledge and increasing innovative activities. In this policy brief, I discuss new evidence showing that immigrants can be an important channel for diffusing knowledge across national borders. Drawing upon the influx of Russian scientists to the United States after the end of the Soviet Union, I present compelling evidence that immigrants contributed to cross-border knowledge flows, which are the basis for innovation and ultimately economic growth.

Evidence on Immigration and Innovation

Scientists and engineers are increasingly moving between countries, typically from developing to developed countries. Given the heated debate regarding the benefits and costs of immigration, a large literature in economics has focused on to what extent receiving countries, like the US and Europe, benefit from high-skilled immigration. Part of this literature is concerned with estimating the impact of immigration on innovation activities, usually measured by patents and scientific publications. Immigrants' contribution to innovation and knowledge production is important as models of economic growth point to the importance of knowledge and innovation for achieving long-run economic growth (Romer 1990).

Immigrants can directly contribute to research and innovation through their own papers and patents. Much of the evidence today suggests that immigrants have contributed to U.S. innovation through their own patenting, with several studies focusing on the U.S. H-1B visa program for temporary immigrants to the United States (Hunt and Gauthier-Loiselle, 2010; Kerr and Lincoln, 2010).

In addition to these direct contributions, economic theory suggests that the "ideas" of these highly-skilled workers should also "spill over" to natives and increase natives' productivity. This suggests that having more highly-skilled immigrants arriving in a country should increase the productivity of natives. It is through the colocation of immigrants with natives in close geographic proximity, which facilitates face-to-face interactions, that knowledge, particularly tacit knowledge (as opposed to codified knowledge which is recorded in articles) may be transferred to natives (Breschi and Lissoni 2009).

The evidence on the existence of knowledge spillovers resulting from high-skilled immigration is very mixed. Previous studies have examined the impact of the arrival or departure of highly skilled individuals on the

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patenting and publishing activity of others, and evidence has shown positive spillovers (e.g. Moser, Voena and Waldinger 2011; Waldinger 2010), no significant impacts (Waldinger 2012, Kerr and Lincoln 2010), or even negative impacts (Borjas and Doran 2012).

A rather separate literature has focused on examining the flows of knowledge themselves that are the basis for knowledge spillovers, especially using the mobility of inventors. Kerr (2008) and Agrawal et al. (2011) use patent citations and the ethnicity of inventors to show that diaspora networks appear to play an important role in diffusing knowledge back to immigrants' home countries. Although these studies suggest that we should expect immigrants to facilitate knowledge flows to natives in receiving countries, there is still little empirical evidence on whether and under what conditions this occurs.

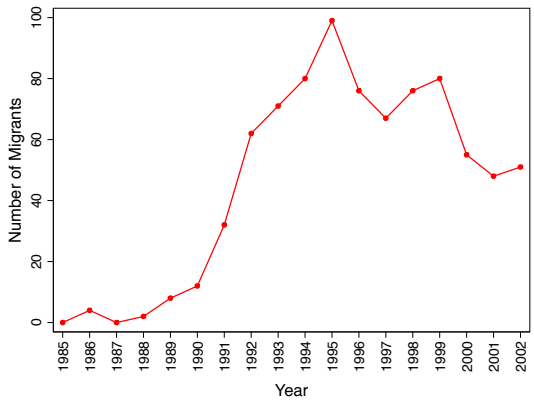
Immigration of Russian Scientists to the U.S.

In Ganguli (2014), I draw upon the end of the Soviet Union and the resulting influx of immigrant scientists to the U.S. to provide the first estimates of the extent to which immigrants bring new ideas across national borders that are the basis for knowledge spillovers.

During Soviet times, the USSR was relatively "closed" to contact with researchers in the West. When the Soviet Union disintegrated in 1991, there were new opportunities for Russian scientists to emigrate, travel and communicate with foreign researchers. Estimates from the 2000 U.S. Census suggest that close to 10,000 Russian scientists and engineers across many science and technology fields immigrated to the United States in the 1990s.

I compile a rich panel dataset of the location of Russian scientists, their publications and US citations to Soviet-era publications using data from the Thomson Reuters Web of Science database. Using data from Soviet-era publications, I create a sample of Russian scientists who were actively doing scientific research near the end of the Soviet Union in 1991. I then identify migrants and non-migrants using information from author addresses and I can identify when a migrant first published in the US and in which city. Figure 1 shows the flows of Russian scientists into the US based on this sample. It shows that there was a large increase in the early 1990s, and the inflows continued for several years.

Figure 1. Flows of Russian Scientists to the U.S.



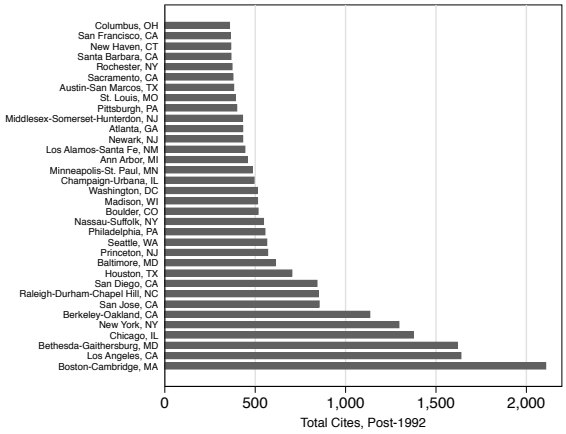
Source: Ganguli (2014), using data from Thomson Reuters Web of Science.

Impact of Immigration on the Diffusion of Knowledge

I use two empirical strategies to estimate the causal impact of immigration on the diffusion of knowledge. First, I use an annual city-field panel dataset of the number of migrants arriving to US cities across scientific fields after the end of the USSR and the number of citations to Soviet-era articles originating in US cities in that period. Figure 2 shows total citations to Soviet-era publications from 1992-2002 for a selection of US cities. It shows that there was considerable variation across cities, partly due to the presence of universities and

reflecting areas that specialize in specific fields.

Figure 2. U.S. Cities with Most Citations to Soviet-era Papers, post-1992



Source: Ganguli (2014), using data from Thomson Reuters Web of Science.

For the second approach, I use matching methods to create a product-level dataset of paper pairs published by migrants and non-US migrants. Thus, I can compare US citations to very similar pre-1990 Soviet papers authored by migrants and non-migrants in both the pre- and post-move periods. If immigrants diffuse knowledge, U.S. authors should be citing migrants' Soviet-era papers more than the similar papers of Soviet scientists who did not move to the US.

There are several challenges in estimating the geographic localization of knowledge flows, especially from immigrants to natives, which these approaches and the natural experiment provided by the Soviet collapse offers. First, the influx of Soviet scientists to the US allows one to identify a large number of immigrants whose location and "ideas" can be traced over time and space using paper-to-paper citations. Second, it allows one to address endogeneity concerns that arise as immigrants are likely to self-select into certain locations. That is, if immigrants enter US cities where natives are already more likely to cite Soviet-era articles, it could be the case that increased citations to Soviet-era work is attributed to increased immigration, when the citations would have increased *anyway*, even in the absence of immigration. In this case, the influx of immigrants was spread over many locations in the US and across many scientific fields, providing useful geographic and field variation over time that can be exploited to address these concerns. Third, the opportunity for tacit knowledge to be shared with US scientists increased tremendously after 1991, with this tacit knowledge representing the large body of Soviet-era knowledge that, while codified and accessible before and after the USSR, was relatively unknown to US scientists.

Both approaches confirm that immigrants do contribute to cross-border knowledge flows. The city-field-level analysis shows that citations to Soviet-era publications increased significantly in cities and fields in years when more migrants arrived there. I also find that after a Russian scientist moved to the US, citations to his or her papers published during Soviet times increased relative to similar control papers authored by non-migrants.

Both approaches also show there are differences in the impact of migration across fields, which suggests that there may be some types of knowledge or conditions that differ by field that make ideas more likely to be diffused by migrants. I also find that the effect is mainly driven by citations to high impact papers, as measured by citations accrued before the Soviet collapse. Moreover, codified knowledge that was already accessible to US scientists (through translated and international journals) was also more like to be transmitted to natives, suggesting that immigration may be especially important in facilitating the transfer of tacit knowledge through face-to-face interactions.

Conclusions

The debate surrounding the costs and benefits of immigration has been heated and empirical

evidence has been mixed. A growing body of literature has focused on estimating the contributions of high-skilled immigrants to both innovative activities and their more indirect contributions to productivity through knowledge spillovers.

This policy brief has discussed a recent study that provides new evidence showing that high-skilled immigrants are a channel for knowledge diffusion. The results suggest that there may be certain types of knowledge that differ by field or conditions that allow cross-border knowledge transfer to flourish. This research points to the need for more evidence from different fields and settings in order to understand more about the nature of knowledge flows and the resulting productivity spillovers. While an influx of highly-skilled immigrants on a similar scale as after the Soviet Union is not likely to occur again, the analysis discussed provides compelling evidence that people can play an important role in diffusing knowledge across borders and this phenomenon will likely only become more important in the years to come. ▪

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