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International knowledge flows and the administrative barriers to mobility

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ABSTRACT

Face-to-face contact, even temporary one, helps researchers form personal ties and transfer tacit knowledge. The ability of researchers to colocate, including attendance at international conferences, workshops and seminars, is affected by the administrative barriers to international mobility. This paper uses a gravity-style empirical framework to examine the link between international knowledge flows and immigration policies. The results suggest that the paper walls erected by such policies reduce not just the mobility of individuals, but also the diffusion of knowledge. A moderately restrictive mobility barrier reduces incoming and outgoing knowledge flows by about 0.8–1.3% per year. The effect of knowledge-exporting country's policy persists for nearly 10 years. There is also a short-term asymmetry: diffusion of recent knowledge is affected more by the immigration policy of a knowledge-exporter rather than a knowledge-importer.

1. Introduction

Knowledge flows, though intangible, sometimes leave a 'paper trail' in the form of citations to patents or academic publications (Jaffe et al., 1993). A citation does not necessarily reflect transfer of knowledge and not every knowledge flow is reflected in a citation, but the paper trails and their absence can be used to understand the diffusion of knowledge. Empirical studies have shown that diffusion of knowledge can be described by a gravity-based framework using factors that have been shown to affect the flows of goods and services, FDI and people (e.g. MacGarvie, 2005; Peri, 2005; Drivas and Economidou, 2015). A common finding is that physical proximity, common language and border are associated with better diffusion of knowledge. The relative importance of these factors is smaller for knowledge flows than for trade, FDI or migration due to the 'weightless' and tariff-free nature of knowledge, which reduces the transaction costs and allows knowledge to reach farther than trade or migration (Peri, 2005).

At the same time, there is a large literature showing the importance of colocation and localised knowledge spillovers (e.g. Jaffe et al., 1993; Collins, 1974; Agrawal and Goldfarb, 2008). One of the benefits of colocation is that it allows authors to develop personal ties, which facilitate transfer of knowledge through the social research network (Jöns, 2009; Jonkers and Cruz-Castro, 2013; Head et al., 2015). The importance of social networks has been also shown to facilitate trade and FDI (e.g. Rauch, 2001; De Simone and Manchin, 2012). However, development of such research networks and personal ties requires some face-to-face contact. The effect of colocation on collaboration and knowledge transfer has been documented in specific subject domains (Collins, 1974, 2001) and observed in (natural) experiments (Boudreau et al., 2017; Catalini, 2017; Iaria and Waldinger, 2016).

The ability of researchers from different countries to colocate temporarily will depend on factors that affect the mobility of researchers, including administrative barriers in the form of immigration policy and travel visa restrictions. These man-made paper walls have been shown to influence the flows of trade, FDI, migration and academic mobility (McKenzie, 2007; Neumayer, 2011; Umana Dajud, 2016; Czaika and de Haas, 2016; Appelt et al., 2015).

This paper examines whether the administrative barriers to mobility influence the direction and magnitude of international knowledge flows. In principle, knowledge can flow across borders without any restrictions.[1] However, transfer of tacit and recent knowledge may require face-to-face contact between the researchers (Collins, 1974, 2001), which in turn depends on their mobility. Paper walls raise the cost of researcher mobility, limiting opportunities for face-to-face contact and development of cross-border research networks. For example, travel visa requirements increase the cost of temporary colocation[2] or even make it impossible (e.g. visa application processing time can make it impossible to attend events on a short notice), reducing opportunities for development of personal ties, such as attending foreign conferences or presenting work at research seminars abroad.

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[1] One exception could be for weapons- or military-related research, but the diffusion of knowledge in such heavily-regulated domains requires a more specialised analysis.

[2] Ng and Whalley (2008) give examples of visa or work permit application costs, including processing time, for several countries, and estimate the global cost of the visa system to be about 0.3% of world GDP. The cost of a passport also varies across countries and can be substantial, see McKenzie (2007).

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Opportunity for informal, face-to-face communication can be important for diffusion of knowledge (Trippl, 2013; Wang, 2015; Catalini, 2017; Iaria and Waldinger, 2016; Collins, 2001, 1974).

The analysis takes into account barriers to short-term mobility (e.g. seminar or laboratory visits for a brief period of time) and long-term mobility (e.g. work-related migration for a period of at least several years). Information on travel visa requirements is used to proxy barriers to short-term mobility, while immigration policy towards skilled workers and students will proxy barriers to long-term mobility. These barriers have been shown to matter for mobility of scientists and their collaborations (Appelt et al., 2015; Mavroudi and Warren, 2013; Kõu and Bailey, 2014).

Identifying the effect of administrative barriers is complicated by correlation between the strictness of a policy and physical or cultural distance between countries. The determination of migration policy is driven by macro-level considerations, often of a political or security-oriented nature (Luedtke et al., 2010; Neumayer, 2010; Lawson and Lemke, 2011; Czaika and de Haas, 2016), hence from the perspective of knowledge flows at the micro-level the immigration policy towards skilled workers can be seen as source of exogenous variation. For example, if country A imposes a visa restriction on country B based on security considerations, then the cost of face-to-face contact between researchers from A and B will increase, but the policy does not make knowledge generated in countries A and B less relevant.[3] Controlling for various country, country-time and country-pair factors, the variation in immigration policy is used to identify the effect of administrative restrictions to mobility on the direction and magnitude of knowledge flows. If knowledge's paper trail goes right through the paper walls, then the role of researcher mobility in diffusion of knowledge is likely to be small.

Specifically, this paper explores how immigration policy of the country in which knowledge flow originates (i.e. country of affiliation of the cited author, referred to as 'knowledge-exporting' country) affects its outbound knowledge flows. Do (entry) barriers to mobility at a destination country (i.e. country of affiliation of the citing author, referred to as 'knowledge-importing' country) also reduce inflows of knowledge from other sources? By controlling for knowledge diffusion costs through standard controls used in the literature (physical distance, common language/border and fixed effects to capture other sources of heterogeneity) and exploiting the variation in administrative barriers to mobility, the paper argues that there is a link between bilateral knowledge flows and barriers to mobility.

Knowledge flows are tracked via publication-level citations among economists. The information on citations is taken from Thomson Reuters' Web of Science database for over 430 thousand publications in Economics and almost 6 million cited-citing publication pairs. The dataset includes information on the country of affiliation of all cited and citing authors, but unfortunately, publications prior to 2008 do not explicitly match each author to their respective affiliation. By aggregating citations to the country-level it is possible to track aggregate international knowledge flows without identifying individual author affiliations.

Information on the administrative barriers comes from a new dataset, DEMIG POLICY, which contains information on more than 6500 policy changes in 45 countries over 1721–2014 period, see DEMIG (2015) and further description in Section 3. This dataset was used to construct country-specific indexes of immigration barriers for skilled workers and students. These indexes are then used to examine whether changes in the barriers to mobility affect the magnitude and direction of knowledge flows between country pairs. The results suggest that increased barriers to immigration of skilled workers and students are associated with reduced incoming and outgoing knowledge flows. A placebo test does not reject a causal link from paper walls to knowledge flows. Robustness checks include a measure of barriers to short-term mobility, travel visa requirements. The data on travel visa requirements comes from Neumayer (2011), who collected it from IATA's 2004 Travel Information Manual.

The main contribution of the paper is in showing that administrative barriers to mobility of the skilled also distort knowledge flows at the aggregate level. This effect is estimated to be about 0.8–1.3% per year for a moderate increase in barriers. The results show that the barriers in the cited country are more important (than barriers in the citing country) for flows of recent knowledge, as proxied by citations to papers published at most 1 year ago. Finally, the effect of knowledge-exporting country's immigration policy towards skilled workers and students is persistent, having a significant impact for about 9 years.

The remainder of the paper is organised as follows. The next section provides a summary of related literature and how the current paper contributes to the literature. Section 3 describes the data used in the paper. The framework used for estimating the effects of administrative barriers is explained in Section 4, while the results and robustness checks are presented in Section 5. The final section concludes with a discussion of the findings and their policy implications. Additional tables are collected in the appendix.

2. Related literature

This paper relates to several strands of the literature on the diffusion of knowledge and academic mobility. The first strand is on the impact of various geographic, cultural, informational and economic barriers on the diffusion of knowledge. Another strand is the importance of administrative restrictions to mobility for various economic outcomes, such as trade, FDI, migration and academic mobility. These two strands are linked by a third strand that examines the impact of academic mobility and colocation on the flow of knowledge.

The diffusion of knowledge has been tracked in the literature by patent citations and scientific article citations. One of the big research questions has been on the role of distance in the diffusion of knowledge, with a general conclusion that distance has a negative effect on the diffusion of knowledge (e.g. Drivas and Economidou, 2015). A recent paper by Head et al. (2015) shows that the role of distance declines after personal ties between authors are taken into account. However, distance still matters to the extent it affects the social network. Improvements in telecommunications lower the communication costs for distant collaboration, but face-to-face interaction appears to be a complement, rather than a substitute for electronic communication (Agrawal and Goldfarb, 2008). Another example on the role of distance can be seen in Agrawal et al. (2017) who examine the connection between road infrastructure and innovation and find that better transportation infrastructure allows innovators to access more distant knowledge inputs. This access increases their innovative activity: a 10% increase in the stock of highways causes almost 2% increase in regional patenting over a five-year period.

Factors often used in the empirical gravity literature include common language and common border. MacGarvie (2005) examines how patent citations are affected by the stocks of patent counts, physical distance, common language, FDI, telephone communications, and the 'vintage' of a citation (year of the cited patent). Common language and FDI were found to enhance diffusion of knowledge (for FDI the effect is significant only between technologically-similar countries). The effect of distance is negative, but its importance declines over time. This finding, however, is not always supported by other studies.[4] In a more recent study, Petersen and Puliga (2017) use a gravity framework to assess the role of various push-pull factors in high-skilled labour

[3] In the long-term it's possible that lack of contact between researchers in two countries can lead to an increase in their bilateral cognitive distance, reducing knowledge flows further.

[4] See Morescalchi et al. (2015) for a summary of relevant literature.