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Gali Halevi Dr
Elsevier

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Section 2:
Country Trends

Migration and co-authorship networks in Mexico, Turkey and India

Dr. Gali Halevi

Scientific networks, collaboration and exchange have been discussed in Research Trends before (1, 2, 3). The main reason for the continuing interest in these topics has been the premise that these types of exchanges benefit scientific progress in that they foster innovation, and enhance and enable the flow of ideas between scientists in different institutions. In addition to the ability to track and sketch scientific collaborations between institutions, the availability of author profiles and their affiliation information in **Scopus** has also made possible the tracking of scientific migration from country to country. Research migration or mobility, although related to the formation of networks and collaboration, has unique characteristics and far reaching implications that go beyond the development of collaborative scientific activities. In a migration scenario, collaboration is achieved through the physical move of a scientist from one country to another. In addition to its impact on immigration rates, economy and culture, scientific migration has professional implications as well. Potential outcomes of research migration include: enhanced scientific contributions to the receiving country, the enrichment of its scientific strength, the flow of new ideas and perspectives in different areas of research as well as its potential to develop new products and technologies.

This article describes the co-authorship networks and researchers' migration trends for three scientifically developing countries. It presents case studies on three countries from different world regions: Mexico from Latin America; India from Asia; and Turkey from Europe. It analyzes scientific migration from each of these three source countries to a set of 17 destination countries from all over the world, including both scientifically developing and big, developed countries, including the USA, China, the UK, Japan and Germany. A full list of destination countries is given in Table 1. In addition, it looks at co-authorship patterns between Mexico, India and Turkey and the 17 selected countries and describes the similarities and differences between these two phenomena. The result is an examination of the unique patterns that both these lines of investigation offer and the ways in which each can be used to shed some light on the development of scientific excellence in different areas of the world.



Developing 8 (D-8)	Europe (EU)	BRIC	Other
Egypt	Romania	Brazil	Thailand
Iran	Portugal	China	Australia
Malaysia	Germany	India	Japan
Pakistan	Italy		United States
	Netherlands		
	United Kingdom		

Table 1: 17 set of selected destination countries

We collected the research output of 17 countries among which 10 are considered "growing" or "developing" countries (noted in italic) and 7 are considered as "established" from different regions in the world (see Table 1). For this study, each country's research output for 2000-2012 was collected. In order to trace the movement of researchers from one country to another we used the unique Author ID offered by Scopus as a way to identify individual authors. The affiliations associated with an author ID as they appear on their publications are kept and become part of the unique author profile constructed within Scopus. This allows for an analysis of migration as one can identify from which institution and country an author published research articles in the course of his or her scientific career. Moreover, the fact that the affiliation is tracked per author allows for a comparison between international migration and co-authorship and enables the distinction between the two as separate indicators of mobility and collaboration, respectively.

Mexico co-authorships

Over 15,000 documents were analyzed in order to track the patterns of co-authorship between Mexico and the 17 selected countries. Figure 1 shows the countries Mexico collaborates with as well as the strength of the co-authorship network. The thickness of the lines and the numbers indicated on the map demonstrate the most frequently co-authored countries, which are Brazil in the first place, Pakistan in the second place and the USA in the third place. Other countries Mexican researchers frequently collaborate with are India, Portugal and Egypt.

The collaborative scientific output between Mexico, Brazil, Pakistan and the United States focuses on the areas of Agriculture, Biology, Medicine and Social Sciences.

Migration from Mexico

The migration of researchers from Mexico to the 17 destination countries studied shows a somewhat different pattern compared to co-authorship (see Figure 2). Brazil, the United States and Portugal are the leading destination countries of Mexican researchers. High co-authorship and migration exchange between Mexico and Brazil could be attributed to the fact that both countries are not only the most populated nations in Latin America but also have the largest global emerging economies and are considered to have high regional powers. In addition, both countries focus on common research issues, especially those related to climate change and the environment.

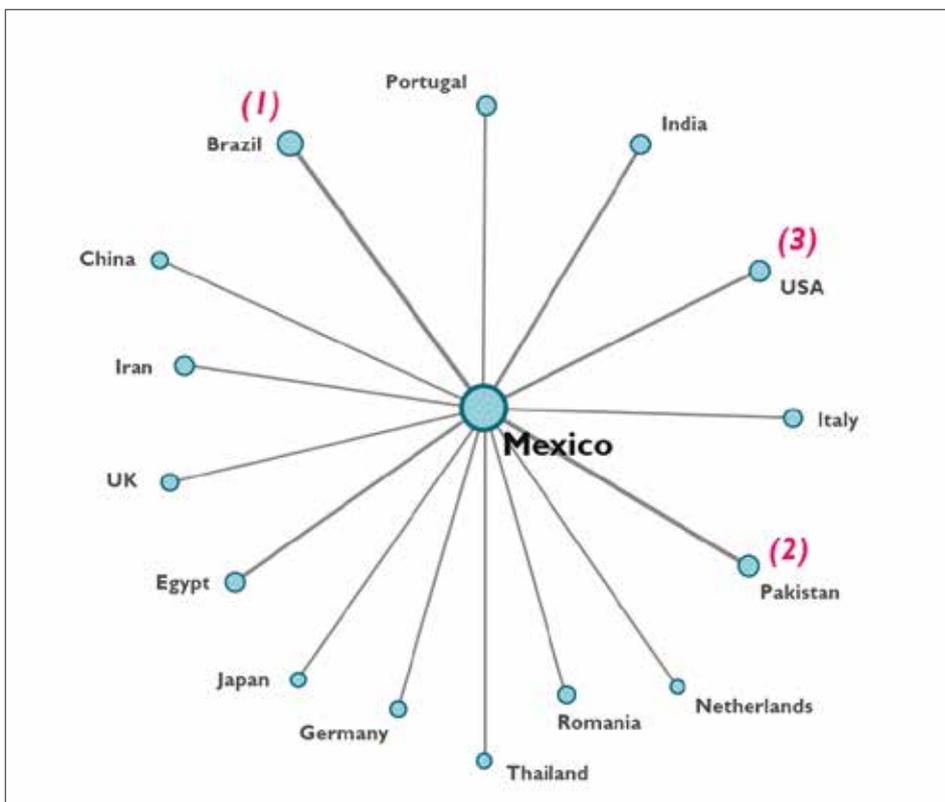


Figure 1: Mexico's co-authorship network (2000-2012)

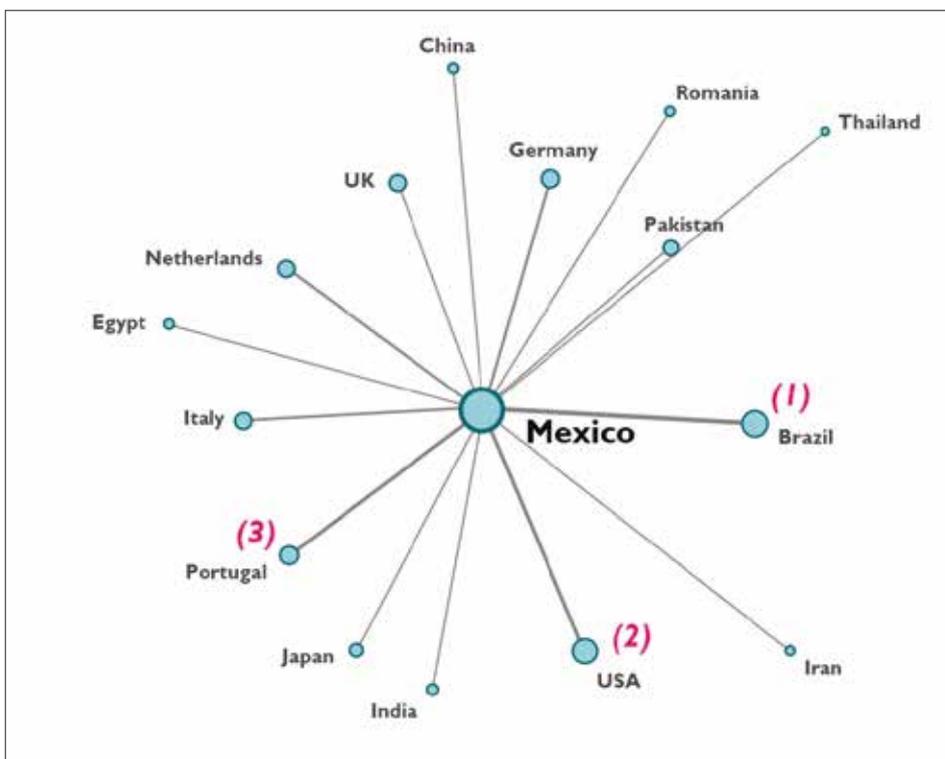


Figure 2: Migration from Mexico (2000-2012)

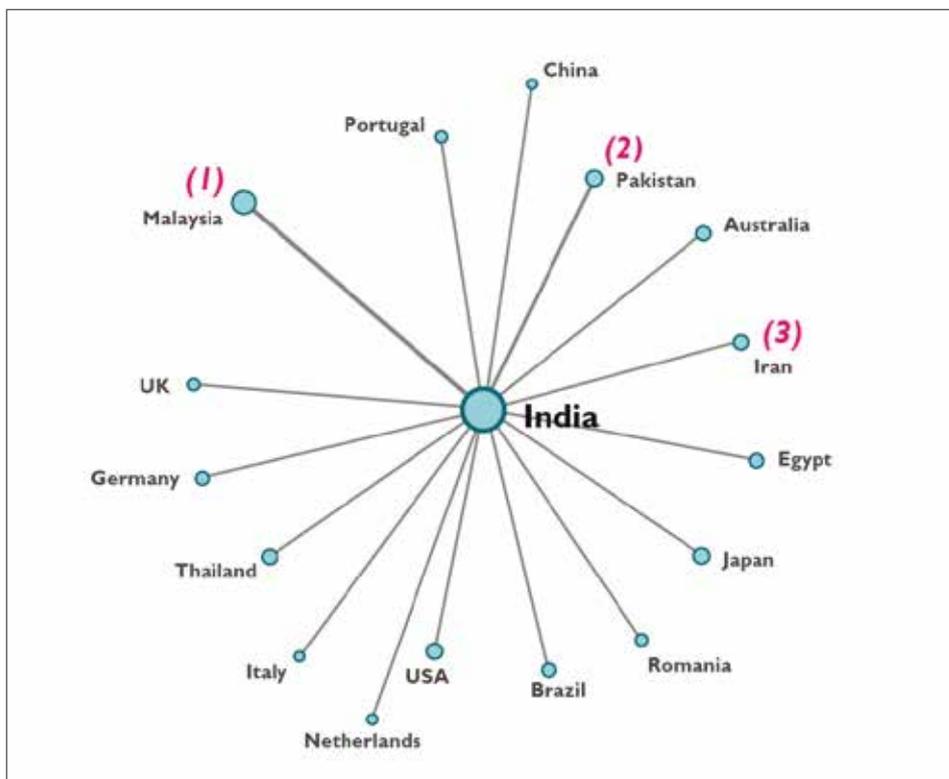


Figure 3: India's co-authorship network (2000-2012)

India co-authorships

India's co-authorship network, as can be seen in Figure 3, is led by Malaysia, Pakistan and Iran followed by Thailand, the United States and Japan. Collaborative research between India, Malaysia and Iran coincides with the close economic relationships between these countries, especially relating to Oil trade. The collaborative scientific output between these countries falls in the areas of Physics, Chemistry and Medicine as well as Materials Sciences.

Migration from India

The migration patterns (see Figure 4) from India show Pakistan and Malaysia as leading destinations followed by the United States, which is somewhat different from the co-authorship patterns of India. Both geographic proximity and close economic ties seem to be the drivers of co-authorships and migration. The migration to the USA might be the result of specialized programs and funding such as the Indo-US Joint Research Programs that received over 200 billion dollars in grants and fellowships in the past year (4).

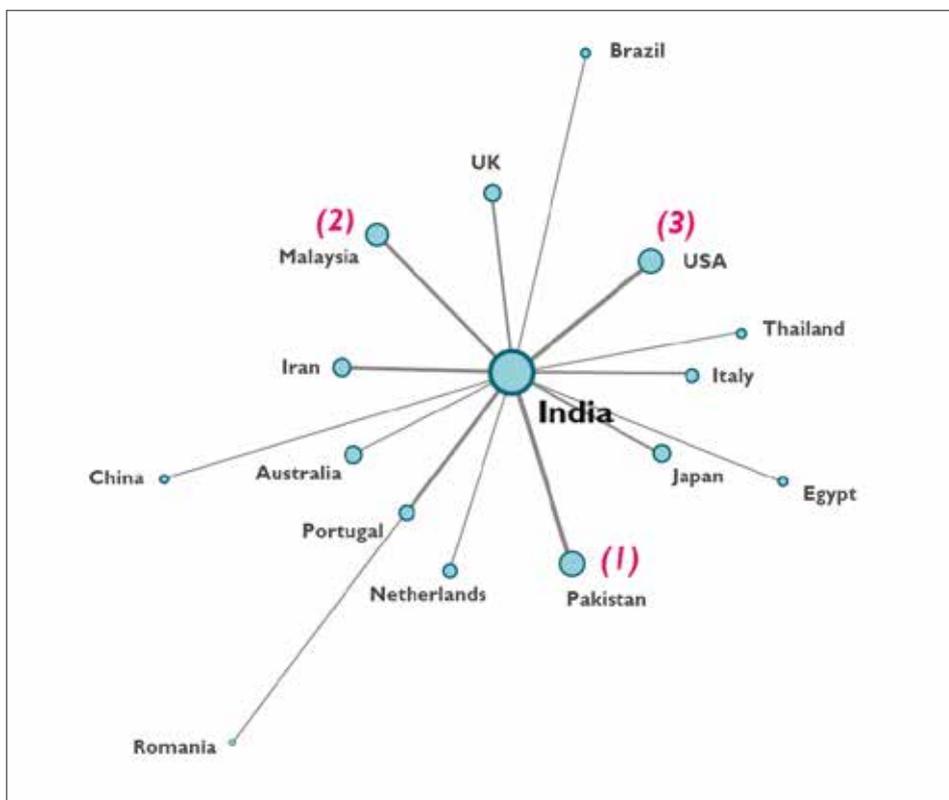


Figure 4: Migration from India (2000-2012)

Turkey co-authorships

Turkey's co-authorship network (see Figure 5) shows strong ties to Pakistan, Iran and Romania and is in areas of Physics, Chemistry and Engineering. The strong ties between Turkey and Pakistan could be the result of the diplomatic efforts to strengthen the economic, educational and technological relationships between the two countries through the High Level Strategic Cooperation Council (HLSCC). Among other topics promoted by the council is the "interaction between universities and academic institutions" (5).

Migration from Turkey

However, the migration from Turkey as depicted in Figure 6 shows a somewhat different pattern. The leading destination country is the United States, followed by the Netherlands and Iran. The high migration to the United States could be attributed to the relatively high number of US National Science Foundation (NSF) funded projects with Turkey. The purpose of these projects is "to promote inclusion of junior researchers in collaborations to stimulate long-term research partnerships." (6). Turkish migration to the Netherlands has historical roots which date back to 1964 when the Dutch government initiated a "recruitment agreement" with Turkey for the purpose of attracting Turkish workers, mainly low skilled laborers, to migrate to the Netherlands. This agreement lasted for 10 years and created a peak in migration from Turkey to the Netherlands in that period.

Summary

Co-authorship and migration patterns can differ, although both are stimulated by economic and diplomatic factors. Grants, fellowships and joint technological projects on national levels drive scientific collaborations, which in turn result in co-authored papers. Migration can sometimes display similar patterns, but is also driven by personal factors such as career opportunities. Although one can see these patterns through the scientific affiliations of published papers, explaining them can only be done by looking at special agreements and diplomatic developments between countries in the preceding years. Language similarity and geographic vicinity are probably some of the factors affecting co-authorships and migration, and though we might not be able to show that through publications since most are published in English, the co-authorship networks could imply that. For migration, however, economic stimuli and opportunities could also be a driving cause, as researchers look to further develop their careers.

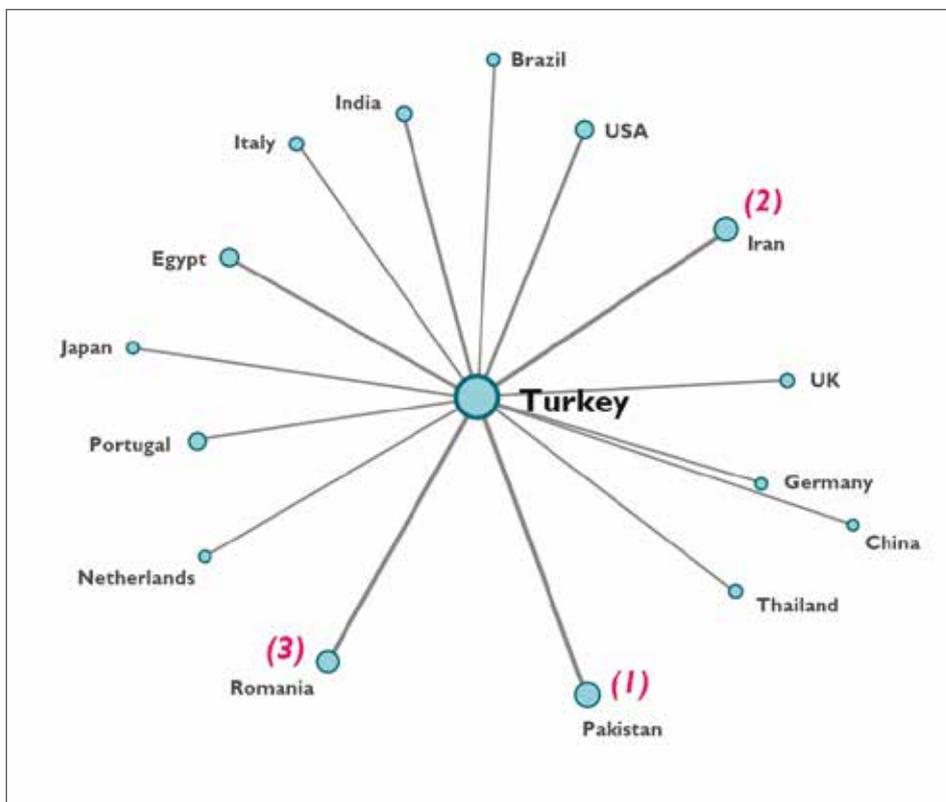


Figure 5: Turkey's co-authorship network (2000-2012)

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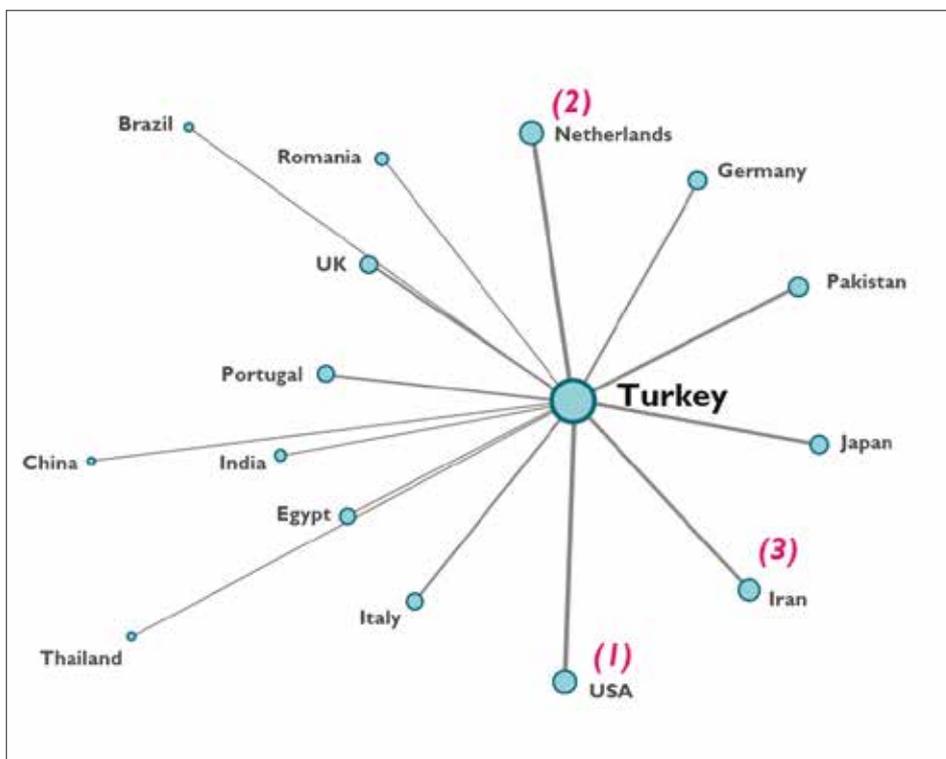


Figure 6: Migration from Turkey (2000-2012)