

# **THE GLOBAL FAMILY PATENTS OF MULTINATIONAL CORPORATIONS**

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## **INTRODUCTION**

Multinational corporations (MNCs) are both important generators of innovation and significant drivers of technology diffusion across countries. Although it has long been argued that MNCs transfer knowledge to their foreign operations (Hymer, 1960; Caves, 1996; Cantwell, 1989) to both overcome liabilities of foreignness and successfully compete in these markets (Hymer, 1960; Zaheer, 1995; Shaver and Flyer, 2000; Berry, 2015), our understanding of the global knowledge generation and diffusion of MNCs is limited because there is no research (of which I am aware) that has actually examined the worldwide patenting and diffusion of knowledge by MNCs. Although several studies have analyzed patent data from only one patent authority and considered differences in the multi-country innovations of these firms (Zhao, 2006; Singh, 2008; Berry, 2014) or differences in the local versus foreign citations of the parents of these firms (Almeida, 1996; Singh, 2008), these approaches can only provide a partial picture of the global generation and diffusion of knowledge by MNCs because it is impossible to know whether patented firm knowledge has equivalent patents in other countries or whether a firm has innovations it has only patented outside of its home country when using data from one patent-granting authority. In addition to underreporting the actual global innovation activities of MNCs, this also lessens the theoretical and empirical lenses from which one can analyze the global innovation of MNCs. This paper overcomes these problems by merging together data on the worldwide operations of US MNCs from the Bureau of Economic Analysis (BEA) with family patent data from Thomson Innovation's Derwent World Patent Index (DWPI). Using this database, this paper is the first study on global innovation and diffusion to provide a comprehensive look at the global knowledge generation and diffusion of US MNCs, to offer three mutually exclusive categories of global family patents, to provide a comprehensive look at the global knowledge generation and diffusion of US MNCs and to reveal how firm and competitor scope of activities influence the global knowledge diffusion of MNCs.

## **GLOBAL PATENTS AND FAMILY PATENTS**

To explore the global diffusion of knowledge by MNCs, I take as my starting point the idea that internationalizing a patent is an important precondition for technology transfer and knowledge diffusion because if a firm holds a patent right in a country, it is more likely to actively share its proprietary technology with foreign operations and/or relocate production to that country. This assumption implies that the international patents of firms offer important insights into the global diffusion of knowledge by firms.

However, it is not so easy to study the international patenting of firms because there is no such thing as a "global" patent. If a patent is patented worldwide, it means that an inventor has a collection of different patents across national patent-granting authorities. Because patents are territorial and jurisdiction-specific, intellectual property protection for innovations must be applied for within individual countries. This creates a situation where a single idea might have

many individual patents associated with it, depending on the countries in which an inventor seeks protection. A patentee will have patent rights enforceable in a country in which she has a patent. This has given rise to what are called “family” patents.

When an inventor seeks protection for his or her innovations across multiple countries, there will be many equivalent documents associated with this one innovation. These multiple, similar patents can be grouped into a family of patents, which are linked together through *priority* details. Priority is established by the application date assigned in the first country in which the invention was filed for protection. Under the Paris Convention, if the invention is filed in another convention country within one year of the original filing, the patent in the second country can claim the original priority date. (And the country in which the priority application was filed is assumed to be the country in which the invention was developed.) After twelve months, innovators may still file for patents in other countries, but the priority from the original filing date (in the original filing country) is no longer granted in other countries. Although not all patent databases track family patents beyond the twelve month filing period (i.e., the European Patent Office PATSTAT data), the DWPI database I use below does track all filings when creating their family patents.

In addition to the Paris Convention, innovators may also pursue simultaneous patenting across multiple countries. The Patent Cooperation Treaty (PCT) was concluded in 1970 and one goal of this convention was to eliminate the threat of an inventor’s work from being stolen and used in another country. The PCT allows firms to seek patent protection simultaneously by filing a single “international” patent application with the World Intellectual Property Organization (WIPO) instead of filing several separate national or regional patent applications. The granting of these patents remains under the control of the national or regional patent offices in what is called a national phase. For these “international” patents, inventors have 30 months from the filing date of the international application to enter the national phase in any country where patent protection is sought. In addition, since the European Patent Convention (EPC) from 1973, the European Patent Office (EPO) has a centralized patent granting procedure for its member states (with inventors designating in which nations they are seeking coverage) Innovators can choose to file a patent application within any EPO covered country or through the EPO office. In both EPO and specific European country patents, innovators must pay fees to the national patent offices and action against infringers is taken in national courts. Both the WIPO and EPO “international” patents can get very expensive because national fees need to be paid to each country and translations into the language of each country may also be needed.

Based on these patent policies and procedures across countries, I can identify three types of global family patents which are mutually exclusive in terms of when or whether firm knowledge is diffused beyond one country. First, are the single-country patents, which include patents of home and foreign-origin that stay in one country. These can be granted under any one patent granting authority (including home or foreign markets for MNCs), but the common aspect of these patents is that they do not leave the originating country. Second, are the foreign equivalent family patents, where firm knowledge is transferred to another country after being introduced in an originating country. These offer protection for firm knowledge that was generated in one country, but is being used in another country. And third, are the family patents that involve the quickest and broadest type of knowledge diffusion from the start, the born global family patents, which are those that are introduced at the same time across several country locations (with the born global family patent category including both the regional EPO and world-wide WIPO patents). These “global” family patents offer firms the ability to vary their

degree of knowledge diffusion both in terms of the speed and extent to which firm knowledge is diffused.

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Regarding my claim that studies using data from one patent generating authority are likely to be underreporting the actual knowledge generation and knowledge diffusion of MNCs, the raw data reveal that over one third of the foreign originating patents of US MNCs have not made their way to the USPTO (either through a patent equivalent or through the WIPO global patent process). While the raw data certainly reinforce prior findings regarding the importance of the home country for knowledge generation by US MNCs (Berry, 2014), with about two-thirds of all patents originating from the US, this information highlights that empirical research on the global innovation of US firms based on the patents from the USPTO are missing foreign generated innovations. This issue is probably larger for studies that use the USPTO data while analyzing non-US firms. The other interesting fact that emerges from the raw data is that foreign originating patents of US MNCs have a higher rate of diffusion than US originating patents. This higher diffusion rate could have to do with regional strategies or firms pursuing global centers of excellence and future research could certainly explore in more detail when and why foreign generated knowledge has a higher diffusion rate than US generated knowledge.

## **MULTIMARKET COMPETITION AND GLOBAL INNOVATION**

With these categories in mind, I now consider the influence of both firm and competitor scope of activities on the diffusion of firm knowledge to understand differences in the timing and extent of knowledge diffusion by MNCs. Building on insights from the multi-market competition and knowledge management literatures, I consider how differences in the scope of activities of both MNCs and their industry competitors influence the timing and extent of knowledge diffusion by MNCs.

Although competition has long been argued to play an influential role in foreign expansion (Knickerbocker, 1973; Flowers, 1973; Yu and Cannella, 2013), the effects of home and foreign rivals on knowledge diffusion has not as yet been examined. Building on studies in the multimarket competition literature that have shown the importance of internal coordination and integration (Golden and Ma, 2003; Yu, Subramaniam and Cannella, 2009), this study argues that higher competition from home-country rivals will necessitate a broader role for firm knowledge across their foreign operations and institutional protections for this knowledge in case of imitative behaviors by key home-country competitors. The results show that higher competition from home country rivals abroad is positively and significantly associated with both foreign equivalent family patents in comparison to single country patents and born global family patents in comparison to single country patents.

I also consider the impact of foreign rivals and argue that more extensive scope of activities by foreign firms in the home country of MNCs will encourage the quickest and most extensive type of global knowledge diffusion by MNCs due to the much less familiar foreign competitors and the more immediate importance of competition in the home markets of these invading foreign competitors (Hutzschenreuter and Grone, 2009). The results confirm that higher patenting by foreign rivals in a firm's home country is positively and significantly

associated with born global family patents. Although not hypothesized, the results also show that higher foreign patenting is negatively and significantly associated with foreign equivalent family patents (compared to both single country patents and born global patents). This suggests that when faced with high foreign competition in a home market, MNCs are more likely to pursue born global family patents over either of the other categories, but are also more likely to keep their knowledge at home versus diffusing that knowledge through foreign equivalents. This may suggest a trade-off between exposing firm knowledge quickly and broadly versus keeping tight control over knowledge in the country in which the innovation was generated. Future research could certainly explore this further because this trade-off implies very different competitive dynamics with foreign rivals – especially when foreign rivals are patenting their knowledge in the home country market of the MNC.

Finally, I argue that the more valuable firm knowledge is, the less likely it is to be exposed quickly and widely across countries because of the difficulties associated with transferring more complex technology (Teece, 1977; Szulanski, 1996; Berry, 2014) and spillover and appropriation risks more generally ((Blomstrom and Kokko, 1998; Javorcik, 2004). The results confirm that the category with the quickest diffusion (born global family patent) are on average less valuable than single country patents. However, it is also interesting to note that the MNC R&D intensity control shows that born global patents are likely to originate from MNCs with lower overall R&D intensities compared to single country patents. Taken together with the foreign competition finding, these results suggest that although increased competition from foreign rivals in a firm's home market may encourage quicker and wider diffusion of firm knowledge, either this competitive dynamic does not encourage these firms to send their most valuable knowledge or this competitive dynamic has more of an influence on less R&D intensive firms. Even within industries, there are different groupings of players, and further research could certainly consider whether strategic groups within industry (and more or less knowledge intensive firms) are differentially by foreign rivals in their market. At a minimum, the present study shows differences in the value of knowledge across family patent categories, confirming that more valuable firm knowledge is less likely to be exposed quickly and widely across countries and revealing that this knowledge is more likely to either remain within one single country or be diffused more slowly through foreign equivalent patents.

Although the majority of studies analyzing the global innovation of MNCs consider patents from only one patent-granting authority, this paper argues that this underreports the actual global innovative activities of these firms and provides at best, an incomplete picture of both knowledge generation and knowledge diffusion by MNCs. While there are a few studies that have examined technology transfers across countries using data on patent families (see Eaton and Kortum, 1996; Johnstone and Hascic, 2009; and Johnstone, 2010), they have focused exclusively on the country level of analysis and traced the diffusion of specific technologies across OECD and developing countries, for example. This paper goes beyond extant research and contributes to our understanding of the global generation and diffusion of knowledge by MNCs by offering three mutually exclusive categories of global family patents, by providing a comprehensive look at the global knowledge generation and diffusion of US MNCs, and by revealing how firm and competitor scope of activities influence the global knowledge diffusion of MNCs.

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