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Tracking the internationalization of multinational corporate inventive activity: national and sectoral characteristics

Floortje Alkemade[a,c,*], Gaston Heimeriks[a], Antoine Schoen[b], Lionel Villard[b], Patricia Laurens[b]

[a] Innovation Studies, Copernicus Institute of Sustainable Development, Utrecht University Heidelberglaan 2, 3584CS Utrecht, The Netherlands
[b] Université Paris-Est–ESIEE–LISIS–IFRIS 2, bd. Blaise Pascal, 93160 Noisy Le Grand, France
[c] School of Innovation Sciences, Eindhoven University of Technology, PO Box 513, 5600 MB Eindhoven, The Netherlands

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ABSTRACT

This paper introduces a unique database, the Corporate Invention Board (CIB). The CIB combines patent data from the PATSTAT database with financial data from the ORBIS database about the 2289 companies with the largest R&D investments. We illustrate the database by showing a comprehensive overview of national and sectoral patterns of R&D internationalization by multinational corporations in the period 1993–2005. The results show heterogeneity in sectoral and national patterns of internationalization. These patterns have remained relatively stable over the 1993–2005 period. China is among the least internationalized countries and European countries, especially the UK and the Netherlands, are among the most internationalized countries. The largest countries in terms of patent production, such as Germany and the US, have internationalization profiles that can be very well predicted based upon their sectoral composition. Other country profiles, however, diverge significantly from the prediction based on sectoral profile. Asian countries are on average less internationalized than would be expected, whereas the European countries and Canada are more internationalized. We find that while national level indicators explain a large part of the variance observed in the ability of countries to attract R&D from foreign multinationals, there are significant differences between sectors and this has large implications for the design of foreign R&D and innovation policies. The CIB opens up a wide array of opportunities to study the internationalization strategies of firms and countries.

1. Introduction

The ongoing internationalization of the R&D activities of firms is a subject of considerable interest to policymakers (UNCTAD, 2005; OECD, 2005), as innovation is recognized as a main driver of productivity and growth for countries, as well as a vital resource in addressing societal challenges. Policy concerns focus on the potential loss of jobs and economic benefits, the potential loss of competitiveness of domestic firms, and the impoverishment of the local knowledge base associated with the increasing local R&D presence of foreign-owned firms and the decreasing presence of R&D by domestic firms (Dunning and Lundan, 2009; Moncado-Paternò-Castello et al., 2011; Carlsson, 2006). Especially the increasing importance of Asian countries as R&D location (Heimeriks and Boschma, 2014) leads to a growing concern among policy makers for hollowing out the national innovation system (Narula and Zanfei, 2005). Many countries therefore have policies in place to enhance their R&D climate, promote inward foreign direct investment in R&D (FDI), and absorb the benefits of both inward and outward FDI. Any policy making in this area starts from the availability of adequate data on the internationalization of the R&D of multinationals.

Empirical research into the drivers of the internationalization of corporate invention in recent years has identified R&D internationalization as a very heterogeneous process where, in addition to national and company related considerations, sectoral considerations are important. More specifically, significant differences in the international dispersion of innovative activity across sectors and countries have been identified. Some small economies, such as Belgium, the Netherlands and Switzerland have internationalized their innovative activity at a faster rate than their production

* Corresponding author at: Innovation Studies, Copernicus Institute of Sustainable Development, Utrecht University Heidelberglaan 2, 3584CS Utrecht, The Netherlands. Tel.: +31 402477325.
E-mail addresses: F.Alkemade@uu.nl (F. Alkemade), Gheimeriks@gmail.com (G. Heimeriks), a.schoen@esiee.fr (A. Schoen), villardl@esiee.fr (L. Villard), p.laurens@esiee.fr (P. Laurens).

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activities (Narula and Zanfei, 2005). This is not case for all countries, which emphasizes the continued importance of national and regional institutions and arrangements (Storper, 1993; Crescenzi et al. 2007, 2012). Likewise, there are also considerable industry-specific differences that encourage or discourage concentration in as few locations as possible (Cantwell, 1989). However, there is currently insufficient evidence to identify general patterns of internationalization of corporate invention with respect to sectoral and national characteristics.

Moreover, while these previous studies have yielded many valuable insights, their level of analysis is usually the multinational company rather than the (national) innovation system, which makes it more difficult to extract policy implications(Archibugi and Iammarino, 2002; Cantwell and Piscitello, 2000). In addition, earlier studies suffer from limitations in data quality. In this paper we follow earlier researchers in using patents, a measure of the output of inventive activity, to identify the internationalization of the inventive activity of multinationals. While several important contributions have used patents to study the globalization of R&D, the data quality of existing patent databases has caused these studies to either use only a subset of multinationals, or all patents (including those from non-multinational actors) in their analysis. Or as Picci and Savorelli stated regarding cleaning data on the entire set of multinational actors: "it would be prohibitively costly to do so" (Picci and Savorelli, 2012). As a result, there is currently insufficient evidence to identify the internationalization of corporate invention with respect to sectoral and national patterns. Informed innovation and (foreign) R&D policies do however critically depend on (1) a good and precise overview of the R&D of multinational enterprises, and (2) insights into the relevance of global, national, and sectoral drivers of *inward* and *outward R&D* flows on the national level. Both are currently lacking.

The aim of this paper is to introduce a unique and previously unavailable database, the Corporate Invention Board (CIB). The CIB combines patent data from the PATSTAT international patent database with financial data from the ORBIS database about the 2289 companies with the largest R&D investments. Merging the two datasets required substantial cleaning and disambiguation of the firm data available in the PATSTAT database. The industrial corporations included in the CIB account for 80% of world total private R&D[1], of the 2289 MNC's, 730 have their corporate headquarters in Asia, 1002 in Europe and 538 in northern America. This unique database allows us to characterize the nature and the extent of technological internationalization, and to analyze the transformation of global patent portfolios of multinational corporations in the last decades. As a measure for the internationalization of R&D, we use transnational priority patents, patents that have been applied for in at least two countries. The sample used in this paper consists of the 712 333 transnational priority patents applied for by the 2289 CIB companies in the period 1993–2005. The (CIB) database has been designed specifically for studying the internationalization of R&D.

As such, the CIB allows for a more evidence based approach than most existing studies that rely on surveys (Gorg and Strobl, 2001), or on a smaller sample of patents within a given sector (Almeida, 1996) or country (Patel and Vega, 1999). Our study is similar to recent studies (Picci and Savorelli, 2012; Picci, 2010), in that it uses worldwide patents. Their use of the PATSTAT database as the single source of data does however not allow distinguishing different types of actors, while the CIB enables to identify multinational corporations, their subsidiaries and link patents to these actors.

The paper proceeds as follows. First, in Section 2 we describe prior work in the area. Section 3 discusses the dataset, and the data collection process and gives some descriptive statistics. The different patterns of internationalization are discussed in Sections 4 and 5, and their relative contributions in Section 6. Finally, Section 7 concludes.

2. The internationalization of R&D

The home country of a multinational corporation (MNC) is usually also its preferred R&D location. The R&D activities of firms seem more difficult to internationalize than other firm activities and the internationalization of the innovative activities of MNCs has lagged behind that of their productive activities (Pavitt, 2001). This centralization of R&D in the home country is explained both from the alignment and co-evolution of MNCs with the innovation system in their home country as well as from economies of scale and agglomeration in R&D. Furthermore, the national specificity of countries is reflected in the product life-cycle. New products are introduced to meet local (i.e., national) needs, and new products are first exported to similar countries, countries with similar needs, preferences, and incomes (Klepper, 1996). Patterns of internationalization thus, change over time.

The past decades have seen a notable increase in the internationalization of corporate R&D (Dunning and Lundan, 2009), increasing the relevance of research into the national and sectoral factors that determine foreign R&D investment. Research on locational factors distinguishes two sets of motives from a corporate perspective for international R&D (Kuemmerle, 1997). In the early literature, such R&D was mostly found to be of a home-base exploiting nature (Casson et al., 1992; Pearce and Singh, 1992). This type of R&D, also called product adaptive R&D, focuses on the exploitation of the home based capabilities of the MNC abroad. While the availability of R&D personnel in the host country does play a role in the location decision, the size of the host market (mostly measured in GDP) is the most important locational factor here.

In recent years, a rise in a second type of R&D internationalization has been observed. This type of R&D, termed home-base augmenting R&D, focuses at generating new knowledge and competencies for MNCs and has increased since the 1990s (Cantwell and Mudambi, 2005; Kuemmerle, 1999; Iammarino and McCann, 2013; Von Zedtwitz and Gassmann, 2002). Home-base augmenting strategies are argued to be particularly important for MNCs that seek to protect their global competitive position and cause firms to move their R&D into locations which have an advantage in a certain area of technology, Florida, (1997) calls this a 'technology-oriented posture'. The quality and character of national innovation systems (Lundvall et al., 2002) is thus important for this type of strategy, as is the sector specific need for technological knowledge.

The tendencies for R&D centralization and internationalization are not equally distributed among sectors. The importance of sectoral considerations is (implicitly) highlighted in the literature at the corporate level (Malerba and Orsenigo, 1996). Empirical evidence suggests that economic factors, such as profitability, capital intensity, and demand size and growth, have little explanatory power with regard to the observed variety of geographical patterns among sectors and that, in order to explain this variety, it is necessary to take into account the nature of technological knowledge in different industrial sectors (Marsili, 2001; Dosi et al., 2006).

Sectors are fundamentally shaped by the underlying conditions affecting the creation and reproduction of technological knowledge. These 'technological regimes' (Winter, 1984), play an important role in determining the interdependencies between industry characteristics and spatial agglomeration. (Nelson and Winter, 1982; Cantwell, 2001). Research focusing on the sector specific features of innovative activities and industrial dynamics, proposed categories that group sectors on the basis of the

[1] http://iri.jrc.ec.europa.eu/scoreboard.html.