



## Are patents with multiple inventors from different countries a good indicator of international R&D collaboration? The case of ABB

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### ABSTRACT

Based on the critical case of ABB, this paper questions the relevance of using patents with multiple inventors from different countries (“cross-country patents”) as an indicator of international R&D collaboration. The study shows that less than half of ABB’s cross-country patents are the result of international R&D collaboration as described by one of the more inclusive definitions found in previous literature. Only a third of the patents are the result of joint R&D activities between different MNC subsidiaries or firms. We also discuss the implications of our study for the assignment of patents to countries based on inventor addresses.

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### 1. Introduction

The internationalization of R&D and technological activity has been described as a “key constituent of the globalization of trade and business, with potentially major impacts on patterns of economic development and public policies worldwide” (Meyer-Krahmer and Reger, 1999, p. 752). It is, thus, not surprising either that there is a large number of scientific studies of this process, or that several of these studies have found evidence of an increasing internationalization of technological activity (primarily R&D) by multinational corporations (MNCs) (cf. Archibugi and Coco, 2001; Gassmann and von Zedtwitz, 1999; Gerybadze and Reger, 1999; OECD, 2004; Patel, 1995; Patel and Vega, 1999).

Technological internationalization by MNCs may come in a variety of different forms: international exploitation of technology produced on a national basis, global technological collaborations and global generation of innovations by MNCs (cf. e.g. Archibugi and Michie, 1995). In this paper, we are primarily concerned with R&D collaboration involving either cross-border projects within the internal R&D networks of individual MNCs or projects involving MNCs and firms in other countries.

Both these forms have been studied empirically using patent data as an indicator of collaborative technological activity. In particular, the apparently ‘inherent’ international and collaborative nature of patents with multiple inventors from more than one country (from here on named ‘cross-country patents’) has caught

the attention of a number researchers, who argue that they can be used as an indicator of international R&D collaboration. That patents with multiple inventors is an indicator of collaboration is argued by, for example, Ma and Lee (2008, p. 382) who state that “. . . the presence of multiple inventors is a clear indicator of collaborative inventive activities” and by Carayol and Roux (2007, p. 278) who claim that when two people appear as inventors of the same patent, it “reveals a strong and deliberate collaboration between two persons.” With reference to the more specific issue of international R&D collaboration, Archambault (2002, p. 21) argue that the largest advantage of tabulating statistics for every country that participates in inventions is the ability to identify trends in international collaboration: “. . . calculating data for multiple addresses . . . reveals the patterns of collaboration in technological development.” Similarly, according to Archibugi and Pianta (1996) international collaborations are revealed in the rapid growth of patents with inventors from different countries. Examples of studies applying this indicator include Guellec and van Pottelsberghe de la Potterie’s (2001) study of European Patent Office patents with several inventors residing in different countries, Yamin and Otto’s (2004) investigation of the collective knowledge sharing of 20 MNCs in the biopharmaceutical industry (in which they counted the share of patents with inventors in more than one country), a study by Frost and Zhou (2005) of the R&D co-practice in the pharmaceutical and automotive sectors, Cincera et al.’s (2006) study of (among other things) international collaboration between Belgian inventors and inventors from other countries and Singh’s (2008) study of cross-regional ties between inventors.

However, no evidence has been presented in the literature that cross-country patents are either truly international (i.e. the result of joint activity between inventors from different countries), or the

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**Table 1**  
Principles for assignment of cross-country patents (by papers using the principle).

Assignment principle	Papers in which the principle is used
First-named inventor	Acs et al. (2002), Bottazzi and Peri (2003), Cantwell and Kosmopoulou (2001), Cantwell and Piscitello (2005), Cantwell and Vertova (2004), Corrocher et al. (2003), Ejermo (2003), Frost (2001), Hu and Jaffe (2003), Patel and Vega (1999), Singh (2008), Sorenson and Fleming (2004), Stolpe (2002) and Trajtenberg (2001)
Fractional counting	Bergek and Berggren (2004), Criscuolo et al. (2005), Dachs and Schibany (2004) and Stolpe (2002)
Multiple counting	Archambault (2002), Grupp and Schmoch (1999), Guellac and van Pottelsberghe de la Potterie (2001), Tijssen (2001) and Yamin and Mäkeläinen (2002)
Majority counting	Jaffe et al. (1993) and Mariani (2004)
Not specified	Almeida and Phene (2004), Cantwell and Piscitello (2000), Eaton and Kortum (1996), Edler (2004), Furman et al. (2002), Jaffe and Trajtenberg (1996), Le Bas and Sierra (2002), Patel (1995, 1996), Patel and Pavitt (1991), Yamin and Otto (2004) and Zander (1999, 2002)

result of real R&D collaboration rather than of other kinds of (technological) activities.<sup>2</sup> In light of this, the purpose of this paper is to examine the cross-country patents of one MNC (ABB) in order to answer the following questions: (1) To what extent are ABB's cross-country patents international and what characterizes the cross-country patents that are not international? (2) To what extent are ABB's international cross-country patents the result of activities corresponding to the notion of R&D collaboration as described in previous literature and what is the origin of those patents that are not the result of R&D collaboration? (3) What are the implications of this case study for the relevance of using cross-country patents as an indicator of R&D collaboration?

The paper is structured as follows. In Section 2, we review previous work on international R&D collaboration in order to understand how the concept of international R&D collaboration can be interpreted, and develop a scheme of analysis that will guide the empirical analysis. Section 3 provides a description of the case selection and data collection method used. In Section 4, we analyze the cross-country patents of ABB, and the activities underlying them, according to the scheme of analysis in order to answer the questions outlined above. We show that a large share of ABB's cross-country patents is not truly international, but rather the result of some spurious features of the patent registration system. In particular, inventor movement creates many false cross-country patents. We also show that most of the international patents are not the result of R&D collaboration as described in the literature. More specifically, a large share of these patents is the result of either intra-organizational interaction or non-R&D activities. Finally, in Section 5 we sum up our conclusions. We argue that our study casts serious doubts on the relevance of using cross-country patents as an indicator of international R&D collaboration. We also discuss the implications of our study for further research in more general terms; in particular we discuss the difference between established principles for assigning cross-country patents to countries for the purpose of identifying the location of inventive activities and give some recommendations to researchers with regards to this issue.

## 2. Cross-country patents as an indicator of international R&D collaboration: literature review and scheme of analysis

### 2.1. Introduction

The focus of this paper is international R&D collaboration. In a general sense, the concept of 'collaboration' describes various situations when two or more partners (people or organizations) interact with each other to produce some kind of outcome. When R&D collaboration is concerned, the focus is obviously on research

and development activities. The word 'international' implies that more than one country is somehow involved. Although perhaps specific enough for more general discussions, this definition allows for a broad range of activities and organizational arrangements and does not reflect, to a full extent, the more specific definitions found in literature. In this section, we will, therefore, review the previous literature in order to qualify the concepts of 'international' and 'collaboration', by identifying categories that, describe the degree to which an activity is international and collaborative, respectively. Based on this categorization, we will develop a scheme of analysis that will be applied in the empirical analysis in the next section.

### 2.2. What characterizes 'international' R&D?

The internationalization of R&D is essentially about the distribution of R&D activities across national borders. What is meant by 'international' is, however, far from clear. In order to clarify the discussion of this topic, we take our departure in the three categories of globalization of innovation developed by Archibugi with colleagues: (1) the international exploitation of technology produced on a national basis, (2) global technological collaborations, i.e. agreements between firms for joint development, and (3) the global generation of innovations by MNCs (Archibugi and Michie, 1995; Archibugi and Iammarino, 1999). Similar to this paper, the unit of analysis of this categorization is the innovation or project level (Archibugi and Iammarino, 1999).

Since the first category is concerned with exports of goods, licensing and production rather than with R&D activities (cf. Archibugi and Iammarino, 1999, Table 1), we will focus the discussion on the second and third categories. The second category includes cases where two different firms, located in two or more countries, decide to establish a joint venture to develop technology (Archibugi and Pietrobelli, 2003). In relation to the definition of 'international', the focus of this category is thus the geographic dispersion of the participating companies between different countries. The third category (the global generation of innovation by MNCs) refers to innovation generated by single proprietors on a global scale (Archibugi and Pietrobelli, 2003). 'International' is here defined primarily in terms of the location of R&D activities outside the home country of the company. For example, the empirical data presented by Archibugi and Iammarino (1999) concern innovation generated outside the home country of the parent companies and all the three strategies for global generation of technology discussed by Archibugi and Pietrobelli (2003) describe R&D activities as primarily local in nature (either in home or host countries) rather than spanning national borders.<sup>3</sup>

Two main perspectives on how to define 'international' R&D activities thus emerge from this categorization: (a) R&D activities distributed between multiple national locations and (b) R&D

<sup>2</sup> Although Meyer and Bhattacharya (2004) discuss the relevance of applying co-authorship analysis to co-invented patents, they never question that they are the result of collaborative inventive efforts.

<sup>3</sup> The resulting technology is, however, commonly thought of as shared across the organisation (cf. Almeida and Phene, 2004).

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