



Co-owner relationships conducive to high quality joint patents



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ABSTRACT

Multi-country joint ownership of a patent positively impacts patent quality, which is evidenced by their receiving statistically more forward patent citations than patents co-owned within a single country. This paper also considers the possibility that university partnerships and income differences between international co-owners further influence joint patent quality. Multi-country co-ownership in countries with similar per capita incomes enhances the likelihood a joint patent is high quality in the short run, when quality is assessed as forward citations received within three years. However, this short run benefit disappears when differences in national patent regimes are controlled for in the analyses. Finally, although co-ownership with a university is not found to have an immediate impact, it does enhance the likelihood that a joint patent is classified as high over the life of the patent.

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1. Introduction

Policymakers continue initiatives to enhance patent quality (USPTO, 2015). Joint patent ownership increasingly appears to be one component to achieving this goal. Belderbos et al. (2014) and Briggs and Wade (2014) find that the quality of jointly owned patents exceeds that of single owner patents. This paper builds on these results to reveal that quality is statistically higher in joint patents with co-owners in multiple countries. Knowledge about which types of co-ownership best enhance quality is not only beneficial to policymakers, but it may also provide useful information to firms that are deciding which collaborative research efforts will most impact firm value. Hall et al. (2005) estimate that receipt of one additional forward citation (a commonly accepted measure of patent quality) can increase a firm's stock value by as much as 3%.

The analysis in this paper is executed using a panel of patent data from the European Patent Office (EPO) between 1978 and 2009 to explore the factors that influence joint patent quality. This data source provides an extensive subsample of jointly owned patents, with information on the country of origin of all patent owners. It also provides detailed information on the list of International Patent

Classification (IPC) technology classifications associated with each joint patent. Identifying technology classifications is critical as patent quality thresholds are commonly believed to be sector specific (Acs et al., 2002; Hagedoorn and Cloudt, 2003; Schmoch, 2008).

A 'high quality' patent threshold is identified for every three-digit IPC level. This heterogeneous threshold is used to compute a binary variable that categorizes a joint patent as high quality or otherwise. Employing logistic regression analysis, the probability that a joint patent is high quality is computed as depending on three key factors: (1) cross-country co-ownership, (2) income differences across co-owners, and (3) the presence of a university co-owner. In all, the results suggest that cross-country co-ownership has a strong and positive influence on the likelihood that a joint patent is high quality. Cross-country co-ownership among firms in countries with similar income levels enhances quality in the short term (as based off of forward patent citations received within three years), but eventually becomes inconsequential in the long run (when quality is assessed in terms of citations received throughout the life of the patent). Contrastingly, co-ownership with a university appears to have a delayed impact on quality, impacting forward citations received over the life of the patent, but not citations received within three years. Rationale and discussion of these findings are presented in the subsequent sections of this paper.

This paper will proceed with a more detailed discussion of related literature on joint patents. It will then formally discuss the

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data and model before presenting the results. Finally, the paper will conclude with a discussion of what the findings could mean for firms and policymakers.

2. Literature review

While the literature on research and development (R&D) collaboration is significant (e.g., [Faems et al., 2005](#); [Hoekman et al., 2010](#); [Hottenrott and Lopes-Bento, 2012](#); [Letaifa and Rabeau, 2013](#); [Freeman et al., 2014](#); [Lin et al., 2014](#)), literature specific to joint patenting is relatively scarce. Joint patenting, also known as co-patenting, is a phenomenon in which more than one firm possesses full ownership of a patent. As underscored by [Belderbos et al. \(2014\)](#), joint patent ownership is not necessarily a clear indication of collaborative research efforts; rather, it combines information on R&D collaboration and its [intellectual property] sharing arrangement (p. 845). It is possible that collaborative R&D efforts result in a patent with a single owner or no patent at all. The appropriateness of using patents to approximate innovativeness is a well-documented debate ([Pavitt 1988](#); [Griliches, 1990](#); [Freeman and Soete, 1997](#); [Acs et al., 2002](#); [Hagedoorn and Cloudt, 2003](#)). This paper acknowledges that joint patents may not capture all collaborative research efforts and subsequent innovation from such efforts, but instead captures a subset of collaborative efforts.

The current literature on joint patenting can largely be grouped into two categories: (1) literature that explores why firms engage in joint patenting, given the traditional belief that it is a 'second best option,' and (2) literature that compares the quality of joint patents to those of single-owned patents. The complexities of joint patenting are well documented ([Hagedoorn, 2003](#); [Paradiso and Pietrowski, 2009](#); [Belderbos et al., 2014](#)). For example, when a patent is jointly owned, innovators forgo the idealized monopoly rents that single ownership permits. In the absence of contractual ownership agreements mandating otherwise, each owner has independence in decisions made about the production of the patented technology, licensing, negotiations with third parties, and the like; these all can result in outcomes that are undesirable to the other patent owners. Complexities with joint patenting can also arise if the patented technology is involved in infringement litigation. In addition, differences in patent protection and contractual agreements across countries with different laws and legal systems can enhance difficulties surrounding joint patenting. For these reasons, joint patent ownership has traditionally been viewed as a second best option relative to sole ownership.

There are a variety of reasons identified as to why joint patenting occurs, despite the complexities that go along with such ownership. [Hagedoorn \(2003\)](#) finds that many innovations that spawn joint patents are often unanticipated results of informal collaborations between firms. However, all joint patenting is not necessarily unanticipated. Collaboration between firms and universities and/or independent researchers is conducive to joint patenting ([Hicks, 2000](#)). In addition, firms in industries with wide patent breadth are often more open to the idea of joint patenting, as they anticipate it to be more difficult to license around a patented technology and garner cross-licensing contracts ([Kim and Song, 2007](#)). Finally, joint patenting has been found to be more prevalent between firms that have jointly patented together in the past ([Hagedoorn, 2003](#)) or have a previous history of successful alliance ([Kim and Song, 2007](#)).

A more recent stream of research has successfully shown that joint patent ownership corresponds to higher quality innovations relative to patents with a single owner ([Belderbos et al., 2014](#); [Briggs and Wade, 2014](#)). Using a panel of approximately 2.5 million patent observations in 188 countries over 32 years, [Briggs and Wade \(2014\)](#) find that, in general, jointly owned patents receive more forward patent citations (a widely accepted proxy for patent

quality) relative to patents with a single owner. In addition, the number of forward citations increases with the number of owners. [Belderbos et al. \(2014\)](#) analyze a subsample of joint patents from 164 firms in Europe, the United States, and Japan between 1996 and 2003 to test whether various types of joint patenting (intra-industry, inter-industry, and collaboration with a university) impact the number of forward citations a patent receives, relative to the omitted comparison group of single-owned patents. [Belderbos et al. \(2014\)](#) find that joint patents, regardless of whether they are co-owned by firms within like industries (intra-industry collaboration) or by firms in different industries (inter-industry collaboration), yield greater forward citations than single-owned patents. However, they find that joint patents co-owned with a university have no statistical difference in forward citations received compared to single-owned citations. This later result is consistent with my findings when considering forward citations received within three years, but contrasts with my findings using total forward citations over the life of the patent (which is the quality measure used by [Belderbos et al., 2014](#)).

Dissimilar from previous research, this paper focuses specifically on the subset of jointly owned patents to characterize differences in quality. The analysis utilizes 141,920 joint patents across 148 countries between 1978 and 2009. The likelihood that a joint patent is categorized as 'high quality' is modeled to depend on three key independent variables: (1) the presence of multi-country co-ownership, (2) national income differences between multi-country co-owners, and (3) co-ownership with a university. A fourth explanatory variable – differences in national patent protection regimes – is also considered to test the robustness of national income differences as a dependent variable.

Multi-country ownership signals some degree of cross-country collaboration. Cross-country collaboration is believed to provide a synthesis of ideas that generate output applicable to a wider variety of standards and preferences. Such international applicability can more easily serve as a sounding board for future innovations, and thereby remove the conceptual international barriers to cumulative innovation noted by [Jaffe et al. \(1993\)](#) and [Thompson and Fox-Kean \(2005\)](#). Cross-country collaboration serves as a platform for firms to expand their knowledge base and increase long run innovative relevance, particularly in the presence of resource constraints ([Hewitt-Dundas, 2006](#); [Gilsing et al., 2008](#); [de Jong and Freel, 2010](#); [Alnuaimi et al., 2012](#); [Ebersberger and Herstad, 2013](#)).

The influence of co-owners' national income differences on joint patent quality is theoretically ambiguous in the wake of two opposing schools of thought. First, [Wuyts et al. \(2005\)](#), [Nootboom et al. \(2007\)](#), and [Gilsing et al. \(2008\)](#) show that interactions between dissimilar, but complementary, partners often generate unique combinations of resources and tacit knowledge that spawn highly novel and valuable creations. Firms located in different countries, especially those in different stages of development, may possess a greater variety of complementarities that collaborating firms can draw on, which could lead to collaborations between firms in countries with greater income differences to produce relatively higher quality patented technologies. An opposing school of thought suggests that countries with more similar income levels possess overlapping demand and supply schedules ([Linder 1961](#); [Hallak 2010](#)), which can lead to more interaction and collaboration among firms in countries with similar income levels. This notion is rooted in the 'Linder Hypothesis', which uses income similarities between countries and their subsequent overlapping demand and supply to explain intra-industry trade.

The final explanatory variable of interest is whether one or more of the co-owners is a university. The various nuanced collaborative relationships between universities and firms, as well as the motivation behind these collaborations, is complex. [Muscio and Pozzali \(2013\)](#) and [Bodas et al. \(2013\)](#) provided thorough literature

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