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Determinants of quadic patenting: Market access, imitative threat, competition and strength of intellectual property rights

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ABSTRACT

This paper analyzes firms' decisions to seek intellectual property rights in global markets, particularly in China. We introduce the notion of a 'quadic patent,' defined as a patent family that consists of patent applications filed at the European Patent Office, the Japanese Patent Office, the United States Patent and Trademark Office, and the national patent office of a fourth country. We examine the determinants of quadic patenting at the industry level for China, and at the country level for a sample of 38 countries. Our results indicate that quadic patenting is driven by the need to access markets, respond to imitative threats, and compete in product markets.

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1. Introduction

As the world economy becomes increasingly integrated, firm-level R&D activities have, accordingly, become increasingly internationalized [1–5]. As this trend has developed, patent protection has been expanding geographically as patent applications increasingly extend beyond the regions in which inventions are first patented or in which the associated inventive activity occurs [6,7]. While a vast and growing body of literature has analyzed the internationalization of R&D activities, only a limited number of studies have explored the factors contributing to the internationalization of patenting

activities. Grupp and Schmoch [8] provide case-study evidence that a firm tends to patent in a foreign country when that country is perceived as the firm's preferred market, even when the invention underlying a patent originates elsewhere. This insight has been confirmed by a handful of econometric studies that have examined the factors shaping patenting by foreigners in a country or a group of countries [9–11]. While early studies focused on patenting activities in advanced countries [9,10], recent studies have taken a broader perspective, analyzing patenting in emerging economies as well [11–14].

A key weakness of these cross-country studies has been the use of national patents, which display considerable variation in quality across countries. As a result of these quality differences, which arise from differences in patent laws and conventions, national patents are at best an imperfect measure for use in cross-country comparisons [8]. To overcome the shortcomings associated with using only national patent statistics, this paper

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introduces a new measure that we call a 'quadic patent' and examines its determinants in two separate panel data analyses, first across 19 manufacturing industries in China, and thereafter at the national level across a sample of 38 countries. Quadic patents provide a country-specific measure that we define as a patent family consisting of patent applications made at four locations: the national patent office of the country in question, the European Patent Office (EPO), the Japanese Patent Office (JPO), and the United States Patent and Trademark Office (USPTO). Quadic patents represent patents that are of substantial innovative value because patents applied for at what are generally known as the triadic patent offices (the EPO, the JPO, and the USPTO) have wide geographic scope, spanning the most advanced and technologically sophisticated regions of the world [15]. Therefore in analyzing global patenting activities, the use of quadic patents eliminates country bias that is often associated with national patents, ensuring comparability of patenting activities across an array of countries.

As we explain in Section 3, quadic patenting has become very important in many emerging economies, but most significantly in China. Between 1985 and 2005, the proportion of triadic patent families that contained patents filed with China's State Intellectual Property Office (SIPO) increased from 9% to 61% and continues to grow. Quadic patenting in China represents the most dominant type of patenting in all non-triadic countries (countries excluding EPO members, Japan, and the US). In other words, China is rapidly emerging as an important destination for patent applications filed by companies seeking intellectual property rights outside of the triadic countries.

From a theoretical perspective, we argue that quadic patenting in China is in part a capability exploitation strategy aimed at tapping into the vast and growing Chinese market by multinational corporations (MNCs) [16,17]. While such a knowledge exploitation strategy is well known in the international business literature, it has been employed previously mainly to inform foreign investment decisions by MNCs [18]. We also propose another, complementary, explanation of quadic patenting. Growing competition in many industries has induced firms to undertake strategic patenting—an activity they pursue to ensure the patentability of their future inventions by warding off potential competing patents, and to strengthen their positions in strategic negotiations with rivals.

Among the factors we consider to be important drivers of quadic patenting are the size of a local market as well as the extent of foreign penetration in that market, as indicated in the findings of prior studies on international patenting [9–13]. While the size of a market indicates to a considerable extent the potential for exploiting a firm's knowledge resources in that market, the need to protect those resources derives from the ability of local manufacturers to imitate a firm's technologies [12,13] as well as the degree of competition in that market [13,19–22]. To capture the imitative capability of local manufacturers—including not only indigenous firms but also foreign firms operating in the host country—we introduce a novel measure that we define as the number of triadic patents one or more inventors of which are located in the host country. This measure represents the technological sophistication of local manufacturing, and therefore is a useful alternative to the conventional measure of technological capability, namely R&D, for which comparable data is either

absent or of poor quality, particularly for Chinese manufacturing industries.

Quadic patenting is triggered not only by technological competition but by product market competition as well. Employing data on sales revenues of firms, we derive an index to measure product market competition in China at the two-digit manufacturing level. To the best of our knowledge, ours is the first study that explicitly examines the role of product market competition in shaping international patenting activities. Our analysis at the national level across a sample of non-triadic countries offers the possibility of testing the importance of an additional variable—the strength of the intellectual property rights (IPR) regime in host countries [23–25].

In the following section we describe the theory that informs our analysis, after which we present the hypotheses we tested with the data. Section 3 details the data and discusses trends in quadic patenting activities. The variables and the econometric model are explained in Section 4. The results of the analyses are discussed in Section 5, and the final section summarizes the findings and implications, acknowledges the study's limitations, and suggests future directions for related research.

2. Theory and hypotheses

2.1. Theory

Theoretical explanations of foreign patenting are conspicuous by their absence from the literature on international patenting, as the focus of most studies is narrowly empirical [11–13]. One exception is Eaton and Kortum [10], who view foreign patenting from the perspective of macroeconomic growth, interpreting it as a form of knowledge spillover from the countries in which inventions are developed to countries in which patents are applied for. In this study, we posit several theoretical rationales for international patenting, basing our analyses of quadic patenting on the traditional theory of internationalization [16,17,26] and on the resource-based theory of the firm [27,28].

According to the traditional theory of internationalization, MNCs enjoy unique competitive advantages, particularly in the form of proprietary technologies that give them an edge over firms in less developed countries. When such technology is standardized and the cost of production abroad drops below the cost of production at home, MNCs may prefer to carry out production abroad for themselves rather than relegating production—and thereby transferring the production technology—to foreign producers. Foreign investment by MNCs in cheaper locations abroad thus enables them to *internalize* and *exploit* their *ownership* advantages.

While this paradigm of internationalization has been developed in the context of Anglo-American enterprises, it has since been adapted to the context of so-called emerging MNCs, explaining internationalization activities on the part of those emerging MNCs that possess unique firm-specific ownership advantages that serve as alternatives to the conventional, technological, or marketing advantages enjoyed by their Anglo-American counterparts [29]. We adapt this theory to argue that as such firms, spurred on by globalization, extend their operations into China and other foreign markets,

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