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Global markets for technology: Evidence from patent transactions

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ABSTRACT

The paper analyses the recent evolution of international markets for technology by examining changes in ownership of US granted patents. We study the effects of the geographical origin of patents, proxied by their first priority country, on the probability of patents being traded, on the timing of the transaction and on the probability of observing a cross-border transaction, while controlling for the characteristics of the patents, the time and sector specificities. The analyses are based on a comprehensive dataset that covers all the patents granted by the USPTO over the 2002–2012 period. The data from the US patent reassignment database have been cleaned and processed and a subset of 95,542 granted patents that have been traded has been identified. We obtain evidence from survival models that there has been an increase in the rate of patent transactions in recent years. The obtained results indicate that patents with a first non-US original applicant have less probability of being traded and show a longer time to transaction than US first priority patents. We also find that more science-based patents, which are usually characterized by a higher technological uncertainty, are more likely to be traded, but are much less likely to be involved in cross-border deals. The results are discussed in light of the impact of asymmetric information and search costs on international patent transactions.

1. Introduction

An increase in the internationalization of research and development (R&D) and inventive activities has been documented in recent years (Castellani and Peri, 2013; Guellec and van Pottelsberghe de la Potterie, 2001; Lewin et al., 2009; Narula and Zanfei, 2005; Picci, 2010), together with a progressive increase in patenting rates. The rising number of patent applications throughout the world can be explained by considering the emergence of complex technologies that often require pools of interdependent patents to be legally protected (e.g. in such fields as software, semiconductors and mobile communications).

These trends have contributed to the recent expansion of the markets for technology, in which patents are increasingly conceived as tradable assets (Arora et al., 2001; Arora and Gambardella, 2010; Benassi and Di Minin, 2009; Cockburn et al., 2010; Monk, 2009). Although globalization has facilitated the internationalization of R&D, it has been shown that innovative activities and technology trade are still

predominantly national in scope (Alcacer et al., 2007; De Rassenfosse et al., 2010; Drivas and Economidou, 2015; Picci, 2010). Three levels of uncertainty that characterize technology deals have been found to greatly limit the geographical reach of technology trade, and are responsible for the dominant role of nearness in patent transactions: uncertainty about the property rights, about the value of the technology and about the patent trading process (Arora and Gambardella, 2010). All these types of uncertainty tend to be more pronounced when technology trade takes place across national boundaries.

Patent transactions can take the form of transfers, sales (outright sales or through auctions) or licensing agreements, depending on whether or not patent ownership is transferred.¹ While there is considerable anecdotal evidence that competitive challenges are leading firms to increasingly adopt new intellectual property (IP) strategies and to play an active role on the markets for patents (Monk, 2009), empirical evidence on patent trade is still scant. Most of the prior studies focused on licensing agreements (Alcacer et al., 2007; Arora and

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¹ Although there is anecdotal evidence that a non-negligible fraction of patents is traded, it is difficult to accurately quantify the volume of such transactions. In fact, most exchanges of patents occur under conditions of utmost secrecy, through private bilateral transactions in which the terms of the negotiated agreement (often a licensing or cross-licensing agreement) are not disclosed to prevent sensitive information from leaking to competitors (Caviggioli and Ughetto, 2013). A few scientific attempts have been made to quantify the size of the market for technology. It has been estimated that in the mid-1990s, the market for technology was globally approximately \$35–50 billion (Arora and Gambardella, 2010). Athreya and Cantwell (2007) reported that licensing revenues accounted for nearly \$100 billion worldwide between 1950 and 2003 (although these figures would be considerably smaller if transactions among affiliated entities were excluded, as noted by Arora and Gambardella, 2010). Moreover, Kulatilaka and Lin (2006) also showed that worldwide revenues from patents increased from \$15 billion in 1990 to \$100 billion in 2000.

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Ceccagnoli, 2006; Arora and Fosfuri, 2003; Gambardella et al., 2007; Motohashi 2008 among others) and only a few recent papers have started to study transactions that involve the sale of patent rights, considering either data on patent auctions (Caviggioli and Ughetto, 2016; Fischer and Leidinger, 2014; Nair et al., 2011; Odasso et al., 2015; Sneed and Johnson, 2008) or on patent reassignments (Drivas and Economidou, 2015; Figueroa and Serrano, 2013; Galasso et al., 2013; Serrano, 2010,2013).

The way geographical factors affect technological flows and knowledge diffusion has been under-investigated in this literature, except for a few exceptions (Burhop and Wolf, 2013; Drivas and Economidou, 2015). In fact, the interplay between geographical origin and technology trade is still not clearly understood, due to a lack of data on trading rates. Hence, the question of whether geographic proximity between buyers and sellers can alleviate the information asymmetries and uncertainty entailed by the markets for technology has largely remained unanswered. In this paper, we provide an empirical analysis that is based on the elaboration of data on patent sales, in which the licensing channel has been excluded, and we explore the international dimension of the phenomenon. We analyze the recent evolution of the international markets for technology by examining changes in ownership of US granted patents. Moreover, we study the effects of the geographical origin of patents, as proxied by their first priority country, on the probability of patents being traded, on the timing of the transaction and on the probability of patents being cross-border traded, while controlling for the characteristics of the patents, the time and sector specificities. The analyses are based on a comprehensive dataset that covers all the patents granted by the USPTO in the 2002–2012 period. Data from the US patent reassignment database has been used and a data cleaning method has been applied that has led to the identification of a subset of 95,542 granted patents that have been traded.

We are in particular interested in understanding whether US patents, filed by companies based in countries other than the US, show different trading patterns from the patents filed by US companies, in order to provide a picture of the international dimension of the market for technology. We exploit the information on the patents originated from such geographical areas and their extension to the US to highlight the presence of patterns related to the uncertainty on the commercial value of the traded patents and to the presence of information asymmetries between patent owners and potential buyers. We expect that patents with a non-US origin will show less probability of being traded on the US market than patents with a US origin. To further explore this issue, we single out patent characteristics that might proxy the degree of asymmetric information that eventually affects the trading of patents in an international arena. We assume that patents covering innovation in emerging or immature technologies are exposed to a higher level of technological uncertainty and asymmetric information about their actual technological and economic value. Since the assessment of the true technical potential of a patented innovation requires substantial resources, proximity may play a significant role in relaxing such a constraint.

An important contribution to patent reassignments was provided by Serrano (2010), who analyzed the bibliographic characteristics and types of patentees of US patents traded between 1980 and 2001. We extend the work of Serrano (2010) in three ways. First, we look at more recent years (from 2002 to 2012), while Serrano's paper was based upon the 1980–2001 period. This temporal extension is important because the last decade witnessed an upsurge of patents with unclear scope that have led to legal disputes and to the emergence of non-practicing entities as major players on the market for technology. Second, we also focus our analysis on the international dimension of patent trading, as described above. Third, we also improve the adopted methods by refining and adding new criteria that can be used to identify the patent transactions that involve an actual change of ownership, while the cases that result from the merger and acquisition (M & As) of companies have been dropped.

We obtain evidence from survival models that there has been an increase in the rate of patent transactions in recent years. These results indicate that US granted patents with a first priority other than the US have less probability of being traded and show a longer time to transaction than US first priority patents. We also find that more science-based patents, which are usually characterized by a higher technological uncertainty, are more likely to be traded, but at the same time are much less likely to be involved in cross-border deals. All the estimates remain robust after the introduction of a wide range of controls at the patent, technology field and time levels.

The remainder of the paper is organized as follows. Section 2 discusses the background literature. Section 3 introduces the data, describes the explanatory variables used in the empirical analysis and provides some relevant descriptive statistics. Section 4 presents the econometric models and discusses the implications of the results on the understanding of the dynamics of international markets for technology. Section 5 concludes and summarizes the paper.

2. Background literature

In the “Markets for technology” sub-section, we review the literature that discusses the effects of technology trade on the innovation system as a whole, the reasons for engaging in patent transactions, and the works which have specifically focused on patent reassignments. In the “Asymmetric knowledge and the geography of technology trade” sub-section, we summarize the studies that have explored the factors that can limit the geographical reach of technology trade to a great extent and which affect the dynamics of trade on the markets for technology: the presence of information asymmetries between sellers and buyers, the uncertainty about the property rights, about the value of the technology and about the patent trading process. The limited number of studies that bridge the issues raised in both strands of literature in the context of intellectual property rights (IPRs) has inspired the contribution of our paper, which has in particular drawn upon the reviewed studies presented hereafter.

2.1. Markets for technology

Markets for technology have recently attracted both academic and policy interest. One stream of literature has discussed the effects of technology trade on the innovation system as a whole. It has been suggested that technology trade generates private and social gains, by reallocating patent rights to firms that are better at commercializing the patented innovation because of superior manufacturing and marketing capabilities (Arora et al., 2001; Gans et al., 2008; Teece, 1986) and at preventing patent disputes from ending up in court (Galasso et al., 2013). Patent trade improves the overall welfare and innovation, as it enhances innovation activity, knowledge diffusion and the emergence of specialized inventors, by stimulating the geographic spread of technology (De Rassenfosse et al., 2016; Drivas and Economidou, 2015; Lamoreaux and Sokoloff, 2001; Spulber, 2008). Patent trade allows knowledge to reach where it may best be used, and to be directed toward firms with superior manufacturing and marketing capabilities (Arora et al., 2001; Gans et al., 2008; Teece, 1986). Firms that pursue innovation strategies through an active acquisition of patents have the opportunity of accessing complementary technologies and of fostering their innovation capacity. However, concerns have been raised about patents that have been acquired for strategic or opportunistic reasons, and which thus adversely affect the innovation activity of other firms. In this regard, the rising role of non-practicing entities (also called patent trolls) on the markets for technology has been regarded with suspicion, because of their practice of extracting excessive licensing fees from manufacturing firms or of engaging in frivolous infringement litigation (Bessen and Meurer, 2014; Caviggioli and Ughetto, 2016; Lemley and Shapiro, 2007; Reitzig et al., 2007).

Other academic works have investigated the reasons for engaging in

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