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R&D outsourcing and intellectual property infringement

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ABSTRACT

We empirically address value appropriation hazards when firms enter into external relationships in search for innovation. Using firm-level data from Germany we document a positive link between R&D outsourcing and intellectual property infringement. In line with theory we show that this effect varies with the market value of knowledge, and the allocation of property rights. We discuss how outsourcing induced spillovers may foster technology diffusion, affecting industry evolution and market structure.

1. Introduction

In this paper we empirically address value appropriation hazards when firms enter into external relationships in search for innovation (Grimpe and Kaiser, 2010; Martinez-Noya et al., 2013; Laursen and Salter, 2014).

Picturing vendors as "bees cross-pollinating between firms, carrying experiences and ideas from one location or context into another" (Bessant and Rush, 1995: 102), it has been argued that outsourcing allows firms to substitute for a lack of internal resources that are essential to keep pace with competitors (Laursen and Salter, 2006; Weigelt, 2013). Complementarities between internal and external knowledge are additionally able to enhance the productivity of internal knowledge (Cohen and Levinthal, 1989; Arora and Gambardella, 1990; Cassiman and Veugelers, 2006). In support for such an argumentation, a growing empirical literature finds a positive link between outsourcing and innovation performance (Grimpe and Kaiser, 2010; Görg and Hanley, 2011; Bertrand and Mol, 2013).

However, a prerequisite to benefit from knowledge spillovers ex-post, is often to ex-ante transfer firm-specific knowledge to the vendor (Bönte and Wiethaus, 2007; Laursen and Salter, 2014). This creates a trade-off that is similar to the inventor's dilemma in the classical work of Anton and Yao (1994): Disclosing information about the invention to a potential buyer increases the buyer's willingness-to-pay, but also increases the risk that the buyer uses this information to imitate without compensating the inventor. The analogy of a 'paradox of openness' (Laursen and Salter, 2014) in the context of our paper is the following. Without disclosure, the vendor has too little information to perform in the client's best interest (Bönte and Wiethaus, 2007), while disclosure puts the vendor into the position to resell knowledge to the client's competitors or directly enter the market (Baccara, 2007; Lai et al., 2009).

In this vein, a first contribution of this paper is to document the existence of non-negligible appropriability hazards put forward in the theoretical literature. Using data from the German part of the European Community Innovation Survey, we show that there is a link between research and development (R&D) outsourcing and intellectual property (IP) infringement.

A second contribution is that we show how firms manage appropriability hazards without losing the benefits of external collaboration. We do this by investigating how and for what types of firms and what types of IP the risk of infringement changes conditional on R&D outsourcing. Specifically, we distinguish between

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infringement of inventions, designs and products, and compare differences in how firms manage outgoing spillovers by allocating property rights either formally (patents, design patents, trademarks and copyright) or strategically (partnering with competitors).

We show that the effect of R&D outsourcing on infringement is stronger concerning generic than firm-specific IP. Hence, spillovers are more likely in early (less firm-specific) stages of product development. This suggests that firms can use the specificity of outsourced tasks to balance risks and benefits of R&D outsourcing. Our results further suggest that the allocation of property rights can reduce spillovers. First, in contrast to vertical outsourcing relationships, we do not find evidence for infringement in horizontal outsourcing relationships. Second, we show that formal IP protection reduces the infringement risk conditional on outsourcing. However, efficacy of formal protection mechanisms is limited, especially in sectors that typically produce products for which standard IP protection mechanisms are not applicable.

Moving away from the perspective of the individual firm, we further discuss broader welfare implications of our findings using examples from the chemical industry and consumer electronics. We argue that outsourcing-induced spillovers may foster technological diffusion (Attewell, 1992; Antonelli, 1998), which affects industry evolution and market structure (Arora and Gambardella, 1998) and has the potential to enhance long-run economic growth (Romer, 1990; Grossman and Helpman, 1994).

We aim to contribute to a broad literature that has made important progress in the study of inter-firm knowledge transfer (Dahlander and Gann, 2010), including recent work on the internationalization of R&D (Schmiele, 2013), co-patenting (Belderbos et al., 2014) and cross-licensing (Grimpe and Hussinger, 2014).

2. Background discussion

2.1. Knowledge accumulation and imitation

Outsourcing is omnipresent these days. On the backside of the iPhone it reads "Designed by Apple in California, assembled in China", and orders in drive-through fast food restaurants are taken by call center agents, hundreds of miles away.[1] Firms do not only outsource mass production and less skilled labor, but recently also more and more knowledge-intensive tasks, such as R&D and information technology (Freund and Weinhold, 2002).

The classical argument in favor of outsourcing is that specialized suppliers can realize economies of scale and hence produce at lower cost. In turn, firms that outsource operate more efficiently. A growing empirical literature highlights that this mechanism also works concerning the production of knowledge by showing a positive link between knowledge-intensive outsourcing and innovation performance (Grimpe and Kaiser, 2010; Görg and Hanley, 2011; Bertrand and Mol, 2013). However, enhanced efficiency here does not only come from scale effects, but also from knowledge accumulation.

Before entering the outsourcing arrangement, clients often make tacit knowledge explicit when they hand concepts, designs or blueprints to the vendor to specify project specifications and align research agendas (Martinez-Noya et al., 2013). Transfer of such *background knowledge* unlocks the vendor's efficiency potentials and lowers prices (Bönte and Wiethaus, 2007).[2] Combining knowledge gained in the interaction with various clients, suppliers accumulate expertise (Bessant and Rush, 1995; Antonelli, 1998; Weigelt and Sarkar, 2009). This generates a relative advantage in the creation of *foreground knowledge*, i.e. technology that reduces a client's production cost, or enables demand-enhancing product innovation. Accordingly, transfer of proprietary information to other firms is at the core of the vendor's business model (Baccara, 2007; Li et al., 2010).

This of course creates a trade-off. Outsourcing does not only enable the firm to learn about technology of other firms, but also other firms learn about technology of the focal firm. Such spillovers are able to reduce uncertainty about the cost of imitation and the cost of entry (Zander and Kogut, 1995; Semadeni and Anderson, 2010), ultimately triggering the adoption of cost-reducing processes or imitation of products by rival firms.[3] In turn, product differentiation and/or cost advantages vanish, monopoly rents break up and firms lose their competitive advantage in the product market (Deephouse, 1999; Barreto and Baden-Fuller, 2006).

The existing empirical literature is not very informative about this aspect of knowledge intensive outsourcing. Even if existent, the embedded imitation hazard is hidden in the net performance effect that those studies typically document (e.g. Grimpe and Kaiser, 2010). Our empirical approach is to focus directly on the relationship between outsourcing and measures of IP infringement.

In doing so, our first aim is to test whether firms that outsource face a higher risk of infringement. We then proceed to test a number of mechanisms that affect the extent to which infringement occurs conditional on outsourcing. The related theoretical literature suggests that the extent of leakage will depend on the outside value of knowledge that is shared with the vendor (Baccara, 2007; Bönte and Wiethaus, 2007), and analyzes how the type of outsourcing arrangement and formal IP protection affect the infringement risk by changing the vendor's gain from leakage as well as the client's lost profit (Lai et al., 2009). In what follows, we build on arguments in those studies to develop predictions.

2.2. Market value of generic and specific knowledge

In the model of Bönte and Wiethaus (2007), a firm can increase the efficiency of a supplier by disclosing proprietary information about a cost-reducing technology.[4] However, the vendor can transfer some or all of this knowledge to a rival, causing also the rival's production cost to decrease. In a one-shot game, the vendor will always transfer all knowledge to the rival, because this will increase the rival's demand for the vendor's product. Anticipating this, the firm will not disclose any knowledge to the vendor. In a repeated game, an equilibrium exists in which the vendor can commit to only leak some but not all information (what Bönte and Wiethaus call a weak firewall). This creates an incentive for the client firm to share background knowledge and enjoy greater efficiency. However, stability of the equilibrium depends on the outside value of

[1] See "The Long-Distance Journey of a Fast-Food Order", in New York Times, April 11, 2006.

[2] Following Hertzfeld et al. (2006), our theoretical argumentation is careful to distinguish between background and foreground knowledge but this distinction will not be crucial in the empirical analysis.

[3] Knowledge transfer is not limited to occur only between firms that contract the same vendor. In the context of an innovation network, even when competitors do not share common suppliers, knowledge transfer may take place through indirect ties between suppliers and clients. The likelihood of indirect spillovers increases with network size, e.g. when firms contract more than one external supplier. At the same time, the process that leads from knowledge sharing to increased competitive pressure may be much more direct when the vendor subsequently enters the client firms' market as a new competitor. Note however, that the empirical analysis in this paper does not distinguish between imitation from competitors that share a common vendor with the focal firm, imitation from competitors that are indirectly connected the focal firm via different vendors, and imitation from vendors that step up as new competitors.

[4] In the model of Bönte and Wiethaus, firms come up with cost-reducing innovation themselves, so there is no foreground knowledge. The basic mechanism, however, is similar when we think of the leaked information as innovation developed by the vendor for the client.

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