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# Location, shared suppliers and the innovation performance of R&D outsourcing agreements

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**ABSTRACT**

The location of an international supplier constitutes a crucial variable when outsourcing research and development (R&D) services, especially if the supplier also serves competitors. Even though shared suppliers have refined capabilities, they may act as hubs for knowledge transfers, exposing their clients to the risk of knowledge leakages to their competitors. Building on Transaction Cost Theory, we argue that a client's ability to benefit from having a shared supplier will be dependent on the appropriability regime of the outsourcing location, whose effectiveness depends on the Intellectual Property Rights (IPR) protection within the country, and the tacit and specific nature of the service outsourced. Using primary data at the transaction level from a survey to 170 technology-intensive firms from the EU and the U.S., we find that sharing R&D suppliers with competitors appear to mimic some of the advantages and disadvantages of being collocated with them, especially in countries offering weak IPR protection.

**KEYWORDS**

Appropriability regime; shared supplier; supplier location; R&D outsourcing; innovation performance; IPR protection

**JEL CLASSIFICATIONS**

F23; O32; O34

## 1. Introduction

It is well known that accessing external knowledge from different sources has become vital for firms' innovation performance. Given the sticky and location-specific nature of technological knowledge (Cantwell and Santangelo 1999), firms have been forced to increasingly establish different types of research and development (R&D) collaborations with a variety of partners, not only located in developed countries but also in emerging ones (Cassiman and Veugelers 2006; Contractor et al. 2010; Howells, Gagliardi, and Malik 2008; Jensen and Pedersen 2011; Lewin, Massini, and Peeters 2009; Martínez Noya and García Canal 2010; Martinez-Noya, Garcia-Canal, and Guillen 2012; Nieto and Rodríguez 2011; Tamayo and Huergo 2017). This disintegration and geographical dispersion of the R&D value chain has contributed to the creation of a worldwide market for R&D services in which some firms act as suppliers of a wide array of R&D services, with different degrees of customisation, and operating in countries offering varying degrees of institutional IPR protection (Gooris and Peeters 2016; Santangelo, Meyer and Jindra 2016). As a consequence, all firms, and especially the technologically intensive ones, have to carefully assess the optimal way of opening their

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innovation processes to external contractors, so as to increase their innovativeness while protecting their own knowledge base.

Although there is agreement on the benefits of accessing external knowledge on innovativeness, recent studies highlight the dark side of such openness to external agents, so more evidence on its effect on innovation is needed (Monteiro, Mol, and Birkinshaw 2016). The main problem of external knowledge openness is that inter-firm knowledge transfers are a two way street, so firms have to protect their own knowledge while gaining access and profiting from the one of their partners (Kale, Singh, and Perlmutter 2000). In this context, the location of the international supplier constitutes a crucial variable when outsourcing knowledge-intensive services. Countries differ in their degree of IPR protection, and these differences facilitate or make more difficult the governance of inter-firm knowledge transfers (Gooris and Peeters 2016). In fact, many of the countries that offer comparative cost advantages for global sourcing of R&D services have weak institutional environments, and thus the use of regulative institutions as a protection mechanism may not be possible (Contractor et al. 2010; Delios and Henisz 2000). Previous research has analysed how IPR protection conditions the governance form of R&D knowledge transfers (Hagedoorn, Cloodt, and van Kranenburg 2005; Oxley 1999), but not its influence on the effectiveness of these transfers. We argue in this paper that a complete analysis of the effectiveness of cross-country knowledge transfers in R&D outsourcing agreements requires not only paying attention to IPR protection, but also the content of the knowledge flows. That is why we focus on a factor that influences both incoming and outgoing spillovers and whose interaction with IPR has not been analysed yet: the degree to which the supplier is shared with other competitors.

Previous research shows that firms collocate with other firms so as to be able to internalise location-specific advantages and enhance a firm's innovativeness, or avoid collocation so as to limit the possibility of unintended knowledge leakages (Alcácer 2006; Narula and Santangelo 2009, 2012). Extending this reasoning, we argue that sharing R&D suppliers with competitors may mimic some of the advantages but also of the disadvantages of being collocated with them. First, sharing suppliers with rivals allows the client firm to benefit from accessing more refined capabilities of the supplier due to the specialisation advantages stemming from the aggregation of demands from clients within the same industry (Jacobides and Winter 2005; Mesquita, Anand, and Brush 2008; Williamson 1985). Second, given that suppliers can act as a hub for knowledge transfers (Ahuja 2000), client firms can benefit from the spillover effects stemming from competitors. Indeed, it has been demonstrated that there are firms that show a preference for suppliers that also deal with their competitors so as to benefit from these potential sources of knowledge spillovers (Alcácer and Chung 2007). However, from a transaction cost perspective, this second advantage could be questioned because knowledge spillovers can act in both directions, so suppliers can transfer, intentionally or not, key information from one client to another (Kang, Mahoney, and Tan 2009; Perri et al. 2013; Ritala et al. 2015; Spencer 2008). It is for this reason that the role of IPR protection needs to be considered in order to determine whether relying on shared suppliers may be beneficial for the client to achieve its innovation objectives, or harmful.

To address this question, in this paper we argue that the level of appropriability hazards perceived by the client firm, and thus its ability to benefit from having a shared supplier, will be dependent on the appropriability regime of the outsourcing location, whose effectiveness basically depends not only on the tacit or specific nature of technological knowledge to be transferred (as shown by a recent study by Martínez-Noya and García-Canal

2015), but also on the strength of the institutional protection (efficacy of legal protection for IPR) (Gooris and Peeters 2016; Pisano 2006; Teece 1986). Based on primary data at the transaction level from a survey to 170 technology-intensive firms from the UE and the U.S., our results suggest that, overall, indirect links to competitors negatively contribute to the client achieving its innovation objectives within the agreement; especially when highly tacit and specific services are outsourced to locations with weak IPR protection. In this case, concerns about coordination and control to avoid potential knowledge leakages to competitors appear to become so high that hinder the client's ability to fully benefit from the specialisation advantages of the shared supplier. It is interesting however that a weak IPR protection appears not to be a significant obstacle for client firms to achieve its innovation objectives when outsourcing highly specific services to exclusive suppliers. In these cases, our results suggest that, despite the high appropriability hazards involved, single-sourcing have trust-building properties that may lower the perceived risks associated to outsourcing highly specific activities to these locations. Finally, our results show that when outsourcing standardised services to locations with weak IPR protection, the most preferable option is to outsource to shared suppliers. In conclusion, we find that while outsourcing non-specific R&D services to shared suppliers contributes very positively to the client achieving its innovation objectives in locations with weak IPR protection, it does not do so if the shared supplier is within a location with strong IPR protection. Our evidence suggests that it is in economies with low IPR protection where the client firms can profit the most from the incoming knowledge spillovers leaked to the shared supplier thanks, maybe in part, to its country's weak IPR protection. Thus, a common supplier located in a country with weak IPR protection becomes a hub for knowledge transfers among their clients, amplifying the advantages and disadvantages of being collocated with them.

## 2. Theoretical background and hypotheses

Very few firms possess in-house all the necessary resources to stay abreast of new technological developments (Teece 1986). For this reason, R&D-intensive firms need to form different types of R&D partnerships (Belderbos, Carree, and Lokshin 2004; Gallié and Roux 2010; Hagedoorn 2002; Narula and Hagedoorn 1999; Narula and Martinez-Noya 2015). However, relying on external sources of technological knowledge poses several risks, which have been mainly analysed by Transaction Costs theorists. Besides the general issues associated to the difficulty of writing complete contracts under the uncertainty surrounding R&D activities (Williamson 1975, 1985), there are important risks of knowledge leakage to or through the partner that can turn it into a future competitor (Alcacer and Oxley 2014; Teece 1986), or improve the competitiveness of a rival linked to it (Kang, Mahoney, and Tan 2009; Martínez-Noya and García-Canal 2015). These two risks are particularly acute when outsourcing R&D activities.[1] First, these activities are considered as high-value adding ones and, thus, key within the firm's competitive strategy (Mudambi 2008). And, second, they require substantial knowledge sharing and continuous interaction between the partners to achieve the innovation objectives (Cantwell and Santangelo 1999), in such a way that establishing knowledge transfer barriers is expected to be very difficult for the client (Narula 2001). In other words, R&D outsourcing generates important appropriability

[1]Outsourcing occurs when an organization contracts a third-party to perform an activity that would have otherwise been performed in-house (Gilley and Rasheed 2000).

hazards (Grimpe and Kaiser 2010; Kogut 1988; Martínez-Noya and García-Canal 2011; Oxley 1997). By appropriability hazards, we mean the risk of inadequate uses or modifications of the technology and knowledge transferred, not intended in the contract, and injurious to the transferor. The mechanisms firms can use to protect themselves from these hazards range from formal mechanism (such as, trademarks, copyrights, or patents) to more informal approaches, such as the use of secrecy, by which the firm opts to lower the degree of transparency with its external partner as a way to avoid unintended knowledge leakages (Spithoven and Teirlinck 2015). This behaviour, however, can have a negative effect on firms' innovativeness (Monteiro, Mol, and Birkinshaw 2016).

This information sharing dilemma between pressure to innovate and unintended private knowledge spillovers becomes even more challenging when outsourcing to a supplier that also serves other direct competitors of the client firm. For example, when studying cases of IT outsourcing practices, Miozzo and Grimshaw (2005) found how conflicts grew between clients and suppliers when the latter started to have other contracts with competitors. They described how some of these relationships came to an end when the supplier started to serve also a firm's competitor due to concerns related to knowledge transfers (for example, there were clients that were reluctant to invite the shared supplier to strategy meetings due to suspicion of opportunistic profiteering). While, in other cases, client firms perceived their suppliers did not fulfil their expectations about the quantity and quality of innovations, being one of the main reasons the lack of exclusivity of the suppliers and thus their lower commitment towards the relationship. For example, one of the clients observed a deterioration in the quality of the personnel allocated to its contract by the supplier, as the supplier started to serve other clients. Finally, in other case, the lack of exclusivity of the supplier led to delays and to a deterioration of the number of the focal client services that were considered as a high priority for the supplier. Therefore, despite the fact of outsourcing to shared suppliers located worldwide to be a frequent practice, it is not clear whether relying on this kind of suppliers may be beneficial for the client to achieve its innovation objectives, or not. Knowledge spillovers are certainly more valuable to direct competitors than to other firms (McCann and Mudambi 2005), which increases appropriability hazards.

We argue that the effectiveness of outsourcing to a shared R&D supplier will depend on both what is being outsourced and where. More specifically, we argue that the client's ability to benefit from accessing the distinctive capabilities of a shared R&D supplier will be dependent on: (i) the institutional quality of the outsourcing location in terms of protection of the IPR and (ii) the degree to which the knowledge required to be transferred to the supplier is tacit and client-specific. The reason to analyse these two factors is that, as argued by Teece (1986), a firm's possibility of profiting from innovation depends fundamentally on the appropriability regime, i.e. on the extent to which innovations can be protected from imitators, that will be mainly dependent on the strength of the institutional IPR protection, and the nature of the knowledge required for the innovation.

### *2.1. Baseline effect of sharing suppliers with competitors on innovativeness*

When analysing outsourcing decisions to shared suppliers under the lens of transaction cost economics, one question that arises is why firms rely on this kind of suppliers given the appropriability hazards involved. To answer this question, we have to take into account that governance choices have an impact on capability formation and development (Argyres

and Zenger 2012). Shared suppliers can benefit from higher specialisation advantages as a result of economies of scale and scope stemming from the aggregation or exploitation of complementarities among the demands of their broad base of clients (Mesquita, Anand, and Brush 2008; Williamson 1985). This is, by serving more clients in the same industry, suppliers can leverage their knowledge about the focal industry and achieve economies of scale, which upgrades their capabilities (Jacobides and Winter 2005). In addition, it should be noted that relying on a qualified shared supplier can bring added credibility to the client firm, especially for new firms working with established suppliers. Indeed, some companies are eager to sign on with established companies because of the name recognition and reputation spillovers (Teece 1986) which reduce the uncertainty surrounding the technological competences and behaviour of the R&D supplier.

However, despite those benefits, sharing suppliers with competitors may also increase the appropriability hazards faced by the client firm because the supplier may act as a bridge for unintended knowledge transfers between the firm and its competitors (Kang, Mahoney, and Tan 2009). The privileged central position of suppliers gives them absorptive capacity and the possibility to redistribute, consciously or unconsciously, the firm's proprietary knowledge to its competitors though their network (Spencer 2008). As a consequence, we expect that the more the supplier is shared with direct competitors, the more accidental knowledge leakages are likely to happen. These accidental leakages occur when a firm's employee coincidentally exposes business-critical knowledge not meant to be shared with external parties (Ritala et al. 2015). For instance, trade secrets may spillover as employees could reveal more than what is necessary to the supplier because there is a lack of organisational control, or they are not clear about what they can actually disclose to partners, among other reasons. In any case, it has been demonstrated that the possibility of accidental leaks to collaborative partners, or third parties, negatively moderates the positive effect of external knowledge sharing on innovation performance (Ritala et al. 2015). And, the threat of a competitor imitating one's innovation limits investments in R&D and, with it, innovativeness (Liebeskind 1996).

Thus, despite the potential benefits that mimic the advantages of being collocated with other competitors, firms sharing suppliers also face the disadvantages of such collocation due to the tension of information sharing (Perri et al. 2013; Santangelo 2012). That is why, as a way to mitigate the risks, we can expect these firms to reduce the bandwidth or degree of intensity of communication with their shared partners (Heiman and Nickerson 2004). However, by behaving in this way, the client may be sending a mixed message to the supplier regarding the type of relationship that the firm wants to have with it (Monteiro, Mol, and Birkinshaw 2016) so delays and conflicts are likely to take place putting at risk the effectiveness of the agreement (Martinez-Noya, Garcia-Canal, and Guillen 2013; Miozzo and Grimshaw 2005). It should be noted that knowledge is not only an output, but also a critical input of R&D partnerships, so firms need to share information since the beginning of the negotiations to define the purpose and plan the activities (Niesten and Jolink 2015). The use of secrecy is thus a significant barrier to benefiting from openness to external knowledge (Monteiro, Mol, and Birkinshaw 2016). Aligned with this literature we argue that, although a shared supplier may allow accessing refined technological capabilities, unintended knowledge leakages may lead the client firm to reduce the transparency required for the effective undertaking of the outsourced task, hindering innovation. Therefore, we expect that:

*H1*: The client's ability to achieve its innovation objectives within the agreement will be lower, the more the R&D supplier is shared with a client's competitors.

### 2.2. Baseline effect of the strength of institutional IPR protection on innovativeness

From a transaction cost perspective, the institutional context matters (Henisz and Williamson 1999; Williamson 1985). Therefore we expect the location of the supplier to also influence the client willingness to be open and share information. This is so because appropriability hazards perceived by the client firm are expected to depend not only on the characteristics of the transaction, but also on the location where the transaction occurs (Henisz 2000; Henisz and Williamson 1999; Oxley 1999; Santangelo, Meyer, and Jindra 2016). Specifically, we argue that when the R&D supplier is located in a country with poor IPR protection, client firms would be more cautious when exchanging information with the supplier. When the IPR regime is weak, formal protection mechanisms such as patents are not effective and imitation is more likely because the exploitation of the external knowledge flows does not require the firm to undertake complex and demanding tasks of knowledge transformation (Zahra and George 2002). This means that, within these locations, firms have less incentives to undertake projects that could then generate important knowledge flows, or they will develop mechanisms to protect their innovation by reducing the amount of information disclosed (Escribano, Fosfuri, and Tribó 2009).

Mowery and Oxley (1995) already showed that countries that had strengthened their national innovation systems were able to benefit more from inward technology transfer. Similarly, Oxley (1999) and Hagedoorn, Cloodt, and van Kranenburg (2005) showed that firms prefer joint ventures over contractual agreements in countries with weak IPR systems. This preference shows that, unsurprisingly, firms want to retain control over their proprietary knowledge and technologies when working under weak IPR systems (Zhao 2006). Moreover, when firms from developed countries outsource to countries characterised by low institutional quality levels, coordination and control costs are expected to be even greater due to differences in their institutional environments and cultures (Teece 1986). Such economies are usually perceived by firms as presenting higher levels of political instability or corruption (Cuervo-Cazurra 2006) which make the enforcement of contracts more difficult. In fact, Gooris and Peeters (2016) found that when offshoring to these weak locations, firms tend to fragment the operations entrusted to foreign units, assigning services with a less strategic content as a way to reduce misappropriation problems. Besides this fragmentation, because the use of formal knowledge protection mechanisms is not effective to protect valuable knowledge, we expect firms outsourcing to these weak IPR locations to rely more on more informal safeguards such as secrecy. However, the higher use of secrecy, or the client unwillingness to make certain knowledge available to its supplier, is a behaviour that it is expected to undermine the creative process, the free flow of ideas and thus innovativeness (Monteiro, Mol, and Birkinshaw 2016). Based on the previous arguments, we argue that:

*H2*: The client's ability to achieve its innovation objectives within the agreement will be lower when the R&D supplier is located in a country offering weak institutional IPR protection than when located in countries offering strong IPR protection.

### 2.3. The effect of the appropriability regime on the client's ability to benefit from outsourcing to a shared supplier

Even though outsourcing to a supplier in a country offering weak IPR protection increases the possibility of knowledge leakages, it should be noted that knowledge transfers spillovers are a two way street. Thus, outsourcing to a shared supplier in countries offering weak IPR protection increases the possibility of not only negative accidental knowledge leakages through the shared supplier, but also of positive ones. This means that sharing suppliers under a weak IPR regime may allow the client firm to also benefit from potential incoming positive spillovers through the shared supplier.

Based on this, we expect the net effect of sharing suppliers in weak IPR locations on the client's ability to achieve its innovation objectives to be dependent on the type of knowledge that is required to be transferred by the client to the supplier. In particular, on the tacit and client-specific nature of the knowledge exchanged with the shared supplier. This is so because, as stated before, the client's ability to benefit from innovation will depend on the extent to which innovations can be protected from imitators (i.e. the appropriability regime), whose efficacy basically depends not only on the strength of the institutional protection (efficacy of legal protection for IPR), but also on the tacit or specific nature of technological knowledge involved (Pisano 2006; Teece 1986). Overall, outsourcing agreements requiring the transfer of tacit and client-specific knowledge not only entail more information exchange, but also more efforts on the side of the client to facilitate the assimilation of this knowledge. Furthermore, the specific nature of the service reduces the benefits the client can obtain as a result of accessing the specialisation advantages of a shared supplier due to its aggregation of the demands of related clients. Given these arguments, our hypotheses regarding the net effect of sharing suppliers in weak IPR locations are summarised in Figure 1.

Literature has shown that the main obstacles for outsourcing R&D projects arise when transferring information to the supplier and when coordinating with it (von Hippel 1994; Mowery and Rosenberg 1989); and these problems become especially evident when the knowledge involved is tacit and embedded within the firm's organisational routines (Nelson and Winter 1982). When outsourcing activities that require the transfer of tacit and non-codifiable knowledge, closer face-to-face interaction is required (Cantwell and Santangelo 1999; Narula 2001). This is due not only to the difficulties in the transfer and assimilation of know-how, which requires more coordination, but also to the non-standardised nature of the outsourced activities, which require more monitoring efforts in order to assure their proper execution and to avoid appropriability hazards (Grindley and Teece 1997; Narula 2001). In response to these problems, managers usually have to adopt knowledge management practices like high bandwidth communication channels among partners that allow for higher intensity of communication and interaction, and communication codes that are increasingly co-specialised as the tacitness of the knowledge exchanged increases (Heiman and Nickerson 2004). These practices, however, pave the way to accidental, or unintended, knowledge leakages (Martinez-Noya, Garcia-Canal, and Guillen 2013).

For this reason, when the transfer of tacit and specific information is needed, trust between the partners can be considered to be a factor facilitating the relationship (Ariño, De La Torre, and Ring 2001; Bäck and Kohtamäki 2016) and single sourcing has been considered to have trust-building properties (Mudambi and Helper 1998). Trust and the development of relation-specific investments have been found to lower the cost of negotiation

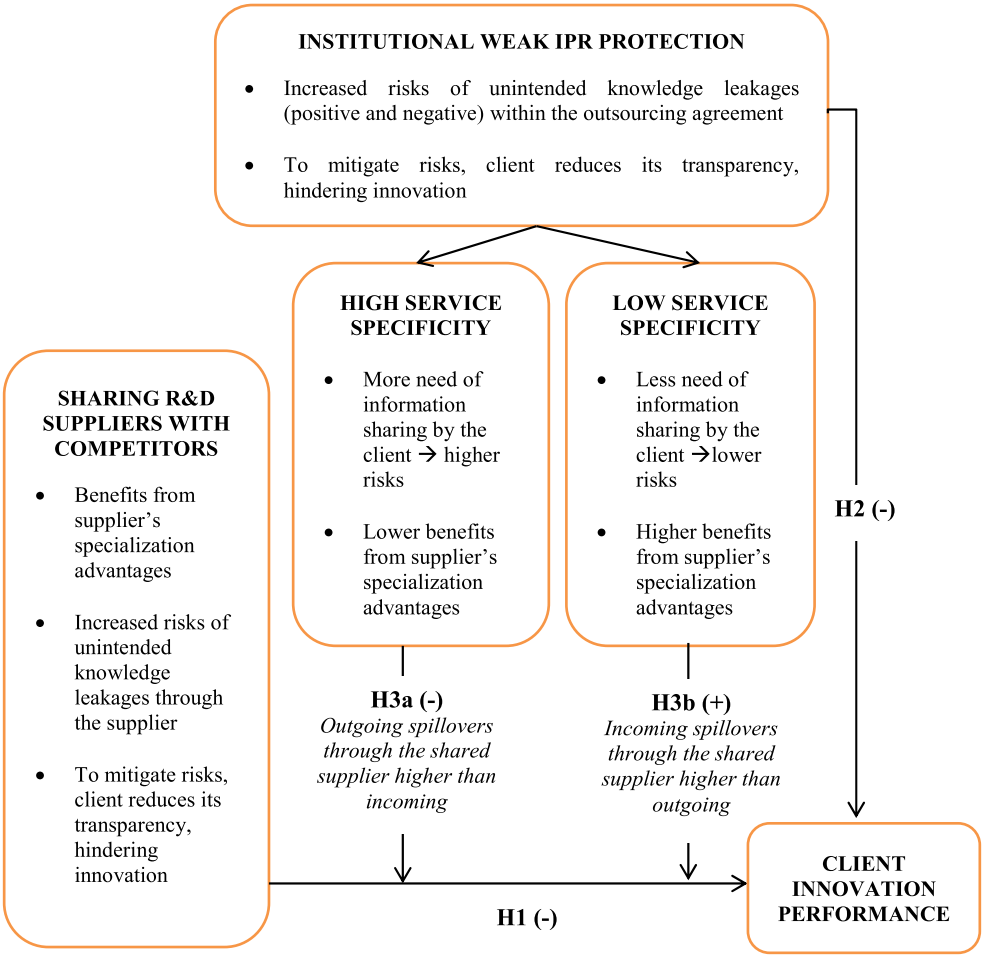


**Figure 1.** Proposed hypotheses on the net effect of sharing R&D suppliers in weak IPR locations.

and resolve conflict (Zaheer, McEvily, and Perrone 1998), thus offering the greatest potential for developing higher-order capabilities within the agreement (Dyer and Singh 1998; Weigelt 2013). Such co-adaptation can lead to what Schilling (2000: 316) called synergistic specificity where a business process 'achieves greater functionality by its components being specific to one another'. It is indeed for this higher receptiveness on the side of the supplier that higher opportunities for innovation emerge. However, these opportunities will be only realised if the client perceives a high level of commitment by its provider, and, thus, a low risk of knowledge leakage to competitors. This is so because, when transferring this kind of knowledge, the supplier gets close enough to the client so as to absorb not only the observable and objective components of the client's capabilities, but also the more tacit ones: the 'how and why' knowledge (Lane and Lubatkin 1998: 463). Indeed, the more tacit the knowledge exchanged is, the more the suppliers will need the client assistance to help them to understand it; increasing appropriability hazards (Mudambi and Tallman 2010). In effect, a non-standardised R&D process entails more uncertainty regarding the desired behaviour of the contracted firm, which increases the chances of opportunistic behaviour (García-Canal, Valdés-Llaneza, and Sánchez-Lorda 2008).

Based on this, we expect that when outsourcing R&D services that require the client to transfer tacit and specific knowledge to a supplier in a country offering higher possibilities of accidental knowledge leakages due to a weak IPR protection, the supplier contracting with rivals will increase the risks of negative spillovers (Martínez-Noya and García-Canal 2015), while the incoming ones will be lower due to the non-standardised nature of the knowledge exchanged. Indeed, previous research shows that when outsourcing more standardised services it is easier for the firm to profit from essential network externalities (Hurmelinna, Kyläheiko, and Jauhiainen 2007). Tacitness, on the contrary, is an obstacle to utilising network externalities. As a consequence, we expect that to mitigate the greater risks, and because formal knowledge protection mechanisms are not effective, client firms will opt to make a higher use of secrecy, reducing more its transparency, which will make even more difficult to achieve the innovation objectives within the agreement. Accordingly, we hypothesise that:

*H3a*. The negative effect hypothesized in H1 will be amplified if the supplier is located in a country offering low institutional IPR protection and the knowledge required to perform the R&D service is more tacit and client-specific.

On the other hand, we expect that when outsourcing services requiring low levels of tacit and client-specific knowledge, the fact of sharing suppliers under a weak IPR regime is not expected to generate severe leakage problems, but instead increase positive incoming spillovers. When the services are more standardised, knowledge transfer barriers can be easily defined and coordination costs decrease because there is a lower need to understand the client's idiosyncratic needs (Weigelt and Sarkar 2012). For these services, there are only advantages in outsourcing R&D services to an established player with a broad customer base because the company can benefit from the specialisation of the supplier without worrying about misappropriation hazards (Janowicz-Panjaitan and Noorderhaven 2009; Oxley and Sampson 2004). For these services, having a shared supplier in countries offering a weak IPR protection increases the potential gains resulting from incoming spillovers and supplier's specialisation advantages that can outweigh the possible loss associated to outgoing spillovers. We expect that when the knowledge that the client firm puts at risk is of a low strategic value, outsourcing to an established supplier that also serves competitors may allow the client firm to manage the uncertainty and risks inherent to outsourcing to economies with weak IPR protection, and, thus, a shared supplier may act as a hub of positive knowledge transfer. Indeed, in these economies, where formal institutions are not yet well developed, it has been found that managerial ties and networking becomes critical for success (Li and Zhang 2007). Accordingly, we hypothesise that:

*H3b*. The negative effect hypothesized in H1 will be reduced if the supplier is located in a country offering low institutional IPR protection and the knowledge required to perform the R&D service is less tacit and client-specific.

## 3. Methods

### *3.1. Sample and data collection*

The data used in this paper stems from an international mail survey on R&D service outsourcing conducted on a sample of firms headquartered in the U.S. and European Union with more than 100 employees, and whose two-digit SIC codes were included in the OECD

classification of technology-intensive industries (OECD 1997) (see Table A1). The reason to focus on these industries is that the fact of achieving their innovation objectives becomes key for these firms to stay competitive (Hagedoorn and Cloodt 2003). Interviews with the heads of technology and innovation of a large U.S.-based multinational helped us to refine the questionnaire. In addition, given the international nature of our sample, we pretested our questionnaire on seven R&D managers located in different countries, and we translated the questionnaire to: English, Italian, German, French and Spanish. To ensure external validity, we made a stratified mailing according to country of origin, industry and firm size using the *Dun and Bradstreet Million Dollar Database* (see Table A1). We mailed the survey in 2006 to the firm's Chief Executive Officer (CEO) along with a request to forward it to the head of R&D or technology if desired. The returned questionnaires were filled out by senior managers (CEOs, VPs and heads of R&D or technology or engineering departments). We received 105 completed questionnaires from the first stratified mailing, and 33 more questionnaires as a result of the second stratified mailing sent three months later. After a telephone follow-up process, we obtained a final sample of 182 usable responses (101 for the EU and 81 for the U.S.). It should be noted that despite the low response rate obtained (4.5% for the U.S. and 5.3% for the EU), the 182 responses obtained are representative of the population of firms to whom the stratified mailing was sent in terms of country of origin and industry[2] (see Table A1). In addition, although we mailed the survey in 2006, we believe that this does not question the validity to our results because the objective of this paper is not to explain the latest trends on R&D outsourcing, but to explain whether having a shared supplier may be an effective strategy to contribute to innovation performance depending on the appropriability regime. To do so we need a representative data-set with transaction-level data like the one that we have. Indeed, we believe that one of the strengths of our data-set is that we have transaction level data so we can measure the performance of a specific outsourcing relationship based on its transaction characteristics, which is rather uncommon in other studies. To test for non-respondent bias, analyses were run to test whether there were differences in terms of country of origin, industry, or firm size between the respondents and non-respondents, but we found no significant differences. We also compared the responses from the first and second mailings, but again we found no significant differences between early and late respondents.

In the questionnaire firms had to indicate how many of the following R&D services they were outsourcing, and where: Basic or fundamental research services; Applied or experimental research services; Designing products or prototypes; Designing production processes or technology systems; Designing and engineering system architectures; Development of product/prototypes or new or improved technologies (including drug manufacturing in the pharmaceutical industry); Software implementation services to help your company to implement new software; Scientific and technical support consulting services for actual or proposed R&D projects; Customised software development services; and Testing and analysis services. This list of R&D services that could potentially be outsourced by firms in the selected industries was elaborated after an exhaustive literature review of different innovation sources, and with the assessment of a consulting firm together with seven

[2]We performed chi-square tests (reported on Table A1 in the appendix) to analyse whether our final sample is representative with respect to the total sample. The tests do not reject the null hypothesis that our final simple is representative.

R&D managers. 108 of the 182 firms indicated to outsource R&D services. Because 96 of those 108 firms declared to be outsourcing more than one type of service, we asked them to identify from those being outsourced: 'the type of R&D service that the company was outsourcing regularly, representative of the R&D activities carried out by the company (in terms of resources compromised and volume being contracted)'. This allowed us to focus our analyses on just one specific outsourcing relationship for each firm and to be sure that the R&D services outsourced were of strategic importance for the firms in the sample. Finally, firms were asked to indicate the supplier of this service and different details of the outsourcing agreement.[3]

### 3.2. Estimation approach and variables

To test our hypotheses, we used Heckman's (1979) two-stage technique to account for the endogeneity associated to the decision to outsource. It consists of re-estimating the regression coefficients by introducing an adjustment term into the second-stage model (i.e. the inverse Mills ratio). We decided to use this approach because the R&D outsourcing decision represents a choice variable not randomly distributed across the sample and thus we need to assess and correct for self-selection bias. By applying this, it has been shown that consistent and unbiased estimates in the second-stage regression can be obtained (Hamilton and Nickerson 2003; Shaver 1998). Therefore, our first stage is a probit model assessing for the firm's likelihood of outsourcing R&D services and the second stage is an ordinary least squares (OLS) regression assessing for the client's ability to fulfil its innovation objectives within the agreement.[4]

Our dependent variable in the second-stage model (INNOVATION PERFORMANCE) was measured by two items. We developed a composite perceptual measure of performance by asking respondents to indicate, using a Likert scale from 1 (accomplished to a very low degree) to 5 (accomplished to a very high degree), the degree to which its company achieved the following objectives in the outsourcing relationship with the R&D supplier compared to what it was expected: (1) 'Increased the number of patents or innovations launched by year' (from 1 to 5) and (2) 'Accessed local knowledge' (from 1 to 5). As a consequence of our dependent variable comprising the average response to two different items (correlation coefficient = 0.91; Cronbach's alpha = 0.9529), the use of a Heckman model with an OLS model in the second performance stage is justified (Fey and Birkinshaw 2005; Li and Zhang 2007). The reason for not just asking about level of patents but also about innovation launched and local knowledge accessed is due to the fact that we are analysing firms operating in different industries, and it is known that not all of them patent at the same level (Hagedoorn and Cloodt 2003). Thus, with this average measure we attempt to capture both the new product and knowledge dimensions within a firm's innovation goals. Given that we could not find any standard measure to account for innovation performance at the transaction level in the literature, we pre-tested these items with R&D managers from different industries and countries who indicated that they found them appropriate to their respective industries. In addition, it should be noted that research shows that subjective measures of performance are

[3]Missing data on some of the variables reduced the sample to 170 usable questionnaires, with 97 of the firms reporting to be outsourcing one or more R&D services.

[4]In the first-stage model, the firm is the unit of analysis and in the second-stage model the unit of analysis was the most representative R&D outsourcing agreement for each firm.

well correlated with objective ones (Dess and Robinson 1984), particularly when respondents are top managers (Krishnan, Martin, and Noorderhaven 2006).

## 4. Results

Table 1 describes the operationalisation of the independent and control variables used in this second-stage model, and Table 2 shows the descriptive statistics and correlations among these variables.[5]

Table 3 reports maximum-likelihood estimates for the outsourcing decision probit model. As the main purpose of this model is to account for endogeneity, we just include the estimates for the sake of brevity.

Table 4 shows the results obtained in our second-stage regression models, controlling for self-selection using three specifications. It can be observed that an *F*-test of the null hypothesis that all coefficients are 0 is rejected in all models; and the estimated coefficients for lambda (the inverse Mills ratio) is significant across models, indicating the presence of self-selection and justifying the use of Heckman's technique.

Overall, consistent with our hypothesis 1, the client's ability to fulfil its innovation objectives within the outsourcing relationship tends to decrease as the supplier becomes more involved with competitors as shown by the negative and significant sign of CONTRACTS WITH CLIENT COMPETITORS ($p < 0.10$) in Model II. In addition, consistent with our hypothesis 2, we find that the supplier being located in a country offering weak institutional IPR protection also decreases the client's ability to fulfil its innovation objectives, as shown by the negative and significant sign of WEAK IPR PROTECTION in Model II ($p < 0.10$). Finally, when analysing the net effect that sharing suppliers with competitors may have on the client's ability to achieve its innovation objectives depending on the appropriability regime (this is, considering both the strength of the IPR location and the specificity of the service) we find in model III that the triple interaction term WEAK IPR PROTECTION × SERVICE SPECIFICITY x CONTRACTS WITH CLIENT COMPETITORS is negative and significant ($p < 0.10$). As two of the interacting variables are continuous, we display the net effect of the provider working for client's competitors on client innovation performance for different requirements of specific knowledge (see Figure 2). To test our hypotheses 3a and 3b, we compared the effects of the provider being located in a country with weak institutional IPR protection versus those located in countries with strong institutional IPR protection. As it can be observed, consistent with hypothesis 3a our results show that, when the level of service specificity is maximum, sharing suppliers with competitors in weak IPR economies appears to be especially detrimental to the client fulfilling its innovation objectives. While, by contrast, consistent with our hypothesis 3b, the results show that as the service specificity decreases, the negative effect of sharing suppliers on innovation performance is reduced in such a way that it turns to be highly positive when the supplier is located in a country offering low levels of institutional IPR protection. This result suggests that when outsourcing standardised services to countries characterised by weak institutional IPR protection, sharing suppliers can be indeed an effective innovation strategy. Our results thus show that the performance achieved is contingent on certain levels of service specificity together with the level of protection of the IPR system. In addition, it should be acknowledged that

[5]We mean-centered the relevant continuous variables before calculating the interactions given the high correlations between the main effects and the interaction ones (Jaccard and Turrisi 2003).

**Table 1.** Description of independent and control variables used in the second-stage model.

| Independent variables | Operationalisation |
|---|---|
| WEAK IPR PROTECTION | = 1 if the supplier is located in a country whose Intellectual Property Rights index is below 3.92 (which is the median value of this index within our sample) and 0 otherwise. This variable is obtained from the index of IPR protection developed by Ginarte and Park (1997) and updated by Park for the year 2000. It has been widely used (Oxley 1999) and it assigns a value from 0 to 5 to each country depending on its national patent legal system (value 5 indicating maximum protection). The relative superiority of this index compared to other alternatives is that this index describes in more detail the standards of the IPR, which leads to a greater variability of the index among countries<br>Specifically, the countries for which the dummy takes value 1 in our study are the following emerging countries: India, China, Taiwan and Malaysia |
| CONTRACTS WITH CLIENT COMPETITORS | To assess for the client assessment of the degree to which their R&D suppliers are shared with their perceived competition we asked the interviewees' to indicate their level of agreement, on a 1–5 scale, with the statement: 'The supplier also has outsourcing relationships with some of our competitors'. |
| SERVICE SPECIFICITY | To capture the client's need to transfer tacit and firm-specific knowledge to the supplier, we used a Likert (1–5) scale and asked interviewees to indicate their levels of agreement with the following statements related to the attributes of the R&D service outsourced: (1) individuals must acquire company-specific or division-specific information to perform the service adequately and (2) it is difficult for third parties to understand the company know-how related to this service. Thus, these items capture the dimensions of the firm-specificity and tacitness of the knowledge being transferred (Cronbach's alpha = 0.7). They were adapted from Poppo and Zenger's (1998) and Kogut and Zander's (1993) works |
| *Control variables* | |
| INTANGIBLE INVESTMENTS | To account for those intangible relation-specific investments aimed at facilitating knowledge transfer and understanding between parties as well as developing a trustful relationship, we introduced the variable INTANGIBLE INVESTMENTS. It is measured as the interviewee level of agreement on a Likert (1–5) scale with: '(1) the supplier incurred high costs in training its staff to meet the specific requirements of our company;' (2) 'the supplier has always shown its commitment to our firm;' (3) 'the supplier has invested in developing knowledge-sharing routines with our company;' (4) 'a high level of personnel transfer exists between the supplier and our company;' and (5) 'the supplier is willing to share its knowledge with our company' (Cronbach's alpha = 0.702) |
| RELATIONSHIP TENURE | Year in which the firm first signed a contract with the supplier |
| JOINT VENTURE | = 1 when the outsourcing agreement involves a joint venture between the parties, and 0 otherwise |
| LONG-TERM CONTRACT | = 1 if it involves a long-term contract between the parties, and 0 otherwise |
| MULTIPLE PROJECTS | = 1 if the supplier provides more services to the company, and 0 otherwise |
| NON-PROFIT RESEARCH CENTER | = 1 if the interviewee indicated that the supplier was a university or a research institute and 0 if it was a business firm |
| FIRM SALES | Logarithm of the firm's 2005 sales in U.S. dollars |
| PATENTS (adjusted), R&D Strategy-Basis, and industry dummies | Controls from the first stage to account for other sources of firm heterogeneity: number of patents assigned to the firm (adjusted by sector), relevance of R&D activities within the firm's corporate strategy, and industry dummies |

**Table 2.** Second-stage descriptive statistics and correlation matrix.

| | | Mean | SD | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | INNOVATION PERFORMANCE | 2.61 | 1.21 | | | | | | | | | | | | | | | | |
| 2 | WEAK IPR PROTECTION | 0.17 | 0.37 | −0.14 | | | | | | | | | | | | | | | |
| 3 | SERVICE SPECIFICITY | 3.07 | 1.05 | 0.00 | 0.10 | | | | | | | | | | | | | | |
| 4 | CONTRACTS WITH COMPETITORS | 3.68 | 1.43 | −0.10 | 0.02 | 0.04 | | | | | | | | | | | | | |
| 5 | INTANGIBLE INVESTMENTS | 1.82 | 0.84 | 0.11 | 0.22 | 0.49 | −0.00 | | | | | | | | | | | | |
| 6 | JOINT VENTURE | 0.07 | 0.25 | −0.14 | −0.02 | 0.13 | 0.06 | −0.03 | | | | | | | | | | | |
| 7 | LONG-TERM CONTRACT | 0.17 | 0.38 | −0.03 | 0.14 | 0.04 | 0.02 | 0.52* | −0.12 | | | | | | | | | | |
| 8 | RELATIONSHIP TENURE | 1995 | 10.01 | −0.05 | 0.10 | −0.15 | 0.06 | 0.03 | −0.04 | 0.15 | | | | | | | | | |
| 9 | MULTIPLE PROJECTS | 0.68 | 0.46 | −0.01 | 0.12 | 0.18 | 0.14 | −0.01 | 0.02 | −0.05 | 0.09 | | | | | | | | |
| 10 | NONPROFIT RESEARCH CENTER | 0.14 | 0.34 | 0.22* | −0.17 | −0.13 | −0.04 | −0.03 | −0.10 | 0.05 | 0.10 | 0.12 | | | | | | | |
| 11 | PATENT (ADJUSTED) | 0.05 | 5.1 | −0.08 | 0.12 | −0.00 | −0.18 | 0.34* | 0.10 | 0.20* | −0.09 | −0.20* | −0.09 | | | | | | |
| 12 | R&D STRATEGY-BASIS | 0.197 | 0.39 | −0.06 | 0.05 | 0.07 | 0.09 | −0.02 | −0.06 | −0.01 | 0.14 | 0.00 | −0.02 | −0.08 | | | | | |
| 13 | FIRM SALES (LOG) | 17.92 | 1.60 | −0.05 | 0.20* | 0.21* | −0.14 | 0.41* | 0.23* | 0.32* | −0.10 | −0.01 | −0.08 | 0.51* | −0.11 | | | | |
| 14 | SIC28 | 0.24 | 0.43 | −0.02 | −0.19 | −0.10 | −0.07 | 0.03 | 0.11 | −0.01 | −0.02 | −0.03 | 0.06 | 0.08 | 0.00 | 0.17* | | | |
| 15 | SIC36 | 0.21 | 0.41 | 0.18 | −0.12 | 0.24* | 0.18 | −0.14 | −0.04 | −0.10 | −0.11 | −0.14 | −0.16* | −0.02 | 0.06 | −0.07 | −0.30* | | |
| 16 | SIC37 | 0.08 | 0.28 | −0.12 | 0.09 | −0.05 | −0.01 | 0.12 | −0.05 | 0.17 | 0.08 | −0.03 | −0.12 | −0.06 | −0.00 | 0.18* | −0.17* | −0.16* | |
| 17 | SIC38 | 0.12 | 0.33 | −0.19 | 0.03 | 0.02 | −0.06 | −0.10 | 0.10 | −0.04 | 0.06 | 0.20* | 0.05 | 0.01 | 0.06 | 0.01 | −0.21* | −0.20* | −0.11 |

*Significant at the 5% level.

**Table 3.** Results of maximum-likelihood probit analysis for the outsourcing decision ($N = 170$).

| Independent variables | Full model |
|---|---|
| PATENTS | 1.139 |
| | (2.90)*** |
| IPR | 0.308 |
| | (1.59) |
| R&D STRATEGY-BASIS | −0.573 |
| | (2.31)** |
| PATENTS × R&D STRATEGY-BASIS | 7.401 |
| | (2.44)** |
| R&D STRATEGY-NO INFLUENCE | −0.139 |
| | (0.26) |
| R&D STRATEGY-INDEPENDENT | 0.208 |
| | (1.03) |
| FIRM SIZE (log) | −0.102 |
| | (1.41) |
| SIC28 | 0.389 |
| | (1.95)* |
| SIC36 | 0.324 |
| | (1.71)* |
| SIC37 | 0.452 |
| | (1.51) |
| SIC38 | 0.120 |
| | (0.43) |
| Constant | 0.186 |
| | (0.12) |
| Log pseudo-likelihood | −112.93 |

Note: Robust *z* statistics in parentheses.
*Significant at 10%; **Significant at 5%; ***Significant at 1%.

we have used a single-item measure to develop our independent variable CONTRACTS WITH CLIENT COMPETITORS (that ranges from 1 to 5) which can be considered as an empirical limitation.

With relation to the control variables, it should be noted that the intangible relation-specific investments made by the supplier, aimed at facilitating knowledge transfer and understanding between parties, contribute to the client achieving its innovation objectives as these investments can facilitate alliance coordination. Similarly, given the positive sign of the variable NON-PROFIT RESEARCH CENTER, we find that, compared to outsourcing to business firms, the supplier being a non-profit organisation (i.e. a university or research institute) positively contributes to the client achieving its innovation objectives. This finding, aligned with Martinez-Noya, Garcia-Canal, and Guillen (2013), reinforces our results because these organisations have lower incentives for imitation (Bercovitz and Feldman 2007) and face more difficulties than business firms in obtaining the complementary assets necessary to exploit the leaked client's knowledge (Teece 1986). As a consequence cooperating with these firms imposes lower appropriability hazards for the client firms.

## 5. Discussion and conclusion

Overall, our study shows that sharing R&D suppliers with competitors can mimic some of the advantages and disadvantages of being collocated with them. Nevertheless, the relative importance of the advantages and disadvantages vary with the appropriability regime of the outsourcing location, as it is expected to determine the client's use of secrecy as an informal protection mechanism when appropriability hazards are present. We find that in countries

**Table 4.** Estimates for second-stage performance regression models ($N = 97$).

| Independent variables | Model I | Model II | Model III |
|---|---|---|---|
| WEAK IPR PROTECTION | | −0.58* (1.73) | −0.74** (2.09) |
| CONTRACTS WITH CLIENT COMPETITORS | | −0.14* | −0.28*** |
| | | (1.74) | (2.95) |
| SERVICE SPECIFICITY | | −0.10 | 0.06 |
| | | (0.78) | (0.50) |
| WEAK IPR PROTECTION × CONTRACTS WITH COMPETITORS | | | 0.94*** |
| | | | (3.36) |
| WEAK IPR PROTECTION × SERVICE SPECIFICITY | | | −0.36 |
| | | | (0.83) |
| CONTRACTS WITH CLIENT COMPETITORS × SERVICE SPECIFICITY | | | −0.09 (1.04) |
| WEAK IPR PROTECTION × SERVICE SPECIFICITY × CONTRACTS WITH COMPETITORS | | | −0.55* |
| | | | (1.67) |
| INTANGIBLE INVESTMENTS | 0.28 | 0.38** | 0.38** |
| | (1.56) | (2.30) | (2.50) |
| JOINT VENTURE | −0.51 | −0.46 | −0.19 |
| | (0.91) | (0.86) | (0.33) |
| LONG TERM CONTRACT | −0.24 | −0.15 | 0.00 |
| | (0.83) | (0.54) | (0.00) |
| RELATIONSHIP TENURE | −0.00 | −0.00 | −0.00 |
| | (0.48) | (0.50) | (0.55) |
| MULTIPLE PROJECTS | −0.02 | 0.13 | 0.12 |
| | (0.08) | (0.51) | (0.49) |
| NONPROFIT RESEARCH CENTER | 0.82** | 0.66* | 0.77** |
| | (2.29) | (1.80) | (2.17) |
| PATENTS (adjusted) | −0.35 | −0.36 | 0.43 |
| | (0.60) | (0.63) | (0.66) |
| R&D STRATEGY-BASIS | −0.30 | −0.19 | −0.21 |
| | (0.86) | (0.65) | (0.72) |
| FIRM SALES (log) | −0.01 | 0.00 | −0.01 |
| | (0.12) | (0.08) | (0.26) |
| SIC28 | −0.15 | −0.28 | −0.39 |
| | (0.42) | (0.82) | (1.16) |
| SIC36 | 0.21 | 0.26 | 0.30 |
| | (0.59) | (0.76) | (0.91) |
| SIC37 | −0.58 | −0.61 | −0.74** |
| | (1.40) | (1.65) | (2.14) |
| SIC38 | −0.61 | −0.65 | −0.76* |
| | (1.39) | (1.45) | (1.95) |
| Constant | 14.53 | 12.62 | 13.63 |
| | (0.63) | (0.58) | (0.65) |
| Lambda ($\lambda$) | −0.58* | −0.49* | −0.39* |
| Log-pseudo likelihood | −239.64 | −236.43 | −228.11 |
| $R^2$ | 0.19 | 0.25 | 0.37 |
| $F$-value | 1.82* | 3.43*** | 7.77*** |

Note: Robust $z$ statistics in parentheses.
*Significant at 10%; **Significant at 5%; ***Significant at 1%.

with weak IPR systems sharing suppliers would be detrimental when outsourcing highly specific services, but not when outsourcing standardised ones. Therefore, our study is in line with the literature showing that a firm's ability to profit from innovation is dependent on its ability to protect their innovations (or valuable technological knowledge) from imitation (Hurmelinna, Kyläheiko, and Jauhiainen 2007; Pisano 2006; Teece 1986).

Our results suggest, as expected, that when the client has reasons to have high knowledge leakage concerns, such as when it needs to transfer tacit and specific knowledge to a shared R&D supplier, the innovative performance of the relationship decays; especially if this supplier is located in a country offering weak institutional IPR protection. The host

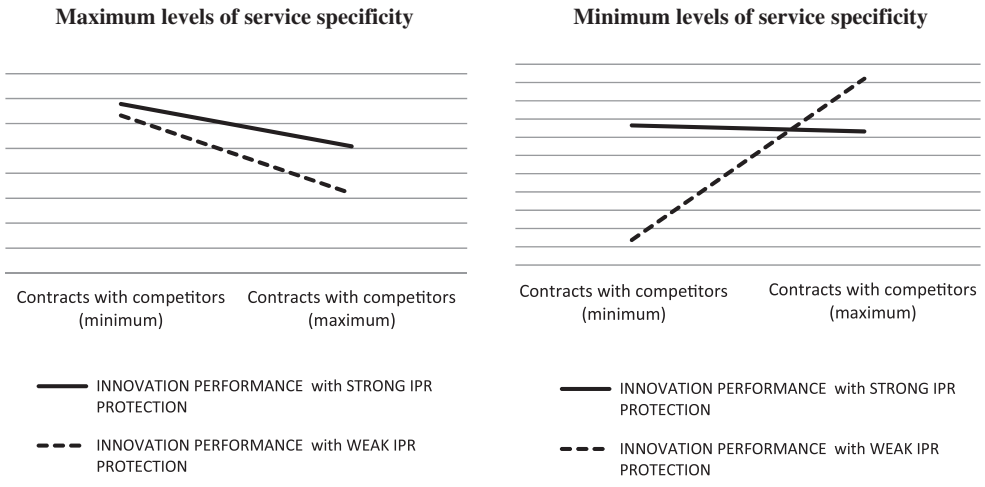


**Figure 2.** Net effect on client innovation performance of the R&D service supplier having contracts with client competitors depending on level of service specificity and the strength of the institutional IPR protection.
[a]Using the estimates from Model III in Table 3. Control variables were evaluated at the sample mean.

locations for which the dummy WEAK IPR PROTECTION takes value 1 in our study are India, China, Taiwan and Malaysia. There is no doubt that, compared to the client firms within our sample that are from the U.S. and the EU, these are emerging countries characterised by high levels of uncertainty due to the weak protection of the IPR, the existence of institutional voids, and huge cultural differences. Nevertheless, these are indeed very important host locations for offshoring services (Elia et al. 2014). We argue that sharing valuable knowledge in these risky locations may lead the client firms to decrease their transparency within the relationship, thus reducing their ability to achieve its innovation objectives. This is so because weak IPR locations offer higher possibilities of accidental knowledge leakages, and thus the supplier contracting with rivals contributes to risks of negative spillovers of valuable knowledge. This result complements Martínez-Noya and García-Canal (2015), and contributes to the literature showing that within these locations, firms have less incentives to undertake projects that could then generate important knowledge flows (Gooris and Peeters 2016), or they will develop mechanisms to protect their innovation by reducing the amount of information disclosed (Escribano, Fosfuri, and Tribó 2009). We show that this behaviour is however expected to have a negative effect on the client's ability to achieve its innovation objectives. Aligned with Monteiro, Mol, and Birkinshaw (2016) our results are indicative that for a technological partnership to flourish, and allow the free flow of ideas, reciprocity and trust between partners are critical, which means that the use of secrecy (although it may be useful to protect propriety knowledge) go against these values and make innovation more difficult.

Within this context, although we find that outsourcing highly specific services to locations offering weak IPR protection consistently leads to lower levels of innovative performance (compared to outsourcing them to locations with strong IPR protection), this difference across locations appears not to be significant when outsourcing these services to exclusive suppliers that do not contract with rivals. In this sense, our study suggests that

the supplier's commitment (refusing to work with client's competitors) appears to be always crucial to overcome the reluctance to be transparent when specific knowledge is required, irrespective of the location of the supplier. These results complement those showing that when tacit and specific information is needed to be transferred, trust between the partners facilitates the relationship (Ariño, De La Torre, and Ring 2001; Bäck and Kohtamäki 2016), and single sourcing has trust-building properties (Mudambi and Helper 1998). We add to this literature by showing that the supplier being located in a country offering weak IPR protection is not an impossible barrier to overcome when it comes to build trust, provided that the supplier do not serve competing firms.

In contrast, we find that when the service to be outsourced does not require the transfer of specific knowledge, the fact of sharing suppliers with competitors may not necessarily contribute negatively to innovation performance. In fact, when outsourcing services that do not require the client to put its specific knowledge at risk to countries offering weak IPR protection, outsourcing to a shared supplier can contribute very positively to the client achieving its innovation objectives. This result suggests that when the perceived appropriability hazards are very low, outsourcing to shared suppliers may be an effective innovation strategy when operating under weak IPR regimes. When dealing with standardised transactions, the institutional voids in knowledge protection appear not to prevent firms from profiting from the expertise accumulated by other firms operating under weak institutional conditions. It seems that in countries with weak institutional IPR protection, shared suppliers may act as a hub of specialised knowledge, and partnering with these suppliers may allow the firm to internalise location-specific knowledge, performing some kind of economic arbitrage (Ghemawat 2007). Thus while, on the one hand, partnering with these established suppliers in these countries for high risk transactions may mimic the disadvantages of collocation, for low risk transactions the fact of outsourcing to a shared supplier may mimic some of the advantages of being collocated with them. These findings are also related to the literature that shows that in transition economies (such as the ones in our sample: China, India, Taiwan and Malaysia) where formal institutions are not still well developed, it appears that who you know is all that counts and thus managerial ties and networking becomes critical for success (Li and Zhang 2007). When outsourcing to countries offering weak IPR protection, where it may be difficult to monitor and enforce contracts, choosing an established and reliable well-known supplier that also serves other foreign competitors may help the client firm (from a more developed country) to circumvent the lack of property rights and become a substitute for law enforcement and the legal system (Li and Zhang 2007). Thus, selecting an established shared supplier can reduce the risk and uncertainty that the client firm may face as a result of operating in weak institutional conditions. In relation to this, it should be noted that from a resource and learning theoretical perspectives, it could have been also argued an alternative direction of our first baseline hypothesis: this is that sharing suppliers with competitors can indeed contribute to achieve a client's innovation objectives by pooling more resources and knowledge. In this paper we took a transaction cost approach and therefore we put the emphasis of our argument on the appropriability hazards generated when having a shared supplier, and not so much on the learning advantages that the supplier could offer on its own. To address this issue, future research could however focus on analysing this phenomenon from different

theoretical perspectives, and in contexts different than R&D outsourcing, to further disentangle the conditions under which sharing suppliers can indeed contribute to a client's innovation performance.

One question that could emerge is why firms would outsource R&D services that imply putting their knowledge at risk. The literature has analysed several reasons for doing so, one of them being a lack of resources (Bertrand and Mol 2013; Cantwell and Santangelo 1999; Hoetker 2005; Narula 2001), because outsourcing is a process where the client may replace its weak capabilities for the stronger ones of its supplier (Weigelt 2013). According to Narula (2001), this may particularly be the case for firms operating in industries in which a wide variety of technological expertise is required in several disparate areas, namely when a firm's scale of production may be below the minimum efficient scale to justify performing the activity in-house, despite the activity being crucial to the competitive advantage of the firm. In these situations, it would make economic sense to provide the performance specifications to a specialised component manufacturer to design in close cooperation. The dilemma emerges when the upgraded capabilities of the supplier come at the cost of working with the client's competitors. Under some circumstances, managers are willing to assume the risks of sharing suppliers in order to benefit from 'world-class' suppliers with global capabilities in particular technological areas. This was exemplified in an interview given by Rolls-Royce CEO Tony Gott in 2002 where he explained that when building a supplier base for their new-brand Rolls-Royce cars, there were no restrictions on sharing suppliers with competitors such as Maybach and Bentley. He stated: 'We go for the best suppliers in the world for the given technology and application'. However, both from a transaction costs and a capability perspective, it could be argued that due to the lower commitment of the supplier towards the focal client – and, given the risks –, the possibilities for capability development within the relationship are reduced because the opportunities for generating synergistic value by bundling together supplier's skills with those of the focal client will be lower (Doz and Hamel 1998; Helfat and Peteraf 2003).

In conclusion, our study attempts to contribute to one of the unresolved puzzles in the innovation literature: whether a firm should innovate through closed and protected one-to-one cooperation based on the exchange of firm-specific knowledge, or through open cooperation based on the exchange of more standard heterogeneously distributed knowledge (Chesbrough 2003; Felin and Zenger 2014). Transaction costs theorists suggested two main risks firms face when outsourcing specific activities: (1) the supplier becoming a future competitor and (2) the risk of the knowledge leaking to competitors. Our study suggests that, at least for the outsourcing of R&D services, it is the latter the one that prevails. We believe that by highlighting the role of the appropriability regime of the location of the partner, we have paved the way for understanding the critical trade-off between incoming and outgoing knowledge spillovers that exist in cross-country knowledge transfers. However, further research is encouraged to analyse the effect of other related factors, such as the quality of subnational institutions, as they may indirectly lower the appropriability hazards due to weak IPR regimes (Santangelo, Meyer, and Jindra 2016). In addition, further evidence is needed to identify how outsourcing relationships can be structured and organised in these countries so as to avoid misappropriation issues and promote trust.

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# Appendix 1

**Table A1.** Distribution of survey responses by country of origin and industry

| | | Population of firms | | Mailed surveys | | Received surveys | |
|---|---|---|---|---|---|---|---|
| | | *N* | % | *N* | % | *N* | % |
| | U.S. | 3529 | *51.12* | 2000 | *50* | 81 | *45* |
| ORIGIN | European Union | 3375 | *48.88* | 2000 | *50* | 101 | *55* |
| | Austria | 95 | *1.38* | 56 | *1.40* | 2 | *1.10* |
| | Belgium | 43 | *0.62* | 25 | *0.63* | 2 | *1.10* |
| | Czech Republic | 33 | *0.48* | 20 | *0.50* | 1 | *0.55* |
| | Denmark | 38 | *0.55* | 23 | *0.58* | 0 | *0.00* |
| | Finland | 54 | *0.78* | 32 | *0.80* | 0 | *0.00* |
| | France | 373 | *5.40* | 221 | *5.53* | 9 | *4.95* |
| | Germany | 1041 | *15.08* | 617 | *15.43* | 24 | *13.19* |
| | Greece | 4 | *0.06* | 2 | *0.05* | 2 | *1.10* |
| | Ireland | 29 | *0.42* | 17 | *0.43* | 0 | *0.00* |
| | Italy | 854 | *12.37* | 507 | *12.68* | 32 | *17.58* |
| | Luxembourg | 2 | *0.03* | 1 | *0.03* | 0 | *0.00* |
| | Poland | 63 | *0.91* | 37 | *0.93* | 3 | *1.65* |
| | Portugal | 22 | *0.32* | 13 | *0.33* | 1 | *0.55* |
| | Spain | 157 | *2.27* | 93 | *2.33* | 9 | *4.95* |
| | Sweden | 71 | *1.03* | 42 | *1.05* | 3 | *1.65* |
| | The Netherlands | 35 | *0.51* | 21 | *0.53* | 1 | *0.55* |
| | UK | 421 | *6.10* | 249 | *6.23* | 12 | *6.59* |
| | East Europe | 40 | *0.58* | 24 | *0.60* | 0 | *0.00* |
| *Chi-square test: 2.2 (p-value: 0.14)* | | | | | | | |
| INDUSTRY | SIC 28 (Chemicals) | 1312 | *19.00* | 760 | *19.00* | 45 | *24.73* |
| | SIC 35 (Transportation Eq.) | 2337 | *33.85* | 1357 | *33.93* | 58 | *31.87* |
| | SIC 36 (Electronics) | 1635 | *23.68* | 947 | *23.68* | 40 | *21.98* |
| | SIC 37 (Machinery) | 840 | *12.17* | 487 | *12.18* | 16 | *8.79* |
| | SIC 38 (Measurement Eq.) | 780 | *11.30* | 449 | *11.23* | 23 | *12.64* |
| *Chi-square test: 5.62 (p-value: 0.23)* | | | | | | | |