



Internal capabilities, network resources and appropriation mechanisms as determinants of R&D outsourcing



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ABSTRACT

This paper contributes to an empirical validation of R&D outsourcing by integrating the influence of internal capabilities, network resources and appropriation mechanisms. Internal capabilities refer to internal R&D and human capital. Network resources account for decisions to outsource R&D which co-depend on informal incoming knowledge spillovers. Appropriation accounts for formal and informal knowledge protection mechanisms. This empirical study discusses the determinants of R&D outsourcing with respect to various theories of the firm that complement each other.

Data from the Third and Fourth European Community Innovation Survey for Belgium reveal internal R&D intensity to exert a strong positive association with R&D outsourcing intensity, emphasising the importance of absorptive capacity and the complementary nature of internal and outsourced R&D. Network resources are also positively associated, suggesting that firms involved in a mixture of informal and formal networks tend to outsource relatively more R&D. In terms of appropriation mechanisms there is a positive association formal and informal protection, but this last mostly through complexity of design.

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1. Introduction

Firms can be conceptualised as organisations in which individuals continuously and simultaneously take ‘make’ or ‘buy’ decisions (Jacobides and Billinger, 2006; Mudambi and Tallman, 2010). These decisions make firm boundaries permeable to attract and use external knowledge and technology and have implications for management and for the organisation of innovation processes (Van de Vrande et al., 2009).

Research and development (R&D) activities are considered of strategic importance for the firm (Holcomb and Hitt, 2007; Howells et al., 2008). These activities are either organised within the firm or are externally sourced. R&D outsourcing, however, should be distinguished from outsourcing in general in the sense that not all activities can be outsourced, nor are all activities that are outsourced strategic in nature (Tiwana and Keil, 2007; Huang et al., 2009). We use the term R&D outsourcing – or external R&D – as an indication of contractually paid R&D performed by an independent provider that is either a firm or a research organisation (Grimpe and Kaiser, 2010).

Outsourcing R&D is not a binary decision. Rather, there is a continuum of options along degree, stage, breadth and form that makes it a multifaceted phenomenon (Harrigan, 1983). R&D outsourcing can take various forms – such as procurement of routine services, technology acquisition, commissioned or joint research – and each form influences the opportunities for R&D outsourcing (Odagiri, 2003). Further, a distinction should be made between core and non-core R&D activities (Mol, 2005). The outsourcing of non-core R&D allows firms to direct managerial attention and resource allocation to those tasks they do best (Narula, 2001). Non-core technological knowledge is often codified and relatively simple to transfer (Kogut and Zander, 1992). R&D outsourcing of core activities facilitates the access to new knowledge and new technology which complement internal capabilities (Kang et al., 2012). Outsourcing core activities occurs when sufficient appropriation of outsourced R&D is guaranteed (Teece, 1986).

In the past 15 years an upsurge in outsourcing R&D has taken place (Jones, 2000; Narula, 2004; Varadarajan, 2009; Lai et al., 2009; Huang et al., 2009) and the strategic decision to outsource R&D has received ample recent attention (Holcomb and Hitt, 2007; Howells et al., 2008; Grimpe and Kaiser, 2010; Teirlinck et al., 2010; Hagedoorn and Wang, 2012).

Our paper investigates under which conditions firms outsource their R&D. So far the antecedents of R&D outsourcing have been

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studied in relative theoretical isolation. This paper sets out to broaden this in an empirical setting. The motives to outsource R&D can be approached from various perspectives on firm behaviour in relation to external knowledge sources: the transaction cost theory (Odagiri, 2003; Gooroochurn and Hanley, 2007); the resource based view and its extensions (Grimpe and Kaiser, 2010), and the relational view (Lavie, 2006; Martinez-Noya et al., 2013). This theoretical diversity is due to the fact that R&D outsourcing is not an exclusive input of external resources. Incoming knowledge spillovers stemming from search strategies (Laursen and Salter, 2006), and research cooperation agreements with external partners (Cassiman and Veugelers, 2002) are alternative external knowledge sources.

Our paper contributes to the literature by looking at the firm-level determinants of R&D outsourcing from various theories of the firm. We focus on the interplay of three determinants in their influence on R&D outsourcing: internal capabilities, network resources and appropriation mechanisms. First, in terms of internal capabilities, the presence of internal R&D received much attention because of its key role in absorptive capacity (Cohen and Levinthal, 1990). Many firms combine internal R&D with outsourcing other R&D activities (Odagiri, 2003) and both types of R&D have been found to be complements rather than substitutes (Veugelers, 1997; Caloghirou et al., 2004; Piga and Vivarelli, 2004; Mol, 2005; Grimpe and Kaiser, 2010). As pointed out by Hagedoorn and Wang (2012), this relationship is conditional on the in-house level of R&D investments. Besides internal R&D also the human capital factor frames internal capabilities (Mowery and Oxley, 1995; Barney et al., 2001; Holcomb and Hitt, 2007; Newbert, 2007; Spithoven et al., 2011).

Second, the strategic decision for R&D outsourcing cannot be seen independently from other kinds of external interaction, including the development of elaborate R&D networks (Narula, 2004; Mudambi and Tallman, 2010; Hagedoorn and Wang, 2012). These interactions involve different types of partners, such as competitors, firms connected by supplier–customer relations, and public research organisations such as universities and public research centres (Piga and Vivarelli, 2004; Nieto and Santamaría, 2007; Holcomb and Hitt, 2007) and tend to become increasingly international (Narula, 2001; OECD, 2008; Lewin et al., 2009; Varadarajan, 2009; Manning, 2013).

Third, appropriation of the results of – especially core activity – R&D outsourcing is an important mechanism to prevent innovation from unintentionally spilling over to third parties (Gooroochurn and Hanley, 2007). Different appropriation mechanisms exist ranging from formal ways, such as patenting, trademarks, confidentiality agreements and copyrights guaranteeing legal protection, to informal mechanisms, such as secrecy, complexity of product design and lead-time advantage over competitors (OECD, 2005; Cassiman and Veugelers, 2006; Pisano and Teece, 2007).

The aim of the paper is to empirically verify the relevance and importance of an array of recognised determinants that influence R&D outsourcing. A cross-section analysis is performed on representative data from the Third and Fourth European Community Innovation Surveys for Belgium, for 1998–2000 and 2002–2004. The two-period approach allows handling the issues of endogeneity and sampling selection. The paper seeks to contribute both from a theoretical as from an empirical stance. First it integrates the understanding of the factors that affect R&D outsourcing by incorporating multiple drivers simultaneously and provided by different streams of literature (see above). Previous research often focussed on one particular driver to the neglect of others. Second, the novelty of this paper lies in the simultaneous analysis of the influences of internal capabilities, network resources and appropriation mechanisms on R&D outsourcing. By doing this, a more complete picture of what impacts R&D outsourcing is offered. We contribute to the literature by highlighting the determinants that

influence R&D outsourcing, by treating it explicitly as a dependent variable. Up to date there have not been many empirical studies on the determinants of R&D outsourcing. Rather R&D outsourcing has been extensively discussed in terms of its contribution or hindrance to innovative performance (e.g. Caloghirou et al., 2004; Huang et al., 2009; Weigelt, 2009; Grimpe and Kaiser, 2010; Hagedoorn and Wang, 2012; Berchicci, 2013). Following Ray et al. (2004) we deviate from the usual empirical strategy, as argued by Newbert (2007), to use the resource-based perspective to explain performance and competitive advantage. Their assertion is that performances are a too crude measure due to their aggregated nature. Scarce empirical work in this direction are Mol (2005), who limited himself to the impact of internal R&D intensity on R&D outsourcing while leaving other determinants undiscussed; and Dhont-Peltrault and Pfister (2011) using the share of the number of outsourcing relationships as dependent variable.

The paper is organised as follows. Section 2 reviews the literature on drivers for R&D outsourcing, identifies the relevant determinants of R&D outsourcing, and formulates the resulting hypotheses to be tested. Section 3 describes the data, the method of estimation and presents the econometric model. The results are presented in Section 4, whereas Section 5 formulates the main conclusions and avenues for further research. Tables with a detailed description of the variables, their summary statistics and zero-order correlations are presented in the appendix.

2. Strategic drivers for outsourcing R&D

We begin Section 2 by presenting an overview of theories explaining R&D outsourcing to identify the key determinants involved: internal capabilities, network resources and appropriation mechanisms. Each of these three sets of determinants will subsequently be discussed and research hypotheses will be formulated.

2.1. Theoretical background

The theoretical background of this empirical paper is formed by the theories of the firm. We subsequently discuss the relation of R&D outsourcing with transaction cost economics, the resource-based view and its extensions – the knowledge-based view and dynamic capabilities – and the relational view.

The theoretical literature on outsourcing stems from three frameworks: transaction cost economics operationalised by Williamson (1975); the resource-based view (Barney, 1991) and its extensions such as the knowledge-based view (Grant, 1996a, 1996b) and the dynamic capability view (Teece et al., 1997); and the relational view (Mol, 2005; Lavie, 2006). Over the past decade these frameworks converged somewhat because of the complementary roles and co-evolution of transactional and capability considerations in the micro-analysis of firm decisions (Odagiri, 2003; Jacobides and Winter, 2005).

Transaction cost economics. The key reasoning of transaction cost economics is that firms internalise R&D activities that minimise the costs incurred from the governance of market exchanges (Gooroochurn and Hanley, 2007). These costs stem from negotiating and supervising contracts and from organisational difficulties that accompany market exchange. The argument is that firms outsource R&D when the costs associated with its internal realisation are lower.

Central concepts in transaction cost economics are asset specificity, uncertainty, and opportunism. R&D outsourcing occurs under conditions of low transaction costs, which is the case when asset specificity, the frequency of transactions and uncertainty are low (Williamson, 1981; Holcomb and Hitt, 2007). R&D outsourcing may

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