



# Open-Innovation Effectiveness: When does the Macro Design of Alliance Portfolios Matter?



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## ABSTRACT

We determine the impact of the macro-design of a firm's alliance portfolio on its open-innovation effectiveness. Three elements of macro-design—international, technological, and partner diversity—are theorized to affect the breadth of knowledge sourcing, which is an important facet of open-innovation effectiveness. We test our hypotheses on a sample of 982 firm-years in the biotech industry. We find a U-shaped relationship between knowledge-sourcing breadth and international diversity. We also find that that technological diversity has no impact on knowledge-sourcing breadth. Furthermore, when seeking valuable knowledge, partner diversity is detrimental to knowledge-sourcing breadth.

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## 1. Introduction

In recent decades, a growing body of literature has highlighted knowledge sourcing as an intriguing and powerful explanation for why some firms are able to innovate (Ambos and Ambos, 2007; Chesbrough and Appleyard, 2007; Doz et al., 2001). In this perspective, competitive advantage is viewed as resting on 'open-innovation' (OI), in which firms access external sources of knowledge through a variety of pathways (Chesbrough, 2003; Hagedoorn and Duysters, 2002; Laursen and Salter, 2006).

However, OI is challenging for many firms. This is partly attributable to the fact that potentially valuable knowledge is scattered across the globe, institutionally embedded, and sticky (Nelson, 1993; Patel and Pavitt, 1997; Szulanski, 1996). OI requires firms to make significant investments in order to dislodge and use knowledge (Phene et al., 2006; Rosenkopf and Almeida, 2003). Nevertheless, our understanding of why some firms might be more effective than others at OI is relatively limited (Keupp and Gassmann, 2009; Laursen and Salter, 2006).

To address this question, we take a closer look at global R&D alliance portfolios, which have become a dominant pathway to OI (Almeida et al., 2002; Faems et al., 2010; Grant and Baden-Fuller, 2004; Mascarenhas and Koza, 2008; Neyens and Faems, 2013; Powell et al., 1996; Vanhaverbeke and Cloodt, 2006). Our main research question can be summarized as the following: *To what extent does the structure of a firm's alliance portfolio have an impact on OI effectiveness?*

More precisely, we examine the extent to which the macro design of an alliance portfolio, i.e., its international and technological spread, influences knowledge sourcing as an important facet of OI effectiveness in relation to *each* partner tie.<sup>3</sup> Accordingly, we define

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<sup>3</sup> We define a 'partner tie' as a dyadic relationship between two firms.

the alliance portfolio's *knowledge-sourcing breadth* as the extent to which the focal firm absorbs knowledge through its R&D partner ties (Laursen and Salter, 2006; Lee et al., 2014; Mowery et al., 1996; Phene and Almeida, 2008; Srivastava and Gnyawali, 2011; Zahra and George, 2002). Our conceptualization of knowledge-sourcing breadth reflects both the ability and the willingness of the focal firm to source knowledge from its alliance portfolio beyond those sourcing opportunities that are available to it (Keupp and Gassmann, 2009; Laursen and Salter, 2006; Phene and Almeida, 2008; Srivastava and Gnyawali, 2011).

Our central thesis is that each partner tie is potentially beneficial in terms of providing access to external knowledge. We assume that firms prefer to source external knowledge across their respective portfolios (Laursen and Salter, 2006; Phene and Almeida, 2008). However, broad knowledge sourcing carries costs, including costs associated with establishing, maintaining, and managing such ties. Concurrently, the firm incurs monitoring and controlling costs, as it must attempt to prevent proprietary knowledge from spilling over to its alliance partners (Dyer and Singh, 1998; Hamel, 1991; Jiang et al., 2010). We argue that the extent to which firms broadly source from their alliance portfolios depends on two main factors. First, the breadth of sourcing depends on the relative costs of sourcing knowledge. When the costs outweigh the benefits, the firm is unlikely to accept additional costs and will refrain from sourcing broadly. Second, synergies in the alliance portfolio arising from its specific macro-design might reduce the costs of sourcing knowledge and allow for broader knowledge sourcing across the portfolio (Vassolo et al., 2004).

We test our propositions using a sample of US-listed biotech and pharmaceutical firms from 1998 to 2002, which gives a total of 982 firm-years. We find that three facets of the macro-design—*international diversity*, *technological diversity*, and *partner diversity*—affect *knowledge-sourcing breadth*. After controlling for firm technological concentration, portfolio size, firm absorptive capacity, and tie strength, we pin down the effect of alliance portfolio macro-designs on knowledge-sourcing breadth.

Our study makes three important contributions to the extant literature. First, in an extension of the alliance-portfolio and OI streams of literature, we elaborate on the concept of portfolio knowledge-sourcing breadth as one key aspect of open-innovation effectiveness. In addition, we draw on the alliance-portfolio literature to explain how certain macro-designs are more conducive to open-innovation. Second, we contribute to the global strategy literature by underscoring the benefits and costs of absorbing internationally diverse knowledge. Third, our study highlights important managerial implications and points to the intricate balancing act that managers need to undertake to create a value from each tie in their alliance portfolios.

## 2. Literature review: alliance portfolios

The need for studies of alliance portfolios, which we define as a firm's direct ties has recently been emphasized (George et al., 2001; Wassmer, 2010). In dynamic environments, innovation imperatives pressure firms to forge multiple, international alliances (Ahuja and Katila, 2004; Hallen and Eisenhardt, 2012; Kogut and Zander, 1992; Powell et al., 1996). Researchers and industry analysts note that even though firms are increasingly engaged in multiple, simultaneous alliances, we lack a thorough understanding of the alliance-portfolio sources of value creation beyond the mere aggregation of dyads (Wassmer, 2010). Mirroring empirical trends, alliance researchers have shifted their level of analysis to the study of portfolio effects. In this regard, Vassolo et al. (2004) find that alliance portfolios exhibit both positive and negative synergies. Such portfolio effects have important consequences for the focal firm's innovation and its competitive advantages (Lavie, 2007; Srivastava and Gnyawali, 2011). In this respect, an understanding of how the macro-design of the alliance portfolio affects firm-level outcomes, such as OI effectiveness, is critical.

More specifically, in literature that adopts the innovation or knowledge-based view, a number of studies have examined the ability and willingness of firms to absorb knowledge from their respective alliance portfolios (Srivastava and Gnyawali, 2011; Vasudeva and Anand, 2011). This research has examined the extent to which the *macro-design* of alliance portfolios enables firms to absorb knowledge from their respective alliance partners (Goerzen and Beamish, 2005; Jiang et al., 2010; Lavie, 2007; Vasudeva and Anand, 2011; Wassmer, 2010). Most of these studies find that simple exposure to knowledge diversity through R&D alliances does not always improve the firm's innovative outcomes. In fact, highly diverse portfolios require significant investments in knowledge-sharing routines, suffer from monitoring and coordination difficulties due to high levels of information asymmetry, and increase the risk of unintentional knowledge leakages (Hamel, 1991; Jiang et al., 2010; Lavie, 2007; Sarkar et al., 2009; Vasudeva and Anand, 2011). In contrast, optimal portfolios are those in which the benefits of knowledge diversity are carefully balanced with the costs of acquiring knowledge.

In the next section, we develop our basic argumentation, which links the macro-designs of alliance portfolios to OI outcomes, especially the breadth of knowledge sourcing.

## 3. Hypotheses

### 3.1. International diversity

National markets have specific characteristics and needs that, in turn, generate idiosyncratic national technological knowledge (Ahuja and Katila, 2004; Frost, 2001). Firms establish international alliances in order to gain access to the valuable, complementary knowledge found in diverse institutional environments (Ahuja and Katila, 2004; Barkema and Vermeulen, 1998; Faems et al., 2010; Nelson, 1993; Penner-Hahn and Shaver, 2005; Phene et al., 2006). Such alliances provide firms with OI opportunities (Chesbrough, 2003).

However, there are costs associated with using international alliances to boost OI. In general, international alliances are more difficult to manage due to potential appropriability hazards as well as problems associated with internationality that hinder knowledge sourcing (Chen et al., 2013; Ghemawat, 2003; Goerzen and Beamish, 2005; Hamel, 1991; Hansen et al., 2005; Inkpen and Beamish,

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