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Hoffmann, Werner H.; Wörner, Roman

*DOI:*

[10.57938/0a1cad0f-0c1b-4794-9838-9ac145e0343e](https://doi.org/10.57938/0a1cad0f-0c1b-4794-9838-9ac145e0343e)

Published: 03/07/2013

*Document Version*

Publisher's PDF, also known as Version of record

[Link to publication](#)

*Citation for published version (APA):*

Hoffmann, W. H., & Wörner, R. (2013). *The relationship between internal and external exploration orientation: the moderating role of the vertical scope of a firm*. WU Vienna University of Economics and Business. Working Papers / Institute for Strategic Management No. 02/2013 <https://doi.org/10.57938/0a1cad0f-0c1b-4794-9838-9ac145e0343e>

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Hoffmann, H. Werner  
Professor and Head of Institute  
Institute for Strategic Management, Vienna University of Economics and Business  
Nordbergstrasse 15 (UZA 4), upper level 6, section A, 1090 Vienna  
Tel.: +43/1/31336 ext. 4566  
e-mail: werner.hoffmann@wu.ac.at

Wörner, Roman  
Doctoral Student  
Institute for Strategic Management, Vienna University of Economics and Business  
Nordbergstrasse 15 (UZA 4), upper level 6, section A, 1090 Vienna  
Tel.: +43/1/31336 ext. 5596  
e-mail: h0953997@wu.ac.at

*Authors are listed in alphabetical order.*

*Key words: exploration and exploitation; balancing; ambidexterity; strategic alliances; vertical scope*

### **ABSTRACT**

Using data from the biopharmaceutical industry, this study analyzes the relationship between internal and external exploration (exploitation) and the moderating role of firm characteristics. We argue that the characteristics of a firm – in particular a firm's vertical scope – are an important but so far overlooked contingency factor determining the relationship between internal and external exploration (exploitation). Our findings indicate that differences in vertical scope result in alternative combinations of internal and external exploration. While specialized firms tend to focus either on exploration or exploitation both within the firm as well as with their alliance portfolio, vertically integrated firms prefer to balance exploration and exploitation across firm boundaries.

## INTRODUCTION

According to March (1991), maintaining an appropriate balance between exploration and exploitation is a primary factor of firm survival and prosperity. Although both types of organizational behavior are argued to be necessary for long-term success, pursuing the two simultaneously creates a significant tension because of their very different requirements in terms of organizational structures, strategies, and contexts as well as the trade-off given a firm's limited set of resources (Levinthal and March, 1993; Gupta, Smith, and Shalley, 2006). Yet, how firms deal with this tension is of researchers' and practitioners' interest ever since March's 1991 landmark article.

Today, strategic alliances are an ubiquitous phenomenon (Gulati, 1998). They provide firms with a flexible way to access external resources relevant to the creation of a competitive advantage and have thus become an important strategic device (Eisenhardt and Schoonhoven, 1996; Ahuja, 2000; Das and Teng, 2000; Lavie, 2006). As a result, many firms find themselves embedded in a network of different types of cooperative inter-organizational relationships (Hoffmann, 2007; Wassmer, 2010). Some authors argue that firms purposefully design their alliance portfolios in a way to master the trade-off between exploration and exploitation (Rothaermel and Deeds, 2004; Hoffmann, 2007). In this study, we build on these insights and examine in greater detail how a firm can use its alliance portfolio to deal with the tension of combining exploration and exploitation activities. More specifically, we analyze how the exploration orientation<sup>1</sup> of a firm's alliance activities is influenced by the internal exploration orientation of a firm and vice versa.

The exploration/exploitation framework has become an essential lens for interpreting various behaviors and outcomes within and across organizations (Raisch *et al.*, 2009; Lavie, Stettner, and Tushman, 2010). However, our knowledge about the interaction of internal and external exploration (exploitation) is still limited (e.g., Lavie, Kang, and Rosenkopf, 2011). Only recently, authors have begun to address how firms balance internal exploration (exploitation) with external exploitation (exploration) and vice versa (Russo and Vurro, 2010), but literature has paid no attention yet to the

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<sup>1</sup> Following Gupta *et al.* (2006) and Lavie *et al.* (2010), we conceptualize exploration and exploitation as two ends of a *continuum*. Low levels of *exploration orientation* indicate a tendency towards *exploitation*, high levels of *exploration orientation* a tendency towards *exploration*. We furthermore distinguish between a firm's *internal* exploration orientation (*IEO*) and *external* exploration orientation (*EEO*).

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role of firm characteristics with regard to the cross-boundary balancing of exploration and exploitation. Our study builds on these findings and argues that the relationship between IEO and EEO is contingent on the vertical scope of a firm.

These predictions are tested using data on the alliance portfolios of 328 firms in the biopharmaceutical industry tracked over a period of ten years. We apply a functional motivation perspective to EEO (proportion of upstream alliances) as well as to IEO (R&D expenses per employee) (Ying, Vanhaverbeke, and Schoenmakers, 2008). Our findings contribute to existing research by highlighting the moderating role of vertical scope on the relationship between IEO and EEO. In particular, we show that for firms with a narrow vertical scope high levels of EEO are associated with high levels of IEO (and vice versa). As hypothesized, the positive relationship between EEO and IEO diminishes with an increase in vertical scope. For vertically integrated firms, EEO and IEO are negatively related. However, we were unable to confirm the same moderating role of vertical scope on the effect of IEO on EEO.

## THEORY AND HYPOTHESES

### Literature review

The exploration/exploitation framework distinguishes two 'gestalts' of organizational behavior: *exploration* and *exploitation* (March, 1991). While exploration means the development of something new, exploitation is about the refinement of something that already exists (Levinthal and March, 1993). Starting from the seminal works of March (1991) and Levinthal and March (1993), the exploration/exploitation framework has drawn considerable academic interest over recent years.<sup>2</sup> Echoing the fundamental assumption that – although at odds – long-term success requires to balance exploration and exploitation, research has devoted much attention to two central issues: (1) how firms might *achieve a balance* between exploration and exploitation and (2) whether balancing exploration and exploitation actually *improves firm performance*. Thanks to prior research we now know that firms can possibly balance exploration and exploitation by modes like organizational separation (e.g., Tushman and O'Reilly, 1996), temporal separation (e.g., Siggelkow and Levinthal, 2003), domain

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<sup>2</sup> For a comprehensive overview of the development and current state of research on the exploration/exploitation framework see Raisch *et al.* (2009) and Lavie *et al.* (2010).

separation (e.g., Lavie and Rosenkopf, 2006; Su and McNamara, 2012), or contextual ambidexterity (e.g., Gibson and Birkinshaw, 2004; Boumgarden, Nickerson, and Zenger, 2012). However, empirical evidence of the positive performance effects of balancing exploration and exploitation is both limited (e.g., He and Wong, 2004; Uotila *et al.*, 2009; Lavie *et al.*, 2011) and mixed.<sup>3</sup>

While most prior work on the exploration/exploitation framework has been conducted either at the intra-organizational (how firms balance exploration and exploitation within their boundaries) or at the inter-organizational (how firms balance exploration and exploitation with their alliance decisions) level (Russo and Vurro, 2010), recently academic research has started to move towards an integration of these two levels (e.g., Rothaermel and Alexandre, 2009; Belderbos *et al.*, 2010; Hoang and Rothaermel, 2010). It were Russo and Vurro (2010), who proposed cross-boundary ambidexterity as an additional mean to balance exploration and exploitation. In their analysis of a sample of firms of the fuel cell industry, they found partial support for their argument that firms tend to balance internal exploration (exploitation) with external exploitation (exploration) and vice versa. Following the call for future research (e.g., Hoang and Rothaermel, 2010; Lavie *et al.*, 2010; Russo and Vurro, 2010; Lavie *et al.*, 2011), the purpose of this paper thus is to analyze in more detail, which mechanisms might affect a firm's tendency to balance exploration and exploitation across firm boundaries.

### **A contingency perspective on balancing exploration and exploitation**

As Ginsberg and Venkatraman (1985, p. 421) point out, *'it is perhaps a truism that any theory of corporate or business strategy must be, by definition, contingency-based.'* Although there is the normative (Lavie and Rosenkopf, 2006) assumption that firms should balance exploration and exploitation (Levinthal and March, 1993), many authors question whether all firms benefit from an ambidextrous strategy (e.g., Lin, Yang, and Demirkan, 2007). Hence, a wide array of papers analyzing the performance consequences of balancing exploration and exploitation applies a contingency perspective (e.g., Ebben and Johnson, 2005; Lin *et al.*, 2007; Lavie *et al.*, 2011; Yamakawa, Yang, and Lin, 2011; Voss and Voss, forthcoming). These studies (1)

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<sup>3</sup> We will elaborate on this aspect in more detail in the section 'A contingency perspective on balancing exploration and exploitation.'

concentrate *either* on the *intra-organizational* or the *inter-organizational* level of the exploration/exploitation framework, (2) *identify* and test *contingency factors* like firm characteristics (firm size and age), firm strategy (cost leadership and differentiation strategy), and the industry environment (industry growth and environmental uncertainty), and (3) analyze these contingencies in regard to the *performance outcomes* of balancing exploration and exploitation.

Nevertheless, prior research is not without limitations. First, the cross-boundary balancing literature currently lacks a closer inspection of potential contingency factors.<sup>4</sup> Second, existing studies employing a contingency perspective exclusively examined the performance outcomes of different approaches in regard to exploration and exploitation. However, since it has been shown that firms tend to use their alliances to support the implementation of exploration and exploitation oriented strategies (e.g., Park, Chen, and Gallagher, 2002; Rothaermel and Deeds, 2004; Hoffmann, 2007), we claim that already the decision to use a particular balancing mode (i.e., cross-boundary balancing) might be contingent on firm characteristics.

We therefore argue that also at the intercept of the intra-organizational and the inter-organizational level (cross-boundary balancing) a contingency perspective could enrich our understanding of a firm's approach towards (balancing) exploration and exploitation. Hence, unlike Russo and Vurro (2010), we don't expect to find all firms balancing exploration and exploitation across their firm boundaries. Instead, we argue that whether firms actually use their alliance portfolio to balance internal exploration with external exploitation (and vice versa) or to reinforce internal exploration (exploitation) with external exploration (exploitation) depends on their vertical scope.

### **The moderating role of vertical scope**

We argue that the vertical scope of a firm (Williamson, 1971; Besanko *et al.*, 2007; Grant, 2010) is particularly relevant in regard to the cross-boundary balancing of exploration and exploitation. This is for two reasons: (1) the *vertical scope* determines a firm's *resource endowment*; (2) the vertical scope (at least in this industry) furthermore provides information on a firm's general *predisposition towards exploration and exploitation*.

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<sup>4</sup> With the notable exception of Rothaermel and Alexandre (2009), who analyze the moderating role of absorptive capacity on the performance consequences of ambidexterity in technology sourcing.

*Resource endowment:* following the arguments of transaction cost economics (Coase, 1937; Williamson, 1975; Williamson, 1985) and the resource based view of the firm (Wernerfelt, 1984; Barney, 1991; Peteraf, 1993), the vertical scope of a firm determines the composition of its resource endowment (e.g., Pisano, 1991; Barney, 1999; Jacobides and Hitt, 2005; Jacobides and Winter, 2005). While firms with a narrow vertical scope specialize in dedicated steps of the biopharmaceutical value chain (e.g., R&D or marketing and sales), firms with a broader vertical scope combine a more diversified resource and knowledge base (Lahiri and Narayanan, forthcoming). In the biopharmaceutical industry vertical scope, firm size, and firm age are argued to be highly correlated (e.g., Baum, Calabrese, and Silverman, 2000; McCutchen Jr and Swamidass, 2004). Thus, although vertical scope (composition of resources), firm size (amount of resources), and age (level of experience) are different constructs, firms with a broad vertical scope are typically larger and also more mature.

*Predisposition towards exploration and exploitation:* the biopharmaceutical value chain is comprised of research, development, manufacturing, and marketing & sales activities (Burns, 2005; Chiaroni, Chiesa, and Frattini, 2008). In this study, we apply a functional motivation perspective to EEO as well as to IEO. EEO thus reflects the share of upstream R&D alliances in a firm's alliance portfolio (Koza and Lewin, 1998). IEO is expressed by a firm's internal investment in R&D per employee. Low levels of IEO and EEO indicate an orientation towards exploitation. When viewed from a functional perspective, the vertical scope of a firm also provides information on a firm's internal predisposition towards exploration and exploitation. Papers in the field of the biopharmaceutical industry often link research and development activities to exploration and manufacturing as well as marketing & sales activities to exploitation (e.g., Pisano, 1991; McCutchen Jr and Swamidass, 2004; Rothaermel and Deeds, 2004; Stuart, Ozdemir, and Ding, 2007; Chiaroni *et al.*, 2008; Rothaermel and Boeker, 2008; Hoang and Rothaermel, 2010; Lavie *et al.*, 2011). Hence, firms with a narrow vertical scope are – depending on their positioning along the value chain – generally oriented either towards exploration (i.e., up-stream activities) or exploitation (i.e., down-stream activities). Differently, firms with a broad vertical scope cover the whole value chain and strive to combine explorative and exploitative tasks.

We expect the vertical scope of a firm – and thus the resource endowment as well as the orientation towards exploration, exploitation or both – to affect its alliance

decisions. According to prior research, the formation of alliances is driven by *need* and *opportunity* (Eisenhardt and Schoonhoven, 1996; Ahuja, 2000; Park *et al.*, 2002). Furthermore, we expect the *dominant logic* of a firm to also impact its positioning towards exploration and exploitation alliances.

The *need* for particular types of alliances is determined by a firm's strategy (Koza and Lewin, 1999; Hoffmann, 2007). We therefore expect firms with a narrow vertical scope, and thus a tendency towards either exploration or exploitation, to primarily intend to enter alliances that support and reinforce their internal orientation. Following this approach helps the firm to both deploy its existing resources in the most productive manner<sup>5</sup> as well as to gain credibility and further develop its specialized resources within their respective domain (Colombo, Grilli, and Piva, 2006). So, for example Stuart *et al.* (2007) have argued that biotech firms tend to enter a wide range of upstream alliances and later on broker the knowledge to downstream partners. Hence, while firms with a narrow vertical scope also enter alliances for the need to access complementary (Teece, 1986) resources ('balance'), we expect these alliances to be outnumbered by alliances entered for the intent to combine similar (Powell, Koput, and SmithDoerr, 1996; Chiaroni *et al.*, 2008) resources ('focus'). On the contrary, firms with a broad vertical scope face the challenge to combine explorative and exploitative tasks (Gupta *et al.*, 2006). Since it is demanding to excel at both explorative and exploitative tasks at the same time, firms with a broad vertical scope might possibly use their alliances to ease this tension (e.g., Russo and Vurro, 2010). Therefore, a firm with a broad vertical scope and a relative emphasis on internal exploitation might use its alliance portfolio to complement this strategy with a relative emphasis on external exploration (and vice versa). This approach helps to both supplement areas of internal weaknesses (Rothaermel, 2001) as well as leverage areas of internal strength (Jacobides and Hitt, 2005; Jacobides and Winter, 2005; Rothaermel and Boeker, 2008). Thus, we assume that while firms with a narrow vertical scope pursue a focused approach, firms with a broad vertical scope tend to balance explorative and exploitative tendencies across their firm boundaries.

Whether a firm is an attractive alliance partner and, thus, its partnering *opportunities* depend on its resources and reputation (Das and Teng, 2000; Park *et al.*,

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<sup>5</sup> For the reasons outlined above, firms with a narrow vertical scope are more likely to face resource constraints and possess less slack resources.



2002). The kind of resources (up-stream assets and capabilities, down-stream assets and capabilities, or both) a firm has to offer is largely determined by its vertical scope (Rothaermel, Hitt, and Jobe, 2006; Li and Tang, 2010; Lahiri and Narayanan, forthcoming). Thus, from an opportunity perspective, firms with a narrow vertical scope are attractive alliance partners because of their specialized resources in selected steps of the value chain. Firms with a narrow vertical scope are therefore expected to face alliance opportunities where the alliance goal matches the firm's resource strength – e.g., firms specialized in exploration will be offered exploration or hybrid alliances. Differently, a firm with a broad vertical scope is expected to face multiple alliance opportunities, since it can provide exploration as well as exploitation resources.

Furthermore, when IEO and EEO are studied within the same domain (R&D vs. commercialization), a firm will experience impediments (Lavie and Rosenkopf, 2006) when it tries to combine exploration and exploitation – even if it attempts to achieve this balance by cross-boundary balancing. This is particularly true for firms with a narrow vertical scope. These firms are typically smaller and younger (Baum *et al.*, 2000; McCutchen Jr and Swamidass, 2004). The *dominant logic* (Prahalad and Bettis, 1986) and culture of such a firm (resource allocation, routines, attitudes and values, etc.) is oriented either towards exploration or exploitation (Gupta *et al.*, 2006). Entering a complementary alliance exposes the firm to an unfamiliar context and poses managerial challenges the firm may not be able to handle (Kale, Dyer, and Singh, 2002; Colombo *et al.*, 2006; Kale and Singh, 2007). Contrarily, a firm with a broad vertical scope has gained experience regarding exploration as well as exploitation activities. Furthermore, due to their size and age, these firms are generally less constrained in their managerial resources and more experienced in managing alliances (Kale *et al.*, 2002; Colombo *et al.*, 2006). For such a firm it's less of a stretch to form exploration as well as exploitation alliances. Thus, the dominant logic makes it more likely for firms with a narrow vertical scope to enter alliances that immerse and reinforce their own resource endowment while firms with a broad vertical scope are more flexible in their alliance decisions and may benefit more from balancing exploration and exploitation using their alliance portfolio.

The strategy of a firm and its strategic alliances are interrelated. The intent for entering a particular alliance is motivated by firm strategy. Similarly, the outcome of

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an alliance alters a firm's resource endowment and affects its strategy (Hoffmann, 2007). As a result, the strategy of a firm, its resource endowment, and its portfolio of alliances co-evolve (Koza and Lewin, 1998; Koza and Lewin, 1999; Hoffmann, 2007). As we have discussed above, the need for particular types of alliances is determined by a firm's strategy. Conversely, we expect firms to internally respond to their alliance behavior according to their strategic intent (orientation towards exploration, exploitation, or both). We therefore assume that firms with a narrow vertical scope that are high/low in EEO follow the same strategy internally, to leverage the knowledge and resources accessed via strategic alliances (focus). They use their alliances to refine their internal resources and advance their positioning and scope. Differently, firms with a broad vertical scope that are high/low in EEO are supposed to be motivated to concentrate on the respective other activity internally, to ease the tension of combining exploration and exploitation (balance). Utilizing complementary resources of their alliance partners allows them to leverage superior internal resources. Thus, we hypothesize:

*Hypothesis 1: For firms with a narrow vertical scope higher levels of (a) EEO / (b) IEO are associated with higher levels of (a) IEO / (b) EEO.*

*Hypothesis 2: With an increase in vertical scope, the positive association between (a) EEO / (b) IEO and (a) IEO / (b) EEO diminishes. For integrated firms, these associations will be negative.*

Figure 1 illustrates the relationship between IEO, EEO, and vertical scope.

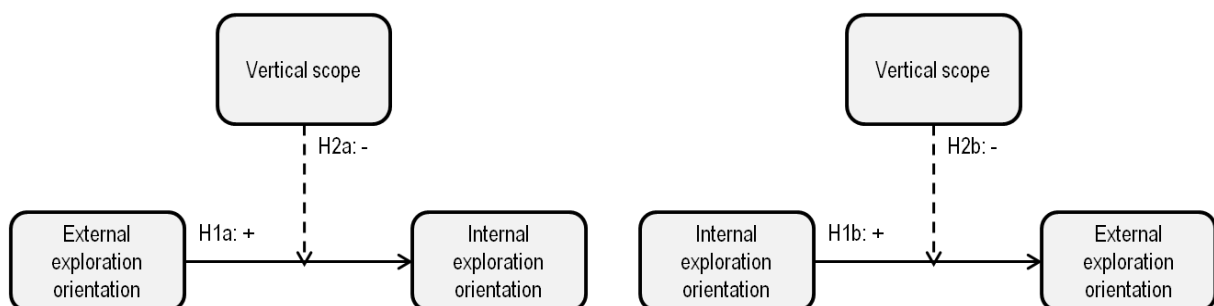


Figure 1, Conceptualizing the impact of the vertical scope of a firm on the relationship between IEO and EEO

## METHODOLOGY

### Research setting

To empirically test the effect of a firm's vertical scope on the relationship between IEO and EEO, we chose the biopharmaceutical industry (SIC codes 283x) as our research setting. We decided on this particular industry for four reasons. First, the biopharmaceutical industry is among the industries with the highest alliance frequency (e.g., Rothaermel, 2001). This is because the innovation as well as the FDA-approval and sales processes along the value chain require very different competences and thus drive the industry participants into cooperative agreements (e.g., Chiaroni *et al.*, 2008), both of explorative and exploitative nature (e.g., Rothaermel and Deeds, 2004). The same mechanisms also foster a tendency towards vertical integration (e.g., Pisano, 1991). Second, different business models have been developed over the recent decades (Burns, 2005). As a result, the industry is populated with a diverse array of fully integrated firms as well as firms specialized on dedicated steps of the value chain. Third, legal reasons have forced more detailed reporting of all alliance and M&A activities in this industry, which makes data availability superior compared to other industries (Wratschko, 2009). Finally, since we use patent data, the research and thus patenting intensity (Rothaermel and Boeker, 2008) of the industry is of particular relevance.

### **Sample and data collection**

We designed our study as a panel analysis for the years of 2002 to 2007.<sup>6</sup> Our unit of analysis is the focal firm and its alliance portfolio. For reasons of data availability and quality, we decided to limit the sample to US-listed firms. The firms to be included in the sample were identified based on the SIC code (283x for drugs). To gather all relevant information, we combined different data sources (Compustat, Windhover SIS, EDGAR-SEC, USPTO, and DataStream). The starting sample consisted of 463 firms, for which financial data is available from 2001 to 2007 in Compustat. By excluding all firms founded later than 1998, we narrowed the sample down to 412 firms. To capture the alliance activities of the sample, we used the Windhover SIS alliance database. Of the 412 firms gathered from Compustat, 328 are also covered by Windhover SIS (forming our final sample). We collected data on all alliance transactions for the years of 1998 to 2007 and later grouped them into six five-year moving windows to

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<sup>6</sup> Since some of our measures are lagged and we use a five-year moving window to calculate the measures based on the alliance portfolio of the firm, the actual time frame of the study spans the years 1998 to 2007.

calculate alliance portfolio measures; a commonly accepted approach in the alliance portfolio and ego network literature (e.g., Stuart, 2000; Padula, 2008; Yang, Zheng, and Zhao, forthcoming). To capture the patenting activities of the sample firms, we created detailed family trees<sup>7</sup> for the period of 2001 to 2006. These family trees are based on the firms' annual reports<sup>8</sup> as published in EDGAR by the U.S. SEC. The information on U.S. patents was obtained from the USPTO. Patents were assigned to the appropriate years based on the application date. We furthermore downloaded company descriptions from DataStream to analyze them for information on the vertical scope of our sample firms.

## Measures

### *Dependent variables*

The dependent variables in our study are IEO and EEO, respectively. We operationalized IEO and EEO based on a firm's intentions (instead of the result) to explore or exploit and thus hope to better capture and separate internal and external exploration (exploitation).<sup>9</sup> Furthermore, we applied a strictly functional perspective to IEO as well as to EEO. Hence, unlike other studies, which used survey- (e.g., He and Wong, 2004) or patent-based measures (e.g., Russo and Vurro, 2010), we measured IEO based on a firm's commitment to R&D (Lavie and Rosenkopf, 2006). We thus computed IEO as R&D expenses (net of in-process R&D expenses) in millions per employee. EEO measures the functional exploration orientation of a firm's alliance portfolio (Koza and Lewin, 2000). Our measure is conceptually similar to those used by Rothaermel and Deeds (2004) and Lavie and Rosenkopf (2006). We defined four functional alliance stages – research, development, manufacturing, and marketing & sales – with weights ranging from four to one. To categorize a particular alliance, we

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<sup>7</sup> The family trees contain all subsidiaries of the focal firm and furthermore consider name changes of the focal firm as well as changes in subsidiaries over time.

<sup>8</sup> We furthermore used the annual reports to add information that was missing in Compustat.

<sup>9</sup> For example Russo and Vurro (2010) applied a functional perspective (upstream vs. downstream focus of an alliance) to external exploration/exploitation and a knowledge distance perspective (used vs. unused citations in patent applications) to internal exploration. While the measure of external exploration/exploitation is intention based, the measure of internal exploration/exploitation is result based (activities, which don't result in a granted patent are not considered by this measure of internal exploration/exploitation). Furthermore, whether a firm cites used or unused patents is for sure considered a valid measure of exploration/exploitation. However, it does not necessarily reflect a firm's *internal* efforts to explore or exploit, since the usage of a prior unused citation could also be based on the knowledge gained from alliances and thus reflect the results of *external* exploration.

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calculated the average value of the alliance stages relevant as according to the alliance description.<sup>10</sup> EEO was calculated as the average value of the scores across all alliances of the respective time window. Low levels of IEO and EEO indicate an orientation towards exploitation.

### *Independent variables*

To study our balance across boundary hypotheses, we incorporated simultaneous measures of exploration at alternative organizational levels (e.g., IEO) when testing for exploration tendencies at a given organizational level (e.g., EEO). This approach exactly follows the procedure used by Lavie and Rosenkopf (2006) in their study on balancing exploration and exploitation across alliance domains.<sup>11</sup> Since our hypotheses suggest a contingency perspective to the cross-boundary balancing of exploration and exploitation, we furthermore included a moderating variable (Venkatraman, 1989) – the vertical scope of a firm. Vertical scope was measured as the percentage share of steps of the biopharmaceutical value chain (Burns, 2005) covered by the firm. The coding is based on a text analysis of the firm descriptions as reported in DataStream at the end of our study period.

### *Control variables*

We also included a detailed set of controls, theoretically motivated by existing research. Similar to Lavie and Rosenkopf (2006) and Russo and Vurro (2010), we controlled for financial performance (return on assets – ROA), market performance (Tobin's Q – TQ), innovation performance (count of patents in the field of biopharmaceuticals), solvency (cash divided by total liabilities), firm size<sup>12</sup> (logarithm of total employees), and alliance experience (the sum of all alliances entered between 1998

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<sup>10</sup> An alliance that includes only research gets a score of 4, an alliance that includes development, manufacturing, and marketing & sales gets a score of  $(3+2+1)/3 = 2$ , etc.

<sup>11</sup> While Lavie and Rosenkopf (2006) study whether firms balance exploration and exploitation across different alliance domains we analyze whether firms balance exploration and exploitation across firm boundaries.

<sup>12</sup> In the biopharmaceutical industry many firms have no positive revenues yet. Furthermore, the ratio of intangible assets is rather high (Rothaermel and Boeker, 2008). We therefore follow Rothaermel and Boeker (2008) and proxy firm size in terms of a firm's human capital (logarithm of total employees). For that reason the normalized measures (IEO, innovation performance, and alliance experience) are also based on the number of a firm's total employees.

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and t).<sup>13</sup> All controls are lagged by one year. Remaining inter-firm heterogeneity was controlled with firm fixed effects. Year dummies were included.

## Model estimation

To test the hypotheses, panel least squares regression models (xtreg) were applied in STATA 12.1. We tested for and found serial-correlation (xtserial) as well as heteroskedasticity (xttest3<sup>14</sup>) in the errors and thus used robust standard errors (vce robust). Since a standard hausman test does require non-robust standard errors, we used xtoverid<sup>15</sup> to test whether the unique errors are correlated with the regressors. The tests of our full models (models 3 and 6 as shown in Table 2) indicate the use of a fixed effects approach. Given this research design, we are unable to account for the main effect of vertical scope, since this variable is time-invariant in our data. Because we use panel data, we follow good practice recommended in the statistics literature and also report within and between standard deviations. These can be found in Table 1. The test of our hypotheses requires to interact the variables measuring IEO and EEO with vertical scope. All variables were centered prior to the computation of the interaction terms (Cohen *et al.*, 2003). The categorical variable vertical scope was centered in a way that zero represents firms with the most narrow vertical scope. VIFs are within conventional standards (the mean and maximum VIF in model 3 are 1.60 and 3.76 respectively; the mean and maximum VIF in model 6 are 1.46 and 2.76 respectively). We therefore conclude that multicollinearity is not a major problem in the present study. Power tests (powerreg<sup>16</sup>) indicate that the sample size is large enough to identify effects at the 0.9 level. We treated missing values with list wise deletion, which accounts for the variation in sample size across the models. Adjusted R<sup>2</sup> fit statistics are reported with the results of our models in Table 2.

## RESULTS

### Descriptive statistics and correlations

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<sup>13</sup> Methodological choices (fixed effects models including year dummies) prevent us from using age as an additional control variable.

<sup>14</sup> STATA command authored by Christopher F Baum.

<sup>15</sup> STATA command authored by Mark E Schaffer and Steven Stillman.

<sup>16</sup> STATA command authored by Philip B Ender and Xiao Chen.

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Table 1 shows descriptive statistics and pair-wise correlations of all the variables used in our study. Table 2 reports the results of the models predicting IEO and EEO, respectively. Because of the centering, EEO in model 3 and IEO in model 6 represent the value of a firm with a narrow vertical scope (one step of the value chain). Vertical scope ranges to 0.75 (four steps of the value chain) in 0.25 increments.

Table 1, Descriptive statistics and correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	
1	IEO											
2	EEO	0.3100*										
3	Size	-0.4150*	-0.2279*									
4	Solvency	0.2019*	0.1098*	-0.3101*								
5	Relative alliance experience	0.1984*	0.0435	-0.3723*	0.0594*							
6	Return on assets	-0.3196*	-0.2532*	0.5045*	-0.1082*	-0.2758*						
7	Relative patent output	0.1962*	0.1288*	-0.2215*	0.0881*	0.1616*	-0.1570*					
8	Tobin's Q	0.0959*	0.1021*	-0.2392*	0.1769*	0.0702*	-0.3300*	0.0973*				
9	Vertical scope	-0.2838*	-0.1715*	0.4745*	-0.1453*	-0.1748*	0.2607*	-0.1257*	-0.0805*			
10	IEO x Vertical scope	0.7680*	0.3206*	-0.4603*	0.2137*	0.1884*	-0.3547*	0.1757*	0.1375*	-0.3011*		
11	EEO x Vertical scope	0.2914*	0.8481*	-0.2394*	0.0747*	0.0613*	-0.2390*	0.1087*	0.1110*	-0.1771*	0.3986*	
	N	1,763	1,696	1,722	1,698	1,722	1,731	1,722	1,627	1,884	1,694	1,620
	Mean	0.211520	2.457209	5.002433	1.245485	0.115330	-0.406100	22.84342	3.306218	0.556529	-0.013275	-0.024753
	Overall standard deviation	0.196645	0.689091	2.209721	1.579796	0.283778	0.578544	55.22826	2.640264	0.209765	0.064013	0.253260
	Between standard deviation	0.167650	0.663638	2.110961	1.245664	0.213423	0.528939	37.04064	2.289366	0.210044	0.058838	0.238217
	Within standard deviation	0.109999	0.283978	0.404956	1.080640	0.181019	0.353662	42.59782	1.758913	0	0.030028	0.104597

\* indicates significance (2-tailed) at the 0.05 level.

In Table 2, models 1 to 3 present the results of the models predicting IEO. Model 1 displays the results of the effect of control variables. Model 2 further includes the direct effect of EEO and model 3 finally reports the results including the hypothesized interaction of EEO and vertical scope. Similarly, models 4 to 6 display the results of the models predicting EEO. Model 4 shows the results of control variables only. Model 5 further includes the direct effects of IEO and model 6 presents the results including the hypothesized interaction of IEO and vertical scope. The fit statistics of our models are ranging between 0.02 and 0.1. Previous studies (e.g., Lavie and Rosenkopf, 2006) report similar values for their within R<sup>2</sup> statistics.

### Results of hypotheses tests

The results of our analyses as shown in Table 2 broadly support our hypotheses that whether firms balance exploration and exploitation across firm boundaries is contingent on their vertical scope.

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Table 2, Fixed effects linear regression of IEO and EEO

	(1)	(2)	(3)	(4)	(5)	(6)
<i>Hypotheses</i>	IEO	IEO	IEO	EEO	EEO	EEO
y2003	-0.0726*** (0.0103)	-0.00590 (0.00853)	-0.00419 (0.00880)	0.0111 (0.0250)	0.00965 (0.0254)	0.0168 (0.0260)
y2004	-0.0619*** (0.00996)	-0.000258 (0.00932)	0.000121 (0.00998)	0.0332 (0.0267)	0.0363 (0.0267)	0.0513+ (0.0270)
y2005	-0.0390*** (0.0101)	0.0199+ (0.0104)	0.0208+ (0.0111)	0.0451 (0.0340)	0.0433 (0.0342)	0.0671+ (0.0348)
y2006	-0.0301** (0.00983)	0.0372** (0.0113)	0.0397** (0.0122)	0.0639 (0.0398)	0.0577 (0.0401)	0.0835* (0.0406)
y2007	0.0127 (0.0107)	0.0745*** (0.0133)	0.0729*** (0.0133)	0.0517 (0.0472)	0.0295 (0.0466)	0.0652 (0.0471)
Size (t-1)	-0.0635*** (0.0161)	-0.0473** (0.0162)	-0.0408* (0.0166)	-0.0996* (0.0490)	-0.0772 (0.0469)	-0.0760 (0.0471)
Solvency (t-1)	-0.00617 (0.00472)	-0.00311 (0.00477)	-0.00318 (0.00484)	-0.00451 (0.0103)	-0.00116 (0.0102)	0.00335 (0.0101)
Relative alliance experience (t-1)	-0.0356 (0.0375)	-0.0967* (0.0382)	-0.0873* (0.0360)	-0.184 (0.131)	-0.140 (0.131)	-0.158 (0.132)
ROA (t-1)	-0.0187 (0.0167)	-0.0137 (0.0147)	-0.0149 (0.0150)	-0.0377 (0.0373)	-0.0381 (0.0373)	-0.0390 (0.0373)
TQ (t-1)	-0.0000262 (0.00258)	0.00430+ (0.00239)	0.00388 (0.00243)	0.0105 (0.00708)	0.00973 (0.00724)	0.00916 (0.00731)
Relative patent output (t-1)	-0.0000913 (0.000188)	0.000122 (0.000161)	0.000160 (0.000161)	-0.000430 (0.000315)	-0.000380 (0.000306)	-0.000390 (0.000297)
EEO	<i>H1a</i>	0.0245+ (0.0137)	0.0835** (0.0320)			
EEO x Vertical scope	<i>H2a</i>		-0.157* (0.0697)			
IEO	<i>H1b</i>				0.208+ (0.113)	0.262* (0.127)
IEO x Vertical scope	<i>H2b</i>					0.143 (0.544)
_cons	0.266*** (0.00827)	0.206*** (0.00838)	0.198*** (0.00978)	2.395*** (0.0315)	2.393*** (0.0313)	2.373*** (0.0326)
<i>N</i>	1,724	1,332	1,272	1,352	1,332	1,272
adj. <i>R</i> <sup>2</sup>	0.079	0.089	0.096	0.015	0.018	0.028

Standard errors in parentheses

\*  $p < 0.1$ , \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

We start our interpretation with the models for IEO. Our control variables solvency, ROA, TQ (except for model 2), and relative patent output are insignificant in predicting IEO – in model 1 as well as in models 2 and 3. Nevertheless, and in line with previous research (Lavie and Rosenkopf, 2006; Russo and Vurro, 2010), we find a significantly negative effect of firm size and relative alliance experience (in models 2 and 3) on IEO. This indicates that firms with higher levels of alliance experience per employee as well as larger firms tend to have lower levels of IEO. In model 2 we included the main effect of EEO. Although we did not generate hypotheses for the main effect of EEO, we find it being positive and marginally significant ( $p=0.073$ ) in predicting IEO. This generally suggests that higher levels of EEO also result in higher



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levels of IEO. What makes this finding particularly interesting is that it provides an alternative perspective to the results of Russo and Vurro (2010), who found partial support for a general tendency of firms to balance internal (external) exploration with external (internal) exploitation and vice versa. Proceeding to model 3, we find support for our contingency based argument. In line with H1a, for firms with a narrow vertical scope higher levels of EEO are associated with higher levels of IEO. This is shown by the significant positive effect ( $p=0.010$ ) of EEO on IEO. Hence, this finding suggests that firms with a narrow vertical scope don't balance exploration and exploitation across firm boundaries but develop their IEO and EEO into the same direction (focus). In support of H2a, our results in model 3 further show a negative and significant interaction ( $p=0.025$ ) of EEO and vertical scope. Thus, an increase in vertical scope reduces the positive effect of EEO on IEO. To facilitate interpretation, we plotted predictions of IEO at four levels of vertical scope across the whole range of EEO while keeping all covariates at their respective mean values. This plot is based on model 3 and shown in Figure 2.

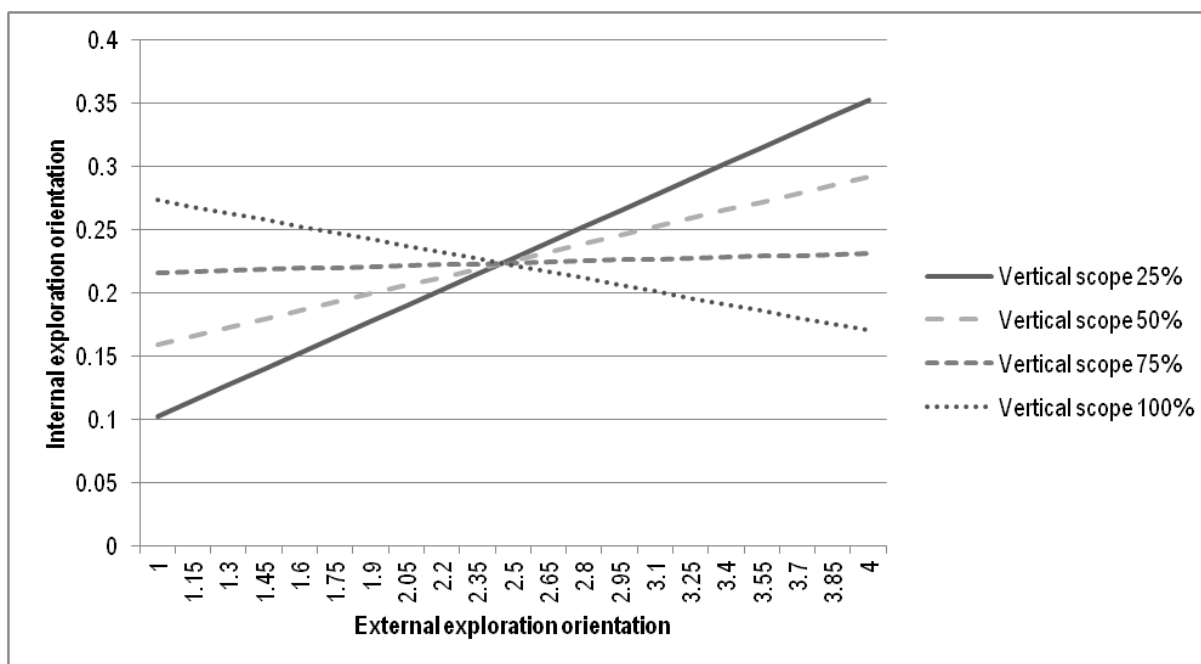


Figure 2, Moderating role of vertical scope on the effect of EEO on IEO (model 3)

As presented in Figure 2, it can be seen that firms with a narrow vertical scope, which are high in the exploration orientation of their alliance portfolio, also have higher R&D expenses per employee. This relationship becomes weaker with an increase in vertical scope. Ultimately, for vertically integrated firms, higher levels in the explo-

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ration orientation of their alliance portfolios correspond with lower levels in their R&D expenses per employee – they balance exploration and exploitation across firm boundaries.

The models 4 to 6 present the results in regard to EEO. Our controls variables (except size in model 4) are all insignificant in predicting EEO. Proceeding to model 5, we find IEO being positive and marginally significant ( $p=0.066$ ) in predicting EEO. Again, we did not generate hypotheses for the main effect of IEO on EEO, but the model generally indicates that higher levels of IEO also result in higher levels of EEO. As with model 2, this finding attracts our attention since it suggests a different relationship than the one found by Russo and Vurro (2010) in their sample of firms in the fuel cell industry. Finally, in model 6 we introduced the vertical scope moderator. The results regarding our contingency based argument are mixed. In line with H1b, for firms with a narrow vertical scope higher levels of IEO are associated with higher levels of EEO. This is shown by the significant positive effect ( $p=0.039$ ) of IEO on EEO. However, unlike hypothesized in H2b, we didn't find a significant negative moderating effect ( $p=0.793$ ) of vertical scope on the effect of IEO on EEO in model 6. Thus, while it generally appears that higher levels of exploration orientation in the alliance portfolios of a firm correspond with higher levels of the firm's R&D expenses per employee, this effect is independent of the vertical scope of the firm – i.e., does not vary with changes in the vertical scope of the firm.

### **Robustness tests**

To check the robustness of our results, we changed the operationalization of EEO according to the measure used by Lavie and Rosenkopf (2006). The results in regard to IEO as well as EEO remained qualitatively the same. Moreover, we also used 2- and 3-year averages of IEO and EEO to account for potential yearly fluctuations; again the results remained qualitatively unchanged. Other papers in the field use 4-year moving windows to calculate alliance portfolio measures (e.g., Baum, McEvily, and Rowley, 2012; Shipilov and Li, 2012). We therefore also estimated our models under these conditions and again found similar results. Finally, since one of our variables of interest is time-invariant in our data, we also used alternative approaches to substantiate our findings. We therefore followed a random instead of a fixed effects

approach. Also the findings of this approach would result in interpretations generally similar to the ones presented here.<sup>17</sup>

## DISCUSSION

It is widely acknowledged that balancing exploration and exploitation is a demanding task (Gupta *et al.*, 2006; Lavie *et al.*, 2010). This study applied a contingency perspective and examined the effect of firm characteristics on the cross-boundary balancing of exploration and exploitation. Prior research has found that firms tend to balance internal exploration (exploitation) with external exploitation (exploration) and vice versa (Russo and Vurro, 2010). However, we hypothesized and found evidence indicating that this behavior is depending on the vertical scope of the firm. Hence, only some firms use cross-boundary ambidexterity to ease the tensions of combining exploration and exploitation activities. Notably, our un-moderated models suggest a general (unconditional) positive correlation between IEO and EEO (and vice versa). This is particularly interesting since this provides an alternative perspective to the findings of Russo and Vurro (2010) and ultimately emphasizes the need for a more differentiated (contingency based) analysis.

It was proposed and found that firms with a narrow vertical scope follow a focused approach. With this approach comes a tendency either towards exploration or exploitation – both within and across firm boundaries. Differently, firms with a broad vertical scope try to combine explorative and exploitative tasks in a balanced way. We proposed that in contrast to firms with a narrow vertical scope, for such firms cross-boundary balancing is a viable mean to reduce the tensions of combining exploration and exploitation activities. In support of our argument, it was found that the positive association between IEO and EEO becomes weaker with an increase in vertical scope. However, when we swap IEO and EEO, we didn't find support for the assumption that also the association between EEO and IEO becomes weaker with an increase in vertical scope. Although we expect both the IEO and EEO of a firm to reflect fundamental strategic decisions, which only change gradually, it might be easier to adjust the R&D expenses per employee in response to a change in the exploration orientation of the alliance portfolio than it is to adjust the exploration orientation

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<sup>17</sup> However, the results of the xtoverid test suggest to follow a fixed effects approach.

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of the alliance portfolio in response to a change in the R&D expenses per employee. This is because changes in IEO and EEO differ in coordination effort, complexity, and lead-time. To account for potential yearly fluctuations, we also used 2- and 3-year averages of IEO and EEO. However, the results remained qualitatively unchanged. This evidence may well indicate that the relationship between IEO, EEO, and vertical scope is driven by multiple motivations. Thus, the negative interaction term of EEO and vertical scope in model 3 could indicate a tendency of firms with a broad vertical scope to substitute IEO by EEO. Conversely, it could be argued that although there is a general tendency of firms with a broad vertical scope to substitute IEO by EEO, as soon as they invest in internal exploration, they try to leverage their investments by also increasing their EEO. These opposing mechanisms – balance vs. substitute & leverage – might explain why we found different effects of EEO on IEO than of IEO on EEO. This appears to be an interesting avenue for future research, which might use fine-grained in-depth field studies to shed more light on the underlying motivations of (fully) integrated firms to combine IEO and EEO.

## **CONCLUSION, LIMITATIONS AND FUTURE RESEARCH**

Our study advances the literature on the exploration/exploitation framework in two ways. First, we contribute to the developing research stream of cross-boundary balancing by shedding some light on the mechanisms that affect a firm's needs and opportunities to balance exploration and exploitation across firm boundaries. Second, by applying a contingency perspective we show that not just the performance outcomes of balancing exploration and exploitation but already the decision to engage in a particular mode to balance exploration and exploitation is affected by firm characteristics.

As in any study, this one too has some limitations. The biopharmaceutical industry is a highly innovative industry, comprising of specialized as well as integrated industry participants (Burns, 2005), which makes it a fruitful setting for our research question. This in mind, some of the effects observed might also be driven by the context of this particular industry and don't apply to other industries. Especially patterns of change along the organizational lifecycle (e.g., Rothaermel and Deeds, 2004; Hwang and Park, 2006) and the differences between the industry participants (e.g.,

Rothaermel, 2001) might affect some of our results. Although the use of a single industry allowed us to control for inter-industry variation, this is also one of the main limitations of this study. Future research might test our arguments in other industry settings.

Furthermore, due to data limitations, we could not investigate the effects of vertical scope to their full extent. In our dataset the vertical scope of a firm is time-invariant. Vertical scope was collected only once at the end of the study period. Although we think that the vertical scope of a firm changes slowly<sup>18</sup> and thus should be relatively stable over a short period of time, it might be the case that some of the firms in the sample have had a different vertical scope at the beginning of the study period. In addition, the properties of our data indicated the use of fixed effects models. We therefore could not account for the unconditional effect of vertical scope.

Finally, the current study elaborates on the relationship between IEO and EEO. We found some firms to combine IEO and EEO in a reinforcing manner while others appear to use it to balance explorative and exploitative tendencies. However, we did not test for the performance consequences of combining IEO and EEO. We would therefore like to encourage future research to elaborate on the performance consequences of combining IEO and EEO. Unlike prior studies, which typically used one performance measure, we would suggest that future research should combine multiple performance measures to create a more comprehensive picture of the benefits and drawbacks of (not) balancing exploration and exploitation across firm boundaries. Furthermore, since the current study suggests the relationship between IEO and EEO being contingent on firm characteristics, this might be a fruitful line of thought also for studies focusing on performance outcomes.

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<sup>18</sup> It takes time to acquire the relevant resources and capabilities – see also Rothaermel and Deeds (2004) and Stuart et al. (2007).

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