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KNOWLEDGE AND INFORMATION LEAKAGES IN STRATEGIC ALLIANCES WITH COMPETITORS

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Contents

Abstract

Alliances allow businesses to access valuable resources in complex environments. Nonetheless, these interfirm agreements also make firms' boundaries permeable to involuntary leakages of information and knowledge. This dissertation theoretically examines the interplay between information and knowledge leakages, the nature and intensity of market competition, and the incentives to pursue strategic alliances with competitors. To this end, the dissertation adopts a game-theoretic approach that accounts for the market consequences of knowledge and information leakages and the incentives to pursue strategic alliances that they generate. The main findings suggest that knowledge and information leakages might induce firms to engage in opportunistic behaviour and that the threat of such behaviour has important effects on the incentives to participate in these interfirm agreements. Thus, while knowledge leakage may drive firms to behave opportunistically by imitating its competitor, information leakage has the potential to alter the information structure of competition, modifying the incentives to generate joint value through the pursuit of strategic alliances. These findings constitute novel theoretical insights about the

effects of knowledge and information leakages on the competitive behaviour of firms interacting in environments in which they simultaneously cooperate and compete with the intent to create joint value.

Chapter 1

Introduction

Strategic alliances allow firms to access external resources in increasingly demanding market environments. Due to external pressures, a firm might engage in a strategic alliance with suppliers, customers, universities, governments, and competitors. Among these, competitors provide firms with a set of internal knowledge and skills that would otherwise be unavailable to them (Todeva and Knoke, 2005). Nonetheless, the interaction and exchange of information that occurs in these alliances are likely to facilitate access to critical know-how information, and the eventual appropriation of key capabilities of their competitors (Laursen and Salter, 2014).

The joint venture between Sony and Samsung (Gnyawali and Park, 2011) is an example of the benefits that firms can generate when collaborating with competitors. For years, Sony and Samsung were fierce competitors in many product-market segments (such as TV, computer, video, and audio) and various geographic markets in the US, Europe, and Asia. Nonetheless, in April 2004, the threat of vulnerability that the new technological dynamics posed drove these two giants and known rivals in the electronic industry to work together in the development and production of 7th generation liquid crystal display (LCD) panels (followed by the development of the 8th generation technology a few years later). This partnership, called the S-LCD alliance, introduced two new products, Bravia (Sony) and Bordeaux (Samsung), which catapulted these companies to the very top of the LCD TV market. Indeed, as Gnyawali and Park (2011, p.655-656) noted, before the S-LCD alliance, Sony and Samsung ranked as the 3rd and 4th LCD TV makers (following Sharp and Phillips), whereas in the 4th quarter of 2008, these companies ranked as the 1st and 2nd TV makers in both the total TV market and the LCD TV segment.

The business and economics literature refers to this duality as *coopetition*, a concept introduced by Nalebuff and Brandenburger (1996) to refer to a business logic combining cooperation and competition. Bengtsson and Kock (2000, p.412) defined coopetition as "*the dyadic and paradoxical relationship that emerges when two firms cooperate in some activities, such as in a strategic alliance, and at the same time compete with each other in other activities.*"[1] These intefirm arrangements can create value in competitive environments (Das and Kumar, 2011), be sources of competitive advantage (Panico, 2017) and financial resources (Diestre and Rajagopalan, 2012; Hallen, Katila, and Rosenberger, 2014), enable knowledge acquisition (Dush-

[1]As the concept of coopetition refers to a strategic alliance specifically made with competitors, throughout this dissertation, there is an indistinct use of "coopetition" and "strategic alliance with competitors".

nitsky and Shaver, 2009), develop economies of scale (Veugelers, 1998), among other features.

Despite their benefits, alliances with competitors involve tensions. Consider, for instance, the alliance between Infoflows –a start-up company, and Corbis –a big photo library and licensing company owned by Microsoft's chairman Bill Gates, which in June 2006 signed a multimillion-dollar agreement to develop a technology that would identify digital objects. Corbis terminated the agreement just a couple of months after signing it and days after receiving key software designs from Infoflows, which triggered a legal dispute with a jury verdict against Corbis for misappropriation of trade secrets, fraud and breach of contract with more than 20 million of awarded damages (Lohr, 2010; Buley, 2010). A similar case occurred when Cisco and the smaller firm XpertUniverse signed an alliance to develop a technology for locating experts on the Internet (Yang, Zheng, and Zaheer, 2015). This alliance ended after three years of partnership when Cisco dropped out of the agreement and launched a product almost identical to that of XpertUniverse. In the words of Yang, Zheng, and Zaheer (2015, p.358), *"clearly this was a covert attempt to learn from the partner by Cisco"*.

Another useful case to illustrate the tension emerging in alliances with competitors is the alliance between Microsoft and Apple. In the summer of 1981, Microsoft entered an agreement with Apple to develop "Multiplan", which is a software that aimed to compete with the leading personal-computer spreadsheet at that time (Visi-

Calc) and eventually gave rise to Excel, for the Apple Macintosh computer, a machine whose distinctive feature was its graphical user interface (GUI). The partnership worked well; Multiplan was released along with Macintosh in January 1984 and instantly dominated the spreadsheet market for Macintosh (Campbell-Kelly, 2007). Nonetheless, in the late 1980s, Microsoft launched Windows, an operating system that, in contrast to its predecessor (MS-DOS), was based on GUI developments to facilitate users' interaction with computers and software. Although Microsoft initially obtained a license from Apple to develop a GUI for Windows 1.0 (similar to Apple's Macintosh GUI), Microsoft did not update this license for subsequent versions of Windows or subsequently adopted features of the Macintosh interface (Samuelson, 2010). Eventually, Apple recognised the appropriation of its distinctive advantage during the development of Multiplan and filed a lawsuit against Microsoft in 1988 for copyright infringement. The courts ultimately ruled in favour of Microsoft, and this firm was subsequently awarded a registered trademark for the name Windows (Li, Eden, Hitt, and Ireland, 2008, p.315).

As the above examples suggest, even when strategic alliances might bring considerable benefits, when a firm accesses external sources, it shares part of its knowledge and private information (Laursen and Salter, 2014). Upon signing partnerships, the benefits of accessing complementary external resources come at the cost of the risk of opportunistic behaviour from the partner (Cassiman, Di Guardo, and Valentini, 2009; Katila, Rosenberger, and Eisenhardt, 2008), as there is the possibility of using the knowledge shared during cooperation when competing (Loebecke, Van Fenema, and Powell, 1999). This suggests the existence of an important tension in alliances with competitors, namely, the need for external resources at the risk of resource misappropriation (Katila, Rosenberger, and Eisenhardt, 2008).

A key distinction is in place here between knowledge and information leakages. *Knowledge* leakage refers to "*the extent to which the focal firm's private knowledge is intentionally appropriated by or unintentionally transferred to partners beyond the scope of the alliance agreement*" (Jiang, Li, Gao, Bao, and Jiang, 2013, p.984). Alternatively, *information* leakage denotes the unintended and unauthorised revelation of private information to another party (Zhang, Cao, Wang, and Zeng, 2012). These two concepts differ in that the latter emphasises unwitting information sharing between the partners, and the former underscores the misappropriation of resources, such as core and non-core knowledge, competencies, and particular skills (Anand and Goyal, 2009; Durst, Aggestam, and Ferenhof, 2015).

Literature has mostly focused on knowledge rather than informational leakage (e.g., Oxley and Sampson, 2004; Walter, Walter, and Müller, 2015; Jiang, Bao, Xie, and Gao, 2016; Raza-Ullah, 2021). This difference is important insofar a firm without the adequate capacities to appropriate, absorb and assimilate it for commercial ends (Cohen and Levinthal, 1990) might fail to generate private rents from new knowledge, but it may successfully do so by merely observing information and adjusting its competitive behaviour accordingly. In this dissertation, I address knowledge and information leakages separately in order to isolate the consequences of each type of leakage on both the nature and intensity of market competition as well as the incentives to engage in strategic alliances with competitors.

In chapter 2, I study the consequences of the knowledge leakages on the incentives to pursue coopetitive alliances. While prior research has focused predominantly on the management of the tension in coopetitive alliances (Tidström, 2009, 2014; Tidström, Ritala, and Lainema, 2018; Crick, 2019), an examination of the factors limiting or increasing the propensity of opportunistic behaviour remains an important issue that extant research has not fully addressed. In practice, decisions to enter into a coopetitive relationship are influenced by the firms' abilities to leverage the knowledge about their partners outside the scope of the alliance (Lavie, 2006; Kumar, 2010; Samant and Kim, 2021). Thus, the chapter aims to fill in this research gap by theoretically examining the role that absorptive capacity (Cohen and Levinthal, 1990) –the ability to earn private benefits through the exploitation of the partner's knowledge outside the alliance and the degree of similarities between firms' products, play in shaping firms' incentives to engage in coopetitive alliances.

Specifically, chapter 2 addresses the following two questions: Does a higher degree of similarities between firms' products reduce or amplify the risks of opportunistic behaviours in coopetitive alliances between firms with asymmetric absorptive capacities? How does the degree of similarities between firms' products affect the incentives to form coopetitive alliances between firms with asymmetric absorptive capacities?

To answer them, I adopt a game theoretic approach to model a differentiated product market in which two firms asymmetrically informed about the economic value of a business opportunity must cooperate to exploit this opportunity. Under coopetition, firms gain access to their partner's core knowledge due to inevitable knowledge leakages, but they differ in their abilities to leverage this new knowledge outside the collaborative activity. In a subsequent extension, I incorporate the possibility for the negatively affected firm to pursue monetary compensation for the damage that the exploited leakage may have caused. The results show that firms with superior absorptive capacities are more likely to devise alliances whose purpose is to gain access to their partners' core knowledge. This opportunistic behaviour remains true even if firms compensate their partners for the damages caused by this deceptive business practice. Findings also show that highly specialised products safeguard firms with limited absorptive capacities against opportunistic behaviour, providing a theoretical analysis of the role that absorptive capacities and product specialisation play in influencing the emergence of such behaviour. This analysis also provides a potential explanation for the formation of alliances between competing firms with asymmetric learning capabilities, i.e., "power" differences between coopetitive partners: how smaller firms can leverage coopetition with larger firms and what their outcomes are (Yang, Zheng, and Zaheer, 2015; Meena, Dhir, and Sushil, 2022).

In chapter 3, I theoretically examine the implications of information leakage on the firms' incentives to pursue strategic alliances and the nature and intensity of market competition between the partners. As extant research has established, sharing intangible assets like knowledge and information is a critical aspect of the value creation objective that firms pursue in strategic alliances (Hamel, 1991; Anand and Khanna, 2000; Oxley and Sampson, 2004). Throughout this process, unintentional revelation of confidential information to their partners might occur. This issue may stem from the incomplete nature of formal procedures, such as legal contracts (Kumar, 2010; Gast, Gundolf, Harms, and Collado, 2019), unintended disclosure of small details about firms' private valuable information (Walter, Walter, and Müller, 2015), informal mechanisms of communication (Naesens, Pintelon, and Taillieu, 2007), or loose collaborative environments (Jiang, Li, Gao, Bao, and Jiang, 2013). As a result, these leakages of information may trigger opportunistic behaviours in which a partnering firm uses this information without prior permission (e.g. Kale, Singh, and Perlmutter, 2000; Luo, 2007; Li, Eden, Hitt, and Ireland, 2008; Walter, Walter, and Müller, 2015; Yang, Zheng, and Zaheer, 2015).

In chapter 3, I aim to shed light on the following questions: To what extent the possibility of unintended access to sensitive private information affects the incentives to join a strategic alliance? How do unintended leakages of information affect the development of common and private benefits in strategic alliances? To answer them, I develop a game-theoretic model in which two firms competing in quantities in a homogeneous product market must collaborate to exploit a business opportunity successfully. The firms are asymmetrically informed about their competitors' production costs as well as about the value of the common profits of said opportunity. By engaging in this collaborative activity, the possibility of (unintended) leakage of confidential information regarding firms' production processes emerges, allowing firms to update their beliefs about their competitors' production costs and the value of the joint profits. Results suggest that information leakage can trigger opportunistic behaviours in which firms engage in alliances that yield expected negative common profits simply because the possibility of learning sensitive information about their competitors increases the private rents that firms expect to earn when competing. Thus, the results suggest the existence of a spillover effect (Hora and Klassen, 2013; Ried, Eckerd, Kaufmann, and Carter, 2021) associated with information leakage that may lead some firms to devise economically unprofitable alliances with the expectation to learn private information. Additionally, I use this theoretical framework to examine the consequence of the leakage in environments in which the firm negatively affected by the leakage can pursue some compensation for the (alleged) damage. Findings show that the incentives to devise alliances for the unique purpose of gaining access to the partner's sensitive private information persist for compensation values that are not too high. Overall, findings support the idea that knowledge accessing rather than knowledge acquisition may be the true motivation for firms to pursue knowledge-based alliances (Grant and Baden-Fuller, 2004; Ryan-Charleton, Gnyawali, and Oliveira, 2022), and also contributes to the idea that the private rent-seeking behaviour inhibits the achievement of common value (Arslan,

2018) i.e., opportunistic behaviour discourages "synergetic" value creation (Lavie, 2006).

The rest of this document is structured as follows. Chapter 2, "*Deceptive behaviour and coopetition: The role of heterogeneous absorptive capacities and product specialisation*" and chapter 3, *"Do you want to know a secret? Strategic alliances and competition in product markets"* contain the full articles that comprise the dissertation. Chapter 4 provides an overview of the entire work, together with some concluding remarks and final comments. Finally, the bibliography presents all the research cited in the dissertation.

Chapter 2

Deceptive behaviour and coopetition: The role of heterogeneous absorptive capacities and product specialisation

2.1 Introduction

Coopetition –the simultaneous pursuit of cooperation and competition with the intent to create joint value (Bengtsson and Kock, 2000, 2014; Gnyawali and Ryan Charleton, 2018), provides firms with not only a valuable tool to create value (Gnyawali and Ryan Charleton, 2018) but also a unique strategy to capitalise on the benefits of co-operation and competition (Bengtsson and Kock, 2000; Levy, Loebbecke, and Powell, 2003; Gnyawali and Park, 2009; Ritala, 2012; Iyer, 2014). The S-LCD joint venture between Sony and Samsung to develop and produce 7th generation liquid crystal display (LCD) panels for flat-screen TVs (Gnyawali and Park, 2011); the Ford-SEAT-Volkswagen collaboration to develop a multi-purpose car (Esteban-Bravo and Lado, 2011); and the Amazon coopetition-based model (Ritala, Golnam, and Wegmann, 2014) are all examples that illustrate the benefits from combining the advantages of cooperation and competition to reach a stronger position in the global competition (Rajala and Tidström, 2021).

Despite these benefits, coopetition also involves risks. Consider, for instance, the alliance between Microsoft and Apple signed in the summer of 1981 to develop Multiplan, a software that aimed to compete with the leading personal-computer spreadsheet at that time (VisiCalc) for the Apple Macintosh computer. Although the partnership worked well –Multiplan was released along with Macintosh in January 1984 and instantly dominated the spreadsheet market for Macintosh (Campbell-Kelly, 2007), it provided Microsoft with an opportunity to acquire critical knowledge about Apple's Graphical User Interface (GUI) that enabled the development of its Windows operating system. Apple filed a lawsuit against Microsoft in 1988 for copyright infringement; however, the courts ultimately ruled in favour of Microsoft, and this firm was subsequently awarded a registered trademark for the name Windows (Li, Eden, Hitt, and Ireland, 2008).[1]

As the Apple-Microsoft example illustrates, firms participating in coopetitive alliances face the risks of transferring confidential information and core-knowledge to their partners as well as the risk of technological imitation (Fernandez, Le, and Gnyawali, 2014). These phenomena can occur intentionally or unintentionally, and they can have significant consequences for the firms –potentially altering the competitive position of a firm vis-à-vis its partner (Hoffmann, Lavie, Reuer, and Shipilov, 2018; Khanna, Gulati, and Nohria, 1998; Hamel, 1991), and the industry (Loebecke, Van Fenema, and Powell, 1999; Levy, Loebbecke, and Powell, 2003; Estrada, Faems, and de Faria, 2016).[2] Prior research has focused predominantly on the management of tensions that these risks generate (Tidström, 2009, 2014; Tidström, Ritala, and Lainema, 2018; Crick, 2019). However, a systematic examination of factors and contingencies that limit (or increase) these risks remains an important issue that extant research has not fully addressed. This is unfortunate because, in practice, decisions on whether to enter into a coopetitive relationship are influenced by firms' abilities to leverage the knowledge about their partners outside the scope of the alliance (Lavie, 2006; Kumar, 2010; Samant and Kim, 2021). We fill in this research gap by theoret-

[1]Microsoft initially obtained a licence from Apple to develop a GUI for Windows 1.0 (which was similar to Apple's Machintosh GUI). However, this firm did not update this license for subsequent versions of Windows or for subsequently-adopted features of the Macintosh interface (Samuelson, 2010).

[2]Unintentional leakage of information can occur due to a loose collaborative atmosphere or unwilling communication of private information (Jiang, Li, Gao, Bao, and Jiang, 2013).

ically examining the role that absorptive capacity (Cohen and Levinthal, 1990) –a factor that is likely to affect the firm's ability to earn private benefits through the exploitation of the partner's core-knowledge outside the cooperation, and the degree of similarities between firms' products, play in shaping firms' incentives to engage in coopetitive alliances for the main purpose of accessing and exploiting the internal capabilities of the competitor. We specifically pose the following two questions: Does a higher degree of similarities between firms' products reduce or amplify the risks of opportunistic behaviours in coopetitive alliances between firms with asymmetric absorptive capacities? How does the degree of similarities between firms' products affect the incentives to form coopetitive alliances between firms with asymmetric absorptive capacities?

To address the above-mentioned questions, we develop a game-theoretic framework in which two firms asymmetrically informed about the economic value of a business opportunity must work cooperatively to exploit this opportunity. Engaging in this collaborative activity involves the (involuntary) leakage of confidential information regarding the production processes of the firms' horizontally differentiated products. Firms do not actively seek access to their partner's valuable know-how; instead, they obtain this information as the result of inevitable leakages of little details that give away valuable private information to the other party (Walter, Walter, and Müller, 2015). Nonetheless, only firms with adequate capacity to recognise, assimilate, and exploit this new knowledge are able to capitalise on these leakages of information. Thus, we conceptualise a firm's ability to leverage the new knowledge about their partners outside the alliance as a firm's *absorptive capacity* (Cohen and Levinthal, 1990), as this concept aims to reflect the firms' potential towards recognition, acquisition, internalisation, and exploitation of knowledge coming from external sources, in this case from competitors (Cohen and Levinthal, 1990; Lane and Lubatkin, 1998; Song, Gnyawali, Srivastava, and Asgari, 2018).[3]

The insights gained from this game-theoretic model allow us to show that the emergence of opportunistic behaviours, such as those described in the Apple-Microsoft example, are related to asymmetries in the absorptive capacities of firms. We show that privately informed firms with superior absorptive capacities are more likely to offer alliances for the main purpose of accessing and exploiting the internal capabilities of the competitor rather than capitalising on the business opportunity that gives rise to the cooperation. These theoretical insights also allow us to shed light on the question of how smaller firms leverage coopetition while interacting with larger firms (Meena, Dhir, and Sushil, 2022). We show that uninformed firms with limited absorptive capacities but highly specialised products (such that the degree of product similarities is low) are less likely to face the type of opportunistic behaviours previously described because, for these firms, even limited learning about the production

[3]Our choice of absorptive capacity as the concept to capture firms' ability to capitalise on knowledge leakages resembles the idea of Kumar (2010), who uses it to explain differential wealth gains in joint venture partners. According to this author, absorptive capacity plays a critical role in influencing differential wealth gains in joint venture partners by influencing a firm's ability to extract private benefits from the partner. Similarly, Samant and Kim (2021) utilise this concept to examine the determinants of common and private benefits in innovation alliances. They find that the firm's absorptive capacity (and knowledge-base relative to its partner) are positively correlated with the firm's ability to extract private benefits.

process of their partners has a significant effect on the degree of competition in the product market. Intuitively, the fact that these firms produce highly specialised products implies that customers become very sensitive to changes in the degree of differentiation of the products. Since access to competitors' core knowledge allows firms to (partially) imitate their competitors' products, any new knowledge that the firm is able to learn helps it make products that resemble more its competitors', leading to a significant increase in the degree of competition in the product market. Anticipating this fiercer competition, the informed firm (in charge of making the offer) refrains from making offers involving unprofitable ventures.

Finally, we use our theoretical framework to examine the consequences of deceptive alliances –i.e., alliances whose main purpose is to access (and exploit) the internal capabilities of the competitor, in environments in which the negatively affected firm can pursue some type of compensation for the (alleged) damage that this deceptive business practice may have caused. We accommodate this possibility by extending the model to include the payment of a compensation to the firm that suffers from its partner's deceptive behaviour any time this practice occurs. We show that the incentives used to devise alliances for the unique purpose of gaining access to the partner's sensitive core knowledge remain true for compensation values that are not too high. However, the fact that we model this compensation in expected terms –i.e., as the product of the amount of money that a firm receives conditional on winning in court times the probability of winning in court, suggests that compensations may not work effectively against the emergence of this type of deceptive behaviour in environments in which proving that knowledge appropriation has occurred is difficult.

2.1.1 Related Literature

Coopetive interactions are subject to tensions that stem from the paradox posed by two contradictory yet interrelated dualities –competition and cooperation, that materialises in the relationship between two firms (Raza-Ullah, Bengtsson, and Kock, 2014; Fernandez and Chiambaretto, 2016; Tidström, 2014). These tensions arise at various levels, including inter-organisational, intra-organisational and inter-individual levels (Bengtsson and Kock, 2000; Fernandez, Le, and Gnyawali, 2014; Gernsheimer, Kanbach, and Gast, 2021). At the inter-organisational level, one important tension stems from the risk of (voluntary or involuntary) leakages of core-knowledge that a rival potentially could use to sustain superior performance in the market in which the firms compete (Ritala, 2009; Jiang, Li, Gao, Bao, and Jiang, 2013; Lee, Saunders, Panteli, and Wang, 2021).

The literature on inter-organisational knowledge management has mainly focused on knowledge sharing, exchange and integration mechanisms, and knowledge protection (Gast, Gundolf, Harms, and Collado, 2019; Ritala, Olander, Michailova, and Husted, 2015). In coopetitive alliances, partners must share information and knowledge to achieve the common goal of the collaboration (Fernandez and Chiambaretto, 2016), which creates tension because partners remain competitors and thus, they must also protect certain information from each other (Khanna, Gulati, and Nohria, 1998; Lane and Lubatkin, 1998; Tidström, 2018). However, highly firm-specific knowledge –which presumably belongs to the set of nonshared resources (Lavie, 2006), presents a high risk of opportunism because the leakage of knowledge associated with such resources is difficult to prevent (Lavie, 2006; Kumar, 2010; Gast, Gundolf, Harms, and Collado, 2019). In order to mitigate the risks associated with unwanted knowledge transfers, coopetitors rely on formal practices such as legal contracts or formal procedures and structures to control which knowledge is shared and which is protected (Gast, Gundolf, Harms, and Collado, 2019). However, due to the incomplete nature of contracts and the impossibility of completely avoiding unintended knowledge leakages (Ritala, 2009), firms also adopt informal protection mechanisms, where reputation and trust have been identified as important informal mechanisms (Jiang, Li, Gao, Bao, and Jiang, 2013; Fernandez and Chiambaretto, 2016; Lascaux, 2020).[4]

We contribute to this literature by developing a theoretical model that underscores the extent to which the risk of opportunism associated with the exploitation of a partner's specific core-knowledge outside the scope of the cooperative activity

[4]The literature suggests two organisational principles to manage this and other coopetitive tensions, namely, separation and integration principle (or a combination of both) (Fernandez and Chiambaretto, 2016). The separation principle is based on the logic that cooperative and competitive activities are separated inside the firm in order to avoid tension, whereas the integration principle is based on the opposite, that is, cooperative and competitive activities are integrated for tension management (Bengtsson and Kock, 2000; Tidström, 2018). Gernsheimer, Kanbach, and Gast (2021) mentions mediation through a third-party advisor as another way to manage tensions in coopetitive activities.

affects not only the nature (and intensity) of market competition but also the incentives to pursue coopetitive activities. In our formulation, firms adopt a passive approach with respect to knowledge sharing and knowledge acquisition, and hence, any benefit accruing from the exploitation of the partner's knowledge must originate from the inevitable leakages that take place while firms interact in the cooperative activity. Our findings also provide some support to a similar idea that knowledge access rather than knowledge acquisition may be the primary motivation for firms to pursue knowledge-based alliances (Grant and Baden-Fuller, 2004; Ryan-Charleton, Gnyawali, and Oliveira, 2022).

Our paper is also related to the literature on absorptive capacity. A firm's absorptive capacity can be defined as the firm's ability to absorb knowledge, assimilate it, and apply it to commercial ends (Cohen and Levinthal, 1990). Since Cohen and Levinthal (1990)'s seminal contribution, several scholars have advanced the theoretical foundations of the concept (Lane and Lubatkin, 1998; Zahra and George, 2002; Song, Gnyawali, Srivastava, and Asgari, 2018; Lane, Koka, and Pathak, 2006), whereas other scholars have empirically examined the relationship between firms' ability to absorb spillovers from other firms and their profitability albeit most of them in the context of R&D collaborative agreements (Kamien and Zang, 2000; Leahy and Neary, 2007; Harris and Yan, 2019; Ritala and Hurmelinna-Laukkanen, 2013; Hurmelinna-Laukkanen and Olander, 2014). We contribute to this literature by theoretically identifying a mechanism –other than a firm's ability to reap benefits from common profits, through which absorptive capacity affects firm's performance. Specifically, we show that absorptive capacity plays a key role in shaping the *value* of knowledge leakages because a firm with superior absorptive capacity, ceteris paribus, can generate higher private benefits by leveraging the partner's knowledge outside the collaborative activity.

Absorptive capacity not only increases a firm's receptivity to the partner's knowledge and skills (Hamel, 1991; Zahra and George, 2002) but also enables a firm to extract greater private benefits from the partner. In the context of joint ventures, Kumar (2010) argues that absorptive capacity plays a critical role in influencing differential wealth gains in joint ventures by impacting a firm's ability to extract private benefits from the partner. Samant and Kim (2021) examine the ex-ante conditions that foster the development of common benefits and private benefits from alliances. These authors argue that a firm's absorptive capacity is positively related to a firm's ability to generate private benefits. We contribute to this strand of literature by providing theoretical insights into this mechanism. In particular, we show that absorptive capacity positively relates to not only a firm's capacity to generate private benefits in coopetitive alliances that involve knowledge leakages but also the emergence of opportunistic behaviours in which firms devise coopetitive alliances with the only purpose of accessing the partner's core-knowledge.

Finally, our paper also contributes to the strand of literature dealing with tensions in coopetitive alliances due to (market and) product overlap (Dorn, Schweiger, and

Albers, 2016; Gernsheimer, Kanbach, and Gast, 2021; Virtanen and Kock, 2022). According to this literature, market commonality –i.e., the degree to which the coopetitive partners operate or focus in same market segments, and resource similarity –which determines the extent to which the partners' products are similar or overlap, defines the competitive dimension of coopetition (Virtanen and Kock, 2022). Tension increases when markets and products overlap (Virtanen and Kock, 2022, p.36). In our theoretical formulation, market overlap is approximated by the degree of product specialisation (von Ungern-Sternberg, 1988) (the idea being that more specialised products target different segments of consumers), whereas product similarities are captured by their degree of horizontal differentiation. Consistent with empirical studies on the subject (Gernsheimer, Kanbach, and Gast, 2021; Tidström, 2009), our theoretical results predict low tension –which in our case manifests through a lower probability of opportunistic behaviours, when products are characterised by a high degree of specialisation and horizontal differentiation.

The remainder of the article is organised as follows. In Section 2.2, we outline the model. In Section 2.3, we characterise and discuss the firms' behaviour and derive the main results of the article. Section 2.5 concludes the article.

2.2 Model

Consider a market comprising two risk-neutral firms, firm A and firm B, that produce horizontally differentiated products, with firm A and firm B initially located at the left and right ends of a linear street of length one. The demand side of the market comprises a continuum of risk-neutral consumers with unit demands uniformly distributed along this street. Consumers have a (common) reservation utility $V > 0$ for the good.

In addition to the horizontal differentiation, the products differ in their degree of functionality or scope. A product with a higher degree of functionality is a product that can perform the functions of various more specialised products almost equally well (von Ungern-Sternberg, 1988). The functionality of seller j's product is captured by the parameter $t_j \in [\underline{t}, \bar{t}]$, $j = A, B$, where a higher value of this parameter represents a more specialised product. Following von Ungern-Sternberg (1988), the parameter t_j is interpreted as a transportation cost parameter that consumers must bear when purchasing from seller j. Thus, a consumer located at distance $d \in [0, 1]$ from seller j that purchases the product at price p_j obtains a utility equal to $V - p_j - t_j d$.

Firm B owns the right to exploit a business opportunity unrelated to the market in which firms A and B compete. Initially, firm B knows the exact value (profit) of this business opportunity, which we denote by $\theta \in [-1, 1]$. Firm A is unaware of this value and only knows that it is the realisation of a random variable uniformly distributed within the interval $[-1, 1]$.

Firm B cannot exploit the business opportunity unless firm A agrees to cooperate with it. If firm A agrees to collaborate, the alliance is formed, and involuntary leakages of information regarding the firms' production processes occur. However, access to information regarding the production process of their competitors is beneficial to a given firm only if the firm has the adequate capacities to internalise the new knowledge. Having adequate absorptive capacities allows a firm with access to its competitor's production process to imitate (to some extent) the horizontal characteristics of its competitor's product. Let $a > 0$ and $b < 1$, $a \leq b \leq 1$ be any two locations on the linear street of firms A and B respectively. Then, the value of a (resp. b) represents the extent to which firm A (resp. firm B) with adequate absorptive capacities that gains access to information regarding the production process of firm B (resp. firm A) is able to imitate some characteristics of firm B's (resp. firm A's) product. In contrast, firm A (resp. firm B), which does not have adequate capacities, remains at the right (resp. the left) end of the linear street regardless of whether it gets access to its competitor's core knowledge. Hereafter, we refer to the locations $a > 0$ and $b < 1$ as firm A's and firm B's absorptive capacities, respectively, and assume that they are common knowledge.[5]

The two firms and the continuum of consumers play a multistage Bayesian game in which the sequence of events is as follows. In the first stage, firm B privately observes the value of θ and decides whether to offer an alliance to firm A. Firm A can accept or reject firm B's offer. If firm A accepts, an alliance is formed, and

[5]Because there are only two firms, absolute and relative absorptive capacity coincide. To see why, observe that the parameter a (resp. b) can be interpreted as firm A's (resp. firm B) capacity to learn from the specific partner firm B (resp. firm A). In more general setups, we could tackle this issue by letting parameter a be partner-specific such that a_j represents firm A's ability to learn specifically from partner j.

information leakages concerning the firms' production processes occur. Firms with adequate absorptive capacities internalise this new knowledge and simultaneously choose whether to move toward the centre of the city and locate at $a > 0$ in the case of firm A and $b < 1$ in the case of firm B (with $a \leq b \leq 1$). A firm without adequate absorptive capacities cannot relocate and must remain at its initial location (one of the ends of the street). The decision to locate at a and b becomes common knowledge in all subsequent game stages. In the case of no offer, the game moves directly to the final stage.

If firm A accepts firm B's offer, the alliance is successful, and each firm earns half of the profits associated with the realisation of θ. If firm A does not accept firm B's offer, the alliance is unsuccessful, and each firm earns zero profit from the alliance regardless of the realisation of θ. In the second stage, firms simultaneously choose the prices of their products; then, the game ends, and all payoffs are realised.

In section 2.3.2, we extend the base model to account for the possibility that firm A receives compensation when it suffers from firm A's opportunistic behaviour. To simplify the analysis, we adopt a reduced-form approach for the litigation dynamics and simply assume that when applicable, firm A receives an expected compensation $K > 0$ when firm B offers an alliance for the unique purpose of accessing firm A's private knowledge regarding its production process.

2.3 Equilibrium analysis

Given the multistage and incomplete information nature of the game described in the previous section, we use Perfect Bayesian equilibrium (equilibrium henceforth) as our equilibrium concept. An equilibrium is a collection of strategies for the firms and a system of beliefs such that (i) strategies are sequentially rational given beliefs, and (ii) beliefs are derived according to Bayes' rule when possible.

Consistent with sequential rationality, we begin with an analysis of the game stage in which firms simultaneously choose the price of their products. Recall that firms reach this stage even if they do not interact within some alliance, although this interaction may alter the degree of horizontal differentiation under which firms compete in prices. Nonetheless, given that the profits that firms expect to earn in the product market when they do not participate in an alliance can be captured by letting $a = 0$ and $b = 1$, we solve for the equilibrium prices considering an extended pair of arbitrary locations (a, b), with $a \geq 0$ and $b \leq 1$.

There are three possible types of equilibria in the pricing game that need to be analysed as follows: (i) one in which the market is fully covered, both firms share the market, and the marginal consumer that is indifferent between purchasing from firm A or B earns non-negative rents; (ii) one in which not all of the market is covered (a local monopoly case); and (iii) one in which the market is fully covered by only one firm.

Take any pair of locations (a, b) such that $a \leq b \leq 1$ and any pair of (non-negative) prices (p_A^*, p_B^*) and suppose that there is an equilibrium in which firm A covers the entire market. Then, firm A must charge a price $p_A^* < p_B^* - t_A(b-a)$. Because firm B earns zero profit, it has incentives to unilaterally lower its price slightly below $p_A^* + t_A b$ to guarantee a strictly positive demand (and hence, positive profits), which contradicts the fact that p_A^* and p_B^* are equilibrium prices. Using a similar argument, we can discard cases in which the market is covered entirely by firm B or those in which $p_A^* = p_B^* - t_A(b-a)$ and each firm sells to a fraction (less than one) of consumers. Therefore, we only need to consider the putative equilibria of types (i) and (ii) above. Take case (i). Given prices p_A^* and p_B^*, the location of the marginal consumer that is indifferent between purchasing from firm A or B becomes $x^* = \frac{p_B^* - p_A^* + t_A a + t_B b}{t_A + t_B}$. Because all consumers located on the left of x^* are better off purchasing from firm A, whereas everyone located on the right of x^* is better off purchasing from firm B, firm A's and firm B's profit functions are simply equal to $\pi^A(p_A, p_B) = p_A x^*(p_A, p_B^*)$ and $\pi^B = p_B[1 - x^*(p_A^*, p_B)]$, respectively. Taking the first order conditions, we obtain the following:

$$p_A^* = \frac{t_A(1+a) + t_B(1+b)}{3} \tag{2.1}$$

$$p_B^* = \frac{t_A(2-a) + t_B(2-b)}{3} \tag{2.2}$$

from which the (putative) equilibrium profits are as follows:

$$\pi_A^*(t_A, t_B, a, b) = \frac{[t_A(1+a) + t_B(1+b)]^2}{9(t_A + t_B)} \tag{2.3}$$

$$\pi_B^*(t_A, t_B, a, b) = \frac{[t_A(2-a) + t_B(2-b)]^2}{9(t_A + t_B)} \tag{2.4}$$

Recall that in this case the marginal consumer is supposed to earn non-negative rents, which holds true when the prices in (2.1) and (2.2) satisfy $V - p_A^* - t_A(x^* - a) \geq 0$. This last inequality holds true in the case of the following:

$$V \geq \bar{V} := \frac{(2-a)t_A^2 + (3 + 2(b-a))t_A t_B + (1+b)t_B^2}{3(t_A + t_B)} \tag{2.5}$$

Condition (5) also allows us to examine the existence of equilibria in which the market is not covered. Momentarily suppose that $V > \bar{V}$ holds true and that there is an equilibrium in which the market is not fully covered. Then, there must be one consumer that is indifferent between purchasing from firm A and not purchasing at all, and the same applies to firm B. The locations of each of these consumers are $x_A = \frac{V - p_A^* + t_A a}{t_A}$ for firm A and $x_B = \frac{p_B^* + t_b b - V}{t_B}$ for firm B. The optimal prices are then $p_A^* = \frac{V + t_A a}{2}$ and $p_B^* = \frac{V + t_B(1-b)}{2}$. By construction, the market is not fully covered, and the consumer that is indifferent between purchasing from either firm must be located between x_A and x_B; hence, $\frac{V - p_A^* + t_A a}{t_A} < \frac{p_B^* - p_A^* + t_A a + t_B b}{t_A + t_B} < \frac{p_B^* + t_b b - V}{t_B}$. For this to hold true, V must be strictly lower than $\frac{t_A t_B (1-a+b)}{t_A + t_B}$. However, $0 \leq a \leq b \leq 1$

implies the following:

$$
\begin{aligned}
\bar{V} &> \frac{(3+2(b-a))t_A t_B}{3(t_A+t_B} \\
&\geq \frac{3t_A t_B}{3(t_A+t_B} \\
&= \frac{t_A t_B}{t_A+t_B}
\end{aligned}
$$

and hence,

$$V < \frac{t_A t_B(1-a+b)}{t_A+t_B} < \frac{t_A t_B}{t_A+t_B} < \bar{V} < V$$

This last inequality is a contradiction to our initial assumption regarding condition (5) holding true. The following results are immediate.

Lemma 1. *Suppose that condition* (2.5) *holds. Then, there cannot be an equilibrium in which the market is not fully covered (the local monopoly case).*

From lemma 1, if $V \geq \bar{V}$, the only plausible equilibrium is one in which the market is fully covered and shared by both firms and the marginal consumer earns non-negative rents. The prices are given by expressions (2.1) and (2.2). However, for these prices to maximise each firm's profit over the whole interval of admissible prices, the following two additional conditions must apply to the locations of the firms:

$$\frac{[t_A(1+a)+t_B(1+b)]^2}{t_A+t_B} \geq 3[(2a+2-3b)t_A+(2-b)t_B] \tag{2.6}$$

$$\frac{[t_A(2-a)+t_B(2-b)]^2}{t_A+t_B} \geq 3[(1+a)t_A+(1-2b+3a)t_B] \tag{2.7}$$

The next result summarises our discussion thus far.

Lemma 2. *Let conditions* (2.5), (2.6), *and* (2.7) *hold. Then, the prices given by expressions* (2.1) *and* (2.2) *characterise the unique Nash equilibrium of the pricing subgame. In this equilibrium, the market is fully covered and shared by both firms and the marginal consumer earns non-negative rents.*

Lemma 2 is interesting for at least two reasons. First, this lemma suggests that firms with adequate absorptive capacities benefit from imitating the characteristics of their competitors' products. This stems from profit functions (2.3) and (2.4) increasing as each firm moves toward the centre of the street (a manifestation of Hotelling (1929)'s principle of minimum differentiation).[6] Thus, a firm with adequate absorptive capacities that is given a chance to access its competitor's knowledge through participation in an alliance will use this opportunity to make its product appear more similar to its competitor's product in the horizontal dimension.

[6]Indeed, the profit function of firm A (Eq. (2.3)) strictly increases in $a \geq 0$ for any $b \leq 1$, and hence, $a > 0$ implies $\pi_A^*(t_A, t_B, a, b) > \pi_A^*(t_A, t_B, 0, b)$. Similarly, the profit function of firm B (Eq. (2.4)) strictly decreases in $b \leq 1$ for any $a \geq 0$. Therefore, $b < 1$ implies $\pi_B^*(t_A, t_B, a, b) > \pi_A^*(t_A, t_B, a, 1)$.

Corollary 1. *For firm A, the profit function in* (2.3) *satisfies* $\pi_A^*(t_A, t_B, a, b) > \pi_A^*(t_A, t_B, 0, b)$*, whereas for firm B, the profit function in* (2.4) *satisfies* $\pi_B^*(t_A, t_B, a, b) > \pi_A^*(t_A, t_B, a, 1)$ *for any two locations* $a > 0$ *and* $b < 1$ *satisfying* $a \leq b$ *and conditions* (2.6) *and* (2.7). *Thus, firms with the capacities to internalise any new knowledge that they learn from their competitors will choose to produce less (horizontally) differentiated products.*

The second interesting aspect of lemma 2 is that it shows that gaining access to and internalising a competitor's knowledge is valuable for the firms only if some *asymmetry* exists between them either in the functionality (degree of purposeness) of their products or their absorptive capacities. To observe this phenomenon, note that the firms' profit functions (2.3) and (2.4) become independent of the firms' locations when $t_A = t_B$, and $a = 1-b$, i.e., when the firms' products are equally functional, and the firms are equally capable of internalising the information and knowledge they access when participating in an alliance. Thus, firms that are equally capable of internalising new knowledge they obtain will not modify their competitive behaviour in the product market (concerning the situation in which neither firm accesses their competitor's knowledge) if their products are equally functional.

Corollary 2. *Accessing and internalising a competitor's core knowledge does not affect sellers' profits when the products are equally functional (i.e., their products have the same degree of purposeness,* $t_A = t_B$*), and the firms are symmetrical concerning their absorptive capacities (i.e.,* $a = 1 - b$*).*

2.3.1 Alliances with competitors

After characterising the equilibrium behaviour in the price-competition game stage, we return to the stage in which firm A must decide whether to accept or reject firm B's offer to form an alliance.

Suppose momentarily that firm B makes an offer that firm A accepts with probability one. Firm B's payoff from extending the offer to firm A is as follows:

$$\pi_B^*(t_A, t_B, a, b) + \frac{\theta}{2}$$

where we used the fact that firms with absorptive capacities a and b make their products more similar when they get access to information regarding each others' production process, which occurs if firm A accepts firm B's offer. As not making an offer yields firm B a payoff equal to $\pi_B^*(t_A, t_B, 0, 1)$, this firm is better off extending an offer when $\theta \geq \theta_B$, where θ_B is the solution to the following:

$$\pi_B^*(t_A, t_B, a, b) + \frac{\theta_B}{2} = \pi_B^*(t_A, t_B, 0, 1)$$

and hence,

$$\theta_B = \frac{2[t_B(b-1) + at_A)(t_B(3-b) + t_A(4-a))]}{9(t_A + t_B)} \tag{2.8}$$

Unsurprisingly, this threshold value equals zero when $a = 0$ and $b = 1$ because firms without adequate capacities place no value on their competitors' knowledge as they are incapable of internalising it. Moreover, firm B will only offer alliances with positive values when $b = 1$ and $a > 0$, reflecting the fact that firm B without absorptive capacities expects lower profits in the product market due to a competitor that will use the newly acquired knowledge to steal a part of its market share when it accepts the offer. Furthermore, for firms with symmetric absorptive capacities (i.e., $a = 1 - b$, $a \neq 0$, $b \neq 1$), θ_B is positive if $t_B < t_A$. Intuitively, consumers are less sensitive to changes in the horizontal characteristics of a product if the product is generic (i.e., a lower value of the transportation cost parameter), providing the firm with the more specialised product (i.e., the firm with a higher transportation cost parameter) a competitive advantage in terms of the market share when competing against a firm with a symmetrically differentiated product. Anticipating this, firm B will offer an alliance only if it generates enough profits to compensate for the deteriorated competitive position that it will face if engaging in this collaborative agreement. Interestingly, if $a = 1 - b$ and $t_B > t_A$, or $a \neq 1 - b$ ($b < 1$) and $t_B > \underline{t}_B := \frac{at_A}{1-b}$, then $\theta_B < 0$, indicating that in all cases, firm B is willing to offer alliances with a negative economic value only to obtain access to its competitor's core knowledge to improve its competitive position in the product market.

Next, consider the decision of firm A after receiving an offer from firm B. Because firm B is fully aware of the exact value of θ, the mere act of offering an alliance signals information to firm A regarding the value of θ. Suppose that firm A believes that firm B extends an offer only if θ is greater than the threshold value θ_B. Then, upon receiving an offer, firm A updates its belief according to Bayes' rule such that firm A believes that θ follows a cdf $F(\theta) = \frac{\theta - \theta_B}{1-\theta_B}$ with full support on $[\theta_B, 1]$. Hence, the expected profit of firm A if it accepts firm B's offer is as follows:

$$\Pi_A(t_A, t_B, a, b|\theta_B) := \int_{\theta_B}^{1} \left\{ \pi_A^*(t_A, t_B, a, b) + \frac{\theta}{2} \right\} dF(\theta)$$

where we used the fact that involuntary leakages of information allows firms with adequate absorptive capacities to make their products more similar. We define θ_A as the solution to the following:

$$\pi_A^*(t_A, t_B, a, b) + \frac{\theta_A}{2} = \pi_A^*(t_A, t_B, 0, 1)$$

such that,

$$\theta_A = \frac{2[(t_B(1-b) - at_A)(t_B(3+b) + t_A(2+a))]}{9(t_A + t_B)}$$

The value of θ_A corresponds to the threshold value for θ above which a *fully informed firm A* would be strictly better off joining the alliance than rejecting it. Notably, $\theta_A > 0$ if and only if $\theta_B < 0$, and thus, a *fully informed* firm A would never agree to exploit a business opportunity with a negative economic value. Interestingly, this suggests that alliances devised as mechanisms to gain access to firm A's core knowledge must be the result of asymmetric information regarding the economic value of the alliance. Furthermore, it is reasonably clear that $\Pi_A(t_A, t_B, a, b|\theta_B)$ is (weakly) greater than $\pi^*_A(t_A, t_B, 0, 1)$ when $t_B \leq \underline{t}_B$ because this last inequality implies $\theta_A < 0 < \theta_B$. Thus, when $t_B \leq \underline{t}_B$ firm A can rest assured by accepting alliances whose profits strictly compensate for any loss produced by fiercer competition in the product market.

For the case in which $t_B > \underline{t}_B$ (where $\underline{t}_B := \frac{at_A}{1-b}$, $b < 1$), we define $\Phi(t_A, t_B, a, b)$ as follows:

$$\begin{aligned}\Phi(t_A, t_B, a, b) &= \Pi_A(t_A, t_B, a, b|\theta_B) - \pi^*_A(t_A, t_B, 0, 1) \\ &= [\pi^*_A(t_A, t_B, a, b) - \pi^*_A(t_A, t_B, 0, 1)] + \frac{\theta_B + 1}{4}\end{aligned} \tag{2.9}$$

Then, it is optimal for firm A to accept firm B's offer when $\Phi(t_A, t_B, a, b) \geq 0$ and reject the offer when $\Phi(t_A, t_B, a, b) < 0$. We observe the following:

$$\lim_{\underline{t}_B \leftarrow t_B} \Phi(t_A, t_B, a, b) = \frac{1}{4}$$

and,

$$\left.\frac{\partial \Phi(t_A, t_B, a, b)}{\partial t_B}\right|_{t_B = \underline{t}_B} = \frac{(b-1)(4b-5a-4)}{9(b-a-1)} < 0$$

Therefore, given the continuity of $\Phi(\cdot)$ with respect to t_B, (i) $\Phi(t_A, t_B, a, b) > 0$ for all $t_B \in (\underline{t}_B, \bar{t})$ or (ii) there exists some $\tilde{t}_B > \underline{t}_B$ such that $\Phi(t_a, \tilde{t}_B, a, b) = 0$ and

$\Phi(t_a, t_B, 1-b, b) > 0$ for all $t_b \in (\underline{t}_B, \tilde{t}_B)$.

Lemma 3. *For any given degree of functionality of firm A's product, t_A, and the firms' absorptive capacities a and b, $0 \leq a \leq b < 1$, such that conditions* (2.6) *and* (2.7) *hold, suppose that $t_B > \underline{t}_B := \frac{at_A}{1-b}$. Then, there exists some value $\bar{t}_B = \min\{\tilde{t}_B, \bar{t}\}$ such that $\bar{t}_B > \underline{t}_B$, and $\Phi(t_A, t_B, a, b) > 0$ for all $t_B \in (\underline{t}_B, \bar{t}_B)$.*

Lemma 3 is important because it establishes the existence of the parameters under which accepting firm B's offer is an optimal action for firm A even though θ is less than zero. Importantly, firm A is not fully aware of the exact value of θ (even though it updates its belief about it upon receiving an offer), and hence, its participation decision is taken in expected rather than ex-post terms.

The following proposition summarises our discussion thus far. Its proof follows from lemma 2, corollary 1, lemma 3, and the discussion surrounding lemma 3.

Proposition 1. *Suppose that condition* (2.5) *holds and that the firms' absorptive capacities satisfy conditions* (2.6) *and* (2.7)*, and $0 \leq a \leq b \leq 1$. Then, there is a perfect Bayesian equilibrium as follows:*

1. *Firm B offers an alliance to firm A when it learns that the value of θ satisfies $\theta \geq \min\{\theta_B; 1\}$, where θ_B is given by the expression* (2.8)*. Firm B does not extend an offer if $\theta < \max\{\theta_B, -1\}$.*

2. *Upon receiving an offer, firm A updates its belief about θ according to Bayes' rule and accepts firm B's offer with probability one when (i) $t_B \leq \underline{t}_B$, $\underline{t}_B = \frac{at_A}{1-b}$;*

or (ii) $t_B > \underline{t}_B$ *and* $t_B \in (\underline{t}_B, \bar{t}_B)$*, where* $\bar{t}_B$ *is defined in lemma 3.*

3. *Firm A with absorptive capacity* $a \geq 0$ *is located at* a*, and firm B with absorptive capacity* $b \leq 1$ *is located at* b*.*

4. *Firms set prices according to the expressions* (2.1) *and* (2.2)*.*

Proposition 1 formalises the idea of alliances used as vehicles to access a competitor's core knowledge as events that we can observe in equilibrium with positive probability. Because firm B offers such alliances to firm A when $t_B > \frac{at_A}{1-b}$ (because this implies $\theta_B < 0$), the probability with which we expect to observe this type of deceptive alliances, $Pr(\theta_B < \theta < 0)$, can be computed as follows:

$$Pr(\theta_B < \theta < 0) = \frac{1}{2} - \frac{\theta_B + 1}{2} \tag{2.10}$$

$$= -\frac{\theta_B}{2} \tag{2.11}$$

$$= \frac{(t_B(b-3) - t_A(4-a))(t_B(b-1) + at_A)}{9(t_A + t_B)} \tag{2.12}$$

which is positive when $\theta_B < 0$. Interestingly, this probability increases as the absorptive capacity of firm B increases, i.e., the more capable firm B is relative to firm A to internalise any new knowledge that it learns from the interaction with its competitor (given product functionalities t_A and t_B). Thus, firms with more limited absorptive capacities are more likely to receive offers from firms with better absorptive capacities that are devised to gain access to core knowledge that helps the latter improve their competitive position in the product market. Nevertheless, highly specialised products mitigate the appearance of this type of deceptive behaviours because customers are more sensitive to changes in the horizontal characteristics of a product if the product is more specialised (less functional). Therefore, a firm with limited absorptive capacities that produces a very specialised product has much to gain when it learns something that helps it make its product and its competitors' products more similar. This, in turn, implies that the firm with superior absorptive capacities anticipates strong competition in the product market, which discourages it from making offers that involve unprofitable ventures.

2.3.2 Deceptive alliances and compensation for damages

Proposition 1 characterises situations in which a firm with superior absorptive capacities uses an alliance (more precisely, the information that is leaked while interacting with its competitor in the alliance) to out-learn and out-compete its partner, similar to the Microsoft–Apple example outlined in the introduction. However, as this example also suggests, such cases are likely to end up in court with the affected firm claiming for compensation for the losses that it suffers as the result of this deceptive business practice. In this section, we extend the base model and include a compensation $K \geq 0$ that firm A receives when firm B offers an alliance that is deceptive. Because this practice can be associated with alliances with strictly negative values of θ, we characterise an alliance as deceptive when its economic value is strictly negative ($\theta < 0$). Moreover, for simplicity we assume that firm A receives this compensation automatically if firm B offers a deceptive alliance.[7]

As before, momentarily suppose that firm A accepts any offer that firm B makes. Assume that firm B learned that $\theta < 0$. Firm B will find it profitable to offer this alliance to firm A in the case of the following:

$$\pi_B^*(t_A, t_B, a, b) + \frac{\theta}{2} - K \geq \pi_B^*(t_A, t_B, 0, 1) \tag{2.13}$$

because firm B knows with certainty that it will have to pay compensation K to firm A because $\theta < 0$. Define $\tilde{\theta}_B$ as the value of θ that makes expression (2.13) hold with equality:

$$\tilde{\theta}_B = 2\left[\pi_B^*(t_A, t_B, 0, 1) - \pi_B^*(t_A, t_B, a, b) + K\right] \tag{2.14}$$

From previous discussions, we already know that $\pi_B^*(t_A, t_B, 0, 1) \geq \pi_B^*(t_A, t_B, a, b)$ if $t_B < \underline{t}_B$, and hence, $\tilde{\theta}_B$ collapses to $\theta_B > 0$. Therefore, let $t_B > \underline{t}_B$ such that $\pi_B^*(t_A, t_B, 0, 1) < \pi_B^*(t_A, t_B, a, b)$. Define $\overline{K}$ as the compensation value above which extending deceptive alliances is unprofitable for firm B:

$$\overline{K} = \frac{(at_A - t_B(1-b))(t_B(b-3) + t_A(a-4))}{9(t_A + t_B)} \tag{2.15}$$

Clearly, $\overline{K} > 0$ if $t_B > \underline{t}_B$ and hence, we can still observe deceptive alliances

[7]We can interpret K as the expected compensation in the case of suffering from firm B's deceptive behaviour, i.e., the amount of money firm A receives conditional on winning in court times the probability of winning.

provided that the compensation value K is not too high.

Lemma 4. *Suppose that firm A accepts with probability one any offer that firm B makes, and that $t_B > \underline{t}_B$. Then, firm B optimally offers deceptive alliances if $K \in [0, \overline{K}]$.*

Next, consider firm A. Suppose that firm A believes that firm B extends an offer only if θ is above some threshold value $\hat{\theta}_B$. Given this belief, firm A accepts firm B's offer if the following condition holds:

$$\int_{\hat{\theta}_B}^{1} \left\{ \pi_A^*(t_A, t_B, a, b) + \frac{\theta}{2} \right\} d\hat{F}(\theta) + Pr(\hat{\theta}_B < \theta < 0)K \geq \pi_A^*(t_A, t_B, 0, 1)$$

where $\hat{F}(\cdot)$ is the cdf of θ conditional on $\theta > \hat{\theta}_B$. By substituting the expression for the probability of accepting a deceptive alliance and rearranging terms, this condition can be written as follows:

$$\left(\pi_A^*(t_A, t_B, a, b) - \pi_A^*(t_A, t_B, 0, 1) + \frac{1}{4} \right) + \left(\frac{\hat{\theta}_B}{4} - \frac{\hat{\theta}_B}{2} K \right) \geq 0 \qquad (2.16)$$

In equilibrium, beliefs must be correct, and hence, $\hat{\theta}_B = \tilde{\theta}_B$. We define $\zeta(K)$ to be equal to the second term in the brackets when $\hat{\theta}_B$ is replaced by $\tilde{\theta}_B$:

$$\zeta(K) = \frac{\tilde{\theta}_B(K)}{4} - \frac{\tilde{\theta}_B(K)}{2} K$$

where we write $\tilde{\theta}_B(K)$ to stress the fact that the lowest value of θ above which firm

B is willing to make an offer depends on the magnitude of the compensation K this firm must pay in the case of offering a deceptive alliance. Replacing the expression for $\tilde{\theta}_B$ given by (2.14) into $\zeta(K)$ yields the following:

$$\zeta(K) = \frac{\delta_B}{2} + \left(\frac{1}{2} - \delta_B\right) K - K^2 \tag{2.17}$$

where, for simplicity, $\delta_B = \pi_B^*(t_A, t_B, 0, 1) - \pi_B^*(t_A, t_B, a, b)$. Observe that the mapping $\zeta(K)$ takes on negative values for K close to zero (because $\delta_B < 0$) and increases, reaching a maximum, and then decreases as K increases. This reflects the fact that low values of K increases firm B's incentives to offer deceptive alliances, whereas higher values decrease this probability but increase the amount that firm A receives in the case that firm B indeed offers such an alliance. Furthermore,

$$\begin{aligned}
\zeta(\overline{K}) &= \frac{\delta_B}{2} + \overline{K}\left(\frac{1}{2} - \delta_B + \delta_B\right) \\
&= \frac{\delta_B}{2} - \frac{\delta_B}{2} \\
&= 0
\end{aligned}$$

and therefore, condition (2.16) must strictly hold (because the first term on the left-hand side is strictly positive) when the compensation value is exactly equal to $\overline{K}$. This suggests the existence of some non-empty set $[\underline{K}, \overline{K}]$ such that if K belongs to this interval, we can still observe cases in which firm B offers deceptive alliances that firm A accepts with probability one in equilibrium. We define $\underline{K}$ as follows:

$$\underline{K} = \inf\left\{K \geq 0 \, : \, \pi_A^*(t_A, t_B, a, b) - \pi_A^*(t_A, t_B, 0, 1) + \frac{1}{4} - \zeta(K) \geq 0\right\} \tag{2.18}$$

where $\zeta(K)$ is given by eq. (2.17).

Proposition 2. *Let* t_B *be strictly greater than* $\underline{t}_B = \frac{at_A}{1-b}$ *and* $\underline{K}$ *and* $\overline{K}$ *be defined by eq.* (2.18) *and eq.* (2.15)*, respectively. Then,* $K \in [\underline{K}, \overline{K}]$ *is sufficient for the existence of an equilibrium in which firm B offers deceptive alliances (i.e., alliances with a strictly negative economic value) that firm A accepts with probability one. The equilibrium probability of this event is as follows:*

$$Pr(\tilde{\theta}_B < \theta < 0) = \frac{(t_B(b-3) - t_A(4-a))(t_B(b-1) + at_A)}{9(t_A + t_B)} - K$$

Proposition 2 provides some support to the idea that deceptive business practices, such as engaging a competitor in a partnership for the unique purpose of gaining access to its sensitive core knowledge, may persist even in the presence of penalties for these types of business misconducts. Certainly, this proposition also suggests that these deceptive behaviours can be eliminated by setting a sufficiently high value of K (specifically, any $K > \overline{K}$). Nonetheless, this reasoning misses the fact that K represents a compensation in expected terms that depends on the probability with which the firm that recognises the knowledge appropriation wins in court. In the Microsoft-Apple case, the courts ruled against Apple's argument of knowledge appropriation based on the *look and feel* of its interface because the idea that Microsoft's automobile dashboard metaphors, which, because of their functionality, are ineligible for copyright protection, was more convincing than Apple's aesthetic-design metaphors (Samuelson, 2010, p.1763).

2.4 Discussion

Absorptive capacity plays an important role in shaping private benefits that coopetitive partners can earn from the exploitation of their competitors' knowledge. Our theoretical model suggests that absorptive capacity is a key element pertaining the value that firms assign to the knowledge of their partners and thus, to the probability of success of the coopetitive relationship. We are able to show that firms with different absorptive capacities evaluate the risks and benefits that can be obtained through coopetition differently, in line with the findings in Chiambaretto, Bengtsson, Fernandez, and Näsholm (2020) for the case of coopeting partners of different sizes.

Our findings also suggest that firms' absorptive capacities influence not only the degree of collaboration and competition but also the success of the entire coopetitive relationship. This is in line with recent research suggesting that coopetition has the potential to change the dynamics of cooperation and competition between rival firms, and hence, the decision to collaborate must depend on the intensity of market competition (Chen, Luo, and Wang, 2019). In our model, firms with relatively similar absorptive capacities have less to gain from the exploitation of their partner's knowledge because this new knowledge results in more similar (less horizontally differentiated) products. As a result, firms engage in coopetitive activities only when they anticipate positive gains from collaboration. In contrast, heterogeneity in firms' absorptive capacities affects firms' abilities to earn private benefits from exploiting their partner's knowledge. This asymmetry may affect price competition in such a way that a leading firm with superior absorptive capacity devises alliances with the only purpose of accessing its partner's knowledge.

Our analysis sheds some light regarding the question of how smaller firms leverage coopetition while interacting with larger firms. If we adhere to the idea that smaller firms are likely to have lower knowledge-building investments, lower accumulated stock of knowledge, and less developed procedures to internally share knowledge (which determine the core of firms' absorptive capacity; (Song, Gnyawali, Srivastava, and Asgari, 2018)), then small firms should also correspond to firms with more limited absorptive capacities. Then, our theoretical findings show that higher degrees of product specialisation mitigate the tension generated by market and product overlaps, as suggested by Virtanen and Kock (2022). In our framework, small firms producing highly specialised products face a very elastic demand with respect to the degree of horizontal differentiation of the products. Consequently, any new knowledge that the small firm can learn about the production process of the large partner will have a significant impact on the intensity of competition. This is sufficient to deter the large firm from behaving opportunistically and thus, from offering unprofitable projects.

2.4.1 Theoretical implications

From a methodological perspective, our research contributes to the strand of literature that examines coopetition from a game-theoretic perspective (Chen, Luo, and Wang, 2019; Meena, Dhir, and Sushil, 2022). Our theoretical analysis uncovers several interesting mechanisms and interactions that improve our understanding of the necessary balance between collaboration and competition in successful coopetitive activities. Our analysis also offers a game-theoretic approximation to the Trojan Horses alliances described in Lavie (2006). In line with this author's claim, we show that deceptive alliances originate from an unintended leakage of rents and involve no synergetic value creation (Lavie, 2006, p.647). Furthermore, our model operationalises Lavie's logic in a simple yet rigorous game-theoretic manner, which contributes to our understanding of this class of phenomena.

The previous argument extends to the analysis of the *dark side* of coopetition (Crick, 2019) originated from tension in these alliances. We offer a novel perspective on this issue based on firms' specific learning capabilities and market (and resource) similarities. Moreover, our theoretical model highlights the informational channel, which provides a better understanding of the market consequences of this tension in alliances that do not necessarily involve innovation activities. Finally, our model is simple enough to provide a theoretical base for future empirical work on the topic.

2.5 Concluding remarks

In this paper, we theoretically examine the role of absorptive capacities, i.e., the capacity to recognise, assimilate, and apply any new knowledge, in environments in a coopetitive alliance that involves the involuntary leakages of sensitive private information. In our model, firms have the possibility to learn new knowledge regarding the production processes of their competitors if they cooperate in the exploitation of a business opportunity whose economic value is the private knowledge of one of the firms. Nonetheless, firms differ with respect to their absorptive capacities, and hence, only those with adequate capacities are able to take advantage of this new knowledge. We show that privately informed firms with superior absorptive capacities are more likely to devise alliances for the only purpose of accessing and exploiting the internal capabilities of their competitors because this new knowledge strengthens their competitive position in the product market.

We also provide a rationale for the formation of alliances between asymmetric firms. According to our findings, firms with limited absorptive capacities but highly specialised products benefit from alliances in which there is knowledge appropriation because of the effect of new information of their competitors' products on the degree of competition in the product market. Because competitors' knowledge about their production processes allows the firms to make their products more similar, accessing and appropriating a competitor's knowledge lead to fiercer competition in the product market, which becomes more important the more specialised the product of the firms with more limited absorptive capacities is. Anticipating this, the firm with superior capacities refrains from offering alliances with an economic value that is not sufficiently high to compensate for the reduced profits in the product market. We also account for the possibility that the firm suffering from this practice expects to obtain compensation and show that this deceptive business practice remains true if this expected compensation is not too high.

Our findings are derived from the informational asymmetries in the model and depend on neither the intensity not the existence of spillovers. This is important because previous findings in the literature are derived by assuming that access to and the appropriation of knowledge occurs through the absorption of spillovers from other firms, which is what determines firms' performance in the product market. Thus, one novelty of this paper is extending the analysis of absorptive capacities beyond the R&D cooperative framework to cases in which the incentives to join an alliance are information-driven, i.e., derived from changes in the information structure under which the firms compete in the product market that result from firms' decisions to pursue a collaborative project.

In addition to these new theoretical insights into coopetitive alliances and the mediating role of absorptive capacities, our paper offers some interesting implications that are relevant to managers and practitioners when selecting competitors as partners for collaborative work. By highlighting the role of absorptive capacities as determinants of firm's competitive behaviour, this paper identifies key characteristics of potential partners that help predict opportunistic behaviours in collaborative work, the most relevant perhaps being the need for managers to carefully assess aspects related to the absorptive capacities of their potential partners before engaging in collaborative work with them. This may be particularly relevant for smaller firms because they are more likely to have less developed absorptive capacities, whereas larger firms should have superior absorptive capacities because they can make significant R&D investments (Muscio, 2007; Lin, Wu, Chang, Wang, and Lee, 2012). Managers of these smaller firms should be aware of the incentives of larger firms to offer alliances that may be designed to exploit their internal capabilities to improve their competitive position in the product market.

Chapter 3

Do you want to know a secret? Strategic alliances and competition in product markets

3.1 Introduction

Strategic alliances –interfirm collaborative models that allow firms to create value through collaboration in competitive environments (Das and Kumar, 2011), are fraught with the risk of opportunism that arises from information and knowledge that firms can acquire from their partners. This risk underlies the very nature of this type of interfirm collaboration because sharing information and intangible knowledge assets is key to increasing the propensity of partnering firms to generate common benefits and to achieve the goals of the collaboration (Ritala, Olander, Michailova, and Husted, 2015). However, once a firm (intentionally or unintentionally) shares valuable sensitive information with its partners, its ability to control or limit what these partners do with this information can be severely compromised. This can have important consequences to not only the competitive position of a firm vis-à-vis its partner (Hamel, 1991; Khanna, Gulati, and Nohria, 1998; Hoffmann, Lavie, Reuer, and Shipilov, 2018) but also the dynamics of the collaborative partnership (Khanna, Gulati, and Nohria, 1998; Inkpen, 2000; Fernandez, Le Roy, and Gnyawali, 2014).

Knowledge leakage –the extent to which the focal firm's private knowledge is intentionally appropriated by or unintentionally transferred to partners (Jiang, Li, Gao, Bao, and Jiang, 2013, p.984), differs from *information* leakage –the unauthorised sharing of a firm's information with another organisation, in that the former focuses on the appropriation of core resources of a firm –such as knowledge assets, competences, and skills (Anand and Goyal, 2009; Durst, Aggestam, and Ferenhof, 2015), whereas the latter refers to the simple revelation of confidential information to an unauthorised party (Zhang, Cao, Wang, and Zeng, 2012). Prior research on strategic alliances and information management has predominantly focused on the implications of *knowledge* rather than *information* leakage on strategic alliances (e.g., Oxley and Sampson, 2004; Jiang, Bao, Xie, and Gao, 2016; Raza-Ullah, 2021). This is unfortunate because a firm without the appropriate ability to absorb knowledge, assimilate it, and apply it to commercial ends (Cohen and Levinthal, 1990) may fail to leverage any new knowledge about their partners outside the alliance but it may very well benefit from new information about their partners by merely adjusting its behaviour to this new information. In this paper, we aim to fill in this research gap by theoretically examining the implications of information leakage on the firms' incentives to pursue strategic alliances and the nature and intensity of market competition between the partners. We specifically pose the following two questions: To what extent the possibility of unintended access to sensitive private information affects the incentives to join a strategic alliance? How do unintended leakages of information affect the development of common and private benefits in strategic alliances?

To address the above-mentioned questions, we develop a game-theoretic framework in which two firms competing à la Cournot in a homogeneous product market must collaborate to successfully exploit a business opportunity that needs not be related to the firm's core business activity. Firms are asymmetrically informed about their competitors' production costs as well as about the value of the common profits that they expect to generate through the collaborative activity. Engaging in this collaborative activity involves the possibility of (unintended) leakage of confidential information regarding firms' production processes, which would allow firms to update their beliefs about their competitors' production costs and about the value of common profits. Importantly, firms in our model do not actively seek access to their partner's sensitive information (i.e., they do not spend effort trying to observe their partner's private information); instead, firms simply know that there is a chance to observe this information while interacting in the alliance due to inevitable leakages of little details that give away valuable private information to the other party (Walter, Walter, and Müller, 2015). We model an alliance between the two firms as a two-stage contract in which firms first bargain over the gains of the collaborative activity and then decide on the implementation of the partnership (i.e., whether to carry out the actual productive tasks related to the business opportunity). Implementation of the alliance takes place only if firms ratify the outcome of the preliminary stage –which is a sharing rule over the gains of the partnership. Following Compte and Jehiel (2007), we conceptualise an alliance as a formal contract with ex-post quitting rights in which partners can terminate the collaboration at any point in time until the production and commercialisation of the new product takes place.[1] The insights gained from this game-theoretic model allow us to show that information leakage can trigger opportunistic behaviours in which firms engage in alliances that are expected to yield negative common profits simply because the possibility to learn sensitive information about their competitors increases the private rents that firms expect to earn when competing in the product market. Thus, our results suggest the existence of a spillover effect (Hora and Klassen, 2013; Ried, Eckerd, Kaufmann, and Carter, 2021) associated with information leakage that may lead some firms to devise

[1] According to Das and Teng (1999), there are four essential stages in any strategic alliance, namely, partner selection, structuring, operation, and evaluation of the alliance. Thus, our modelling of the alliance as a two-stage contract assumes that the selection of partners has already occurred and hence, firms must deal with structuring, operating, and evaluating the alliance.

economically unprofitable alliances with the hope to access the internal barriers of their competitors and thus, to learn sensitive private information. We also use our theoretical framework to examine the consequences of this *Trojan-horse behaviour* in environments in which the negatively affected firm can pursue some type of compensation for the (alleged) damage that this deceptive business practice may have caused.[2] We accommodate this possibility by extending the model to include the payment of compensation to the firm that suffers from its partner's deceptive behaviour any time this practice occurs. We show that the incentives to devise alliances for the unique purpose of gaining access to the partner's sensitive private information remain true for compensation values that are not too high. However, the fact that we model this compensation in expected terms –i.e., as the product of the amount of money that a firm receives conditional on winning in court times the probability of winning in court, suggests that compensations may not work effectively against the emergence of this type of deceptive behaviour in environments in which proving that information leakages have occurred is difficult to prove.

3.1.1 Related Literature

Sharing information, intangible knowledge assets, and learning from each other are critical aspects of value creation in strategic alliances (Hamel, 1991; Anand and

[2]The Trojan-Horse behaviour allegory –that we use here to refer to the opportunistic behaviour of the partnering firms, is not new in the literature. Hennart, Roehl, and Zietlow (1999) use it to depict the behaviour of Japanese firms entering into joint ventures with non-Japanese firms to learn about their partner just enough to later acquire the firms or dissolve them.

Khanna, 2000; Oxley and Sampson, 2004). However, during this process firms may suffer from unintentional revelation of confidential information to their partners due to the incomplete nature of formal procedures –such as legal contracts, to control which knowledge and information are shared and which are protected (Kumar, 2010; Gast, Gundolf, Harms, and Collado, 2019), unintended disclosure of small details about firms' private valuable information (Walter, Walter, and Müller, 2015), informal mechanisms of communication (Naesens, Pintelon, and Taillieu, 2007), or loose collaborative environments (Jiang, Li, Gao, Bao, and Jiang, 2013). As a result, these leakages of information may trigger opportunistic behaviours in which one of the parties in the alliance uses this information about their partners in a manner that was not agreed beforehand (e.g Kale, Singh, and Perlmutter, 2000; Luo, 2007; Li, Eden, Hitt, and Ireland, 2008; Walter, Walter, and Müller, 2015; Yang, Zheng, and Zaheer, 2015).[3] The subject of information leakage has been an active research topic in the supply chain management literature, where scholars have mainly discussed optimal information sharing strategies of the informed party under information leakage (Anand and Goyal, 2009; Fang and Ren, 2019; Wang, Zhen, and Yan, 2021), the

[3] In the context of knowledge appropriation, several authors (e.g. Katila, Rosenberger, and Eisenhardt, 2008; Diestre and Rajagopalan, 2012; Hallen, Katila, and Rosenberger, 2014) examine the tension that arises when firms in need of external resources face potential misapproppriation of their resources from other firms and label this tradeoff as 'swimming with sharks dilemma'. Likewise, the literature on coopetition –i.e., the simultaneous pursuit of cooperation and competition with the intent to create joint value (Bengtsson and Kock, 2000, p.411), refers to this tension as a 'double-edged sword', where coopetitive alliances can strengthen competitiveness at the risk of endangering firm's market performance (Veer, Yang, and Riepe, 2022). As a result, coopetitive partners must constantly be balancing the tension between knowledge appropriation and knowledge protection (Kale, Singh, and Perlmutter, 2000; Katila, Rosenberger, and Eisenhardt, 2008; Hallen, Katila, and Rosenberger, 2014; Laursen and Salter, 2014) and hence, thinking about ways to reduce the risk of knowledge misappropriation.

evaluation and mitigation of the risk of information leakage (Zhang, Cao, Wang, and Zeng, 2012; Kong, Rajagopalan, and Zhang, 2013), or the way in which information leakage affects supply chain relationships from a network perspective (Ried, Eckerd, Kaufmann, and Carter, 2021). Alternatively, the strategic information management and economic literature have mostly focused on the implications and consequences of information leakages in R&D alliances in which firms cooperate to obtain cost-reducing innovations (e.g. Choi, 1993; Kesteloot and Veugelers, 1995; d'Aspremont and Jacquemin, 1988; Kesteloot and Veugelers, 1997; Perez-Castrillo and Sandonis, 1997; Conti and Marini, 2019). The standard assumption in this literature is that information leakages translate into some informational spillover from R&D investments that manifests through some efficiency parameter, and which becomes the driving force behind the competitive interactions of the partnering firms. Thus, the less efficient firm *free-rides* on the more efficient one by exploiting the benefits of the R&D investments that the more efficient firm makes (e.g., Kesteloot and Veugelers, 1995; Petit and Tolwinski, 1999; Rosenkranz, 2001; Conti and Marini, 2019). We depart from this approach in at least two respects. First, we assume that value creation through cooperation and firms' abilities to appropriate from this commonly created value is unaffected by information about the production processes of the firms. Thus, in our model leakages of information act on firms' competitive behaviour indirectly through the change that they induce in the information structure under which the partnering firms compete. Second, we do not rely on firms' ability to absorb spillovers from other firms to link information leakages with the incentives to join a strategic alliance and the nature and intensity of the resulting competition. Instead, we conceptualise information leakage as a purely informational phenomenon with no direct effect on firms' payoffs, which allows us to isolate the effects of information on the interplay between collaboration and competition in alliances, an issue that has been underlooked in the literature (Cui, Yang, and Vertinsky, 2018; Hoffmann, Lavie, Reuer, and Shipilov, 2018).

Similar to Kesteloot and Veugelers (1997) and Petit and Tolwinski (1999), we also show that firms' asymmetries regarding production processes are relevant to determine whether an alliance is formed or not. Nonetheless, the reasons that explain why these differences matter when firms decide whether to form an alliance are different in the present case. In the above-cited works, the driving force is related to the existence of spillovers that make firms more symmetric in terms of production processes. Thus, less efficient firms in Kesteloot and Veugelers (1997) and Petit and Tolwinski (1999) can reduce their production costs in order to look more alike, which is what precludes cooperative partnerships from materialising due to the possibility of opportunistic behaviours. Instead, we show that asymmetries in production costs influence firms' decisions to enter into an interfirm collaboration because these decisions change the information structure under which firms ultimately compete. In this sense, our results show that firms can benefit from the simple revelation of confidential information even if they lack the ability to absorb knowledge from their partners. Our paper also relates to Conti and Marini (2019)'s work in which the authors study the consequences of uncertainty about some rival's characteristics on the firms' decisions to invest in R&D activities. They theoretically examine this problem using a three stage game with two competing firms where one of them has private information about its R&D productivity and the other one is uninformed about it. The authors show that uncertainty on the R&D productivity of the rival intensifies the under-investment in R&D activities and that this under-investment can be mitigated by letting firms commit to a certain level of R&D investment in the first stage. The intuition is that firms can use these commitments to screen their rivals' private information. However, for this screening mechanism to work – and hence, for informational asymmetries to play any role, it is necessary that some (sufficiently high) cost-reducing spillovers exist as otherwise uncertainty –which has to do with efficiency in R&D activities, has no channel to affect production cost and ultimately, firms' competitive behaviour in the product market. In contrast, we consider uncertainty about production costs (since we are not dealing with research-based alliances) and show that the incentives to form an alliance and the nature and intensity of competition depend on how likely is for firms to learn sensitive information about their partners rather than on the intensity (or even the existence) of spillovers.

The remainder of the paper is organised as follows. In Section 2, we outline the model. In Section 3, we present the theoretical analysis and derive the main results of this research. Section 5 concludes the paper. Proofs not included in the main text are presented in Appendix.

3.2 Model

There are two firms, firm 1 and firm 2, that compete in a market for a homogeneous good (the core market) in which they simultaneously choose quantities. This market is characterised by a linear demand function $P(Q) = 1 - Q$, where $Q = q_1 + q_2$ and q_j is the quantity produced by firm j, $j = 1, 2$.

Firm j's marginal cost of production is constant and equal to $c_j \in (0, 1)$. Firm 1's cost is common knowledge, whereas firm 2's is this firm's private information. Firm 2's cost can be either low (c_L) or high (c_H), with $c_L < c_1 < c_H$. The common knowledge prior probability that firm 2's cost is high is $\mu_0 \in (0, 1)$.

Firm 1 has developed a certain innovation that can lead to a new product, different from the one that firms currently produce. Nevertheless, firm 1 is unable to transform this innovation into a new product unless it has the collaboration of firm 2.[4] Let $t \in [\underline{t}, \overline{t}]$ subsume all relevant characteristics associated with firm 1's innovation (we may think of this as the quality of firm 1's innovation), and $\theta(t)$ denote the (reduced-form) net profit associated to the production and commercialisation of the

[4]This can be due to the lack of internal resources to scale up an innovation or financial constraints that prevent the firm to undertake the project on its own. Firms ally and put something on the table that the others lack to develop innovations (Hora, Gast, Kailer, Rey-Marti, and Mas-Tur, 2018) so that in our framework, firms must actively collaborate in order to exploit the profits of the innovation.

new product that obtains from exploiting firm 1's innovation. We assume that $\theta(\cdot)$ is common knowledge and that it is a strictly increasing function of t. Initially, firm 2 is unaware of the exact value of t (it is firm 1's private information) and it only knows that it follows a cumulative distribution function (cdf) $F(\cdot)$, with positive density $f(\cdot)$, and full support. Moreover, $\mathbb{E}[\theta(t)] = 0$. Occasionally, we refer to the parameter t and the cost c_τ, $\tau = L, H$, as firm 1's and firm 2's types respectively.

Firms have the opportunity to form a collaborative partnership (an alliance) that will allow them to produce and commercialise the product that obtains from firm 1's innovation. We model the alliance as a two-stage contract: the first stage –the *preliminary stage*, involves the bargaining over the gains of the partnership, whereas the second stage –the *implementation stage*, corresponds to the actual production and commercialisation of the new product. To capture the possibility that firms end the partnership before its term, we assume that the outcome of the preliminary stage –which is a sharing rule over the gains of the partnership, is subject to ratification (which firms simultaneously do) before the alliance can reach its implementation stage.[5]

As our aim in this paper is to discuss the implications of information leakage on strategic alliances –rather than examining the different contractual agreements that firms are capable of reaching, we assume that bargaining is conducted by some uninterested third party (a mediator) who does not know the types of the firms,

[5]Thus, in the current paper an alliance is a contract with ex-post quitting rights in which firms can terminate the collaboration at any point in time until the production and commercialisation of the new product take place (Compte and Jehiel, 2007).

and does not possess any private information itself. As Gerchak and Khmelnitsky (2019) show, in an environment like this the mediator chooses a 50-50 sharing rule, which is then the outcome that firms must ratify before the alliance can move on to its implementation stage.[6] However, the interaction and exchange of information that occur while the firms bargain over the gains of the partnership generates *involuntary* leakages of sensitive private information, i.e., leakages of information that cannot be prevented regardless of any protective measure that firms may adopt. To formally model these involuntary leakages of information, we assume that during the preliminary stage firms observe the realisation of a pair (s_1, s_2) of independent random signals such that (i) $s_1 = c_\tau$ with probability $q \in (0,1)$, where c_τ is firm 2's true cost, and with complementary probability $(1-q)$ the signal s_1 is independently drawn from a probability distribution that assigns probability μ_0 to $s_1 = c_H$ and probability $1-\mu_0$ to $s_1 = c_L$; and (ii) $s_2 = t$ with probability $p \in [0,1]$, and s_2 is i.i.d noise coming from the distribution $F(\cdot)$. Firms can distinguish which kind of signals they observe, that is, they know whether any specific signal contains the truth or not.[7] Signals are publicly observed and hence, the act of learning (or not)

[6]The mediator's problem when disagreement renders firm 1's innovation useless (which appears to be a reasonable assumption in the current case) can be written as the choice of a function $s(\tilde{\theta})$, where $\tilde{\theta} \in [\theta(\underline{t}), \theta(\bar{t})]$ is the realisation of a random variable with cdf $G(\tilde{\theta}) := F(\theta^{-1}(\tilde{\theta}))$, that solves,

$$\max_{s(\cdot)} \left\{ \int_{\theta(\underline{t})}^{\theta(\bar{t})} s(x)dG(x) \times \int_{\theta(\underline{t})}^{\theta(\bar{t})} [x - s(x)]dG(x) \right\}$$

From here it is fairly clear that $s(\theta) = \frac{s(\theta)}{2}$ must be a solution to the mediator's problem.

[7]Our focus is not on the refinement of signals; we are primarily concerned about how the learning affects the firms' incentives to form alliances.

each other's type becomes common knowledge in all subsequent stages of the game.[8]

The timing of the game is as follows. After learning their private information, firm 1 decides whether to invite firm 2 to form an alliance. If firm 2 accepts firm 1's invitation, the alliance is formed and firms enter into the preliminary stage in which they bargain over the gains of the partnership. The outcome of this bargaining process is a 50-50 sharing rule that firms must simultaneously ratify before the alliance reaches the implementation stage. During the bargaining process, firms may learn the private information of their competitors, and hence, the information structure under which firms ratify their participation in the alliance needs not to be the same as the one used to decide about the formation of the partnership. The alliance terminates if either firm chooses not to ratify in which case no action regarding the production of the new product is taken and no profit associated with the exploitation of firm 1's innovation is realised. Firms' ratification decisions become common knowledge in every subsequent stage. Also, firms compete in the core market regardless of whether the alliance terminates early or not. However, the profits associated with the exploitation of the new product, $\theta(t)$, realise only if both firms ratify the outcome of the bargaining process.

[8]This simplifies the analysis by preventing any issue regarding higher-order beliefs about the firms' types.

3.3 Analysis

Given the multistage and incomplete information nature of the game described in the previous section, we adopt Perfect Bayesian equilibrium (equilibrium henceforth) as our equilibrium concept.[9]

Consistent with sequential rationality, we begin with an analysis of the game stage in which firms simultaneously choose the quantities to produce in the core market. Recall that firms reach this stage even if they do not interact within some alliance, although this interaction may alter the information structure under which firms compete in the core market. Let $\mu \in [0, 1]$ denote some arbitrary belief about firm 2 having a high cost. Then, firm 1's problem becomes,

$$\max_{q_1 \geq 0} \{\mu[1 - c_1 - q_1 - q_2(H)]q_1 + (1 - \mu)[1 - c_1 - q_1 - q_2(L)]q_1\}$$

where $q_2(\tau)$ stands for the quantity chosen by the firm 2 with the τ-cost, $\tau \in \{L, H\}$. Likewise, the problem that firm 2 with the τ cost faces is,

$$\max_{q_2 \geq 0} \{(1 - c_\tau - q_1 - q_2(\tau))q_2(\tau)\}$$

Solving for the positive quantities $q_1(\mu)$ and $q_2(\tau)$, and replacing them into the

[9] An equilibrium is a collection of sequentially rational strategies that specify firm 1's decision to offer an alliance, the ratification decision, and the quantity to produce in the core market, and firm 2's decision to accept or reject firm 1's invitation to participate in the alliance, the ratification decision, and the quantity to produce in the primary market and a system of beliefs about firms' types derived according to Bayes' rule when possible.

firms' profit functions yields the standard results:[10]

$$\pi_1^*(\mu) := \frac{[1 + \mu c_H + (1-\mu)c_L - 2c_1]^2}{9} \tag{3.1}$$

$$\pi_2^*(\mu, \tau) := \frac{[2 - \mu c_H - (1-\mu)c_L + 2c_1 - 3c_\tau]^2}{36} \tag{3.2}$$

These two expressions correspond to the reduced-form profits that firms expect to earn in the core market when they compete under the belief that assigns probability μ to firm 2 having the high cost. The following remark is immediate.

Remark 1. *Let $\mu \in [0,1]$ denote the belief about firm 2 having the high cost. Then,*

(i) $\pi_1(0) \leq \pi_1(\mu) \leq \pi_1(1)$

(ii) $\pi_2(\mu, L) \leq \pi_2(0, L)$

(iii) $\pi_2(\mu, H) \geq \pi_2(1, H)$

where all three inequalities are strict whenever $\mu \in (0,1)$.

Remark 1 is standard and simply reflects the benefits of being the most efficient firm in the market whenever this condition becomes common knowledge among the firms. The opposite holds true for the firm with the highest cost: this firm benefits from uncertainty about its cost because this uncertainty softens competition in the product market.

[10]Unless otherwise stated, we assume that the non-negativity conditions associated with the quantities that firms 1 and 2 produce hold true throughout the paper.

3.3.1 Information leakages and strategic alliances

Firms ratify their participation in the alliance after observing the outcome of the preliminary stage, which may include knowledge about their competitors' private information. This observation is key because it suggests that firm 1 can benefit at no cost from offering any alliance –regardless of its profitability because quitting for this firm is a costless action. To avoid this, we explore the case in which the contract includes a clause that specifies the payment of some penalty $K > 0$ by firm 1 whenever this firm quits the alliance before the implementation stage. We can interpret this penalty as the cost that firm 1 expects to pay due to litigation, or the loss in reputation associated with what can be considered a misleading business practice.

Consider any continuation game following a history in which both firms learn each other types. In any such continuation game, competition takes place under complete knowledge of firms' costs and hence, firms' decisions to ratify (or quit) the alliance do not affect the information structure under which they compete in the product market. Hence, quitting whenever $\theta(t) < 0$, and ratifying whenever $\theta(t) \geq 0$ must be firm 2's optimal decision regardless of firm 1's. Given this behaviour, ratifying will be optimal for firm 1 whenever the following holds

$$\pi_1^*(\mu_\tau) + \max\left\{\frac{\theta(t)}{2}; 0\right\} > \pi_1^*(\mu_\tau) - K$$

where the left-hand side corresponds to the payoffs of ratifying while quitting payoffs are represented by the right-hand side, where $\mu_H = 1$ and $\mu_L = 0$, because firm 2 quits any alliance with $\theta(t) < 0$. Because firm 1 must pay a penalty in case of quitting, ratifying must be firm 1's optimal decision regardless of the value of K whenever it expects firm 2 to ratify alliances with $\theta(t) \geq 0$ and to quit alliances with $\theta(t) < 0$.

Next, we consider any continuation game that follows a history in which only firm 1 learns its competitor's type (i.e., firm 2 does not learn firm 1's type). In this case, firm 2's optimal decision depends on what this firm learned about firm 1's type after observing the firm's invitation. Suppose that firm 2 believes that only types of firm 1 above a certain threshold t_1 are willing to extend an invitation. With some abuse of notation, let $G(\theta|t_1)$ denote the distribution of $\theta(t)$ truncated on the left at $\theta(t_1)$. Then, conditional on accepting firm 1's invitation this firm's expected payoff from continuing in the alliance conditional on firm 1's type being at least t_1 is equal to the probability that it does not learn firm 1's type, $(1-p)$, times

$$(1 - F(\theta^{-1}(t_1))) \left(\frac{\int_{\theta_1}^{\overline{\theta}} \frac{\theta}{2} dG(\theta|t_1)}{1 - F(\theta^{-1}(t_1))} \right) = \int_{\theta_1}^{\overline{\theta}} \frac{\theta}{2} dG(\theta|t_1) \tag{3.3}$$

where $\theta_1 := \theta(t_1)$ and $\overline{\theta} = \theta(\overline{t})$. This integral is nonnegative regardless of the value of θ_1 (because the expectation of $\theta(\cdot)$ is zero) and hence, firm 2's optimal action must be to ratify its participation in the alliance after any history in which it does not learn firm 1's type.[11] Consequently, firm 1 is better off ratifying the alliance if

$$\pi_1^*(\mu_\tau) + \frac{\theta(t)}{2} \geq \pi_1^*(\mu_\tau) - K$$

which holds true whenever $\theta(t) \geq 0$ regardless of the value of K. If $\theta(t) < 0$, then firm 1 will be better off ratifying if $\frac{\theta(t)}{2} \leq K$, and quitting otherwise.

Lemma 5. *Firm 1 ratifying its participation in the alliance, and firm 2 ratifying its if $\theta(t) \geq 0$, and quitting if $\theta(t) < 0$, must be an equilibrium of any continuation game that follows a history in which both firms learn each other's types. Likewise, firm 1 ratifying its participation if $\frac{\theta(t)}{2} \geq -K$ and quitting otherwise, and firm 2 ratifying its must be an equilibrium of any continuation game in which only firm 1 learns its competitor's type.*

Using a similar logic, we examine firms' behaviour after any history in which firm 1 did not learn firm 2's type. Because firm 2's decision is type-dependent, this firm's choice has the potential to signal its private information. First, consider continuation games in which firm 2 learns firm 1's type. Let $\theta(t_2)$ be a threshold value such that,

[11] The integral is positive whenever $\theta_1 \geq 0$. Hence, let $\theta_1 < 0$. Then,

$$\begin{aligned}\int_{\theta_1}^{\overline{\theta}} \theta dG(\theta|t_1) &= \frac{1}{1-F(\theta_1)}\left[\int_{\theta_1}^{\overline{\theta}} \theta dF(\theta) + \int_{\underline{\theta}}^{\theta_1} \theta dF(\theta) - \int_{\underline{\theta}}^{\theta_1} \theta dF(\theta)\right] \\ &= \frac{1}{1-F(\theta_1)}\left[\int_{\underline{\theta}}^{\overline{\theta}} \theta dF(\theta) - \int_{\underline{\theta}}^{\theta_1} \theta dF(\theta)\right] \\ &= \frac{1}{1-F(\theta_1)}\left[-\int_{\underline{\theta}}^{\theta_1} \theta dF(\theta)\right]\end{aligned}$$

which is non negative because the values between $\underline{\theta}$ and θ_1 are negative and $f(\cdot) > 0$.

on path, both types of firm 2 are expected to ratify if $\theta(t) \geq \theta(t_2)$, and to quit if $\theta(t) < \theta(t_2)$. Take type τ of firm 2, $\tau \in \{L, H\}$. On path, this type expects a payoff equal to

$$\pi_2^*(\mu_0, \tau) + \frac{\theta(t)}{2}$$

because firm 1 remains unaware of firm 2's type when competing in the product market. Alternatively, this type's expected payoff, if it chooses to quit, depends on firm 1's belief about firm 2's type upon observing this off-path action. Let $\tilde{\mu}$ denote the probability that firm 1 assigns to firm 2 having the high cost upon observing quitting. Then, the expected payoff of type τ of firm 2 becomes $\pi_2^*(\tilde{\mu}, \tau)$. Suppose further that $\tilde{\mu} > \mu_0$. Then $\pi_2^*(\tilde{\mu}, \tau) < \pi_2^*(\mu_0, \tau)$ and,

$$\pi_2^*(\tilde{\mu}, L) - \pi_2^*(\mu_0, L) < \pi_2^*(\tilde{\mu}, H) - \pi_2^*(\mu_0, H) < 0$$

Let $\theta(t_H) = 2[\pi_2^*(\tilde{\mu}, H) - \pi_2^*(\mu_0, H)]$, and $\theta(t_L) = 2[\pi_2^*(\tilde{\mu}, L) - \pi_2^*(\mu_0, L)]$. It is fairly clear that $\theta(t_L) < \theta(t_H) < 0$ and hence, both types of firm 2 must be willing to ratify if $\theta(t) > \theta(t_H)$ because quitting becomes equilibrium dominated in this case, and they must be willing to quit if $\theta(t) < \theta(t_L)$. However, if $\theta(t) \in (\theta(t_L), \theta(t_H))$ then,

$$\pi_2^*(\mu_0, L) + \frac{\theta(t)}{2} > \pi_2^*(\tilde{\mu}, L)$$

and,

$$\pi_2^*(\mu_0, H) + \frac{\theta(t)}{2} < \pi_2^*(\tilde{\mu}, H)$$

and different types are willing to take different actions, which is inconsistent with an equilibrium in which firm 2's ratification decision is characterised by a single threshold $\theta(t_2)$ such that both types of firm 2 ratify if $\theta(t) \geq \theta(t_2)$, and quit if $\theta(t) < \theta(t_2)$. We can apply a similar argument to rule out equilibria characterised by a single cutoff if firm 1's off-path belief is such that $\tilde{\mu} < \mu_0$. Consequently, $\tilde{\mu} = \mu_0$ must be the unique off-path belief consistent with an equilibrium in which firm 2's behaviour regarding ratification can be characterised by a single threshold $\theta(t_2)$ – which in this case is equal to zero, such that both types ratify if $\theta(t) \geq \theta(t_2) = 0$ and quit otherwise. This implies a payoff equal to

$$\pi_1^*(\mu_0) + \max\left\{\frac{\theta(t)}{2}; 0\right\}$$

if firm 1 also ratifies, and a payoff equal to $\pi_1^*(\mu_0) - K$ if firm 1 quits. From here, it follows that firm 1 finds optimal to ratify its participation in the alliance in response to both types of firm 2 ratifying when $\theta(t) \geq 0$ and quitting when $\theta(t) < 0$, regardless of the value of K. The following lemma is immediate.[12]

Lemma 6. *Let firm 1's belief about firm 2's type be equal to* μ_0 *regardless of whether*

[12] There are also cases in which firm 2's ratification decision may signal this firm's private information. However, this behaviour only occurs for certain combinations of parameters, and off-path belief specifications. See the Appendix for a formal analysis of this point.

firm 2 continues or quits the alliance. Then, firm 1 ratifying its participation in the alliance, and both types of firm 2 ratifying its if $\theta(t) \geq 0$ and quitting if $\theta(t) < 0$ must be an equilibrium of the continuation game that follows a history in which firm 1 does not learn firm 1's type and firm 2 learns firm 1's.

The consequences of lemmas 5 and 6 are summarised in the following corollary which provides a characterisation of the equilibrium in continuation games in which neither seller learns its competitor's type.

Corollary 3. *Any continuation game that follows a history in which neither firm learns its competitor's type has an equilibrium in which both types of firm 2 ratify their participation in the alliance, and firm 1 ratifies it when $\theta(t) \geq -2K$, and quits the alliance when $\theta(t) < -2K$. This equilibrium can be sustained using passive off-path beliefs according to which firm 1 assigns probability μ_0 to the high type of firm 2 whenever it observes quitting.*

Proof. Suppose that firm 1 is expected to ratify whenever $\theta(t) \geq -2K$, and quit otherwise. Take type τ of firm 2, and let $\theta_1 := \theta(t_1)$ represent the lowest type of firm 1 willing to extend an invitation to firm 2 to participate in some alliance. Type τ's expected payoff if it behaves according to the putative equilibrium is

$$\pi_2^*(\mu_0, \tau) + \int_{\max\{\theta_1; -2K\}}^{\bar{\theta}} \frac{\theta}{2} dG(\theta|t_1)$$

where θ_1 is the lowest type willing to extend an invitation to participate in an alliance. Alternatively, deviating to quitting yields this type an expected payoff equal to $\pi_2^*(\mu_0, \tau)$ because firm 1 assigns probability μ_0 to type H of firm 2 whenever it observes quitting. Because the integral term is nonnegative, then ratifying must be type τ's optimal action to firm 1's decision to ratify when $\theta(t) \geq -2K$ and quit otherwise. To see that firm 1's actions are optimal given firm 2's behaviour, observe that ratifying yields firm 1 a payoff of

$$\pi_1^*(\mu_0) + \frac{\theta(t)}{2}$$

whereas quitting yields a payoff of $\pi_1^*(\mu_0) - K$. □

The characterisation of the optimal behaviour of firms at the end of the preliminary stage allows us to focus on the reduced-form game in which firm 1 decides whether to invite firm 2 to participate in the alliance, and firm 2 chooses whether to accept or reject any such invitation. In what follows, we construct a (putative) equilibrium in which both types of firm 2 are expected to accept on path any invitation that firm 1 extends. As already mentioned, the mere act of inviting firm 2 to collaborate in the alliance may signal some relevant information about firm 1's type. Let t_1 be the lowest type of firm 1 willing to extend an invitation to firm 2. On path, firm 2 updates its belief about the profitability of the alliance according to Bayes' rule such that $G(\theta|t_1)$ describes firm 2's belief about firm 1's type, with $\theta_j := \theta(t_j)$, $j = 1, 2$, $\underline{\theta} := \theta(\underline{t})$, and $\overline{\theta} := \theta(\overline{t})$.[13] The payoff a firm τ expects to earn if it accepts

[13] Of course, firm 2 also updates its belief whenever it is not invited to participate in the alliance.

firm 1's invitation is,

$$\Pi_2^*(q|\tau, t_1) =$$

$$q\pi_2^*(\mu_\tau, \tau) + (1-q)\pi_2^*(\mu_0, \tau) +$$

$$\underbrace{p\left[q\int_0^{\overline{\theta}} \frac{\theta}{2} dG(\theta|t_1) + (1-q)\int_{\max\{\theta(t_1);0\}}^{\overline{\theta}} \frac{\theta}{2} dG(\theta|t_1)\right] + (1-p)\int_{\max\{\theta(t_1);-2K\}}^{\overline{\theta}} \frac{\theta}{2} dG(\theta|t_1)}_{\mathbb{E}_G(\theta|t_1)} \tag{3.4}$$

where $\mu_L = 0$ and $\mu_H = 1$. The first line captures firm 2's expected payoff in the product market as a result of the occurrence of information leakages, whereas the second line captures the expected payoff from the implementation of the alliance (which we label as $\mathbb{E}_G(\theta|t_1)$ for future reference) taking into account the ratification decisions of the firms characterised in lemmas 5, 6 and corollary 3, and the fact that firm 2 believes that $\theta(t)$ must be at least equal to $\theta(t_1)$.

In the putative equilibrium we are constructing, rejecting firm 1's invitation is an off-path action. Therefore, the payoff that type τ of firm 2 expects to earn depends on firm 1's off-path belief about firm 2's type after observing rejection. Intuition suggests that this off-path belief may depend on the value of q because it is the possibility that firm 1 learns about firm 2's private information which alters the information structure in the product market. However, some algebra shows that

$$\pi_2^*(1, H) - \Pi_2^*(q|H, t_1) > \pi_2^*(1, L) - \Pi_2^*(q|L, t_1)$$

However, this updated belief is unimportant because no alliance is ever formed.

and therefore, rejecting firm 1's invitation becomes more attractive for the firm 2 with the high cost whenever firm 1 believes that rejection comes from this type. Moreover, (i) $\pi_2^*(1, H) - \Pi_2^*(0|H, t_1) > \pi_2^*(1, L) - \Pi_2^*(0|L, t_1)$; and (ii) the gain from deviating toward rejecting firm 1's invitation increases (decreases) for the high (low) type of firm 2 the higher the value of q. Consequently, rejecting when firm 1 expects acceptance of its invitation must be more attractive for firm 2 with the high cost regardless of the value of q, and this putative (pooling) equilibrium must survive (Cho and Sobel, 1990)'s intuitive criterion, regardless of the value of q, $q \in (0, 1)$. Moreover, because $\Pi_2^*(q|H, t_1) \geq \pi_2^*(1, H)$ implies $\Pi_2^*(q|L, t_1) \geq \pi_2^*(1, L)$, then it suffices that firm 2 with the high cost accepts firm 1's invitation for the firm 2 with the low cost to be willing to do so as well.

A firm 1 with type t that extends an invitation to form an alliance expects a payoff equal to,

$$\Pi_1(q|t) =$$
$$q[\mu_0\pi_1^*(1) + (1 - \mu_0)\pi_1^*(0)] + (1 - q)\pi_1^*(\mu_0) + p \max\left\{0; \frac{\theta(t)}{2}\right\} + (1 - p) \max\left\{-K; \frac{\theta(t)}{2}\right\}$$

because regardless of its type, firm 2 quits any unprofitable alliance with probability p (which is the probability with which it learns firm 1's type), and firm 1 quits any alliance whose profit is less than the penalty K. Momentarily assume that $-K < \frac{\theta(t)}{2}$ such that firm 1 always prefers to continue in instead of quitting from the alliance.

Define $\Gamma(q|\mu_0, t)$ by

$$\Gamma(q|\mu_0, t) = \Pi_1(q|t) - \pi_1^*(\mu_0)$$

and such that type t of firm 1 offers an alliance whenever $\Gamma(q|\mu_0, t) \geq 0$, and it refrains from doing so otherwise. Because $\pi_1^*(\cdot)$ is a convex function of μ_0, $\Gamma(q|\mu_0, t) > 0$ if $\theta(t) \geq 0$. Nonetheless, continuity of this mapping implies the existence of some threshold value $\theta(t_1) < 0$ defined by

$$\theta(t_1) = -\frac{2q(1-\mu_0)\mu_0(c_L - c_H)^2}{9(1-p)}$$

such that $\Gamma(q|\mu_0, t) \geq 0$ if $\theta(t) \geq \theta(t_1)$, and $\Gamma(q|\mu_0, t) < 0$ if $\theta(t) < \theta(t_1)$. This threshold characterises the highest amount of money that firm 1 is willing to lose in order to face the chance of learning firm 2's private information.

Observe that $\pi_2^*(\mu_0, H) > \pi_2^*(1, H)$ and $\mathbb{E}_G(\theta|t_1) \geq 0$ (with t_1 implicitly defined by $\theta(t_1)$ above) and hence,

$$\Pi_2^*(q|\theta_1) - \pi_2^*(1, H) = (1-q)[\pi_2^*(\mu_0, H) - \pi_2^*(1, H)] + \mathbb{E}_G(\theta|t_1) > 0$$

Therefore, on path both types of firm 2 are indeed willing to accept any invitation that firm 1 extends.

Proposition 3. *For all $q > 0$, and $p \neq 1$, there exists an equilibrium in which:*

1. *Firm 1 invites firm 2 to form an alliance whenever $t \geq t_1$, where t_1 is implicitly*

defined by

$$q[\mu_0\pi_1^*(1) + (1-\mu_0)\pi_1^*(0) - \pi_1^*(\mu_0)] + (1-p)\frac{\theta(t_1)}{2} = 0$$

Types of firm 1 for which $\theta(t) < \theta(t_1) < 0$ refrain from extending any invitation to firm 2.

2. *Firm 1 assigns probability μ_0 to type H of firm 2 upon observing acceptance of its invitation to form an alliance and probability one to this type upon observing rejection of it. Thus, by accepting firm 1's invitation firm 2 does not signal any of its private information.*

3. *On path, alliances with strictly negative profits are implemented with probability one whenever firm 1 is the only firm that learns the competitor's type, and $\frac{\theta(t)}{2} \geq -K$. In all other cases, only alliances that yield strictly positive profits are implemented.*

Proposition 3 is interesting because it shows that not only inviting a competitor to participate in an alliance that yields strictly negative profits is an event that occurs with positive probability in equilibrium but also some of these alliances go through the implementation stage. Intuitively, this occurs because the gains that firm 1 expects as a result of the more favourable competitive position in the product market outweigh, in expected terms, the costs of losing money due to the possibility of implementing an unprofitable alliance. How much money firm 1 is willing to lose increases not only with the probability of learning firm 2's private information –which suggests that $\theta(t_1)$ can be considered as an estimate of how much firm 1 *values* firm 2's private information, but also with the probability that firm 2 learns firm 1's. Intuitively, firm 1's cost of learning firm 2's private information falls with the value of p because the higher the probability that firm 2 learns that it is immersed in an unprofitable deal, the more likely is that this firm quits the agreement and hence, the less likely is that the losses associated to the alliance are realised.

3.3.2 Trojan-horse behaviour and compensation for damages

According to proposition 3, there are alliances whose purpose appears to be the access and appropriation of competitors' private information rather than the exploitation of a genuine business opportunity. These *deceptive alliances* or Trojan-Horse behaviour, causes in most cases, a deterioration of firm 2's competitive position in the product market, which manifests in the form of reduced profits. In this section, we examine environments in which this kind of misconduct not only arises but also triggers legal disputes in which firm 2 goes to court in search of some compensation that helps mitigate the (alleged) damages.

As the first step, we define what we understand as a deceptive alliance.

Definition 1. *An alliance is said to be deceptive if the following two conditions simultaneously hold: (i)* $\theta(t) < 0$*; and (ii) firm 2's profits in the product market* *fall as a result of its participation in the alliance relative to the profits that this firm would have earned in the absence of any alliance.*

Several comments are in order here. First, genuinely profitable business opportunities are not considered to be deceptive even if they cause a fall in firm 2's profits in the product market. The intuition here is that cases against firm 1 would not hold in court because firm 1 can argue that the invitation was made in good faith (after all, the alliance is a profitable business opportunity) and under complete ignorance about firm 2's type. Second, because damages to firm 2's competitive position can only be evaluated after competition in the product market takes place, the definition of a deceptive alliance must be given in ex-post rather than ex-ante terms. Third, an alliance cannot be considered deceptive if firm 1 does not learn firm 2's private information at the end of the preliminary stage. The reason is that firm 2's profits in the product market should not be affected by its participation in the alliance if firm 1 must compete under incomplete information about firm 2's cost. Fourth, the definition of deceptive alliances estimates the harm to firm 2's competitive position using the profits that firm 2 would have earned in the absence of any alliance. We consider this to be an adequate benchmark because the profits that firm 2 would have obtained if it had rejected firm 1's invitation depends on firm 1's (off-path) belief about firm 2's type, which is an equilibrium object.

To account for the consequences associated with the legal disputes that deceptive alliances are likely to trigger, we adopt a reduced-form approach in which firm 2's participation in a deceptive alliance triggers a legal process in which the court finds out the true value of t (and hence, of $\theta(t)$) with probability $\alpha_1 \in (0, 1)$ if firm 1 quits the alliance before the end of its term, and with probability $\alpha_2 \in (0, 1)$ if the firm continues in the alliances until the end of it, where $\alpha_1 \geq \alpha_2$. That is, we assume that firm 1 is no longer bounded by a legal clause that mandates the payment of some penalty in case of early termination of the alliance but instead by a legal process in which firm 1 pays some positive amount $\kappa > 0$ to firm 2 only in the event that the alliance is deceptive. Likewise, the assumption about α_1 being greater than α_2 is motivated by the previous idea that a guilty firm 1 (i.e., a firm 1 that offers a deceptive alliance) has stronger incentives to quit a deceptive alliance when quitting is costless. As a result, quitting should be interpreted as suggestive of firm 1's deceptive behaviour and hence, subject to legal investigation.[14] In what follows, we let $P_1 = \alpha_1 \kappa$ denote the expected compensation that firm 1 pays to firm 2 whenever it offers a deceptive alliance from which it quits, and $P_2 = \alpha_2 \kappa$ the expected compensation that this firm pays if it offers a deceptive alliance from which it never quits.

Define $\theta(L)$ by,

$$\theta(t_L) = 2[\pi_2^*(\mu_0, L) - \pi_2^*(0, L)] \tag{3.5}$$

[14]Moreover, observe that in the current setup there is no motive other than accessing its competitor's technological know-how would that can explain firm 1's decision to form an alliance from which it pulls off before reaching its term.

with $\theta_H = 0$. Then, $\theta(t_L) < 0$ because $\pi_2^*(1, H) < \pi_2^*(\mu_0, H)$ and $\pi_2^*(0, L) > \pi_2^*(\mu_0, L)$, which implies that an alliance is deceptive for type L if the associated profits are sufficiently negative.

Consider a continuation game that follows a history in which both firms learn each other types. For type τ of firm 2, continuing in the alliance yields a payoff equal to

$$\pi_2^*(\mu_\tau, \tau) + \frac{\theta(t)}{2} + \mathbb{I}_{[\theta(t)<\theta_\tau]} P_2$$

if firm 1 also decides to continue, and a payoff equal to $\pi_2^*(\mu_\tau, \tau) + \mathbb{I}_{[\theta(t)<\theta_\tau]} P_1$ if firm 1 quits the alliance, where $\mu_\tau = 1$ if $\tau = H$, $\mu_\tau = 0$ if $\tau = L$, $\tau = L, H$, and $\mathbb{I}_{[\cdot]}$ is an indicator function. In contrast, quitting the alliance yields this type of firm 2 a payoff equal to $\pi_2^*(\mu_\tau, \tau)$ plus P_1 if firm 1 decides to continue and the alliance is deceptive, or P_2 if the firm chooses to quit (and the alliance is deceptive). The following figure summarises type τ's payoffs.

		Firm 2	
		Continuing	Quitting
Firm 1	Continuing	$\pi_2^*(\mu_\tau, \tau) + \frac{\theta(t)}{2} + \mathbb{I}_{[\theta(t)<\theta_\tau]} P_2$	$\pi_2^*(\mu_\tau, \tau) + \mathbb{I}_{[\theta(t)<\theta_\tau]} P_2$
	Quitting	$\pi_2^*(\mu_\tau, \tau) + \mathbb{I}_{[\theta(t)<\theta_\tau]} P_1$	$\pi_2^*(\mu_\tau, \tau) + \mathbb{I}_{[\theta(t)<\theta_\tau]} P_1$

Figure 3.1: Type τ' payoffs

As it is fairly clear from the figure, type τ of firm 2 is weakly better off quitting the alliance when $\theta(t) < 0$ (continuing involves a chance to lose half the value of $\theta(t)$ in case of a deceptive alliance), and continuing when $\theta(t) \geq 0$. Given this, firm 1 expects a payoff equal to $\pi_1^*(\tau)$ minus $\mathbb{I}_{[\theta(t)<\theta_\tau]}P_2$ if it decides to continue, or $\mathbb{I}_{[\theta(t)<\theta_\tau]}P_1$ if it chooses to quit. Because $P_1 \geq P_2$ then, firm 1's optimal action in response to firm 2 quitting is to continue regardless of the value of $\theta(t)$.

Next, consider a continuation game that follows a history in which firm 1 learns firm 2's type and firm 2 remains unaware of firm 1's. Suppose that type τ of firm 2 expects firm 1 to continue in the alliance whenever $\theta(t)$ is greater than some $\theta_1 := \theta(t_1)$. Let $G(\cdot|\theta_1)$ denote the distribution of θ conditional on being greater than θ_1. Then, continuing in the alliance yields to this type of firm 2 an expected payoff equal to

$$\pi_2^*(\mu_\tau, \tau) + \int_{\theta_1}^{\overline{\theta}} \frac{\theta}{2} dG(\theta|t_1) + G(\theta_\tau|t_1)P_2$$

because firm 2 receives compensation P_2 only in the event that $\theta(t) < \theta_\tau$, $\tau = L, H$. Alternatively, quitting the alliance yields an expected payoff of

$$\pi_2^*(\mu_\tau, \tau) + G(\theta_\tau|t_1)P_2$$

Because the integral in the former expression is nonnegative, firm 2 must find optimal to continue in the alliance whenever it expects firm 1 to continue if $\theta(t) \geq \theta_1$. As for firm 1, continuing in the alliance when it expects both types of firm 2 to continue yields a payoff equal to

$$\pi_1^*(\tau) + \frac{\theta(t)}{2} - \mathbb{I}_{[\theta(t)<\theta_\tau]}P_2$$

whereas quitting yields a payoff equal to

$$\pi_1^*(\tau) - \mathbb{I}_{[\theta(t)<\theta_\tau]} P_1$$

It is fairly clear that continuing in the alliance if $\theta(t) \geq 0$ is the optimal response for firm 1. For the case in which $\theta(t) < 0$, firm 1 prefers to continue in the alliance if

$$\theta(t) \geq \theta_\alpha := -2\kappa[\alpha_1 - \alpha_2] \tag{3.6}$$

Expression (3.6) formalises the intuition about firm 1 implementing deceptive alliances in cases in which losses are less than the payment that firm 1 is expected to make if it quits the agreement before its term. Interestingly, the higher the probability with which a court of law rules in favour of firm 2 after observing the early termination of the agreement, the more likely is to observe the implementation of economically unprofitable ventures.

Lemma 7. *Firm 1 continuing for any value of $\theta(t)$ and firm 2 quitting if $\theta(t) < 0$ and continuing if $\theta(t) \geq 0$ is an equilibrium of any continuation game in which both firms learn each other's type. Likewise, firm 1 continuing if $\theta(t) \geq \theta_\alpha$, and quitting if $\theta(t) < \theta_\alpha$, where θ_α is defined in expression* (3.6)*, and firm 2 continuing in the alliance is an equilibrium of any continuation game in which firm 1 learns firm 2's type and firm 2 remains unaware of firm 1's.*

Equilibria of continuation games that originate after histories in which either firm

2 is the only firm that learns the competitor's type or no firm learns its competitor's private information can be characterised along the lines of lemma 6 because alliances in which firm 1 remains unaware of firm 2's are not considered to be deceptive. In particular, continuation games in which only firm 2 learns firm 1's type have an equilibrium in which firm 1 ratifies its participation in the alliance and both types of firm 2 ratify theirs if $\theta(t) \geq 0$, and quit the alliance if $\theta(t) < 0$. Likewise, continuation games in which no firm learns its competitor's type have an equilibrium in which both types of firm 2 ratify their participation in the alliance, and firm 1 ratifies its if $\theta(t) \geq 0$, and quits if $\theta(t) < 0$ (because, in the current setup, $K = 0$).

Similar to the analysis in the preceding section, consider a putative equilibrium in which both types of firm 2 accept firm 1's invitation with probability one. The payoff that type τ of firm 2 expects to receive when it accepts firm 1's invitation can be written as follows:

$$\Pi_2^*(q|\tau, \tilde{t}_1) = q\pi_2^*(\mu_\tau, \tau) + (1-q)\pi_2^*(\mu_0, \tau) +$$

$$q\left[p\int_0^{\bar{\theta}} \frac{\theta}{2} dG(\theta|\tilde{t}_1) + (1-p)\int_{\max\{\theta_1, \theta_\alpha\}}^{\bar{\theta}} \frac{\theta}{2} dG(\theta|\tilde{t}_1)\right] + (1-q)\int_{\max\{\theta_1;0\}}^{\bar{\theta}} \frac{\theta}{2} dG(\theta|\tilde{t}_1) +$$

$$q\left[pG(\theta_\tau|\tilde{t}_1)P_2 + (1-p)\left(G(\theta_\tau|\tilde{t}_1)G(\theta_\alpha|\tilde{t}_1)P_1 + G(\theta_\tau|\tilde{t}_1)(1-G(\theta_\alpha|\tilde{t}_1))P_2\right)\right]$$

where $\tilde{t}_1$ is the lowest type of firm 1 willing to invite firm 2 to participate in an alliance, $\theta_1 := \theta(t_1)$, θ_L is given by expression (3.5), $\theta_H = 0$, and θ_α is given by (3.6). The two novelties with respect to expression (3.4) are the inclusion of θ_α in the computation of the expected profit in those cases in which firm 1 is the only firm learning the competitor's type, and the inclusion of the expected compensations that firm 2 receives every time firm 1 offers a deceptive alliance. Note that the amount of this (expected) compensation depends on whether firm 1 quits the alliance (which occurs when $\theta(t)$ turns out to be lower than θ_α) or it continues in it (which occurs if $\theta(t)$ is greater than θ_α). Firm 2 expects no compensation in any continuation game in which firm 1 does not learn firm 2's type.

As before, rejecting firm 1's offer is an off-path action. Applying a similar argument as that of the preceding section, we let firm 1 assign probability one to the type H of firm 2 whenever it observes rejection such that $\Pi_2^*(q|H, t_1) \geq \pi_2^*(1, H)$ suffices to guarantee that both types of firm 2 are willing to accept firm 1's invitation.

Next, consider the optimal decision of firm 1. By extending an invitation, firm 1 expects a payoff equal to,

$$\begin{gathered}\Pi_1(q|t) = \\ q[\mu_0\pi_1^*(1) + (1-\mu_0)\pi_1^*(0)] + (1-q)\pi_1^*(\mu_0) + p\max\left\{0; \frac{\theta(t)}{2}\right\} + (1-p)\mathbb{I}_{[\theta(t)\geq\theta_\alpha]}\frac{\theta(t)}{2} \\ -q\left[\mu_0\mathbb{I}_{[\theta(t)<0]} + (1-\mu_0)\mathbb{I}_{[\theta(t)<\theta_L]}\right]P_2 - q(1-p)\mathbb{I}_{[\theta(t)<\theta_\alpha]}P_1\end{gathered} \tag{3.7}$$

The first two terms in the first line of expression (3.7) capture the payoff that firm 1 expects to earn when competing in the product market. The remaining terms describe the expected profits accruing from the implementation of the alliance. Note that only profitable alliances are implemented conditional on firm 2 learning firm 1's type, whereas unprofitable alliances can be implemented if $\theta(t)$ is not too low to deter firm 1 from quitting. The final line corresponds to the expected compensation that firm 1 must pay to firm 2 in case of offering a deceptive alliance.

Let $\alpha_1 > \alpha_2$ (such that $\theta_\alpha < 0$) and momentarily suppose that firm 1 offers an alliance with slightly negative economic value $\theta(t)$ such that $\max\{\theta_\alpha, \theta_L\} < \theta(t) < 0$. Firm 1's expected payoff becomes:

$$\Pi_1(q|t) = q[\mu_0 \pi_1^*(1) + (1-\mu_0)\pi_1^*(0)] + (1-q)\pi_1^*(\mu_0) + (1-p)\frac{\theta(t)}{2} - q\mu_0 P_2$$

By not offering any alliance, firm 1 expects a payoff equal to $\pi_1^*(\mu_0)$. Hence, firm 1 will find it profitable to offer this alliance when $\Pi_1(q|t) \geq \pi_1^*(\mu_0)$, which is equivalent to

$$(1-p)\frac{\theta(t)}{2} + q\mu_0 \left[\frac{(1-\mu_0)(c_L - c_H)^2}{9} - P_2\right] \geq 0 \tag{3.8}$$

It is fairly clear that $\theta(t) < 0$ requires the term in square brackets to be positive for expression (3.8) to hold. That is, if firm 1 finds it attractive to offer a deceptive alliance then it must be true that it is very unlikely that this firm loses in court or, conditional on losing, the amount that firm 1 has to pay as compensation is low (or both).

Let κ_1 be defined as follows,

$$\kappa < \kappa_1 := \frac{(1-\mu_0)(c_L - c_H)^2}{9\alpha_2} \tag{3.9}$$

The following proposition summarises our discussion so far.

Proposition 4. *If $\kappa < \kappa_1$ then there exists an equilibrium in which firm 1 invites form 2 to form an alliance whenever $\theta(t) \geq \theta(\tilde{t}_1)$, where $\theta(\tilde{t}_1) < 0$ is given by*

$$\theta(\tilde{t}_1) = -\frac{2q\mu_0}{1-p}\left[\frac{(1-\mu_0)(c_L - c_H)^2}{9} - \alpha_2\kappa\right]$$

whereas types for which $\theta(t) < \theta(\tilde{t}_1)$ refrain from extending any invitation. Beliefs on and off path are those described in Proposition 3.

Similarly to proposition 3, we are able to characterise conditions under which deceptive behaviour arises, and which are dependent on the possibility extract individual private rents through the exploitation of private information. Specifically, we show that this deceptive behaviour emerges even if the firm incurring such practices is forced to pay a compensatory amount to the negatively affected firm, which suggests that these types of legal measures might not be effective to inhibit these types of deceptive behaviours.

3.4 Conclusions and final remarks

In this paper, we theoretically investigate the implications of information leakage on both the firms' incentives to join strategic alliances and the nature and intensity of competition in the product market in which the partnering firms compete. Our analysis is conducted within a game-theoretic framework in which two competing firms must collaborate in order to generate common profits from a business opportunity not necessarily related to their core activities. We derive conditions under which it is optimal for the focal firm to devise unprofitable alliances to have the chance to learn sensitive private information and thus, to improve their competitive position in the product market. Our findings do not depend on the existence of a cost-reducing parameter, as has been customary in the literature. Thus, our findings support the idea that firms without the adequate capacity to absorb knowledge from their partners can still benefit from the simple observation of confidential information about their competitors.

We also examine the case in which a negatively affected firm can pursue some type of compensation for the (alleged) damage that its partner's deceptive behaviour may have caused. We show that the incentives to devise alliances for the unique purpose of gaining access to the partner's sensitive private information persist for some range of compensation values. This, however, must be interpreted within a context in which compensations are actually paid conditional on winning in court. Therefore, imposing fines (or compensations) to deter this type of deceptive practice may not be effective in environments in which proving that information leakage has occurred is difficult to prove.

Our theoretical analysis helps uncover an interesting mechanism through which information leakage affects firms' incentives to participate in a strategic alliance. In our model, learning sensitive information about a competitor alters the information structure under which partners compete, which in turn affects the private rents that firms expect to earn when collaborating. Thus, it is neither the firms' capacity to create value from cooperation nor their ability to appropriate from these common profits what determines firms' incentives to join a strategic alliance. Instead, information leakage can alter the information structure under which firms compete in the product market which determines the interplay between collaboration and competition and hence, the decision to pursue a strategic alliance. This is in line with recent research suggesting that the decision to collaborate must depend on the intensity of market competition (Chen, Luo, and Wang, 2019).

Our analysis also offers a game-theoretic approximation to the Trojan-Horse behaviour described in Lavie (2006). In line with this author's analysis, we show that deceptive alliances originate from the change in firms' abilities to generate higher private rents that involve no synergetic value creation (Lavie, 2006, p.647). Finally, our theoretical model highlights the informational channel, which provides a better understanding of the market consequences of this tension in alliances that do not necessarily involve innovation activities.

3.5 Appendix

Equilibria in which firm 2's ratification signals its private information

Because the payoff that the firms expect to earn if the alliance is ratified increases monotonically with t (through $\theta(t)$), there must exist some (sufficiently high) value of t such that both types of firm 2 are willing to ratify regardless of firm 1's belief. Furthermore, as $\pi_2^*(\mu, \tau)$ is decreasing with respect to μ, this value must be implicitly given by,

$$\pi_2^*(1, L) + \frac{\theta(t_L)}{2} = \pi_2^*(0, L)$$

It is fairly clear that for $t \geq t_L$,

$$\pi_2^*(\mu_0, \tau) + \frac{\theta(t)}{2} \geq \max_{\tilde{\mu} \in [0,1]} \pi_2^*(\tilde{\mu}, \tau)$$

$\tau = L, H$ and hence, both types of firm 2 are indeed willing to ratify their participation in the alliance provided that $\theta(t) > \theta(t_L)$. Next, take any t such that $\theta(t) \in [\theta(t_H), \theta(t_L)]$, where

$$\theta(t_H) = 2[\pi_2^*(0, H) - \pi_2^*(1, H)]$$

If firm 1 expects the firm 2 with the high cost to ratify and the firm with the low cost to quit, then

$$\pi_2^*(1, H) + \frac{\theta(t)}{2} \geq \pi_2^*(0, H)$$

and

$$\pi_2^*(1, L) + \frac{\theta(t)}{2} < \pi_2^*(0, L)$$

which holds true by construction. Next, consider any t such that $\theta(t_H) - \theta(t) = \varepsilon$, with $\varepsilon > 0$ but small such that $\theta(t) > 0$. There are three possible cases: (i) firm 2 with the low cost ratifies and the firm 2 with the high cost quits; (ii) both types quit; and (iii) both types ratify. Case (i) implies

$$\pi_2^*(0, H) + \frac{\theta(t)}{2} < \pi_2^*(1, H)$$

which requires $\theta(t) < 0$, a contradiction. Case (ii) implies that $\pi_2^*(\mu_0, \tau)$, $\tau = L, H$, must be higher than the payoff that type τ expects to earn by ratifying. Because in this case ratifying is an off-path action, let $\tilde{\mu}$ be the probability that firm 1 assigns the firm 2 with the high cost upon observing ratification. Then,

$$\pi_2^*(\tilde{\mu}, \tau) + \frac{\theta(t)}{2} \leq \pi_2^*(\mu_0, \tau) \tag{3.10}$$

and $\theta(t) \leq 2[\pi_2^*(\mu_0, \tau) - \pi_2^*(\tilde{\mu}, \tau)]$. Because $\pi_2^*(\cdot, \tau)$ is decreasing with respect to its first argument, $\theta(t) \leq 0$ whenever $\tilde{\mu} \leq \mu_0$, and condition (3.10) cannot hold for ε small. Hence, suppose that $\tilde{\mu} > \mu_0$. Letting $\tau = H$, condition (3.10) implies

$$\theta(t) \leq 2[\pi_2^*(\mu_0, H) - \pi_2^*(\tilde{\mu}, H)] < 2[\pi_2^*(0, H) - \pi_2^*(1, H)] = \theta(t_H)$$

which also is violated if ε is small enough. Therefore, the only plausible case for values of $\theta(t)$ in the left neighbourhood of $\theta(t_H)$ is the case (iii) in which both types of firm 2 ratify.

Take some t such that $\theta(t) < \theta(t_H)$ and suppose that both types of firm 2 ratify. A necessary condition for this to be the case is

$$\pi_2^*(\mu_0, \tau) + \frac{\theta(t)}{2} \geq \pi_2^*(\tilde{\mu}, \tau)$$

which holds true if $\theta(t) \geq \theta(\tilde{t}_\tau) = 2[\pi_2^*(\tilde{\mu}, \tau) - \pi_2^*(\mu_0, \tau)]$. For the case in which $\tilde{\mu} < \mu_0$, $0 < \theta(\tilde{t}_H) < \theta(\tilde{t}_L)$ and hence, both types of firm 2 will be willing to ratify as long as $\theta(\tilde{t}_L) < \theta(t_H)$. Because the difference between these two values decreases with $\tilde{\mu}$, the interval $[\theta(\tilde{t}_L), \theta(t_H)]$ will be non-empty as long as $\theta(\tilde{t}_L) < \theta(t_H)$, which holds provided that μ_0 is less than some threshold $\mu_0^* < 1$. Suppose that this is indeed true (and hence, $\theta(\tilde{t}_L) < \theta(t_H)$) and both types of firm 2 are willing to ratify whenever $\theta(t) \in [\theta(\tilde{t}_L), \theta(t_H)]$. This would imply that if $\theta(t)$ is less than $\theta(\tilde{t}_L)$ then different types are willing to take different actions, or both types are willing to quit. Regarding the first alternative, we have already shown that type H ratifying and type L quitting is not possible for values below $\theta(t_H)$. However, type H quitting and type L ratifying cannot hold either because $\pi_2^*(0, H) > \pi_2^*(1, H)$ and $\theta(t) > 0$ (and thus, type H is willing to ratify instead of quitting). Finally, having both types to be willing to quit requires a strictly negative value of $\theta(t)$, which does not hold here.

Hence, let $\tilde{\mu} = \mu_0$ such that $\theta(\tilde{t}_H) = \theta(\tilde{t}_L) = 0$. It is fairly clear that both types are indeed willing to ratify when $\theta(t) \in [0, \theta(t_H)]$. As for values such that $\theta(t) < 0$, both types expect a higher payoff by quitting the alliance.

Lemma 8. *The (behavioural) strategy in which (i) both types of firm 2 ratify the alliance if $\theta(t) > \theta(t_L)$ or $\theta(t) \in [0, \theta(t_H)]$; (ii) firm 2 ratifies if its cost is high and quits if its cost is low whenever $\theta(t) \in [\theta(t_H), \theta(t_L)]$; (iii) both types of firm 2 quits if $\theta(t) < 0$; together with the belief system in which the probability μ that firm 2 has the high cost is,*

$$\mu = \begin{cases} \mu_0 & \textit{if } \theta(t) \in [\theta(\underline{t}), \theta(t_H)] \cup [\theta(t_L), \theta(\bar{t})] \\ 1 & \textit{if firm 2 ratifies and } \theta(t) \in [\theta(t_H), \theta(t_L)] \\ 0 & \textit{if firm 2 quits and } \theta(t) \in [\theta(t_H), \theta(t_L)] \end{cases}$$

constitute an equilibrium of the continuation game that follows a history in which firm 1 does not learn firm 2's cost, and firm 2 learns firm 1's type.

Finally, consider the case in which $\tilde{\mu} > \mu_0$. Then, $\theta(\tilde{t}_L) < \theta(\tilde{t}_H) < 0$, and both firms are willing to ratify whenever $\theta(t) \in [\theta(\tilde{t}_H), \theta(t_H)]$. For values of t such that $\theta(t) < \theta(\tilde{t}_H)$, it is true that

$$\pi_2^*(\mu_0, \tau) \geq \pi_2^*(\tilde{\mu}, \tau) + \frac{\theta(t)}{2}$$

for $\tau = L, H$, because $\pi_2^*(\mu_0, \tau) > \pi_2^*(\tilde{\mu}, \tau)$ and $\theta(t) < 0$. Consequently, it must be the case that both types of firm 2 are better off quitting the alliance whenever $\theta(t) < \theta(\tilde{t}_H)$ and $\tilde{\mu} > \mu_0$.

Lemma 9. *The (behavioural) strategy in which (i) both types of firm 2 ratify the alliance if $\theta(t) > \theta(t_L)$ or $\theta(t) \in [\theta(\tilde{t}_H), \theta(t_H)]$; (ii) firm 2 ratifies if its cost is high and quits if its cost is low whenever $\theta(t) \in [\theta(t_H), \theta(t_L)]$; (iii) both types of firm 2 quit if $\theta(t) < \theta(\tilde{t}_H)$; together with the belief system in which the probability μ that firm 2 has the high cost is,*

$$\mu = \begin{cases} \mu_0 & \text{if} \left[\begin{array}{c} \textit{firm 2 ratifies and } \theta(t) \in [\theta(\tilde{t}_H), \theta(t_H)] \cup [\theta(t_L), \theta(\bar{t})]; \textit{ or} \\ \textit{firm 2 quits and } \theta(t) \in [\theta(\underline{t}), \theta(\tilde{t}_H)]; \end{array} \right] \\ \tilde{\mu} \in [\mu_0, 1) & \text{if} \left[\begin{array}{c} \textit{firm 2 quits and } \theta(t) \in [\theta(\tilde{t}_H), \theta(t_H)] \cup [\theta(t_L), \theta(\bar{t})]; \textit{ or} \\ \textit{firm 2 ratifies and } \theta(t) \in [\theta(\underline{t}), \theta(\tilde{t}_H)] \end{array} \right] \\ 1 & \textit{if firm 2 ratifies and } \theta(t) \in [\theta(t_H), \theta(t_L)] \\ 0 & \textit{if firm 2 quits and } \theta(t) \in [\theta(t_H), \theta(t_L)] \end{cases}$$

constitute an equilibrium of the continuation game that follows a history in which firm 1 does not learn firm 2's cost, and firm 2 learns firm 1's type.

Chapter 4

Conclusion

This dissertation theoretically examines the interplay between information and knowledge leakages, the nature and intensity of market competition, and the incentives to pursue strategic alliances with competitors.

Chapter 2 shows that firms with superior absorptive capacities –and hence, more capable of exploiting knowledge leakages in the market– are more likely to engage in opportunistic behaviour. The chapter also shows that highly specialised products safeguard firms with limited absorptive capacities against these behaviours.

Chapter 3 highlights a purely informational mechanism through which information leakage affects competition, as firms might engage in alliances that are expected to yield negative common profits simply because the possibility of learning sensitive information about their competitors increases the rents that firms expect to earn when competing.

Both chapters provide a novel approach to the tension that stems from strategic alliances with competitors, and they contribute to a better theoretical understanding of the duality between cooperation and competition. When managers evaluate engaging in alliances, it becomes key to consider the effects in the market of informational structure settings, product differentiation, and product specificity.

Bibliography

Anand, B. N., and T. Khanna (2000): “Do firms learn to create value? The case of alliances,” *Strategic management journal*, 21(3), 295–315.

Anand, K. S., and M. Goyal (2009): “Strategic information management under leakage in a supply chain,” *Management Science*, 55(3), 438–452.

Arslan, B. (2018): “The interplay of competitive and cooperative behavior and differential benefits in alliances,” *Strategic Management Journal*, 39(12), 3222–3246.

Bengtsson, M., and S. Kock (2000): “”Coopetition” in business Networks—to cooperate and compete simultaneously,” *Industrial marketing management*, 29(5), 411–426.

——— (2014): “Coopetition—Quo vadis? Past accomplishments and future challenges,” *Industrial marketing management*, 43(2), 180–188.

Buley, T. (2010): “Start-Up Goes Public On Corbis Fraud, Starring Bill Gates,” *Forbes*.

Campbell-Kelly, M. (2007): "Number crunching without programming: The evolution of spreadsheet usability," *IEEE Annals of the History of Computing*, 29(3), 6–19.

Cassiman, B., M. C. Di Guardo, and G. Valentini (2009): "Organising R&D projects to profit from innovation: Insights from co-opetition," *Long Range Planning*, 42(2), 216–233.

Chen, X., Z. Luo, and X. Wang (2019): "Compete or cooperate: intensity, dynamics, and optimal strategies," *Omega*, 86, 76–86.

Chiambaretto, P., M. Bengtsson, A.-S. Fernandez, and M. H. Näsholm (2020): "Small and large firms' trade-off between benefits and risks when choosing a coopetitor for innovation," *Long Range Planning*, 53(1), 101876.

Cho, I.-K., and J. Sobel (1990): "Strategic stability and uniqueness in signaling games," *Journal of Economic Theory*, 50(2), 381–413.

Choi, J. P. (1993): "Cooperative R&D with product market competition," *International Journal of Industrial Organization*, 11(4), 553–571.

Cohen, W. M., and D. A. Levinthal (1990): "Absorptive capacity: A new perspective on learning and innovation," *Administrative science quarterly*, pp. 128–152.

Compte, O., and P. Jehiel (2007): "On quitting rights in mechanism design," *American Economic Review*, 97(2), 137–141.

Conti, C., and M. A. Marini (2019): "Are you the right partner? R&D agreement as a screening device," *Economics of Innovation and New Technology*, 28(3), 243–264.

Crick, J. M. (2019): "The dark side of coopetition: when collaborating with competitors is harmful for company performance," *Journal of Business & Industrial Marketing*.

Cui, V., H. Yang, and I. Vertinsky (2018): "Attacking your partners: Strategic alliances and competition between partners in product markets," *Strategic Management Journal*, 39(12), 3116–3139.

Das, T. K., and R. Kumar (2011): "Regulatory focus and opportunism in the alliance development process," *Journal of Management*, 37(3), 682–708.

Das, T. K., and B.-S. Teng (1999): "Managing risks in strategic alliances," *Academy of Management Perspectives*, 13(4), 50–62.

d'Aspremont, C., and A. Jacquemin (1988): "Cooperative and noncooperative R & D in duopoly with spillovers," *The American Economic Review*, 78(5), 1133–1137.

Diestre, L., and N. Rajagopalan (2012): "Are all 'sharks' dangerous? new biotechnology ventures and partner selection in R&D alliances," *Strategic Management Journal*, 33(10), 1115–1134.

Dorn, S., B. Schweiger, and S. Albers (2016): "Levels, phases and themes of coopetition: A systematic literature review and research agenda," *European Management Journal*, 34(5), 484–500.

Durst, S., L. Aggestam, and H. A. Ferenhof (2015): "Understanding knowledge leakage: a review of previous studies," *Vine*.

Dushnitsky, G., and J. M. Shaver (2009): "Limitations to interorganizational knowledge acquisition: The paradox of corporate venture capital," *Strategic Management Journal*, 30(10), 1045–1064.

Esteban-Bravo, M., and N. Lado (2011): "Brand value in horizontal alliances: the case of twin-cars," *Journal of the operational research society*, 62(8), 1533–1542.

Estrada, I., D. Faems, and P. de Faria (2016): "Coopetition and product innovation performance: The role of internal knowledge sharing mechanisms and formal knowledge protection mechanisms," *Industrial Marketing Management*, 53, 56–65.

Fang, D., and Q. Ren (2019): "Optimal decision in a dual-channel supply chain under potential information leakage," *Symmetry*, 11(3), 308.

Fernandez, A., F. Le, and D. Gnyawali (2014): "Sources and management of tension in co-opetition case evidence from telecommunications satellites manufacturing in Europe," *Industrial Marketing Management*, 43(2), 222–235.

Fernandez, A.-S., and P. Chiambaretto (2016): "Managing tensions related to information in coopetition," *Industrial Marketing Management*, 53, 66–76.

Fernandez, A.-S., F. Le Roy, and D. R. Gnyawali (2014): "Sources and management of tension in co-opetition case evidence from telecommunications satellites manufacturing in Europe," *Industrial Marketing Management*, 43(2), 222–235.

Gast, J., K. Gundolf, R. Harms, and E. M. Collado (2019): "Knowledge management and coopetition: how do cooperating competitors balance the needs to share and protect their knowledge?," *Industrial marketing management*, 77, 65–74.

Gerchak, Y., and E. Khmelnitsky (2019): "Bargaining over shares of uncertain future profits," *EURO Journal on Decision Processes*, 7(1), 55–68.

Gernsheimer, O., D. K. Kanbach, and J. Gast (2021): "Coopetition research-A systematic literature review on recent accomplishments and trajectories," *Industrial Marketing Management*, 96, 113–134.

Gnyawali, D. R., and B.-j. Park (2009): "Co-opetition and technological innovation in small and medium-sized enterprises: A multilevel conceptual model," *Journal of small business management*, 47(3), 308–330.

Gnyawali, D. R., and B.-J. R. Park (2011): "Co-opetition between giants: Collaboration with competitors for technological innovation," *Research Policy*, 40(5), 650–663.

Gnyawali, D. R., and T. Ryan Charleton (2018): "Nuances in the interplay of competition and cooperation: Towards a theory of coopetition," .

Grant, R. M., and C. Baden-Fuller (2004): "A knowledge accessing theory of strategic alliances," *Journal of management studies*, 41(1), 61–84.

Hallen, B. L., R. Katila, and J. D. Rosenberger (2014): "How do social defenses work? A resource-dependence lens on technology ventures, venture capital investors, and corporate relationships," *Academy of Management Journal*, 57(4), 1078–1101.

Hamel, G. (1991): "Competition for competence and interpartner learning within international strategic alliances," *Strategic management journal*, 12(S1), 83–103.

Harris, R., and J. Yan (2019): "The measurement of absorptive capacity from an economics perspective: definition, measurement and importance," *Journal of Economic Surveys*, 33(3), 729–756.

Hennart, J.-F., T. Roehl, and D. S. Zietlow (1999): "'Trojan horse'or ‘workhorse’? The evolution of US–Japanese joint ventures in the United States,” *Strategic Management Journal*, 20(1), 15–29.

Hoffmann, W., D. Lavie, J. J. Reuer, and A. Shipilov (2018): “The interplay of competition and cooperation,” *Strategic Management Journal*, 39(12), 3033–3052.

Hora, M., and R. D. Klassen (2013): “Learning from others’ misfortune: Factors influencing knowledge acquisition to reduce operational risk,” *Journal of Operations Management*, 31(1-2), 52–61.

Hora, W., J. Gast, N. Kailer, A. Rey-Marti, and A. Mas-Tur (2018): “David and Goliath: causes and effects of coopetition between start-ups and corporates,” *Review of Managerial Science*, 12(2), 411–439.

Hotelling, H. (1929): “Stability in Competition,” *The Economic Journal*, pp. 41–57.

Hurmelinna-Laukkanen, P., and H. Olander (2014): “Coping with rivals’ absorptive capacity in innovation activities,” *Technovation*, 34(1), 3–11.

Inkpen, A. C. (2000): “Learning through joint ventures: A framework of knowledge acquisition,” *Journal of management studies*, 37(7), 1019–1044.

Iyer, K. N. (2014): “Operational impact of collaboration and resource specificity:

the moderating role of technology context," *Journal of Business & Industrial Marketing*.

Jiang, X., Y. Bao, Y. Xie, and S. Gao (2016): "Partner trustworthiness, knowledge flow in strategic alliances, and firm competitiveness: A contingency perspective," *Journal of business research*, 69(2), 804–814.

Jiang, X., M. Li, S. Gao, Y. Bao, and F. Jiang (2013): "Managing knowledge leakage in strategic alliances: The effects of trust and formal contracts," *Industrial Marketing Management*, 42(6), 983–991.

Kale, P., H. Singh, and H. Perlmutter (2000): "Learning and protection of proprietary assets in strategic alliances: Building relational capital," *Strategic management journal*, 21(3), 217–237.

Kamien, M. I., and I. Zang (2000): "Meet me halfway: research joint ventures and absorptive capacity," *International journal of industrial organization*, 18(7), 995–1012.

Katila, R., J. D. Rosenberger, and K. M. Eisenhardt (2008): "Swimming with sharks: Technology ventures, defense mechanisms and corporate relationships," *Administrative Science Quarterly*, 53(2), 295–332.

Kesteloot, K., and R. Veugelers (1995): "Stable R&D cooperation with spillovers," *Journal of Economics & Management Strategy*, 4(4), 651–672.

——— (1997): "R&D cooperation between asymmetric partners," in *Competition, Cooperation, Research and Development*, pp. 97–125. Springer.

Khanna, T., R. Gulati, and N. Nohria (1998): "The dynamics of learning alliances: Competition, cooperation, and relative scope," *Strategic management journal*, 19(3), 193–210.

Kong, G., S. Rajagopalan, and H. Zhang (2013): "Revenue sharing and information leakage in a supply chain," *Management Science*, 59(3), 556–572.

Kumar, M. S. (2010): "Differential gains between partners in joint ventures: Role of resource appropriation and private benefits," *Organization Science*, 21(1), 232–248.

Lane, P. J., B. R. Koka, and S. Pathak (2006): "The reification of absorptive capacity: A critical review and rejuvenation of the construct," *Academy of management review*, 31(4), 833–863.

Lane, P. J., and M. Lubatkin (1998): "Relative absorptive capacity and interorganizational learning," *Strategic management journal*, 19(5), 461–477.

Lascaux, A. (2020): "Coopetition and trust: What we know, where to go next," *Industrial Marketing Management*, 84, 2–18.

Laursen, K., and A. J. Salter (2014): "The paradox of openness: Appropriability, external search and collaboration," *Research Policy*, 43(5), 867–878.

Lavie, D. (2006): "The competitive advantage of interconnected firms: An extension of the resource-based view," *Academy of management review*, 31(3), 638–658.

Leahy, D., and J. P. Neary (2007): "Absorptive capacity, R&D spillovers, and public policy," *International Journal of Industrial Organization*, 25(5), 1089–1108.

Lee, J. Y.-H., C. Saunders, N. Panteli, and T. Wang (2021): "Managing information sharing: Interorganizational communication in collaborations with competitors," *Information and Organization*, 31(2), 100354.

Levy, M., C. Loebbecke, and P. Powell (2003): "SMEs, co-opetition and knowledge sharing: the role of information systems," *European Journal of Information Systems*, 12(1), 3–17.

Li, D., L. Eden, M. A. Hitt, and R. D. Ireland (2008): "Friends, acquaintances, or strangers? Partner selection in R&D alliances," *Academy of management journal*, 51(2), 315–334.

Lin, C., Y.-J. Wu, C. Chang, W. Wang, and C.-Y. Lee (2012): "The alliance innovation performance of R&D alliances—the absorptive capacity perspective," *Technovation*, 32(5), 282–292.

Loebecke, C., P. C. Van Fenema, and P. Powell (1999): "Co-opetition and knowledge transfer," *ACM SIGMIS Database: the DATABASE for Advances in Information Systems*, 30(2), 14–25.

Lohr, S. (2010): "In a Partnership of Unequals, a Start-Up Suffers," *The New York Times*.

Luo, Y. (2007): "Are joint venture partners more opportunistic in a more volatile environment?," *Strategic Management Journal*, 28(1), 39–60.

Meena, A., S. Dhir, and S. Sushil (2022): "A review of coopetition and future research agenda," *Journal of Business & Industrial Marketing*.

Muscio, A. (2007): "The impact of absorptive capacity on SMEs' collaboration," *Economics of Innovation and New Technology*, 16(8), 653–668.

Naesens, K., L. Pintelon, and T. Taillieu (2007): "A framework for implementing and sustaining trust in horizontal partnerships," in *Supply chain forum: An international journal*, vol. 8(1), pp. 32–44. Taylor & Francis.

Nalebuff, B. J., and A. Brandenburger (1996): *Coopetition*. HarperCollins-Business London.

Oxley, J. E., and R. C. Sampson (2004): "The scope and governance of international R&D alliances," *Strategic Management Journal*, 25(8-9), 723–749.

Panico, C. (2017): "Strategic interaction in alliances," *Strategic Management Journal*, 38(8), 1646–1667.

Perez-Castrillo, J. D., and J. Sandonis (1997): "Disclosure of know-how in research joint ventures," *International Journal of Industrial Organization*, 15(1), 51–75.

Petit, M. L., and B. Tolwinski (1999): "R&D cooperation or competition?," *European Economic Review*, 43(1), 185–208.

Rajala, A., and A. Tidström (2021): "Unmasking conflict in vertical coopetition," *Journal of Business & Industrial Marketing.*

Raza-Ullah, T. (2021): "When does (not) a coopetitive relationship matter to performance? An empirical investigation of the role of multidimensional trust and distrust," *Industrial Marketing Management*, 96, 86–99.

Raza-Ullah, T., M. Bengtsson, and S. Kock (2014): "The coopetition paradox and tension in coopetition at multiple levels," *Industrial marketing management*, 43(2), 189–198.

Ried, L., S. Eckerd, L. Kaufmann, and C. Carter (2021): "Spillover effects of information leakages in buyer–supplier–supplier triads," *Journal of Operations Management*, 67(3), 280–306.

Ritala, P. (2009): "Is coopetition different from cooperation? The impact of market rivalry on value creation in alliances," *International Journal of Intellectual Property Management*, 3(1), 39–55.

——— (2012): "Coopetition strategy–when is it successful? Empirical evidence on innovation and market performance," *British Journal of management*, 23(3), 307–324.

Ritala, P., A. Golnam, and A. Wegmann (2014): "Coopetition-based business models: The case of Amazon. com," *Industrial Marketing Management*, 43(2), 236–249.

Ritala, P., and P. Hurmelinna-Laukkanen (2013): "Incremental and radical innovation in coopetition—The role of absorptive capacity and appropriability," *Journal of Product Innovation Management*, 30(1), 154–169.

Ritala, P., H. Olander, S. Michailova, and K. Husted (2015): "Knowledge sharing, knowledge leaking and relative innovation performance: An empirical study," *Technovation*, 35, 22–31.

Rosenkranz, S. (2001): "To reveal or not to reveal: know-how disclosure and joint ventures in procurement auctions," *Journal of Institutional and Theoretical Economics JITE*, 157(4), 555–567.

Ryan-Charleton, T., D. R. Gnyawali, and N. Oliveira (2022): "Strategic alliance outcomes: Consolidation and new directions," *Academy of Management Annals*, 16(2), 719–758.

Samant, S., and J. Kim (2021): "Determinants of common benefits and private benefits in innovation alliances," *Managerial and Decision Economics*, 42(2), 294–307.

Samuelson, P. (2010): "The uneasy case for software copyrights revisited," *Geo. Wash. L. Rev.*, 79, 1746.

Song, Y., D. R. Gnyawali, M. K. Srivastava, and E. Asgari (2018): "In search of precision in absorptive capacity research: A synthesis of the literature and consolidation of findings," *Journal of Management*, 44(6), 2343–2374.

Tidström, A. (2009): "Causes of conflict in intercompetitor cooperation," *Journal of Business & Industrial Marketing*.

——— (2014): "Managing tensions in coopetition," *Industrial Marketing Management*, 43(2), 261–271.

——— (2018): "Coopetitive tensions," in *The Routledge Companion to Coopetition Strategies*, pp. 149–157. Routledge.

Tidström, A., P. Ritala, and K. Lainema (2018): "Interactional and procedural practices in managing coopetitive tensions," *Journal of Business & Industrial Marketing*.

Todeva, E., and D. Knoke (2005): "Strategic alliances and models of collaboration," *Management Decision*, 43(1), 123–148.

Veer, T., P. Yang, and J. Riepe (2022): "Ventures' conscious knowledge transfer to close partners, and beyond: A framework of performance, complementarity, knowledge disclosure, and knowledge broadcasting," *Journal of Business Venturing*, 37(3), 106191.

Veugelers, R. (1998): "Collaboration in R&D: an assessment of theoretical and empirical findings," *De economist*, 146(3), 419–443.

Virtanen, H., and S. Kock (2022): "Striking the right balance in tension management. The case of coopetition in small-and medium-sized firms," *Journal of Business & Industrial Marketing*.

von Ungern-Sternberg, T. (1988): "Monopolistic competition and general purpose products," *The Review of Economic Studies*, 55(2), 231–246.

Walter, S. G., A. Walter, and D. Müller (2015): "Formalization, communication quality, and opportunistic behavior in R & D alliances between competitors," *Journal of Product Innovation Management*, 32(6), 954–970.

Wang, J., Z. Zhen, and Q. Yan (2021): "Information sharing and leakage in the two-echelon supply chain," *RAIRO-Operations Research*, 55, S307–S325.

Yang, H., Y. Zheng, and A. Zaheer (2015): "Asymmetric learning capabilities and stock market returns," *Academy of Management Journal*, 58(2), 356–374.

Zahra, S. A., and G. George (2002): "Absorptive capacity: A review, reconceptualization, and extension," *Academy of management review*, 27(2), 185–203.

Zhang, D. Y., X. Cao, L. Wang, and Y. Zeng (2012): "Mitigating the risk of information leakage in a two-level supply chain through optimal supplier selection," *Journal of Intelligent Manufacturing*, 23(4), 1351–1364.