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The effect of coopetition intensity on first mover advantage and imitation in innovation related coopetition: Empirical evidence from UK firms

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ABSTRACT

Research in innovation-related coopetition has documented that collaboration between competing firms can be beneficial for firms' innovation performance. However, the role of coopetition as a means of accelerating innovation to achieve a first mover advantage (FMA) is underexplored in empirical coopetition work. The purpose of this study is to introduce a more granular typology of coopetition strategies, including balanced moderate coopetition, and examine quantitatively the relationship between innovation-related coopetition and firms' FMA. Based on an analysis of a large sample of 21,140 observations in the UK over the period 2002–2014, we measure the effect of the *presence* and *intensity* of coopetition on FMA and imitation from competitors. We find that the coopetition intensity decreases the propensity of achieving an FMA as well as radical innovation, while propensity to imitate increases with an increase in coopetition intensity. Moreover, there is a linear effect of coopetition intensity on the one hand and FMA and imitation propensity on the other hand. The results hold regardless of the industry. This study informs coopetition research by shedding light on how innovation-related coopetition influence FMA and imitation. Theoretical contributions and managerial implications are discussed.

1. Introduction

Organizations navigate through a highly dynamic, uncertain, and turbulent business environment where technological, socio-political, and environmental changes recurrently challenge any competitive advantage created, making it transient and temporary (D'Aveni et al., 2010). Technological advancement and innovation are not only the major drivers to achieve a temporary advantage but also the means by which that advantage is eroded over time. This is the reason why firms develop strategies, tactics, and operational tools to accelerate their innovation activities so that they can recreate at a fast pace a competitive advantage, once eroded (D'Aveni, 1994). Increasingly, strategies, tactics, and tools that enable firms to recreate their competitive advantage rely on coopetition arrangements (Ketchen, Snow, & Hoover, 2004).

Coopetition, namely the pursuit of cooperation between competing economic actors (Brandenburger & Nalebuff, 1996) – often underpinned by trust (Raza-Ullah & Kostis, 2020) – has been found to enable knowledge sharing (Bouncken & Kraus, 2013; Ritala & Hurmelinna-Laukkanen, 2009), cost reduction by improving efficiency (Parzy & Bogucka, 2014), improve sales and market performance (e.g., Bouncken & Fredrich, 2012; Ritala, 2018, pp. 317–325; Wu, Choi, & Rungtusanathan, 2010), foster business model reconfiguration (Belitski & Mariani, 2022), and increase economic and financial performance (Liu, Luo, Yang, & Maksimov, 2014; Luo, Slotegraaf, & Pan, 2006). Although coopetition is likely to enhance firm innovation performance (Bengtsson, Eriksson, & Wincent, 2010; Gnyawali, He, & Madhavan, 2008; Huang & Yu, 2011), innovation performance could also suffer due to the intensified tension from coopetition resulting from the strong contradictions inherent in such relationships (Gnyawali, Madhavan, He, & Bengtsson, 2012; Park, Srivastava, & Gnyawali, 2014).

A vast body of literature has been produced at the intersection of coopetition and innovation (e.g., Bouncken & Kraus, 2013; Le Roy, Robert, & Lasch, 2016; Park et al., 2014; Ritala & Hurmelinna-Laukkanen, 2013, 2009; Ritala & Sainio, 2014; Yami & Nemeh, 2014). However, this large body of literature has explicitly ignored the role played by horizontal coopetition - namely coopetition between two or more firms within horizontal inter-organizational relationships and alliances (Bengtsson & Kock, 1999, 2000) - as a means of accelerating innovation to achieve a first mover advantage (FMA)

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(Nemeh & Yami, 2019). To the best of our knowledge, there is only one qualitative study that has attempted to identify different types of strategies conducive to FMA in coopetitive new product development (NPD) (Nemeh & Yami, 2019).

Given that FMA and imitation strategies are increasingly organized and planned in advance (Cirik & Makadok, 2021), innovation managers are likely to make decisions that shape their coopetition relationships with other firms and coopetition intensity, ranging from "weak" to "moderate" to "strong". Yet, to the best of our knowledge, extant coopetition literature explicitly examining FMA (i.e., Nemeh & Yami, 2019) has failed to analyze whether and to what extent coopeting firms' propensity to achieve a FMA (or imitate) is influenced by coopetition intensity (weak, moderate, or high), although several researchers have suggested that coopetition intensity plays a paramount role in innovation-related coopetition (Park et al., 2014).

The present work bridges this important research gap by addressing the following research question: "*Does coopetition intensity influence firms' propensity of achieving a FMA and/or engage in imitation*?" Addressing this question is important for several reasons: (1) an increasing number of firms are engaging in coopetition to innovate in a sustained and sustainable way (Munten, Vanhamme, Maon, Swaen, & Lindgreen, 2021); (2) FMA and imitation strategies are increasingly designed, planned, and organized in advance by innovative firms (Cirik & Makadok, 2021); and (3) innovation managers are likely to make decisions that shape their coopetition relationships with other firms and the level of coopetition intensity, in view of tangible benefits (Cirik & Makadok, 2021).

To address the overarching research question, we develop hypotheses about the effect of coopetition intensity on the propensity to achieve a FMA and the propensity to imitate as two possible outcomes of coopetition for innovation (Park et al., 2014). We test our hypotheses on a large sample of the most innovative firms across multiple industries in the UK, including 21,140 observations during the period 2002–2014. Accordingly, this study makes three key contributions to coopetition literature. First, we illustrate empirically that coopetition intensity influences negatively coopeting firms' propensity of achieving a FMA, while it influences positively coopeting firms' propensity of imitation. Second, we develop a more nuanced conceptualization of coopetition intensity. By recognizing that both the cooperation and competition intensity can assume an intermediate value (i.e., "moderate") between the two extremes of "weak" and "strong," we extend the typology of coopetition strategies developed by Park et al. (2014). More specifically, we suggest that there are nine rather than four possible types of coopetition strategies because the possible combinations stem from matching "weak," "moderate," and "strong" cooperation intensity with "weak," "moderate," and "strong" competition intensity. Relatedly, we introduce the concept of *balanced moderate coopetition* that materializes when both the cooperation and competition intensity are moderate. Third, we contribute to the innovation-related coopetition literature that displays mixed results in relation to incremental and radical innovation outcomes (Bouncken, Fredrich, Ritala, & Kraus, 2018; Ritala, Kraus, & Bouncken, 2016; Tidström, 2014). Based on a more fine-grained definition of coopetition intensity, relying on the concept of *balanced moderate coopetition,* we are able to discern that there are opposite effects of coopetition intensity on radical vs. incremental performance.

2. Theoretical background

2.1. Coopetition, innovation, and innovation-related coopetition

Management literature in coopetition is expanding over time in terms of range and variety of focal themes (Dorn, Schweiger, & Albers, 2016). Beyond literature examining mostly antecedents of coopetition (Czakon, 2009), the relationship and nexus between coopetition and innovation have been largely covered in extant literature (e.g., Bouncken & Kraus, 2013; Bouncken et al., 2018; Estrada, Faems, & de Faria, 2016; Le Roy et al., 2016; Park et al., 2014; Ritala & Hurmelinna-Laukkanen, 2013, 2009; Ritala & Sainio, 2014; van den Broek, Boselie, & Paauwe, 2018; Yami & Nemeh, 2014).

Most of the empirical studies (e.g., Bouncken et al., 2018; Bouncken & Fredrich, 2012; Estrada et al., 2016; Le Roy et al., 2016; Pereira & Leitão, 2016; Quintana- García & Benavides- Velasco, 2004; Ritala, 2012; Ritala & Hurmelinna-Laukkanen, 2013; Steinicke, Marcus Wallenburg, & Schmoltzi, 2012) have found that coopetition positively influences innovation. For instance, Quintana- García and Benavides-Velasco (2004) conduct a study on a panel of 73 European biotechnology SMEs and find that coopetition is a relevant strategy for new product line development as it is conducive to acquiring new skills, knowledge, and capabilities from the competitor/partner and strengthens technology resources diversity. Examining 469 German IT firms, Bouncken and Fredrich (2012) empirically detect that coopetition enhances radical innovation by means of assisting knowledge combination across partner firms and also found that the effect of coopetition is more pronounced on radical innovation than on incremental innovation.

Ritala and Hurmelinna-Laukkanen (2009) develop some theoretical propositions suggesting that coopetition between organizations, by increasing the common knowledge base concerning markets and technologies, generates important innovation value. Interestingly, they suggest that the positive effect of common knowledge on innovation performance/value would be stronger on generating incremental innovations than on generating radical innovations. The two authors later test the proposition in an empirical study of 138 Finnish firms (Ritala & Hurmelinna-Laukkanen, 2013) and find support that coopetition is more likely to lead to incremental than radical innovation. By leveraging a RBV approach, Ritala (2012) examines 212 Finnish firms and finds that coopetition leads to superior innovation performance under high market uncertainty conditions (as firms can share both costs and risks with competitors) and when there are relevant network externalities.

Steinicke et al. (2012) analyze 225 firms in the German logistics industry and observe that different forms of governance of cooperation among competitors can play a key role in enhancing innovativeness. Leveraging the fourth wave of Community Innovation Survey (CIS), Le Roy et al. (2016) focus on 3933 firms and find that cooperation with suppliers (i.e., vertical cooperation) has no significant effect on radical innovation, while international coopetition allows to foster innovation. Estrada et al. (2016) analyze 627 manufacturing firms participating in the fifth wave of CIS, finding that coopetition influences innovation performance only if formal knowledge protection mechanisms are in place beyond internal knowledge-sharing mechanisms. The study of Bouncken et al. (2018) on 1049 NPD alliances in the German machinery and medical sector reveal that coopetition intensity influences positively incremental innovation both in the product pre-launch and launch phases, while it affects positively radical innovation only in the launch phase.

Several other studies have found that the relationship between coopetition and innovation is more complex and that there is an optimal level of coopetition to improve innovation performance (e.g., Bouncken, Clauß, & Fredrich, 2016; Park et al., 2014; Wu, 2014). For instance, Bouncken et al. (2016) analyze 372 German firms in the medical device industry to find that as coopetition increases, product innovativeness declines due to greater transactional governance, and there is no direct effect of coopetition on innovation performance when governance is absent. By conducting an empirical study on 1930 firms in the semiconductor industry, Park et al. (2014) observed that in a coopetitive relationship, when coopetition intensity increases beyond a certain threshold, innovation is also enhanced. They also find that balanced coopetition (where neither cooperation nor competition dominate) brings about the best results in terms of innovation performance. By adopting a game-theoretical approach, Wu (2014) analyses almost 1500 Chinese firms and finds that there is an inverted U-shaped functional relationship between coopetition and innovation performance; they also observe empirically that collaboration is not equal as cooperation with research centers and universities negatively influences the effect of coopetition on product innovation.

Lastly, a minority of studies has found that coopetition does not influence innovation (Mention, 2011; Tomlinson & Fai, 2013). For instance, Mention (2011) analyze 1052 firms participating in the fourth wave of the CIS and discovers that coopetition does not enhance innovation in service firms; rather she suggests that sourcing information from competitors triggers imitation. Tomlinson and Fai (2013) collect and analyze data on a sample of 371 UK manufacturing SMEs and find that coopetition has no significant impact on innovation.

To summarize, the empirical findings stemming from literature at the intersection of coopetition and innovation are mixed. Most of the empirical studies (e.g., Bouncken et al., 2018; Bouncken & Fredrich, 2012; Estrada et al., 2016; Le Roy et al., 2016; Pereira & Leitão, 2016; Quintana- García & Benavides- Velasco, 2004; Ritala, 2012; Ritala & Hurmelinna-Laukkanen, 2013; Steinicke et al., 2012) have found that coopetition positively influences innovation; others have found that the relationship is more complex and there is an optimal level of coopetition to improve innovation performance (e.g., Bouncken et al., 2016; Park et al., 2014; Wu, 2014). A minority of studies have found that coopetition does not influence innovation at all (Mention, 2011; Tomlinson & Fai, 2013).

We synthesize extant literature on coopetition performance implications in Table 1:

Among the studies that have focused on the effect of coopetition intensity on coopetition-based innovation, Park et al. (2014) have developed a conceptual model whereby the intensity of coopetition is conceptualized as the outcome of the intensity of competition on the one hand and the intensity of cooperation on the other hand. Consistently with the typologies of coopetition developed in the literature (Bengtsson et al., 2010; Bengtsson & Kock, 2000), Park et al. (2014) recognize that there are four types of coopetition: 1) weak coopetition when both cooperation and competition in a coopetitive relationship are low; 2) balanced-strong coopetition when both cooperation and competition in a coopetitive relationship are high; 3) cooperation-dominant coopetition when cooperation is high and competition is low; and 4) competition-dominant coopetition when competition is high and cooperation is low. Departing from the observation that firms can benefit from coopetition for innovation performance through three key mechanisms – co-development, partner resource acquisition, enhanced internal efforts – Park et al. (2014) suggest that the superior situation is balanced-strong coopetition as in this situation firms focus on both value creation and appropriation.

The work of Park et al. (2014) is particularly relevant to this study, as we also define coopetition intensity as a function of the relative strength/weakness of competition and cooperation. However, in this study, we extend the typology proposed by Park et al. (2014) by recognizing that both cooperation and competition intensity may also be moderate (in addition to being simply "high" or "low"). Accordingly, we provide a more nuanced conceptualization of the intensity of coopetition. In other terms, rather than having four possible combinations as in Park et al. (2014), nine different combinations of coopetition intensity could be identified (see Table 2):

In particular, we introduce the concept of *balanced moderate coopetition* which is a situation whereby both cooperation and competition are moderate – neither weak nor strong – and has implications on coopetition innovation that are distinctively different from the implications of weak coopetition and balanced strong coopetition previously recognized in the literature (Park et al., 2014). This way, we extend the way how coopetition intensity has been conceptualized so far (Park et al., 2014) by suggesting that our more nuanced conceptualization better mirrors real-world coopetition intensity.

Extant literature displays several gaps. First, it has not examined how balanced moderate coopetition can affect innovation. Second, it has devoted a very limited attention to the effect of coopetition on innovation strategies such as first mover advantage (FMA) and imitation, apart from a recent qualitative study by Nemeh and Yami (2019). In this paper, we argue that coopeting firms' propensity to achieve a FMA or imitate might depend on a number of factors: 1) the complexity and newness of the knowledge received through coopetition (Katila & Ahuja, 2002; Smith, Collins, & Clark, 2005); 2) the depth of cooperation and competition between coopeting firms (Park et al., 2014) which can be weak, moderate and strong; 3) the technological distance between competitors and the required knowledge and skills such as absorptive capacity to recognize new knowledge and choose the innovation strategy (Nooteboom, Van Haverbeke, Duysters, Gilsing, & Van den Oord, 2007; Rosenkopf & Almeida, 2003); 4) the ease of learning from competitors (Lane, Koka, & Pathak, 2006; Park et al., 2014); and 5) the different types of required resources and the different degrees of complementarity between human and financial resources (Stieglitz & Heine, 2007).

Hence, it is highly plausible to assume that contingent on the aforementioned factors, a specific innovation strategy – FMA or imitation – will be pursued and ultimately that the effect of coopetition intensity (weak, moderate, or high) on the propensity to achieve a FMA or imitate in coopetitive relationships will vary. For this reason, in this paper, we distinguish between FMA and imitation, which are reviewed in subsections 2.2 and 2.3, respectively.

2.2. FMA in innovation-related coopetition

In the strategic management literature, a firm is said to have a FMA when it (i) innovates rapidly to enter a market before other competitors by compressing the time elapsing between the development of a new offering (product/service) and its commercialization (Murmann, 1994) and (ii) manages to maintain this advantage over time. In this study, we define the FMA as a firm's market entry with a new-to-market product or service before its competitors (Lieberman & Montgomery, 1988, 1998). Research on FMA revolves around the order and timing of firms' actions and responses and the related benefits (Ketchen et al., 2004). More specifically, the notion of FMA pertains to the benefits gained by pioneering firms that enter into a new market, introduce a new product or service, or implement a new process (Lieberman & Montgomery, 1988; Rugman & Verbeke, 2000). The aforementioned benefits come under the guise of profits and can stem from the control and orchestration of rare resources, learning curve effects, and buyer switching costs (Ketchen et al., 2004; Lieberman & Montgomery, 1988, 1998). In this study, we refer to FMA with a focus on firm's ability to introduce a new product into the market before competitors and not the ability to retain a FMA position.

In relation to the FMA and speed of innovation, extant literature distinguished firms' internal factors and external factors. The internal factors include (1) strategic orientations; (2) scope-related strategic orientation factors such as the breadth of the project; and (3) individual/team factors related to human resources (Nemeh, 2018). Among the external factors, there are the degree of technological complexity and market uncertainty as well as the management of R&D collaboration with external partners (Kessler & Chakrabarti, 1996; Van Beers & Zand, 2014) and competitors (McGrath, Tsai, Venkataraman, & MacMillan, 1996).

While the relationship between coopetition and innovation performance, and more broadly innovation-related coopetition (Ritala & Hurmelinna-Laukkanen, 2009), has been largely discussed in coopetition literature as clarified in section 2.1, the role of horizontal coopetition as a means of expediting innovation to achieve a first mover advantage (FMA) is largely underexplored (Nemeh & Yami, 2019) and does not feature at all as a theme in the extant coopetition literature (Dorn et al., 2016). To the best of our knowledge, there is only one study that very partially examines the link by exploring *qualitatively* how resource orchestration strategies affect FMA in coopetitive new product development for a very specific industry and without paying attention to

Table 1
A synthesis of the literature on coopetition innovation.

Article	Sector	Method	Impact on innovation performance
Bouncken and Fredrich (2012)	IT sector (Germany)	Survey of 469 firms. Structural equation modelling (SEM)	Coopetition enhances radical innovation as knowledge is combined across partners. Coopetition is more beneficial for radical innovation than for incremental innovation.
Bouncken et al. (2016)	Medical device industry (Germany)	Survey of 372 vertical alliances. Covariance-based SEM (added to latent-moderated structural equation method)	Transactional governance reduces product innovativeness with growing coopetition. Relational governance improves product innovativeness with growing levels of coopetition. Relational and transactional governance conjointly allow improving product innovativeness. No positive effect of coopetition on innovation if governance is absent.
Bouncken et al. (2018)	Medical and machinery sectors (Germany)	Survey of 1049 NPD alliances. Covariance-based SEM.	Coopetition influences positively incremental innovation in both pre-launch and launch phases. Coopetition influences positively radical innovation only in the launch phase.
Estrada et al. (2016)	Manufacturing firms (Flemish area)	Survey (CIS) of 627 firms. Tobit regression	Coopetition influences positively product innovation performance only when internal knowledge sharing mechanisms and formal knowledge protection mechanisms are present.
Le Roy et al. (2016)	Different industries (France)	Survey of 3933 firms. Dichotomic logic model.	International coopetition with firms located in North America and Europe influences positively radical product innovation. Cooperating with customers has more impact on radical innovation than incremental product innovation. Cooperation with universities influences positively radical and incremental product innovation. Cooperation with suppliers influences negatively radical product innovation and does not influence incremental product innovation.
Mention (2011)	Services (Luxembourg)	Survey (CIS) of 431 firms. Logistic regression.	Coopetition (in the guise of exploiting information from competitors) does not influence innovation. Sourcing information from competitors influences positively imitation rather than innovation.
Park et al. (2014)	Semiconductor industry (All USA + major non-USA)	Panel data (1990–2003) with 1930 observations (118 firms). Regression.	The effect of competition on innovation increases non-monotonically: at a very high level of competitive intensity, competition with the alliance partner adversely affects innovation output. Benefits of competition- dominant coopetition are less that cooperation-dominant coopetition. Balanced coopetition provides most of the innovation benefits.
Pereira and Leitão (2016)	Manufacturing firms (Italy and Portugal)	Survey of 4912 Italian firms and 3660 Portuguese firms. Logit regression.	Acquiring external knowledge influences positively product innovation for high-tech and medium- and low-tech firms.
Quintana-García & Benavides-Velasco (2004)	Biotech (Europe)	Panel of 73 firms. Poisson model and linear regression.	Coopetition allows acquiring new knowledge and skills from the partner and to access other capabilities through the intensive exploitation of existing ones. Coopetition influences positively technological diversity as partners can access complementary resources.
Ritala (2012)	Different industries (Finland)	Survey of 209 firms. Hierarchical regression.	A coopetition strategy is beneficial in terms of both innovation and market performance. Coopetition is successful under high market uncertainty as risks and costs can be shared with competitors. Coopetition is successful under high network externalities.
Ritala and Hurmelinna-Laukkanen (2013)	Different industries (Finland)	Survey of 138 firms. Multivariate regression and multivariate analysis of covariance.	Coopetition engenders more frequently incremental than radical innovation. Potential absorptive capacity and appropriability regime influence positively incremental innovation in coopetition. In the case of radical innovation, appropriability regime has a positive effect, while the effect of absorptive capacity is not significant. Standardization is the most common type of coopetition; new product development is the least common.
Ritala and Sainio (2014)	Different industries (Finland)	Survey of 209 firms. Linear regression.	Coopetition is negatively related to technological radicalness and positively related to business-model radicalness.
Steinicke et al. (2012)	Logistic industry (Germany)	Survey of 209 firms. Structural equation modelling.	Innovation is influenced by governance forms. Formal and relational governance mechanisms help promoting coordination and hinder opportunism among partners. Relational governance is more (less) Important than formal governance for service (manufacturing) firms 62% of the firms rely on contractual set- ups.
Tomlinson and Fai (2013)	Manufacturing (UK)	Survey of 371 firms. Hierarchical multivariate regression	Coopetition has no significant impact upon innovation. Cooperation with suppliers or buyers enhances product and process innovation.
Wu (2014)	Different industries (China)	Survey of 1499 Chinese firms. Zero- inflated negative Binomial regression.	Coopetition has an inverted U-shaped relationship with innovation performance. Strong technological capability weakens the relationship between coopetition and product innovation. Cooperation with universities influences negatively the effect of coopetition and product innovation.

Table 2
A granular view of coopetition intensity in coopetition-based innovation, extending the work of Park et al. (2014).

	Strong	Cooperation-dominant coopetition	Cooperation-prevailing coopetition	**Balanced strong coopetition**
Cooperation	Moderate	Cooperation-moderate coopetition	**Balanced moderate coopetition**	Competition-prevailing coopetition
	Weak	**Weak coopetition**	Competition-moderate coopetition	Competition-dominant coopetition
		Weak	Moderate **Competition**	Strong

the intensity of coopetition. Nemeh and Yami (2019) develop a qualitative study on four competitors in the telecommunication industry. Interestingly, they find that those firms that orchestrated their resources early to render them available for bundling during coopetition were able to introduce products faster than firms that orchestrated them during coopetition. Furthermore, the authors find that coopetitors develop and implement different orchestration strategies based on speed objectives and that coopetition per se "is not a 'magical' tool to boost the product development efforts of all the competitors involved, since only those that are ready for coopetition will obtain this advantage" (Nemeh, 2018, p. 303).

While first moves can be rather risky (Boulding & Christen, 2001), firms might intentionally decide to not take an optimal position but simply carve out a niche (Tyagi, 2000) where the costs of competitors would still be higher than their own. In other cases, both first movers and late followers are able to contain their costs, while early followers might incur a higher cost than first movers or late followers (Durand & Coeurderoy, 2001). While both strategies and tactics of first movers might differ (e.g., Covin, Slevin, & Heeley, 2000; Eisenmann & Bower, 2000), it is the intensity of coopetition that allows firms to access the tacit knowledge of competitors (Brockmann & Anthony, 2002) that ultimately translates into FMA.

Therefore, we argue that FMA is conditional on coopetition intensity. First, closer and more frequent interactions enable learning from competitors (Hamel, 1991; Lane et al., 2006; Park et al., 2014). However, the trade-off is innovation coordination and the ability to reduce cognitive distance between competitors (Nooteboom et al., 2007; Rosenkopf & Almeida, 2003), which takes a longer time and may be costly. Second, more frequent interactions and closer relationships enhance the emergence of trust and reciprocity (Dyer & Singh, 1998; Schilling & Phelps, 2007), which may result in tacit knowledge transfer (Hansen, 1999) between two competitors. This might lock both competitors into a code of conduct of decision coordination that increases transaction costs and prevents either of the collaborators from independently introducing new-to-market products. Coopetitors will work together towards knowledge creation and transfer and a joint market entry (Ahuja, 2000). Third, an increase in coopetition intensity potentially fosters the formation of long-term relationships between competitors, which are assumed to be beneficial for radical innovation (Kobarg, Stumpf-Wollersheim, & Welpe, 2019). Accordingly, it is more likely that greater trust and collaboration will result in coordinating the effort to market entry, preventing either competitor of doing it ad-hoc. Fourth, an increase in coopetition intensity supports co-development mechanisms, resulting in joint R&D and joint protection of knowledge and locking in coopetitors in joint projects that result in coordination of market entry with coopetitors (Park et al., 2014). Fifth, opportunism could be the outcome of intense and close coopetition with rivals (Salvetat & Géraudel, 2012), resulting in knowledge leaks (Estrada, 2016) and "snapping off" the market-specific knowledge from rivals, thus dissipating the competitive advantage and delaying or halting the FMA (Lieberman & Montgomery, 1988, 2013). Accordingly, we hypothesize that:

H1. Coopetition intensity decreases the propensity of achieving a FMA.

2.3. Imitation in innovation-related coopetition

Regarding product introduction, innovation is not the only strategy available. Because there can be only one pioneer in any product market, imitation strategies remain the most common type of innovation strategies (Schnaars, 2002; Zhou, 2006). There is a continuum along which imitation strategies can fall, whose extremes are pure clones on the one hand and creative imitation on the other hand. The former one consists of identical products (the so-called "me-too" products), whereas the latter one involves taking an existing product and improving on it (Schnaars, 2002; Shankar, Carpenter, & Krishnamurthi, 1998). In between these two extremes, there is a myriad of forms of imitation strategies that imply increasing levels of creativity moving from the pure clone extreme to the creative imitation extreme.

Imitation strategies have been initially examined in historical and qualitative analyses (see Schnaars, 2002). Leveraging data related to 13 brands in the pharmaceutical industry, Shankar et al. (1998) discover that late entrants adopting a creative imitation strategy can grow faster, delay and slow down the pioneer's diffusion, and ultimately, overtake the pioneer. On the contrary, late entrants adopting a non-creative imitation strategy, can achieve a reduced market potential, less effective marketing strategies and activities and lower repeat rates compared with the pioneer.

Prior research has illustrated who benefits from imitation and when it would be most profitable for a firm to imitate (Lieberman & Asaba, 2006), without paying enough attention to the role of coopetition as a major driver of adopting and pursuing imitation strategy. For example, in their study Shankar et al. (1998) analyze data of 29 brands in drug markets and find that entry timing significantly influences a late mover's success. Fast followers grow more rapidly than either pioneers or mature-stage entrants and tend to outperform the pioneers. On the contrary, mature-stage entrants achieve a poor market response to their product improvement and marketing activities and grow slowly, and thus are disadvantaged. Adopting a behavioral approach, Zhang and Markman (1998) develop three laboratory experiments and found that late entrants with enhanced features are evaluated more favorably than the pioneer, thus suggesting that a creative imitation strategy can be effective.

Prior research provides mixed evidence about the effect of coopetition on imitation. By adopting an isomorphism theoretical lens, and by examining 83 firms in the retail industry engaged with mergers and acquisitions, Moatti (2009) suggests that the likelihood to imitate competitors declines as the experience in alliances increases. In their analysis, Hallberg and Brattström (2019) find that knowledge concealing and revealing may result in imitation by competitors. The authors argue that firms seek protection from imitation by using complementary assets, causal ambiguity, and intellectual property protection.

In one of the few studies in coopetition literature focusing on imitation, Mention (2011) conducts an analysis of 1052 firms participating in the fourth wave of the innovation survey and discovers that coopetition does not enhance innovation in service firms. More specifically, she suggests that utilizing information from competitors does not stimulate innovation novelty in service firms; on the contrary, it may increase the imitation rate.

In a nutshell, firms that rely on coopetition are less likely to radically innovate independently from their competitors They may use tacit knowledge acquired via coopetition to pursue an imitation strategy. Based on the literature reviewed and the finding of Mention (2011), we argue that coopetition enables learning from competitors that is used to replicate competitor's innovation (Roper, Love, & Bonner, 2017) and hence enables firms to replicate the products manufactured by competitors.

We further argue that repeated, deep interactions within a specific knowledge domain can be equated with the repeated use of similar knowledge elements (Katila & Ahuja, 2002). Moreover, imitation can be regarded as a process of combining various knowledge within close rival technological domains that is stimulated by high levels of familiarity (Shane, 2000). Coopetition intensity increases absorptive capacity of firms and brings tacit knowledge in a narrow set of closely related technological domains and industries (Van den Bosch, Volberda, & de Boer, 1999). The establishment of such familiarity with the routines and tacit knowledge of firms' competitors (Katila & Ahuja, 2002), will disable firm's tight control over knowledge flow between competitors, generating unintended knowledge leakages (Srivastava & Gnyawali, 2011). Along with competences and deep knowledge about customers and market where rivals operate together, this creates conditions to imitate competitor's products. Therefore, we hypothesize that:

H2. Coopetition intensity increases the propensity of imitation.

3. Data and method

3.1. Data matching and sample description

To test our hypotheses, we used two databases: the Business Structure database (known as Business Register) and the UK Innovation Survey (UKIS) over 2002–2014. The UK Innovation Survey is part of a wider Community Innovation Survey (CIS) covering EU countries. Although two datasets were pooled together and constructed from two different sources, they are matchable. First, we collected and matched six consecutive UKIS waves (UKIS 4 2002–04, UKIS 5 2004–06, UKIS 6 2006–08, UKIS 7 2008–10, UKIS 8 2010–12, and UKIS 9 2012–14); each of them was conducted every second year by the Office of National Statistics (ONS), United Kingdom (UK) on behalf of the Department of Business Innovation and Skills (BIS). Second, we used the Business Structure database (BSD) data for the years 2002, 2004, 2006, 2008, 2010, and 2012: the data were matched to the correspondent CIS survey waves with the data from the BSD taken for the initial year of UKIS period. The BSD is a version of the Inter-Departmental Business Register for research use; it includes data on changes in firm legal status, ownership (foreign or national firm), alliance information (whether the firm belongs to a larger enterprise network), export, turnover, employment, industry category at the 5-digit level, and the location of the firm according to the postcode. The BSD is the key sampling frame for UK business statistics and is maintained and developed by the Business Registers Unit (BRU) within the ONS. The data are derived by specifically using Value Added Tax (VAT) businesses and Company Registration (for businesses that wish to operate with limited liability). Each wave of the UKIS is selected as a stratified sample of a pool of firms by industry, region, and size. The panel element in a sample if any, is treated using the multilevel estimation approach. The overall sample consists of 21,140 observations.

The surveys and our dataset include all industrial sectors among which we have five major innovative industries: high-tech manufacturing, ICT, KIBS, creative industries, and the remaining industries (other sectors). The creative sector represents 4.4% of the sample, followed by ICT (7.3%) and KIBS (10.5%). High-tech manufacturing accounts for the highest share, with 11.6% of the observations. Other sectors represent 66.2% of the sample.

The distribution of firms across estimated and population samples with regard to industries, regions and size remains stable over the period 2002–2014. This is important as it enables us to generalize the results of our estimates to a larger sample.

3.2. Dependent and explanatory variables

3.2.1. Dependent variables

While our focal dependent variables are FMA and imitation, we also added two additional dependent variables in our analysis: radical and incremental innovation as part of the robustness checks. Our first focal-dependent variable is FMA measured as a binary variable that equals one if the business introduced a new good or service to the market before competitors and zero otherwise. This operationalization of FMA is consistent with the notion of FMA that pertains to the benefits or first market entry and introducing a new-to-market product or service (new product/process) (Lieberman & Montgomery, 1988; Rugman & Verbeke, 2000). This measurement is also consistent with FMA as it is defined by Murmann (1994) as a strategy whereby a business enters a market before the other competitors by compressing the time elapsing between the development of a new offering (order of entry) and its commercialization. Consistent with prior research on FMA, we operationalize it using UKIS question 710 as "This business introduced a new good or service that were new to the market before your competitors" (Murmann, 1994; Patterson, 1993; Varadarajan, Yadav, & Shankar, 2008).

Our second dependent variable is *imitation*, which is measured based on question 720 of the UKIS survey as a binary variable that equals one if the business introduced a new good or service that was essentially the same as a good or service already available from competitors, zero otherwise and this question is in line with other scales used to measure imitation (e.g., Faems, Van Looy, & Debackere, 2005; Laursen & Salter, 2006, 2014; Oerlemans, Knoben, & Pretorios, 2013).

As additional dependent variables, we deployed both radical and incremental innovation consistent with the prior research on external knowledge collaboration and innovation strategies (Kobarg et al., 2019; Ritala & Hurmelinna-Laukkanen, 2013; Roper et al., 2017; Van Beers & Zand, 2014) and on coopetition and innovation performance (Bengtsson et al., 2010; Park et al., 2014; Srivastava & Gnyawali, 2011). We deployed revenues from new-to-market products, as a percentage of total sales and as a measure of radical innovation. This indicator is based on UKIS question 810: "percentage of total turnover over the last 3 years from goods and services that are new to the market."

To measure incremental innovation, we considered UKIS survey question 820: "percentage of total turnover over the last 3 years from goods and services that are new to the firm." The new product share varies from 0% to 100%. By definition, measures of innovation based on products are characterized by a lower bound of zero as no negative values are possible. Firms report zero in cases where no innovation project was undertaken or this was not completed over the 3-year period to which the questionnaire referred. Innovation plans may not have been completed within the 3-year period because of one of the following reasons: the project was abandoned or seriously suspended; the project was seriously delayed with respect to initial planning; the project requires more than 3 years to be completed. Firms reporting positive values of innovation have demonstrated commercialization of new products.

3.2.2. Independent variables

For each external partner, firms indicated whether and with which partner type collaboration was conducted and the extent of collaboration. Based on the synthesis of extant literature on coopetition performance implications described in Table 1 (e.g., Park et al., 2014; Ritala, 2012; Ritala & Hurmelinna-Laukkanen, 2013; Roper et al., 2017) and on the consideration that we need to distinguish between weak, moderate, and strong levels of both competition and cooperation (see our model in Table 2) to define coopetition intensity, we operationalized coopetition intensity as the extent of the interactions between the focal firm and its competitor as 1-low, 2-medium, and 3-high level of coopetition intensity. This corresponds to the coopetition intensity identified in Table 1 as "weak," "balanced moderate," and "balanced strong." Our second explanatory variable is the presence of coopetition, which is a binary variable that equals one if a firm collaborates with a competitor on innovation or is zero otherwise.

3.2.3. Control variables

Our first control variable is a binary variable that takes the value of 1 if the firm is foreign owned, e.g., the headquarters are not in the UK, and 0 otherwise. Knowledge collaboration is an important channel of knowledge transfer: therefore, we included controls for collaboration intensity across six main types of collaboration partners (Faems et al., 2005) including government, universities, consultants, customers, suppliers, and the enterprise groups.

Existing research suggests that start-ups are more likely to commercialize knowledge from government and universities as well as within alliances (Gulati & Singh, 1998; Lavie & Miller, 2008) for further innovation. Young companies will be drawing more heavily on innovation and in particular from institutional collaboration partners. For all these reasons, age in years is used as a control variable matched from the ABS data for the first year of the UKIS wave (2002–2004 as a reference year). Moreover, we include regional fixed effects using dummies for 11 regions (Northeast of England is the reference category). We also controlled for used constraints to innovation such as risk and cost of innovation and lack of technology. Finally, we introduced control variables for the export activity, firm size, whether firms survived until 2017, and market concentration measure, including the Herfindahl index.

Some studies have found that firms creating technology (Ketchen et al., 2004) or having a direct sales force (Schoenecker & Cooper, 1998) are more likely to create the first move. Accordingly, we control for the intensity of technology use by including high-tech and medium-tech manufacturing binary variables, with low-tech manufacturing as a reference category. By including high-tech manufacturing controls, we measure whether the presence of cooperation between horizontal competitors (i.e., horizontal coopetition) increases the propensity of imitating new products/services more for technology firms than for non-technology ones, and more for firms with a direct sales force than for firms without a direct sales force (Audretsch & Belitski, 2020).

The description of the variables, including the source of variable and summary statistics – mean and standard deviation – are illustrated in Table 3. The correlation matrix can be viewed in Appendix 1.

3.3. Model specification

To test our research hypotheses, we employ logit regressions for the binary dependent variables of FMA and imitation. We also examine the effect of coopetition on radical and incremental innovation by deploying a Tobit model. We also controlled for heteroscedasticity in standard errors. The following model was estimated:

$$y_{it} = f(\beta x_{it,}\ \theta z_{it},\ \mu_{it})\ \mathrm{i} = 1, \ldots \mathrm{N};\ \mathrm{t} = 1,\ \mathrm{m} \quad (1)$$

where y_{it} is the outcome (FMA or imitation) of firm i in time t which varies from 0 to 1 in the logit model or innovation performance (radical or incremental) that varies from 0 to 100 in the Tobit model. β and Θ are parameters to be estimated, x_{it} is a vector of independent explanatory variables including coopetition of firm i in time t, z_{it} is a vector of control variables of firm i in time t; u_{it} is the error term. To address concerns of multicollinearity, we used variance inflation factor (VIF) in all models. We used logistic regression with industry, year, and city fixed effects to evaluate the effect of coopetition (presence and intensity) on the propensity of achieving an FMA or undertaking an imitation strategy. Moreover, we applied the Tobit estimation with year and city fixed effects to evaluate the effect of coopetition (presence and intensity) on radical and incremental innovation.

4. Findings

4.1. Evaluating the effect of coopetition on FMA

We start by reporting the results of Table 4 that shows to what extent the ability to introduce new goods/services to the market before competitors, namely the FMA, is affected by the presence and intensity of coopetition using a logit estimation (columns 1–3, Table 4). It also reports – for the sake of space – the effect of coopetition on radical innovation in the guise of sales of new-to-market products (columns 4–6, Table 4) estimated by means of a Tobit regression.

As shown in Table 4, Model (3), the intensity of horizontal coopetition influences significantly FMA: indeed, an increase by one unit (from medium to high or from no coopetition to low) of the coopetition intensity reduces the likelihood of a FMA by 13%. Therefore, our H1 is supported. Interestingly, we also find that the presence of horizontal coopetition does not per se influence radical innovation, while the intensity of coopetition negatively influences radical innovation: more specifically, an increase by one unit of coopetition intensity reduces radical innovation by 0.87%. Taken together, the effects of coopetition intensity on FMA and radical innovation suggest that a coopeting firm, while cooperating, opens a “small window” of knowledge into competitors that is not sufficient enough to enable it to appropriate the knowledge created by the competing firms (Hall, Helmers, Rogers, & Sena, 2014). Overall, we find support for our hypotheses that coopetition intensity (weak, moderate, and strong) influences FMA: this extends and expands what we know about the effects of coopetition on FMA (Nemeh, 2018; Nemeh & Yami, 2019).

Overall, if we read the results conjointly, the higher the coopetition intensity, the lower the propensity to develop new products before the competitors and the lower the radical innovation. This seems to suggest that the more intensely firms collaborate with their competitors, the less they will generate radical innovation as coordination with competitors is needed. Firms are at risk of remaining “locked” into their markets, thus preventing them from making the first move into new markets (Balland, Boschma, & Frenken, 2015).

4.2. Evaluating the effect of coopetition on imitation

Table 5 portrays the results of the extent to which the propensity to imitate an existing product - namely an imitation strategy – is affected by the presence and intensity of coopetition using a logit estimation (columns 1–3, Table 5). It also reports – for the sake of space – the effect of coopetition on incremental innovation in the guise of sales of new-to-market products (columns 4–6, Table 5) estimated using Tobit regression.

As shown in Table 5, Model (3), the intensity of horizontal coopetition positively and significantly influences imitation: indeed, an increase by one unit (from medium to high, from low to medium, or from no coopetition to low) of the coopetition intensity increases the likelihood of product imitation by 22%. Therefore, our H2 is supported as collaboration with competitors increases the propensity of imitation.

Interestingly, we also find that the presence of horizontal coopetition positively influences incremental innovation, while the intensity of coopetition positively influences incremental innovation: more specifically, an increase by one unit of coopetition intensity, increases incremental innovation by 0.97%. Taken together, the effects of coopetition intensity on product imitation and incremental innovation suggest that when competing firms collaborate, they open a “small window” of knowledge into competitors that is sufficient enough to enable them to appropriate some of the knowledge created by the competing firms (Hall et al., 2014) that can be used to mimic the product with a clone or another form if imitation. This finding is partially in line with extant literature which found that coopetition generates imitation rather than radical innovation (e.g., Mention, 2011). Moreover, the finding related to incremental innovation is consistent with the results obtained by

Table 3
Description of variables.

Variable (source)	Definition	Observations	Observations that are not zero	Mean	St. dev.
Radical Innovation (UKIS)	% of firm's total turnover from goods and services that were new to the market (%)	21,140	6480	3.68	12.17
Incremental Innovation (UKIS)	% of firm's total turnover from goods and services that were new to the firm (%)	21,140	8308	4.22	11.87
First mover advantage	This business introduced a new good or service to the market before competitors = 1, zero otherwise	21,140	6821	0.50	0.51
Imitation	This business introduced a new good or service that was essentially the same as a good or service already available from competitors = 1, zero otherwise	21,140	8785	0.63	0.48
Age (BSD)	Age of a firm (years since the establishment)	21,140	21,140	17.85	9.71
Employment (BSD)	Number of full-time employees, in logarithms	21,140	21,140	4.00	1.48
High-tech manufacturing (UKIS)	Binary variable equals one if SIC2007 (2 digit): 21, 26, 30; zero otherwise	21,140	357	0.01	0.06
Med-tech manufacturing (UKIS)	Binary variable equals one if SIC2007 (2 digit): 20, 22–25, 27–29, 32; zero otherwise	21,140	2236	0.06	0.24
Economic risks	Scores 0 to 3 for the factors that are the main constraints to innovation: cost of finance	21,140	16,380	1.08	1.09
Cost of finance	Scores 0 to 3 for the factors that are the main constraints to innovation: firm has experienced excessive economic risks, zero otherwise	21,140	16,374	1.16	1.13
Lack of technology	Scores 0 to 3 for the factors that are the main constraints to innovation: lack of information on technology	21,140	14,669	0.74	0.83
Scientist (UKIS)	The proportion of employees that hold a degree or higher qualification in science and engineering at BA/BSc, MA/PhD, PGCE levels	21,140	12,247	6.49	16.18
Exporter (UKIS)	Binary variable = 1 if a firm sells its products in foreign markets, 0 otherwise	21,140	11,059	0.35	0.48
Survival (BSD)	Binary variable = 1 if a firm survived as an independent unit or as a part of a group until year 2017, 0 otherwise	21,140	14,994	0.58	0.49
Herfindahl Index	Herfindahl Index calculated using concentration in sales by 2 SIC digit industry.	21,140	21140	0.04	0.05
Foreign (BSD)	Binary variable = 1 if a firm has headquarters abroad, 0 otherwise	21,140	10,699	0.45	0.50
Subsidiaries (BSD)	Number of firm's subsidiaries and local units, in logarithms	21,140	20,748	1.00	0.92
Enterprise group	Binary variable = 1 if firm uses information for business' innovation activities from within the enterprise group and other firms in the enterprise group, zero otherwise	21,140	17.933	0.69	0.46
Suppliers	Binary variable = 1 if firm uses information for business' innovation activities from suppliers of equipment, materials, services, or software and other suppliers, zero otherwise	21,140	18,333	0.72	0.45
Customers	Binary variable = 1 if firm uses information for business' innovation activities from clients or customers from the private and public sector and clients, zero otherwise	21,140	18,063	0.73	0.44
Presence of coopetition	Binary variable = 1 if firm uses information for business' innovation activities from competitors in the industry, zero otherwise	21,140	17,276	0.67	0.47
Consultants	Binary variable = 1 if firm uses information for business' innovation activities from consultants, commercial labs, or private R&D institutes; zero otherwise	21,140	11,922	0.45	0.50
University	Binary variable = 1 if firm uses information for business' innovation activities from universities or other higher education institutes, zero otherwise	21,140	8323	0.29	0.46
Government	Binary variable = 1 if firm uses information for business' innovation activities from government or public research institutes, zero otherwise	21,140	8543	0.31	0.46
Enterprise group intensity	How important to business' innovation activities (from zero – not important to 3 – highly important) was the extent of the interactions between the focal firm and its enterprise group	21,140	17.933	1.60	1.22
Suppliers intensity	How important to business' innovation activities (from zero – not important to 3 – highly important) was the extent of the interactions between the focal firm and its suppliers of equipment, materials, services, or software	21,140	18,333	1.44	1.10
Customers intensity	How important to business' innovation activities (from zero – not important to 3 – highly important) was the extent of the interactions between the focal firm and its clients or customers	21,140	18,063	1.68	1.20
Coopetition intensity	How important to business' innovation activities (from zero – not important and not used to 1- low, 2- medium and 3- highly important) was the extent of the interactions between the focal firm and its competitors in the industry	21,140	17,276	1.23	1.05
Consultants' intensity	How important to business' innovation activities (from zero – not important to 3 – highly important) was the extent of the interactions between the focal firm and consultants, commercial labs, or private R&D institutes	21,140	11,922	0.67	0.87
University intensity	How important to business' innovation activities (from zero – not important to 3 – highly important) was the extent of the interactions between the focal firm and universities or other higher education institutes	21,140	8323	0.42	0.74
Government intensity	How important to business' innovation activities (from zero – not important to 3 – highly important) was the extent of the interactions between the focal firm and government or public research institutes	21,140	8543	0.43	0.73

Office for National Statistics. (2017). *Business Structure Database, 1997–2017: Secure Access*. [data collection]. 9th *Edition.* UK Data Service. SN: 6697, http://doi.org/10.5255/UKDA-SN-6697-9.
Source: Department for Business, Innovation and Skills, Office for National Statistics, Northern Ireland. Department of Enterprise, Trade and Investment. (2018). *UK Innovation Survey, 1994–2016: Secure Access*. [data collection]. 6th *Edition.* UK Data Service. SN: 6699, http://doi.org/10.5255/UKDA-SN-6699-6

Bouncken et al. (2018) who observed a positive relationship between coopetition intensity and incremental innovation outcomes regardless of NPD phase and industry.

4.3. *Linear effect of coopetition intensity on innovation performance*

Should the relationship between coopetition and innovation performance outcomes – namely FMA and imitation – be non-linear, it could not be interpreted directly from Tables 3 and 4. To address this issue, we plotted the predictive margins of the effect of coopetition intensity on FMA and radical innovation (see Fig. 1A and 1B). Both the effects are negative, thus corroborating the results in Table 4 and clearly indicating that there is a linear effect of coopetition intensity on the one hand and FMA and radical innovation on the other hand. This means that the effect of the coopetition intensity on "major" innovation outcomes such as FMA and radical innovation does not change at any level of coopetition, and that independently of the level of coopetition (high or low), the marginal effect on the innovation outcome does not change. This finding is in contrast with literature that has detected different and more complex functional forms of the relationship between coopetition and innovation outcomes: for instance, Wu (2014) has observed an inverted U-shape relationships between coopetition and innovation.

We also plotted the predictive margins of the effect of coopetition intensity on imitation and incremental innovation (see Fig. 1C and 1. D). Both the effects are positive, thus corroborating the results in Table 5, and emphasizing that there is a linear effect of coopetition intensity on the one hand and imitation FMA and incremental innovation on the other hand. This implies that the effect of coopetition intensity on "minor" innovation performance outcomes such as imitation and incremental innovation does not change at any level of coopetition intensity, and that independently of the level of coopetition (high or low), the marginal effect on the innovation outcome does not change. This finding enriches the literature wherein a positive relationship was found between coopetition and incremental innovation but has not explicitly shown the linear relationship (e.g., Bouncken et al., 2018; Estrada, 2016; Pereira & Leitão, 2016; Ritala, 2012; Ritala & Hurmelinna-Laukkanen, 2013).

5. Discussion and summary

5.1. Summary of key findings

We make multiple contributions to the literature at the intersection of coopetition and innovation performance outcomes and more generally innovation-related coopetition. First, we show that coopetition intensity negatively influences FMA, thus contributing the first quantitative empirical evidence to the emergent research stream revolving around coopetition and FMA in response to recent calls for more research on the area (Nemeh, 2018; Nemeh & Yami, 2019). The effect observed should be read in tandem with the detected negative influence of coopetition on radical innovation performance. This latter negative effect is quite novel in the innovation-related coopetition literature that has found either positive or no effect of coopetition on radical innovation. This discrepancy might be explained in two different and complementary ways: first, most of the previous literature has focused on the mere presence of a coopetitive relationship, without operationalizing coopetition intensity based on observational measures; second, absorptive capacity might not be counterbalanced by strong

Table 4
Logistic and Tobit regression estimation results for first mover advantage and radical innovation.

Dependent variables	First mover advantage (odds ratio)			Radical innovation		
Specification	(1)	(2)	(3)	(4)	(5)	(6)
Weighting	No	No	Yes	No	No	Yes
Estimation method	Logit	Logit	Logit	Tobit	Tobit	Tobit
Age	0.99 (.01)	1.00 (.01)	1.00 (.01)	−0.64*** (.13)	−0.61*** (.13)	−0.60*** (.13)
Age squared	1.00 (.01)	1.00 (.01)	1.00 (.01)	0.01*** (.00)	0.01** (.00)	0.01** (.00)
Employment	1.02 (.01)	0.99 (.01)	0.98 (.01)	−1.05*** (.24)	−1.35*** (.24)	−1.50*** (.24)
High-tech manufacturing	1.50 (.35)	1.46 (.38)	1.48 (.39)	5.51 (3.6)	4.87 (3.6)	5.47 (3.5)
Med-tech manufacturing	1.03 (.12)	1.04 (.12)	1.07 (.13)	1.61 (1.6)	1.90 (1.6)	2.16 (1.6)
Economic risks	1.16*** (.02)	1.10*** (.02)	1.08*** (.02)	1.09*** (.32)	0.75* (.32)	0.57 (.32)
Cost of finance	1.01 (.02)	0.96 (.02)	0.97 (.02)	0.96** (.32)	0.75* (.33)	0.74* (.32)
Lack of technology	1.16*** (.03)	1.06* (.03)	1.06* (.03)	0.59 (.39)	−0.06 (.4)	−0.10 (.4)
Scientist	1.01*** (.00)	1.01*** (.00)	1.01*** (.00)	0.21*** (.01)	0.19*** (.01)	0.18*** (.01)
Exporter	1.78*** (.07)	1.60*** (.07)	1.56*** (.07)	5.45*** (.65)	4.86*** (.65)	4.60*** (.65)
Survival	1.04 (.04)	1.05 (.04)	1.05 (.04)	0.05 (.61)	0.05 (.61)	−0.04 (.61)
Herfindahl Index	1.39 (.41)	1.34 (.41)	1.29 (.4)	4.37 (4.9)	4.74 (4.9)	4.22 (4.9)
Foreign	1.06 (.05)	1.05 (.05)	1.05 (.05)	−0.62 (.72)	−0.78 (.72)	−0.84 (.72)
Subsidiaries	1.00 (.01)	1.00 (.01)	1.00 (.01)	−0.04 (.00)	−0.05 (.00)	−0.01 (.00)
Enterprise group		1.50*** (.14)	1.23*** (.03)		2.85* (1.4)	1.59*** (.37)
Suppliers		1.14 (.09)	0.99 (.02)		1.14 (1.3)	0.63 (.35)
Customers		1.45*** (.16)	1.21*** (.03)		4.27** (1.60)	1.75*** (.40)
Presence of coopetition		0.93 (.07)			−0.18 (1.1)	
Coopetition intensity (H1)			0.87*** (.02)			−0.87* (.37)
Consultants		1.10 (.05)	1.09*** (.02)		1.29 (.74)	1.12** (.37)
University		1.30*** (.07)	1.25*** (.01)		1.57 (.84)	1.44** (.45)
Government		1.12* (.06)	1.05 (.03)		1.52 (.82)	0.65 (.46)
Constant	−0.25 (.31)	−0.76* (.33)	−0.64* (.33)	3.96 (4.3)	−2.53 (4.5)	−1.30 (4.4)
Error variance				594.7*** (13.0)	592.0*** (12.0)	587.2*** (12.0)
City-region controls	No	Yes	Yes	No	Yes	Yes
Regional controls	No	Yes	Yes	No	Yes	Yes
Left censored				4524	4524	4524
Chi^2	3846.27	2008.00	2149.11	1478.12	1554.30	1618.63
Log-likelihood	−8640.06	−7828.00	−7757.60	−26598.26	−26535.78	−26503.60
R^2	.18	.11	.12	.03	.02	.03

Number of observations - total sample: 21,140.
Note: Reference category for legal status is Company (limited liability company), industry (mining), region (Northeast of England).
Robust standard errors are in parentheses. The coefficients of the regressions (1–3) are the marginal effect of the independent variable on the propensity to develop new products before the competitors, ceteris paribus. The coefficients of the regressions (4–6) are the marginal effect of the independent variable on the radical innovation sales, ceteris paribus. For dummy variables, it is the effect of a discrete change from 0 to 1. Significance level: *$p < 0.05$; **$p < 0.01$, ***$p < 0.001$.
Source: Department for Business, Innovation and Skills, Office for National Statistics, Northern Ireland. Department of Enterprise, Trade and Investment. (2018). UK Innovation Survey, 1994–2016: Secure Access. [data collection]. 6th Edition. UK Data Service. SN: 6699, http://doi.org/10.5255/UKDA-SN-6699-6.
Office for National Statistics. (2017). Business Structure Database, 1997–2017: Secure Access. [data collection]. 9th Edition. UK Data Service. SN: 6697, http://doi.org/10.5255/UKDA-SN-6697-9.

Table 5
Logistic and Tobit regression estimation results for imitation and incremental innovation.

Dependent variables	Imitation (odds ratio)			Incremental innovation		
Specification	(1)	(2)	(3)	(4)	(5)	(6)
Estimation method	Logit	Logit	Logit	Tobit	Tobit	Tobit
Weighting	No	No	Yes	No	No	Yes
Age	0.99 (.00)	0.99 (.00)	0.99 (.00)	−0.64*** (.11)	−0.63*** (.11)	−0.61*** (.11)
Age squared	1.00 (.00)	1.00 (.00)	1.00 (.00)	0.01*** (.00)	0.01*** (.00)	0.01*** (.00)
Employment	0.97 (.01)	0.95* (.01)	0.95** (.01)	−0.89*** (.21)	−1.05*** (.21)	−1.14*** (.21)
High-tech manufacturing	1.24 (.31)	1.29 (.37)	1.37 (.40)	0.45 (3.3)	0.13 (3.3)	0.54 (3.3)
Med-tech manufacturing	1.03 (.13)	0.93 (.12)	0.93 (.12)	2.65 (1.4)	2.74 (1.4)	2.71 (1.4)
Economic risks	1.09*** (.02)	1.03 (.02)	1.03 (.02)	1.02*** (.28)	0.72** (.28)	0.62* (.28)
Cost of finance	1.07** (.02)	1.03 (.02)	1.03 (.02)	0.43 (.29)	0.25 (.29)	0.26 (.29)
Lack of technology	1.13*** (.03)	1.05 (.03)	1.07* (.03)	0.68* (.35)	0.25 (.35)	0.33 (.35)
Scientist	0.99*** (.00)	0.99*** (.00)	0.99*** (.00)	0.50 (.01)	0.12 (.01)	0.59 (.01)
Exporter	1.14** (.05)	0.96 (.04)	0.95 (.04)	0.45 (.57)	−0.05 (.57)	−0.14 (.58)
Survival	0.96 (.04)	0.95 (.04)	0.95 (.04)	0.05 (.53)	−0.37 (.53)	−0.40 (.53)
Herfindahl Index	1.47 (.46)	1.21 (.42)	1.160 (.40)	−3.41 (4.6)	−3.13 (4.6)	−3.46 (4.6)
Foreign	0.93 (.05)	0.96 (.05)	0.96 (.05)	−0.24 (.64)	−0.31 (.64)	−0.36 (.63)
Subsidiaries	1.01 (.00)	1.01 (.00)	1.01 (.00)	−0.01 (.00)	−0.04 (.00)	−0.01 (.00)
Enterprise group		1.65*** (.15)	1.15*** (.03)		3.80** (1.2)	1.47*** (.32)
Suppliers		1.04 (.08)	1.05* (.02)		−1.69 (1.1)	0.73* (.30)
Customers		1.08 (.11)	0.97 (.02)		4.98*** (1.4)	0.61 (.35)
Presence of coopetition		1.48*** (.12)			2.75** (.98)	
Coopetition intensity (H2)			1.22*** (.03)			0.97** (.33)
Consultants		1.01 (.05)	0.96 (.02)		0.56 (.64)	0.17 (.33)
University		0.87* (.057)	0.89** (.03)		0.73 (.74)	0.08 (.41)
Government		0.95 (.061)	0.96 (.03)		−0.20 (.72)	−0.40 (.42)
Constant	0.95** (.32)	0.35 (.34)	0.61 (.34)	12.88** (4.0)	5.43 (4.2)	7.69 (4.1)
Error variance				478.1*** (9.1)	475.7*** (9.0)	475.0*** (9.0)
City-region controls	No	Yes	Yes	No	Yes	Yes
Regional controls	No	Yes	Yes	No	Yes	Yes
Left censored				2869	2869	2869
Chi^2	5320.21	2376.21	2383.80	736.76	821.50	823.69
Log-likelihood	−8265.69	−6906.24	−6897.08	−29846.14	−29803.7	−29802.6
R^2	.24	.14	.14	.02	.01	.01

Number of observations-total sample: 21,140.
Note: reference category for legal status is Company(limited liability company), industry(mining), region(North East of England).
Robust standard errors are in parenthesis. The coefficients of the regression(1–3) are the marginal effect of the independent variable on the propensity to imitate products and services produced by the competitors, ceteris paribus. The coefficients of the regression(4–6) are the marginal effect of the independent variable on the incremental sales, ceteris paribus, For dummy variables, it is the effect of a discrete change from 0 to 1. Significance level: *p < 0.05; **p < 0.01, p < 0.001.
Office for National Statistics. (2017). Business Structure Database, 1997–2017: Secure Access. [data collection]. 9th Edition. UK Data Service. SN: 6697, http://doi.org/10.5255/UKDA-SN-6697-6.
Source: Department for Business, Innovation and Skills, Office for National Statistics, Northern Ireland. Department of Enterprise, Trade and Investment. (2018). UK Innovation Survey, 1994–2016: Secure Access. [data collection]. 6th Edition. UK Data Service. SN: 6699, http://doi.org/10.5255/UKDA-SN-6699-9

appropriability mechanisms, and this makes firms feel that they do not have sufficient protection to engage in radical innovation (see Ritala & Hurmelinna-Laukkanen, 2013).

Second, we found that coopetition intensity positively influences imitation, suggesting that the more intensely competing firms collaborate with one another, the more likely they will be imitating their coopetitor's products. The effect observed should be read in tandem with the detected positive influence of coopetition on incremental innovation performance. This latter positive effect is consistent with most of the studies that have analyzed the relationship between coopetition and incremental innovation (e.g., Bouncken et al., 2018; Ritala & Hurmelinna-Laukkanen, 2013). In the following subsections, we discuss both theoretical contributions and managerial implications.

5.2. Theoretical contributions

Several theoretical implications emerge from this work, thus making multiple contributions at the intersection between the coopetition, innovation, and FMA literatures. First, we contribute to the nascent literature stream revolving around coopetition and FMA (Nemeh, 2018; Nemeh & Yami, 2019) by illustrating the differential effect of coopetition intensity on FMA and imitation (negative and positive, respectively). We thereby contribute to coopetition literature by improving scholarly understanding of innovation strategies at different levels of coopetition intensity. Accordingly, this study is the first to bridge empirically and conceptually the FMA literature (e.g., Ketchen et al., 2004; Lieberman & Montgomery, 1988, 2013; Murmann, 1994) with the coopetition innovation research stream (e.g., Bouncken et al., 2018; Estrada et al., 2016; Ritala & Sainio, 2014; van den Broek et al., 2018), thus mobilizing concepts and constructs that have never been considered conjointly to illuminate coopetitive strategies leading to innovation outcomes.

Second, our study contributes to a more nuanced conceptualization and operationalization of coopetition intensity compared to extant prevailing conceptualizations (e.g., Park et al., 2014). From a conceptual point of view, Park et al. (2014) suggested that cooperation and competition intensity can be either weak or strong, and thus, they derived their typology of coopetition including four different combinations: weak coopetition, cooperation-dominant coopetition, competition-dominant coopetition, and balanced-strong coopetition. In our study, we recognize that both cooperation and competition can also assume an intermediate value – namely moderate – between the two extremes of weak and strong. This implies that the possible combinations are nine and not four. In particular, we introduce the concept of *balanced moderate coopetition* which is a situation whereby both cooperation and competition are moderate – neither weak nor strong.

Balanced moderate coopetition has implications on coopetition innovation that are distinctively different from the implications of weak coopetition and balanced strong coopetition. More specifically, we suggest that there is a more fine-grained typology of coopetition than

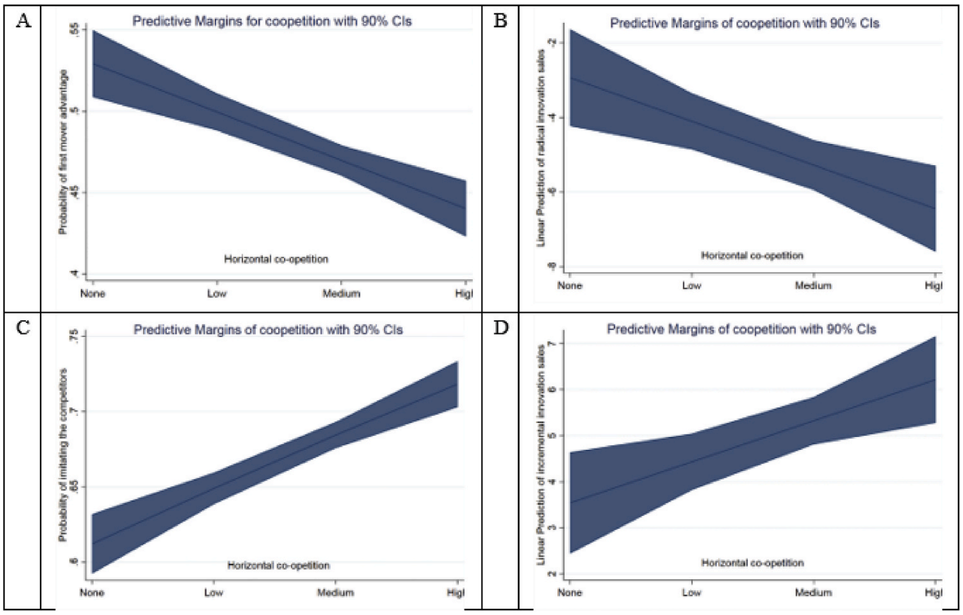

Fig. 1. Predictive margins for horizontal coopetition and the propensity of first market entry before competitors(1.A), rate of radical innovation sales(1.B), imitating Competitors' products(1.C), incremental innovation sales(1,D).
Source: Department for Business, Innovation and Skills, Office for National Statistics, Northern Ireland. Department of Enterprise, Trade and Investment. (2018). *UK Innovation Survey*, 1994–2016: Secure Access. [data collection]. *6th Edition.* UK Data Service. SN: 6699, http://doi.org/10.5255/UKDA-SN-6699-9 Office for National Statistics. (2017). *Business Structure Database*, 1997–2017: *Secure Access.* [data collection]. *9th Edition.* UK Data Service. SN: 6697, http://doi.org/10.5255/UKDA-SN-6697-9.

that introduced by Park et al. (2014) and adopted so far by most of the scholars dealing with coopetition innovation. From a conceptual point of view, the new typology introduced entails nine types of coopetitive strategies instead of four, and it better mirrors real-world coopetition situations. Similarly, we also make a conceptual extension to the way *coopetition intensity* has been conceptualized so far (Park et al., 2014) by suggesting that our more nuanced typology bears implications on the way we can examine coopetition intensity in multiple real-world scenarios. Future research might build on the novel typology of coopetition strategies introduced to examine whether: (1) it is able to capture a higher number of real-world coopetition arrangements across different contexts and settings and (2) it leads to a more granular understanding of the influence of coopetition intensity on FMA and other innovation outcomes.

Third, we contribute to the innovation-related coopetition literature which displays mixed results in relation to incremental and radical innovation outcomes (Bengtsson, Raza-Ullah, & Vanyushyn, 2016; Bouncken et al., 2018; Le Roy and Fernandez, 2016; Raza-Ullah, Bengtsson and Kock, 2014; Ritala et al., 2016; Tidström, 2014). Based on a more fine-grained definition and conceptualization of coopetition intensity than that proposed by Park et al. (2014), we are able to recognize and measure that the effects of coopetition intensity on radical vs. incremental performance do not have the same sign and direction (i.e., coopetition intensity influences negatively radical innovation and positively incremental innovation). Relatedly, this is the first study to clearly measure – by plotting the predictive margins – a linear effect between coopetition intensity and innovation outcomes (be it FMA, radical innovation, imitation, or incremental innovation). This advances extant research that has not always clarified the functional relationship between coopetition and innovation outcomes and adds to those studies that have found different functional forms (e.g., Wu, 2014).

Lastly, we contribute to the contingency perspective on coopetition (e.g. Estrada et al., 2016; Ritala, 2012), and we find that the effect of coopetition on the speed of introduction of new products is consistent with the effect of coopetition on radical innovation: both these effects are negative and suggest that coopeting firms are discouraged to undertake radical innovation and launch their products faster because the value creation advantages of coopetition are overcome by the value appropriation liabilities that have been described by a number of scholars (e.g., Belitski & Mariani, 2022; Estrada, 2016; Ritala & Hurmelinna-Laukkanen, 2013). Accordingly, if a firm wants to drive radical innovation (McDermott & O'Connor, 2002), coopetition might not be the right strategy to opt for. This might potentially help incumbents and strengthen incumbent strategies in response to radical innovation threats (Sarkar, Osiyevskyy, & Clegg, 2019).

5.3. Practical implications

This study offers several practical implications. First, while coopetition is becoming an increasingly popular approach through which firms can gain complementary knowledge and resources from their rivals, it is certainly also a way through which they can enhance their innovation performance by appropriating the highest share of the value stemming from collaboration activities. Our study suggests that coopetition is neither conducive to FMA nor to radical innovation outcomes, and therefore, managers and entrepreneurs are cautioned to enter a coopetitive arrangement if this does not entail clear value appropriation mechanisms. This might suggest that firms should invest more in their organizational design to ensure that value appropriability mechanisms work effectively (Estrada et al., 2016), thus enabling coopeting firms to protect themselves while they pursue first moves or radical innovation.

Second and related to the previous point, for market leaders, coopetition is risky and needs to be protected by value appropriation mechanisms such as IP and other legal mechanisms that should be designed ad hoc. They are therefore encouraged to generally avoid open innovation initiatives, assess their future partners, and agree with them formal terms and conditions over the appropriation of the value generated through collaboration.

Third, coopetition can be beneficial for both incremental innovation and imitation strategies: as such coopetition might represent an effective strategy for those firms that are willing to pursue a more modest innovation outcome. In this case, putting in place mechanisms encouraging limited and controlled knowledge sharing might be conducive to the enhancement of the innovation performance of partners. Accordingly, for collaborators with little absorptive capacity, coopetition enhances the likelihood of introducing new-to-firm products and imitation from competitors.

5.4. Limitations and research agenda

This paper has contributed to advance our knowledge of the impact of coopetition on innovation by considering not only traditional impact measurement but also innovation speed under the guise of FMA (Nemeh & Yami, 2019).

Despite the growing relevance of coopetition as a product innovation and new product development strategy (Bouncken et al., 2018; Estrada, 2016; Quintana- García & Benavides- Velasco, 2004; Ritala, 2012; Wu, 2014), thus far, few studies have investigated simultaneously the effect of coopetition on FMA, imitation, and radical and incremental innovation. In this paper, we aim to shed new light on the relationship between coopetition and innovation outcomes by addressing the way coopetition intensity can influence both innovation performance and speed.

Based on different bodies of literature (FMA, coopetition, innovation), we develop a thorough understanding of the effect of coopetition intensity on a variety of innovation performance outcomes. By deploying a sample of more than 12,000 observations in the UK economy, our analysis shows that coopetition is an effective strategy for product imitation and incremental innovation, but is negatively correlated with FMA and radical innovation. Jointly, our findings reveal that firms interested in radical innovation or in pursuing a FMA should place more emphasis on value appropriation mechanisms as well as organizational design that might make such mechanisms more effective.

The present study has some limitations. First, while there are different ways of operationalizing FMA (e.g., VanderWerf & Mahon, 1997), we decided to opt for measures that are already embedded in the UKIS questionnaire. Further research should develop different measures. Second, while this study focused mainly on horizontal coopetition (collaboration between competitors), future studies might move the unit of analysis to vertical coopetitive relationships (including coopetition with customers and suppliers) to gain a well-rounded picture of the way vertical coopetition can affect both FMA and imitation strategies. Moreover, mixing qualitative methods might allow us to dig in depth about the perceptions (Czakon, 2010; Czakon & Kawa, 2018; Czakon et al., 2020) of the innovation managers involved in coopetition. Furthermore, future research might control for the extent to which digital technologies and capabilities are adopted by firms to innovate (Mariani & Nambisan, 2021) earlier than their competitors. Lastly, future research might also control the geographical location that some coopetition scholars (e.g., Pereira and Leitão. 2016) have found to interact with the relationship between coopetition and innovation performance outcomes.

More generally, this work opens different research avenues in relation to the contributions made. First, future coopetition research might try to enrich our quantitative assessment of the effect of coopetition intensity on FMA (imitation) through qualitative evidence and case studies. This might allow to gain a more fine-grained understanding of processes that cannot be captured by our quantitative analysis and might allow to build a joined-up body of knowledge with the nascent qualitative research on FMA in coopetitive settings (Nemeh, 2018; Nemeh & Yami, 2019). Second, coopetition researchers might build on the novel typology of coopetition strategies introduced (as well as on the concept of *balanced moderate coopetition)* to examine whether it is more suitable to represent a larger number of real-world coopetition arrangements across different innovation contexts and settings.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.emj.2022.05.001.

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