

Coopetition as a Driver of Open Innovation: The Case of the Automotive Business Ecosystem.

Auteur 1 : EL BOUZIDI Oumaima.

Auteur 2 : BEN MASSOU Si Mohamed.

Oumaima EL BOUZIDI, (ORCID : 0009-0004-2399-0032, PhD in Management Sciences)

1 National School of Business and Management (ENCG Marrakech), Cadi Ayyad University, Morocco
LAREGO Research Laboratory

Si Mohamed BEN MASSOU, (ORCID : 0000-0002-6897-3082, PhD, Professor)

2 National School of Business and Management (ENCG Marrakech), Cadi Ayyad University, Morocco
CRESEM, University of Perpignan Via Domitia, France (Associate Researcher)

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Abstract

Our century is marked by increased globalization, intense competition, and rising customer expectations and uncertainties, pushing organizations toward collaborative practices that involve a broader network of stakeholders, including competitors. The automotive sector is among the industries most affected by this dynamic of innovation openness.

Grounded in open innovation and coopetition theory, this study examines the impact of coopetitive relations on open innovation practices within the automotive ecosystem of Renault, a major global company. Building on a literature review, we formulated hypotheses tested through quantitative analysis with SPSS. The findings reveal a positive relationship between coopetition and open innovation, highlighting the pivotal role of inbound open innovation as a distinctive practice in the automotive ecosystem. We recommend that ecosystem actors formalize coopetitive partnerships to strengthen inbound knowledge acquisition as a priority lever for innovation performance.

Keywords

Coopetition; Business ecosystem; Open innovation; Automotive sector

Introduction

Over the past two decades, open innovation has become one of the most vibrant streams of research in strategic management and innovation studies, as firms increasingly look beyond their boundaries to acquire, combine, and exploit knowledge (Alam, Rooney & Taylor, 2022; Baldwin, Bogers, Kapoor & West, 2024). The Airbus consortium, born from the collaboration of three rival European manufacturers to challenge Boeing, remains an emblematic case: direct competitors chose to cooperate rather than to innovate alone — a pattern since echoed in electronics, with Samsung and Sony's joint development of LCD technology (Gnyawali & Park, 2011), and in aerospace, with the USD 1.8 billion Arabsat program built on cooperation between Airbus and Thales (Fernandez, Le Roy & Gnyawali, 2014).

This apparent paradox is what coopetition scholarship seeks to explain: competing firms entering cooperative relationships to innovate and differentiate themselves from one another (Bouncken & Fredrich, 2025). Open innovation research typically distinguishes three typologies through which such cooperation unfolds: inbound (acquiring external knowledge), outbound (transferring internal knowledge externally), and coupled (combining both) (Dahlander & Gann, 2010). Opening the innovation process is now recognized as a central lever of technical innovation, performance, and sustained competitiveness (Cassiman & Veugelers, 2006; Chesbrough, 2006), particularly in the automotive industry, where rising customer expectations, globalization, and converging technologies push manufacturers to seek capabilities beyond their own boundaries (De Massis, Lazzarotti, Pizzurno & Salzillo, 2012; Gassmann, 2006).

Yet this body of knowledge has been built almost entirely on evidence from mature, developed-economy settings. Emerging economies increasingly host automotive ecosystems of their own, anchored by global manufacturers through public-private partnerships designed to attract foreign investment and accelerate industrial catch-up — yet the mechanisms by which coopetition shapes open innovation within them remain largely untheorized, risking the generalization of conclusions from mature markets to settings where knowledge exchange and capability-building may operate quite differently. This study addresses that gap by examining how coopetition shapes the three forms of open innovation, inbound, outbound, and coupled, within an emerging-economy automotive business ecosystem.

Our focus is on the automotive sector, a domain inherently driven by innovation despite severe cost constraints (Ili, Albers & Miller, 2010). Industry players have pursued disruptive approaches to generate and capture value from innovation in new ways. These transformations stem primarily

from two forces: on one hand, rising customer expectations for more advanced vehicles at stable prices, and on the other hand globalization, which has increased the strategic pressures on Original Equipment Manufacturers (OEMs) to meet diverse consumer demands (De Massis, Lazzarotti, Pizzurno & Salzillo, 2012).

The growing demand for innovation, cost pressures, globalization, and the convergence of multiple technologies required to build vehicles have pushed automotive firms to look beyond their boundaries. In this context, open innovation provides opportunities to enhance knowledge, creativity, and capabilities by involving external stakeholders in new product development (Gassmann, 2006; Ili et al., 2010; Bartl, Jaweck & Wiegandt, 2010).

Within this dynamic, a distinctive automotive business ecosystem has emerged in Morocco, driven largely by public–private partnerships (PPPs) and anchored by Renault as a global industry leader (Flanders Investment & Trade, 2015; Sebti & El Bekri, 2020; Amachraa, 2023). Since the opening of Renault’s plant in Tangier in 2012 (DEPF, 2015), successive investments in manufacturing and assembly have expanded the country’s automotive platform, enhancing Morocco’s attractiveness to global industrial investors. Today, Morocco is considered a growth engine for the automotive sector, supported by the Renault–Nissan–Mitsubishi alliance and reinforced by strategic collaborations with both local and international suppliers (Amachraa, 2023; Hakam, 2020).

In light of this, the present study seeks to answer the following question: *to what extent do coopetitive relationships shape inbound, outbound, and coupled open innovation within Renault’s automotive business ecosystem in Morocco?* More specifically, it aims to evaluate how coopetition affects each of these three open innovation practices and to determine which of them benefits most from coopetitive ties in an emerging-economy setting. To achieve this aim, a quantitative survey was administered to 208 professionals operating within the ecosystem; the data were collected using established measurement scales, and the hypotheses were tested through Principal Component Analysis and linear regression.

To address this question, the study is structured as follows. First, we introduce the general context of the research. Second, we develop the conceptual framework surrounding coopetition and open innovation. Third, we present the research methodology, based on a quantitative study testing the links between coopetition and each form of open innovation. Finally, we analyze the results and discuss their theoretical and managerial implications.

1. Literature Review

1.1. Coopetition dynamics in business ecosystems

Coopetition is a relatively recent management concept describing simultaneous collaboration and competition among potentially rival actors (Bengtsson & Kock, 2014), defined as a situation in which independent parties cooperate and coordinate activities to achieve mutual objectives while competing with each other and with other firms (Zineldin, 2004). Tracing back to Brandenburger and Nalebuff's (1995, 1996) win-win framing of relationships among firms, suppliers, customers, and complementors, coopetition can take the form of alliances, joint ventures, networks, and supplier relationships that enhance firm performance (Bouncken, Kraus & Roig-Tierno, 2021; Zineldin, 1998).

By combining cooperation and rivalry within multi-actor networks (Wegmann, Ritala, Tapandjieva & Golnam, 2018), coopetition is closely linked to the concept of business ecosystems — networks of actors that collectively create value within a shared environment while coordinating efforts to manage and grow the system (Adner, 2017; Moore, 1993). Firms adopt coopetition strategies to develop emerging or incremental technologies while navigating market uncertainties (Pereira & Leitão, 2015; Brandenburger & Nalebuff, 1996), achieving critical mass and pooling R&D efforts that exceed what any single firm could gather alone amid globalization and technological pressures (Le Roy & Chesbrough, 2018).

The concept of coopetition has been further developed and popularized through the emergence of a new organizational form: the business ecosystem (Moore, 1993; Koenig, 2012). In this context, ecosystems comprise networks of actors who collectively create value within a shared environment, goal, or value proposition, while coordinating efforts to manage and grow the system (Adner, 2017; Moore, 1993; Iansiti & Levien, 2004; Ritala, Agouridas, Assimakopoulos & Gies, 2013; Rohrbeck, Hölzle & Gemünden, 2009; Williamson & De Meyer, 2012). Once considered desirable, this organizational form is now essential (Primario et al., 2024).

Coopetition is primarily managed as a strategic component of both cooperation and competition among rival actors, aimed at sustaining innovation projects (Rusko, 2011). Firms may compete when interests conflict but simultaneously cooperate when common objectives emerge (Bengtsson & Kock, 2014). Within this framework, companies adopt coopetition strategies to develop emerging or incremental technologies while navigating market uncertainties and volatility (Pereira & Leitão, 2015; Brandenburger & Nalebuff, 1996; Gomes-Casseres, 1996; Nieto & Santamaría, 2007; Ritala & Hurmelinna-Laukkanen, 2009).

Coopetition unfolds in innovation-friendly environments to address several market imperatives. First, it enables firms to achieve critical mass in a globalized economy, compensating for insufficient internal resources—particularly relevant in digital industries where high fixed costs of data analytics must be spread across multiple transactions. Second, it facilitates the pooling of R&D efforts to match the increasing budgets required for technological development. Companies are no longer able to innovate independently or gather all necessary resources without external collaboration (Le Roy & Chesbrough, 2018).

In response to globalization and technological pressures, coopetition has thus emerged as a strategic avenue to achieve critical R&D scale and pursue efficient innovation projects.

1.2. Coopetition as a key enabler of open innovation

Coopetition strategies aimed at innovation objectives have expanded significantly (Gnyawali & Park, 2009), with research consistently demonstrating a positive effect of coopetition on firms' innovation performance (Bengtsson & Kock, 2000; Le Roy, Robert & Lasch, 2016; Tomlinson, 2010). This link originates from a subfield examining firms that integrate competitors into their innovation processes (Bez & Le Roy, 2023) — variously termed “open coopetition” (Le Roy & Chesbrough, 2018), “OI coopetition” (Lee, Fong, Barney & Hawk, 2019), “horizontal alliances for open innovation” (Cano-Kollmann, Awate, Hannigan & Mudambi, 2018), or “coopetitive open innovation” (Bez & Le Roy, 2023).

The link between open innovation and coopetition originates from a subfield examining firms that integrate competitors into their innovation processes (Bez & Le Roy, 2023). Within this framework, collaboration with rivals in open innovation has been referred to using terms such as “open coopetition” (Le Roy & Chesbrough, 2018), “OI (i.e., open innovation) coopetition” (Lee, Fong, Barney & Hawk, 2019), “horizontal alliances for open innovation” (Cano-Kollmann, Awate, Hannigan & Mudambi, 2018), and “coopetitive open innovation” (Bez & Le Roy, 2023).

The innovation literature draws on foundational work in coopetition to explain the contingent variables linking these two concepts, highlighting competitors as optimal partners for innovation (Bez & Le Roy, 2023). Collaboration among rival stakeholders provides access to new technologies and capabilities, allows the sharing of costs and risks, and accelerates competitive advantage with minimal effort (Hamel, Doz & Prahalad, 1989). Competitors are considered optimal innovation partners (Bez & Le Roy, 2023): collaboration among rivals provides access to new technologies and capabilities, allows the sharing of costs and risks, and accelerates competitive advantage with minimal effort (Hamel, Doz & Prahalad, 1989), since competitors share common markets,

resources, and comparable processes that facilitate combining and exploiting complementary knowledge (Chen, 1996; Bouncken & Fredrich, 2016).

Open innovation itself emerged as a paradigm suggesting that firms should leverage both internal and external ideas and commercialization channels to improve their technologies (Baldwin & Von Hippel, 2011), managing intentional knowledge flows across organizational boundaries while respecting their business model, which regulates which knowledge enters and exits the firm and how value is created and captured (Chesbrough, 2003; Chesbrough & Bogers, 2014; Chesbrough, Vanhaverbeke & West, 2006).

Moreover, firms must consider the architecture of their value chain and the ecosystem in which they operate, not only to manage technical interdependencies but also to create opportunities to contribute to and benefit from research on new technologies. This creates a need for firms to maintain efficient connections, enabling collaboration with peers in the ecosystem while simultaneously competing with them (Chesbrough, 2003).

Today, open innovation also involves the management of intentional knowledge flows as part of a distributed innovation process, spanning organizational boundaries and employing both financial and non-financial mechanisms, while respecting the firm's business model (Chesbrough & Bogers, 2014). The business model dimension regulates which knowledge enters the organization and which can cross external boundaries. It also serves to create value and capture a portion of that value, ensuring the sustainability of the firm's innovations.

1.3. Development of research hypotheses

We formulated the hypotheses of our conceptual model (Figure 1) by examining the relationship between coopetition and the three fundamental flows of open innovation (Chesbrough, 2003): inbound, outbound, and coupled open innovation, which assess the innovation process along two dimensions — the origin of knowledge flows (internal or external) and their destination (the market via the firm, or external parties).

Inbound open innovation, or the outside-in process, refers to the integration of external knowledge into the firm's innovation activities through licensing, patent acquisitions, or corporate takeovers (Le Roy & Chesbrough, 2018), drawing on diverse sources such as universities, customers, suppliers, competitors, and research institutes (Pénin, Burger-Helmchen, Guittard, Schenk & Dintrich, 2013).

Inbound open innovation is the most frequently studied form in the literature, particularly in relation to the use of external technologies to reduce costs and improve innovation efficiency. By

capturing external knowledge flows (the outside dimension) and integrating them internally (the in dimension), firms accelerate technological development and enhance their understanding of emerging trends in their fields. Accordingly, we propose the following hypothesis:

H1: Coopetition positively influences inbound open innovation.

Outbound open innovation, or the inside-out process, involves exposing a firm's internal knowledge and resources to external markets, moving knowledge from inside the organization to the external environment (Pénin et al., 2013) through IP sales, spin-offs, or other forms of industrial dissemination — opening new revenue streams for innovations no longer central to the firm (Le Roy & Chesbrough, 2018). Based on this rationale, we propose the following hypothesis:

H2: Coopetition positively influences outbound open innovation.

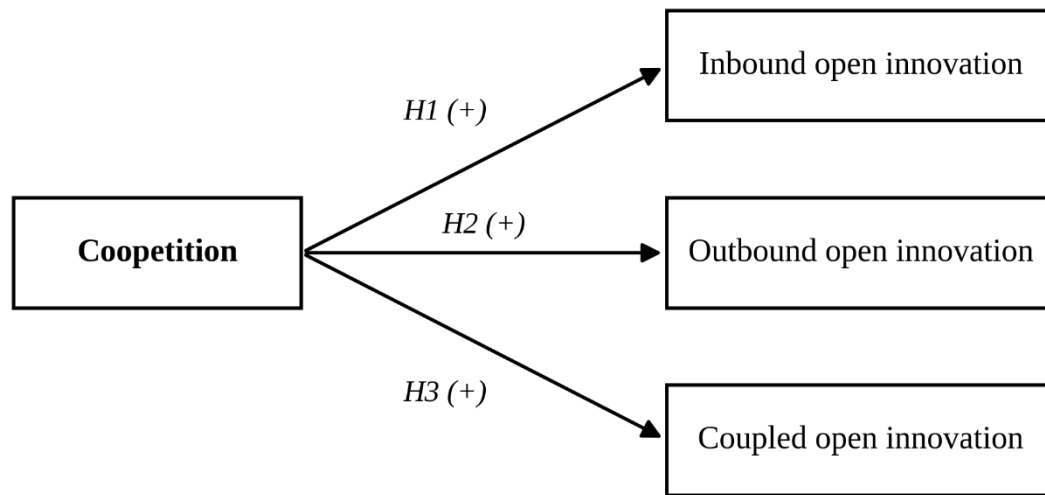
Coupled open innovation combines inbound and outbound processes: firms acquire knowledge from external partners while also transferring their own expertise in return (Pénin et al., 2013), often through corporate consortia, strategic alliances, and collaborations with heterogeneous actors including competitors, customers, suppliers, universities, and firms from other industries; to co-create new knowledge (Le Roy & Chesbrough, 2018). This process enables a reciprocal exchange of knowledge, integrating partners' resources internally while providing access to the firm's own assets.

This innovation type combines the strengths of both inbound and outbound processes, often taking the form of technology licensing or sales agreements. Cooperation is particularly emphasized, demonstrating collaborative relationships with competitors for innovation purposes (Enkel, Gassmann & Chesbrough, 2009). This is the most commonly employed form, and inherently embodies coopetition (Enkel, Gassmann & Chesbrough, 2009). Accordingly, we propose the following hypothesis:

H3: Coopetition positively influences coupled open innovation.

Based on this literature review, we propose the conceptual model in Figure 1, illustrating the relationships between coopetition and inbound, outbound, and coupled open innovation.

Figure N°1 : Conceptual model: the impact of coopetition on inbound, outbound, and coupled open innovation



Source : Authors

2. Research Methodology

The methodology adopted for this study is based on a quantitative analysis of the relationships between coopetition and the three types of open innovation: inbound, outbound, and coupled.

A quantitative approach was employed to examine complex interactions involving multiple variables across various statistical treatments (Creswell & Creswell, 2017), emphasizing the collection of quantifiable data and enabling systematic data analysis (Bryman, 2016).

Given the complexity of business ecosystems, the diverse nature of actors within them, and the limited prior research in this context, a quantitative study allows for efficient use of time and resources (Eyisi, 2016), emphasizes the collection of quantifiable data and statistical figures, and enables systematic data analysis (Bryman, 2016).

This approach relies on predefined hypotheses and variables (Bryman, 2012; Creswell, 2009; Descombe, 2010; Johnson & Christensen, 2012), which can be validated or rejected, facilitating in-depth examination of predetermined paradigms. In this study, the focus is on exploring the links between coopetition and its role within the paradigm of open innovation.

Furthermore, SPSS software was utilized to conduct complex data analyses and generate statistically robust tests, including ANOVA and regression analysis (Pervin, Sarker & Begum, 2020; Sarker, Sarker, Rani Shaha, Saha & Sarker, 2024).

2.1. Sampling and data collection

We employed a non-probabilistic convenience sampling approach, given its frequent use in research on populations with restricted access — in this case, ecosystem actors difficult to reach through other methods (Golzar, Noor & Tajik, 2022). This sampling method is characterized by the availability and accessibility of participants, who cannot be selected from other populations or potential research sites (Golzar, Noor & Tajik, 2022; Koerber & McMichael, 2008).

Given that the sample was drawn from a population of ecosystem actors with restricted access, this method facilitated easier selection of participants for the study (Rahi, 2017). It addresses concerns regarding accessibility and availability of the research field and takes into account access to the research context, participants, and methodological framework (Koerber & McMichael, 2008).

The use of this sampling method allowed us to build a robust database by including a relatively large sample (Skowronek & Duerr, 2009). We surveyed 208 actors from the automotive business ecosystem of the Renault plant in Tangier, Morocco. The sample size aligns with Roscoe's (1975) guidelines, which recommend sample sizes between 30 and 500 for most studies.

Data collection was conducted via questionnaires distributed through social media (LinkedIn) to ecosystem participants between June 2023 and January 2024, targeting employees of Renault-Tangier, associated clients and suppliers, automotive manufacturers, and vocational training institutes in the sector.

This approach allowed us to build a robust database of 208 actors from the automotive business ecosystem of the Renault plant in Tangier, Morocco.

2.2. Selection of measurement scales

This study identifies four main variables: coopetition (the independent variable) and inbound open innovation, outbound open innovation, and coupled open innovation (the dependent variables).

We conducted an extensive literature review to identify existing measurement scales for each variable, highlighting the diversity of concepts and their attributes (Zikmund, Babin, Carr & Griffin, 2013).

Additionally, we adopted multi-item Likert scales, standardized to a 1-to-5 scoring system, with items designed to be clear and unambiguous. A pre-test was conducted to ensure the items were well understood, thereby enhancing the interpretability and reliability of the results for readers (Rossiter, 2002).

Independent variable

The coopetition scale was selected for its pragmatic approach to measuring collaborative relationships among actors. We adopted the five-point scale developed by Bouncken and Fredrich (2012), ranging from 1 (“Strongly Disagree”) to 7 (“Strongly Agree”). The items were adapted to the context of strategic alliances, emphasizing the simultaneous efforts of collaboration and competition among partners.

Dependent variables

Open innovation was examined through its three dimensions: inbound, outbound, and coupled, using scales aligned with the characteristics of knowledge and skills exchange within a strategic alliance such as Renault.

Specifically, we adopted the following scales:

- Inbound open innovation: the scale by Naqshbandi (2016) and Sisodiya (2008);
- Outbound open innovation: the scale by Pisano and Teece (2007) and Jaworski and Kohli (1993);
- Coupled open innovation: the scale by Mazzola et al. (2016), Ahn et al. (2015) and Cheng and Huizingh (2014).

2.3. Validity and reliability of measurement scales

Validity of measurement scales

The validity of the measurement scales refers to the degree to which a concept is accurately measured; the selected variables (coopetition, and inbound, outbound, and coupled open innovation) closely reflect the predefined theoretical concepts. Validity was assessed through convergent validity, i.e., the extent to which a measurement instrument correlates strongly with other instruments measuring similar variables.

Our study employed Principal Component Analysis (PCA) to reduce and eliminate less relevant factors while retaining sufficiently correlated variables, with a total variance threshold of 60%, simplifying complex data representations into more interpretable and homogeneous variable combinations.

Reliability of measurement scales

The reliability of measurement scales assesses the rigor and consistency of measurement instruments through internal consistency, most commonly estimated via Cronbach’s alpha coefficient, with an acceptable threshold of 0.7 or higher.

3. Data Processing and Results Analysis

3.1. Principal Component Analysis (PCA)

The analysis of validity constitutes the first step in refining the items of the adopted measurement scales. To this end, we employed Principal Component Analysis (PCA) while adhering to the following premises:

Table N°1 : Premises of the Principal Component Analysis

Premises of the Analysis	The Coopetition scale	The inbound open innovation scale	The outbound open innovation scale	The coupled open innovation scale
Number of items in the measurement scales	The analysis focused on three items.	The analysis focused on six items.	The analysis focused on four items.	The analysis focused on five items.
	The objective is to identify the underlying components and significantly reduce the number of initial variables.			
Type of variables	The measurement scales are of the Likert type, yielding responses of an ordinal nature.			
Sample Size	A total of 208 completed questionnaires were collected. Furthermore, the sample meets the minimum acceptable threshold, which ranges between 30 and 500 individuals (Sekaran & Bougie, 2016).			

Source : Authors

Conducting the Principal Component Analysis (PCA)

3.1.1. Results of the coopetition scale

The analysis yielded a good KMO index (close to 0.7) and a highly significant Bartlett's test ($p < 0.05$), confirming meaningful intercorrelations among items ($r = 0.4-0.6$).

Table N°2 : PCA – KMO Results for the coopetition scale

KMO Index and Bartlett's Test		
Kaiser-Meyer-Olkin Index for Assessing Sample Adequacy		0,674
Bartlett's Test of Sphericity	Approximate Chi-Square	171,140
	Degrees of Freedom (df)	3
	Significance	<0,001

Source : Authors, based on SPSS output

Communalities exceeded 0.5 for all items, and the first two factors accounted for more than 80% of the total variance, exceeding the 60% extraction threshold (Carricano, Poujol & Bertrandias, 2010).

Table N°3 : PCA – Total Variance results for the coopetition scale

Total Variance Explained			
Component	Eigenvalue	% of Variance	Cumulative %
1	2,089	69,646	69,646
2	,555	18,506	88,152
3	,355	11,848	100,000

Source : Authors, based on SPSS output

All items of the coopetition scale were therefore retained for further analysis.

3.1.2. Results of the inbound open innovation scale

The analysis yielded an excellent KMO (> 0.8) and a highly significant Bartlett's test ($p < 0.05$), confirming meaningful intercorrelations ($r = 0.4-0.6$) and communalities above 0.5 for all items.

Table N°4 : PCA – KMO Results for the inbound open innovation scale

KMO Index and Bartlett's Test		
Kaiser-Meyer-Olkin Index for Assessing Sample Adequacy		0,896
Bartlett's Test of Sphericity	Approximate Chi-Square	698,909
	Degrees of Freedom (df)	15
	Significance	<0,001

Source : Authors, based on SPSS output

The first two factors explained 77.41% of the total variance, exceeding the 60% extraction threshold (Carricano et al., 2010); the second factor's contribution was minor.

Table N°5 : PCA – Total Variance results for the inbound open innovation scale

Total Variance Explained			
Component	Eigenvalue	% of Variance	Cumulative %
1	4,096	68,262	68,262
2	,549	9,145	77,407
3	,444	7,408	84,815
4	,369	6,153	90,968
5	,316	5,264	96,233

Total Variance Explained			
6	,226	3,767	100,000

Source : Authors, based on SPSS output

Examination of the rotated component matrix (items with loadings > 0.5 on multiple factors or < 0.3 on any retained factor) led to the removal of three items: use of external sources to complement R&D, the search for external technologies/patents, and the purchase of external IP.

Table N°6 : PCA – Rotation of the Component Matrix- Inbound open innovation scale

Rotation of the Component Matrix ^a		
	Component	
	1	2
"My organization actively seeks external sources of knowledge and technology—such as research groups, universities, suppliers, clients, and competitors—when developing new products."	,894	,185
"My organization often brings in knowledge and technologies developed externally to use them in conjunction with our own R&D."	,753	,391
"My organization constantly analyzes the external environment in search of inputs such as technology, information, ideas, knowledge, and so on."	,698	,459
"My organization seeks technologies and patents from other companies, research groups, or universities."	,602	,566
"My organization purchases external intellectual property to use in our own R&D."	,237	,920
"My organization believes it is beneficial to use external sources—such as research groups, universities, suppliers, clients, and competitors—to complement its own R&D."	,620	,650

Source : Authors, based on SPSS output

Re-running the PCA without these items produced a KMO of 0.724 with a significant Bartlett's test ($p < 0.001$).

3.1.3. Results of the outbound open innovation scale

The factor analysis presents a good KMO (> 0.7) and a highly significant Bartlett's test ($p < 0.05$), with interrelated items ($r = 0.4-0.6$) and communalities above 0.5 for all items.

Table N°7 : PCA – KMO Results for the outbound open innovation scale

KMO Index and Bartlett's Test		
Kaiser-Meyer-Olkin Index for Assessing Sample Adequacy		0,791
Bartlett's Test of Sphericity	Approximate Chi-Square	291,716
	Degrees of Freedom (df)	6
	Significance	<0,001

Source : Authors, based on SPSS output

The first two cumulative factors explained over 80% of the variance, exceeding the 60% extraction threshold (Carricano et al., 2010).

Table N°8 : PCA – Total Variance results for the outbound open innovation scale

Total Variance Explained			
Component	Eigenvalue	% of Variance	Cumulative %
1	2,661	66,518	66,518
2	,574	14,358	80,876
3	,429	10,715	91,591
4	,336	8,409	100,000

Source : Authors, based on SPSS output

All items of the outbound open innovation measurement scale were therefore retained.

3.1.4. Results of the coupled open innovation scale

The analysis shows an excellent KMO (> 0.8) and a highly significant Bartlett's test ($p < 0.05$), with interrelated items ($r = 0.4-0.6$) and communalities above 0.5 for all items.

Table N°9 : PCA – KMO Results for the coupled open innovation scale

KMO Index and Bartlett's Test		
Kaiser-Meyer-Olkin Index for Assessing Sample Adequacy		0,820
Bartlett's Test of Sphericity	Approximate Chi-Square	409,744
	Degrees of Freedom (df)	10
	Significance	<0,001

Source : Authors, based on SPSS output

The first two factors explained more than 77% of the variance, exceeding the 60% extraction threshold (Carricano et al., 2010).

Table N°10 : PCA – Total Variance results for the coupled open innovation scale

Total Variance Explained			
Component	Eigenvalue	% of Variance	Cumulative %
1	3,118	62,358	62,358
2	,743	14,858	77,215
3	,480	9,601	86,816
4	,370	7,392	94,208
5	,290	5,792	100,000

Source : Authors, based on SPSS output

Examination of the rotated Component Matrix (items with loadings > 0.5 on multiple factors or with no loading of at least 0.3 on any retained factor) led to the elimination of one item: “informal interactions with other organizations.”

Table N°11 : PCA – Rotation of the Component Matrix- Coupled open innovation scale

Rotation of the Component Matrix ^a		
	Component	
	1	2
Participation in conferences and trade fairs	,907	,024
Collaborative projects supported by regional public funding	,762	,353
Patents shared with other organizations	,697	,368
Informal interactions with other organizations	,687	,551
Joint doctoral theses	,177	,951

Source : Authors, based on SPSS output

Re-running the PCA after removing this item produced a KMO of 0.739 with a significant Bartlett's test ($p < 0.001$).

3.2. Analysis of Cronbach's Alpha Coefficient

Item reliability was assessed through Cronbach's alpha, which exceeded 0.7 for all measurement scales (coopetition, inbound, and outbound open innovation), with moderate to high inter-item correlation.

Table N°12 : Cronbach's alpha results – Scales: coopetition, inbound open innovation, and outbound open innovation

	Reliability statistics		
	Cronbach's alpha	Cronbach's alpha based on standardized items	Number of items
The coopetition scale	0,777	0,781	3
The inbound open innovation scale	0,838	0,838	3
The outbound open innovation scale	0,830	0,832	4

Source : Authors, based on SPSS output

These scales demonstrate acceptable internal consistency, and no item removal would improve their alpha coefficient.

The coupled open innovation scale showed an alpha of 0.776; removing the “joint doctoral theses” item increased this to 0.789.

Table N°13 : Cronbach's alpha results – The coupled open innovation scale

Reliability statistics			
Cronbach's alpha	Cronbach's alpha based on standardized items	Number of items	Cronbach's alpha if an item is deleted
0,776	0,780	4	0,789

Source : Authors, based on SPSS output

We can summarize the validity and reliability results to identify the measurement scale items that will be used in the regression analyses:

Table N°14 : Summary table of the validity and reliability results of the measurement scale items

Research variables	Retained items
The coopetition	We are in close competition with our partners. We collaborate with our competitors to achieve a common goal. Active competition with our collaborators is important to us.
The inbound open innovation	My organization constantly analyzes the external environment in search of inputs such as technology, information, ideas, knowledge, etc. My organization actively seeks external sources of knowledge and technology (e.g., research groups, universities, suppliers, clients, competitors, etc.) when developing new products. My organization often brings in externally developed knowledge and technologies to use in conjunction with our own R&D.
The outbound open innovation	In general, all technologies can be commercialized externally. External commercialization of technologies is limited to technologies that are not used internally. External commercialization of technologies is limited to relatively mature technologies. External commercialization of technologies is limited to non-essential technologies.
The coupled open innovation	Use of the following practices over the past three years: Patents shared with other organizations Collaborative projects benefiting from regional public funding Participation in conferences and trade fairs

Source : Authors, based on SPSS output

3.3. Hypothesis Testing Using Linear Regression

The refinement and purification of the measurement scales allowed for the testing of the research hypotheses using linear regression.

This method, widely used for explaining and predicting a dependent variable—inbound, outbound, and coupled open innovation—establishes relationships between an independent variable and a defined outcome (Hair, Black, Babin & Anderson, 2009).

3.3.1. Analysis of the relationship between coopetition and inbound open innovation

Coopetition explains 45.6% of inbound open innovation (Adjusted R²), with a highly significant ANOVA relationship ($p < 0.05$) and a significant, positive t-test coefficient ($t = 12.81 > 2$).

Table N°15 : Linear Regression – Adjusted R² – Inbound Open Innovation Model

Summary of the models				
Model	R	R-squared (R ²)	Adjusted R-squared	Standard error of the estimate
1	,677 ^a	,458	,456	1,07217

Source : Authors, based on SPSS output

Table N°16 : Linear Regression – ANOVA – Inbound Open Innovation Model

ANOVA ^a						
Model		Sum of squares	Degrees of Freedom (df)	Mean square	F	Sig.
1	Regression	188,673	1	188,673	164,128	,000 ^b
	t-test	223,011	194	1,150		
	Total	411,684	195			

Source : Authors, based on SPSS output

Table N°17 : Linear Regression – Coefficients – Inbound open innovation model

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Standard Error	Beta		
1	(Constant)	2,227	,240		9,297	,000
	MeanCoopétition	,588	,046	,677	12,811	,000

Source : Authors, based on SPSS output

$$\text{Inbound open innovation} = 2.227 + (0.588 * \text{Coopetition})$$

The resulting model, Inbound open innovation = $2.227 + (0.588 \times \text{Coopetition})$, confirms that coopetition is a significant, positive determinant of inbound open innovation: the more actors engage in coopetitive relationships, the more likely they are to produce it.

3.3.2. Analysis of the relationship between coopetition and outbound open innovation

Coopetition explains 32.1% of outbound open innovation (Adjusted R^2), with a highly significant ANOVA relationship ($p < 0.05$) and a significant, positive t-test coefficient ($t = 9.66 > 2$).

Table N°18 : Linear Regression – Adjusted R^2 – Outbound open innovation model

Summary of the models				
Model	R	R-squared (R^2)	Adjusted R-squared	Standard error of the estimate
1	,570 ^a	,325	,321	1,19832

Source : Authors, based on SPSS output

Table N°19 : Linear Regression – ANOVA – Outbound open innovation model

ANOVA ^a						
Model		Sum of squares	Degrees of Freedom (df)	Mean square	F	Sig.
1	Regression	134,108	1	134,108	93,392	,000 ^b
	t-test	278,579	194	1,436		
	Total	412,687	195			

Source : Authors, based on SPSS output

Table N°20 : Linear Regression – Coefficients – Outbound open innovation model

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Standard Error	Beta		
1	(Constant)	2,175	,268		8,124	,000
	MeanCoopétition	,496	,051	,570	9,664	,000

Source : Authors, based on SPSS output

$$\text{Outbound open innovation} = 2.175 + (0.496 * \text{Coopetition})$$

The resulting model, Outbound open innovation = $2.175 + (0.496 \times \text{Coopetition})$, confirms that coopetition is a significant, positive determinant of outbound open innovation: the more actors engage in coopetitive relationships, the more likely they are to produce it.

3.3.3. Analysis of the relationship between coopetition and coupled open innovation

Coopetition explains 30.5% of coupled open innovation (Adjusted R^2), with a highly significant ANOVA relationship ($p < 0.05$) and a significant, positive t-test coefficient ($t = 9.307 > 2$).

Table N°21 : Linear Regression – Adjusted R^2 – Coupled open innovation model

Summary of the models				
Model	R	R-squared (R^2)	Adjusted R-squared	Standard error of the estimate
1	,556 ^a	,309	,305	1,24084

Source : Authors, based on SPSS output

Table N°22 : Linear Regression – ANOVA – Coupled open innovation model

ANOVA ^a						
Model		Sum of squares	Degrees of Freedom (df)	Mean square	F	Sig.
1	Regression	133,378	1	133,378	86,627	,000 ^b
	t-test	298,700	194	1,540		
	Total	432,079	195			

Source : Authors, based on SPSS output

Table N°23 : Linear Regression – Coefficients – Coupled open innovation model

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Standard Error	Beta		
1	(Constant)	2,339	,277		8,439	,000
	MeanCoopétition	,494	,053	,556	9,307	,000

Source : Authors, based on SPSS output

Coupled open innovation = $2.339 + (0.494 * \text{Coopetition})$

The resulting model, Coupled open innovation = $2.339 + (0.494 \times \text{Coopetition})$, confirms that coopetition is a significant, positive determinant of coupled open innovation: the more actors engage in coopetitive relationships, the more likely they are to produce it.

4. Discussion of the Results

4.1. The impact of coopetition on inbound open innovation

Our focus is on the first typology of open innovation, namely the inbound category, which is predominant in our study. According to empirical studies, firms engage in inbound open innovation more than its outbound counterpart (Michelino, Caputo, Cammarano & Lamberti, 2014). Following this principle, the adoption of any inbound process by one organization is the reciprocal result of an outbound process by another organization (Chesbrough & Crowther, 2006).

Coopetition's impact on innovation has long been central to R&D, marketing, and strategic management research (Le Roy et al., 2016). Our results show this impact is strongest on inbound open innovation, consistent with prior evidence that firms engage more heavily in inbound than outbound activities (Michelino, Caputo, Cammarano & Lamberti, 2014; Van der Meer, 2007), a pattern also found in the biopharmaceutical (Bianchi, Cavaliere, Chiaroni, Frattini & Chiesa, 2011) and German automotive sectors (Ili et al., 2010). In this context, our findings align with Van der Meer (2007), who reported that companies are more likely to adopt inbound activities (with 74% adoption of imported mechanisms) compared to only 54% engaging in the export of innovative mechanisms (i.e., outbound activities). This trend is further supported by Schroll and Mild (2011), who highlight a stronger adoption of inbound collaborations over outbound ones. Similarly, in the biopharmaceutical sector, 60% of open innovation activities are inbound in origin (Bianchi, Cavaliere, Chiaroni, Frattini & Chiesa, 2011; Chiaroni, Chiesa & Frattini, 2009). The German automotive sector shows comparable results, where the inbound exploitation of patents is highly valued by industry actors (Ili et al., 2010).

Coopetitive relationships offer partner firms enhanced innovation outcomes by giving them access to external knowledge from suppliers, clients, competitors, and universities to strengthen internal innovation resources (Ahn, Minshall & Mortara, 2015; Gnyawali & Park, 2011).

Our study supports the identification of a positive impact of coopetition ties on open innovation practices. In this context, coopetition offers unique and significant advantages by introducing enhanced resulting innovations for partner firms (Gnyawali & Park, 2011; Park, Srivastava & Gnyawali, 2014). Its distinctive feature lies in acquiring knowledge from external sources; such as suppliers, clients, competitors, and universities; for internal exploitation, aiming to strengthen the

firm's internal innovation resources (Ahn, Minshall & Mortara, 2015; Greco, Grimaldi & Cricelli, 2015).

In this framework, we highlight the model of coopetition's impact on inbound open innovation, which shows the most pronounced results. Compared to its influence on outbound and coupled open innovation, coopetition carries the greatest weight on inbound practices. It is also important to consider the nature of the context studied and the actors involved. Indeed, the composition of the automotive business ecosystem is primarily focused on the manufacturing and mechanical assembly of automotive products, giving rise to "manufacturer-led ecosystems" headed by a leading actor such as Renault (Sebti & El Bekri, 2022).

This predominance of inbound practices reflects the nature of the automotive business ecosystem studied, a manufacturer-led ecosystem centered on Renault (Sebti & El Bekri, 2022) whose manufacturing and assembly mission favors the acquisition of external knowledge flows, fostering cooperative innovation with external partners and facilitating pathways for commercial exploitation (Crema, Verbano & Venturini, 2014).

4.2. The impact of coopetition on outbound open innovation

Outbound open innovation accounts for nearly 32% of the organization's activities, ranking second after inbound processes. Firms engaging in outbound open innovation seek not only to transfer processes to the market but also to identify external organizations better suited to commercialize certain technologies (Chesbrough & Crowther, 2006; Karlsson & Sköld, 2013). Nevertheless, outbound openness holds an important position in the structure of Renault's business ecosystem. Companies engaging in outbound open innovation are not only looking to transfer their processes internally to the market but also to identify external organizations better suited for the commercialization of certain technologies (Chesbrough & Crowther, 2006; Karlsson & Sköld, 2013; Spithoven, Clarysse & Knockaert, 2011). This pattern is largely a byproduct of inbound activity: while many firms use external knowledge, few provide it (Huizingh, 2011), and the accumulated, unused innovation and IP capital generated through inbound processes is what firms subsequently exploit through outbound innovation (Michelino et al., 2014; Schroll & Mild, 2011). Outbound open innovation, being the counterpart to inbound open innovation, has primarily been the focus of discussions regarding the influence of coopetition in the context of multinational enterprises (MNEs) capable of implementing open innovation practices in technology- and innovation-driven industries—i.e., technologically turbulent sectors (Kraus, Klimas, Gast & Stephan, 2019; Ritala & Sainio, 2014). The demands of R&D, as well as the time and cost burdens

required to meet innovation needs, encourage firms to adopt an open innovation perspective, sharing their knowledge and introducing technologies from external sources. Unused licenses and technologies not aligned with a company's needs can be transferred to organizations better positioned to exploit and commercialize them (Spithoven et al., 2011).

The positive effect of coopetition on firms' innovation openness has been confirmed in numerous studies (Faccin, Balestrin, Volkmer Martins & Bitencourt, 2019; Fernandes, Ferreira, Veiga & Marques, 2019; Ritala & Sainio, 2014). This pattern is mainly observed among multinational enterprises operating in technologically turbulent industries (Kraus, Klimas, Gast & Stephan, 2019), where R&D, time, and cost pressures encourage firms to share knowledge and transfer unused licenses to better-positioned partners (Spithoven et al., 2011), creating value by expanding market size and opportunities (Christ, Burritt & Varsei, 2017; Fernandes, Ferreira, Veiga & Marques, 2019).

4.3. The impact of coopetition on coupled open innovation

Coupled open innovation, a blend of inbound and outbound processes (Piller & West, 2014), reflects the flow of partners' reactions and adjustments within cooperative relationships over time (Kostis, Albers, Vanderstraeten, Chinchankar & Bengtsson, 2024). It operates through innovation alliance structures that extend beyond dyads to multiple competing firms (Crick, 2025), from alliances among multiple companies (Gernsheimer, Kanbach & Gast, 2021), such as alliances among small firms (Ferreira, Coelho & Moutinho, 2021), SMEs (Chiambaretto, Bengtsson, Fernandez & Näsholm, 2020) and high-tech companies (Bouncken, Fredrich, Ritala & Kraus, 2020) to national and global R&D consortiums (Hani & Dagnino, 2021), requiring firms to collaborate with competitors to co-create knowledge across a network of customers, suppliers, universities, and other-industry partners (Le Roy & Chesbrough, 2018).

Coupled open innovation is presented as a blend of inbound and outbound processes (Piller & West, 2014). It goes beyond merely internalizing or externalizing technologies. Firms are required to collaborate with competitors to innovate, co-create knowledge, and assemble a network of partners including customers, suppliers, universities, competitors, and companies operating in other industries (Le Roy & Chesbrough, 2018).

In this context, coupled open innovation demands a combination of inbound and outbound innovation efforts, exemplified by the Renault–Nissan–Mitsubishi strategic alliance. The success of this type of innovation stems from coopetition capabilities, particularly the integration of cooperative and competitive interactions. Three major aspects underpin successful coopetition

partnerships: first, a coopetition mindset (i.e., the ability to cognitively recognize and accept the paradoxical nature of coopetition); second, analytical discernment (i.e., the ability to thoroughly examine paradoxical situations, explore potential opportunities, and develop strategies to manage existing tensions); and third, execution capabilities (i.e., the ability to make sound strategic choices and implement them) (Kostis et al., 2024; Rai, Gnyawali & Bhatt, 2023).

Our results, exemplified by the Renault–Nissan–Mitsubishi alliance, show that successful coupled innovation stems from three coopetition capabilities: a mindset that accepts coopetition's paradoxical nature, analytical discernment to manage its tensions, and the execution capability to implement sound strategic choices (Kostis et al., 2024).

Conclusion

Open innovation emerged as a response to the limitations of the traditional “closed innovation” paradigm, in which firms relied solely on internal resources to generate, develop, and commercialize ideas (Chesbrough, 2003). By opening the innovation process to external collaborators, including competitors, firms gain access to a wider pool of knowledge, expertise, and market opportunities (Gassmann, 2006; Karlsson & Sköld, 2013).

The influence of inbound open innovation compared to its outbound and coupled counterparts is at the core of our study. Previous empirical studies show a greater exploitation of inbound processes across various sectors (Bianchi et al., 2011; Chiaroni et al., 2009; Huizingh, 2011; Ili et al., 2010; Michelino et al., 2014; Schroll & Mild, 2011; Van der Meer, 2007). Inbound practices are considered substitutes for internal R&D, both being efforts undertaken by the firm within its innovation process. Outbound practices, on the other hand, are seen as complementary activities resulting from inbound processes (Michelino et al., 2014).

Attention is given to “open coopetition,” a portmanteau describing cooperation within open innovation among competitors that includes third-party stakeholders such as networks, platforms, communities, ecosystems, and other partners in political, scientific, and broader societal domains (Roth et al., 2020). Open coopetition involves “R&D activities jointly conducted by competing firms to maximize plan transparency and collaborative attributes” (Teixeira & Lin, 2014, p. 6). Research supports a positive relationship between the outcomes of coopetition and open innovation (Faccin et al., 2019; Fernandes et al., 2019; Gernsheimer et al., 2021; Moon, Yoon & Park, 2022; Ritala & Sainio, 2014).

Coopetition generates stimulating tensions capable of enhancing radical innovation projects, particularly those approaching launch phases (Bouncken, Fredrich, Ritala & Kraus, 2018). As a result, coopetition among established firms has positive impacts on participants by opening access to resources of established companies and providing access to start-ups’ innovation capabilities (Hora, Gast, Kailer, Rey-Marti & Mas-Tur, 2018). The weaving of links between coopetition and innovation relationships lies at the heart of scientific research, with many studies highlighting the role of coopetition partnerships as more favorable than other forms of relationships for creating innovative products (Lan, Liu & Dong, 2019).

In the automotive sector, this openness manifests through licensing agreements, alliances, and joint ventures, with inbound open innovation typically the most developed practice and outbound remaining comparatively less exploited (Lazzarotti, Manzini, Pellegrini & Pizzurno, 2013), a

pattern our results confirm. Coopetitive relationships, in particular, generate the kind of complex knowledge exchange, tension, and continuous learning that can accelerate radical innovation (Bouncken, Fredrich, Ritala & Kraus, 2018; Bouncken & Fredrich, 2016), a dynamic increasingly recognized in both academic and managerial communities as central to open innovation research (Faccin, Balestrin, Volkmer Martins & Bitencourt, 2019; Roth, Leydesdorff, Kaivo-Oja & Sales, 2020).

Research contributions

This study contributes to a still-limited body of research extending coopetition-driven open innovation beyond ICT-based products and services into traditional, technology-intensive industries such as automotive (Apolinario, 2023; Akpinar & Vincze, 2016). By examining coopetition through a business ecosystem lens, it offers ecosystem actors more tailored guidance on how strategic alliances can pool R&D efforts, strengthen knowledge, and support differentiation, highlighting, in particular, the competitive advantage that open innovation provides in navigating environmental turbulence, value chain instability, and hyper-competition.

Our study provides a broader perspective on innovation within a business ecosystem framework that is open and focused on the automotive industry. We highlighted the attributes of strategic alliances to raise awareness among organizations about pooling their R&D efforts, enhancing their knowledge, and differentiating themselves in the market. This allows us to offer more tailored suggestions to ecosystem actors, regarding coopetition relationships and their contributions to outbound innovation. Our most distinctive contribution is emphasizing the competitive advantage that open innovation brings to the development of partners' activities and the differentiation from competitors. The adoption of coopetitive links is therefore vital to addressing environmental turbulence, value chain instability, and hyper-competition.

Limitations and future research perspectives

Our research examined how coopetition ties shape each type of open innovation activity, inbound, outbound, and coupled, within an automotive business ecosystem, identifying the most favored practices and the strength of coopetition's influence on each.

Future research could extend this work by examining the relationship between open innovation and firm performance, building on evidence linking open innovation predisposition to overall business performance (Hung & Chiang, 2010) and linking each specific type to distinct performance outcomes, inbound to innovation outcomes, outbound to financial performance, and coupled to innovation performance (Ju, Chen, Yu & Wei, 2013). Examining how all three forms jointly shape

innovation performance, particularly within an ecosystem-based perspective, remains a promising avenue tailored to the automotive context.

Practical relevance for policymakers

For policymakers supporting emerging automotive ecosystems, our findings suggest that industrial policy should prioritize incentives for inbound knowledge acquisition, such as supplier technology-transfer programs and university–industry linkages, as the most immediately effective lever for strengthening local innovation capacity. Public–private partnerships of the kind anchoring Morocco's Renault-centered ecosystem offer a replicable model for other emerging economies seeking to convert foreign direct investment into sustained innovation spillovers, provided that accompanying institutional frameworks actively facilitate coopetitive knowledge exchange between local and international ecosystem actors.

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