The research hypotheses were tested through logistic regression analysis. The dependent variable in the study is a dummy variable that indicates if the company cooperates technologically with competitors. The independent variables are:

- Four measures of external flexibility: the percentage of temporary employees in the workforce, the hire of employees with R&D experience (dummy), the outsourcing of R&D activities (dummy), and the financial participation in firms that are developing technological innovations (dummy).

- Two dummies of technological cooperation in the supply chain with customers and suppliers.

The regression analysis controls for: firm size (logarithm of sales) because firm size is widely accepted as a predictor of competitive behaviour (e.g., Miller and Chen, 1996); R&D effort (percentage of R&D employees in the workforce); firm's performance (return on sales) as previous performance is likely to influence competitive behaviour (Young et al., 1996); identity between firm ownership and control (dummy), and industry. Before the multivariate analysis, a comparative study was also carried out to study differences between coopetition and non-coopetition firms. Contingency analysis and means comparisons (t-test) are used in this descriptive study.

RESULTS

Coopetition is a marginal strategy among Spanish manufacturing firms. Only 2.63% of companies cooperated technologically with competitors in the period 2003-2006, whereas technological cooperation with suppliers (21.24%), customers (18.03%), and R&D centres (22.26%) is more widespread. Nevertheless, coopetition is positively associated to these other forms of technological cooperation. Exhibit 2 indicates several contingency indicators between coopetition and technological cooperation with suppliers, customers and R&D centres. The results indicate that coopetition is positively associated to other forms of technological cooperation in the value added chain: firms that cooperate technologically with competitors also cooperate with suppliers (82.95%), customers (76.13%) and R&D centres (86.93%).

Exhibit 2. Contingency Indicators of Association between Coopetition and Other Forms of Technological Cooperation in The Supply or Value Added Chain

	Suppliers	Customers	R&D centres
Chi-square Pearson	411,345***	412,870***	436,769***
Continuity Correction	407,566***	408,843***	432,940***
Likelihood Ratio	316,941***	293,486***	346,516***
Phi Statistic	0.248***	0.248***	0.256***

+p<0.1 *p<0.05 **p<0.01 ***p<0.001

The percentage of coopetition firms increases in the sample of innovative firms. Considering only those firms (21% of total firms) that have developed at least 1 product innovation in the surveyed period, 6.23 per cent cooperated technologically with competitors. The percentage of coopetition firms is also higher (5.56%) in the sample of firms that have developed at least 1 process innovation in the surveyed period (27% of total firms). Similarly, the percentage of coopetition firms in the group of patenting firms (6.3% of total firms) is much higher (51%) than among non-coopetition firms. The contingency indicators for these sub-samples of firms also show that coopetition is positively associated to other types of technological cooperation and that cooperation with suppliers, customers and R&D centres is higher among coopetition firms and the differences are statistically significant (p<0.001). The percentages of coopetition firms that also cooperate with suppliers, customers and R&D centres are similar to the percentages in the total sample; for instance product innovative firms that cooperate technologically with competitors also cooperate with suppliers (79.5%), customers (75%) and R&D centres (90.9%).

Exhibits 3, 4 & 5 show mean differences (t-test) of several characteristics of the firm: organization (size, age, employment type,…), innovation inputs, and innovation outputs. Exhibit 3 shows the differences of organizational variables. The statistically significant results indicate that coopetition firms are larger, older and more foreign-owned than non-coopetition firms (p<0.001). They are also highly

dynamic and exporting firms and use more intensively their production capacity. Exhibit 4a indicates that coopetition firms invest more resources in R&D activities and have a higher percentage of R&D employees than non-coopetition firms. These differences are also found for those firms with positive R&D inputs (Exhibit 4b); however the difference between coopetition and non-coopetition firms is now significant for the percentage of equipment expenditures on sales: coopetition firms invest less intensively in equipment than non-coopetition firms. Regarding innovation outputs, Exhibit 5a shows that coopetition firms are more innovative than non-coopetition firms because they obtain more patents and product innovations; however Exhibit 5b indicates that these differences are less statistically significant for those firms with positive R&D outputs, and even the number of product innovations is lower in coopetition than in non-coopetition firms.

Exhibit 3. Mean Differences (T-Test) of Several Organizational Variables between Coopetition and Non-Coopetition Firms

	Non-coopetition firms	Coopetition firms
Firm sales (thousand euros)	68,574	310,000***
Total employees	233	1,037***
Firm age	30.6	41.3***
Percentage of foreign capital	16.07	41.19***
ROA (return on assets - percentage)	8.51	8.97
Export intensity	18.87	34.50***
Capacity utilization	82.9	87.2***
Market dynamism	52.7	68.7***
Percentage of temporary employment	13.94	14.10
Percentage of agency workers	3.79	2.46
Percentage of full-time permanent contracts	80.01	84.23**
Percentage of part-time permanent contracts	2.02	1.11*

+p<0.1 *p<0.05 **p<0.01 ***p<0.001

Exhibit 4A. Mean Differences (T-Test) of R&D Inputs (All Firms)

	Non-coopetition firms	Coopetition firms
Percentage of in-house R&D on sales	0.63	2.39***
Percentage of external R&D on sales	0.23	1.39***
Percentage of R&D employees	1.65	6.42***
Percentage of equipment expenditures on sales	0.9	0.65

Exhibit 4B. Mean Differences (T-Test) of R&D Inputs (Only Firms with Positive R&D Inputs)

	Non-coopetition firms	Coopetition firms
Percentage of in-house R&D on sales	2.18	2.58
Percentage of external R&D on sales	1.03	1.72*
Percentage of R&D employees	5.37	7.40**
Percentage of equipment expenditures on sales	4.05	1.59**

Exhibit 5A. Mean Differences (T-Test) of R&D Inputs Outputs (All Firms)		
	Non-coopetition firms	Coopetition firms
Number of product innovations	1.76	2.64+
Number of national patents granted	0.17	0.52***
Number of international patents granted	0.24	2.90***
Number of total patents granted	0.41	3.42***
Number of total patents/Number of product innovations	0.33	2.94***

Exhibit 5B. Mean Differences (T-Test) of R&D Inputs Outputs (Only Firms with Positive R&D Outputs)		
	Non-coopetition firms	Coopetition firms
Number of product innovations	9.25	5.63**
Number of national patents granted	3.23	2.71
Number of international patents granted	7.29	20.40*
Number of total patents granted	6.98	14.68*
Number of total patents/Number of product innovations	2.07	10.13**

+p<0.1 *p<0.05 **p<0.01 ***p<0.001

Exhibit 6 indicates contingency indicators of the association between coopetition and different types of product innovation. All types of product innovation are significant and positively associated to coopetition. However, only 50% of coopetition firms have developed product innovations in the surveyed period although this percentage is greater than among non-coopetition firms (20.3%). In the sample of coopetition firms that develop product innovations, the main type of product innovation is new design (79.76%), followed by new functions (61.9%), new components (55.8%) and new materials (50%).

Exhibit 6. Contingency Indicators of Association between Coopetition and Different Types of Product Innovation				
	New components	New design	New functions	New materials
Chi-square Pearson	91.908***	87,361***	98,794***	84,307***
Continuity Correction	73,597***	70,080***	75,213***	68,655***
Likelihood Ratio	89,090***	86,808***	98,701***	70,762***
Phi Statistic	0.117***	0.114***	0.122***	0.112***

+p<0.1 *p<0.05 **p<0.01 ***p<0.001

Exhibit 7 shows that there are some statistically significant differences of types of product innovation among product innovative firms, according to the type of external cooperation. There is a larger percentage of product innovative firms that use several types of product innovation among the group of cooperation firms (columns 'Yes' in Exhibit 6). Technological cooperation with customers introduces more statistically significant differences than other forms of external cooperation. Coopetition only produces significant differences for the type of product innovation based on new functions.

Exhibit 7. Mean Differences of Percentage of Product Innovative Firms According to the Source of Product Innovation and The Type of Technological Cooperation in the Supply Chain

	Coopetition		Customers		Suppliers		R&D Centres	
	No	Yes	No	Yes	No	Yes	No	Yes
New components	49	56	46	55***	44	55***	45	55***
New design	74	80	78	70**	74	74	77	71*
New functions	48	62*	40	60***	42	55***	42	55***
New materials	52	50	48	56**	48	56**	48	56**

Regarding the access to sources of external technology, Exhibit 8 shows the contingency indicators of the association between coopetition and different sources of external technology. First, the financial participation in R&D firms that develop technological innovations is carried out by 28.4% of coopetition firms versus 4.8% of non-coopetition firms. Second, 23.86% of coopetition firms hire personnel with business R&D experience versus 4.88% of non-coopetition firms. Coopetition firms also hire more frequently personnel with public R&D experience (13.07% vs. 1.78%), and outsource R&D activities than non-coopetition firms (3.4% vs. 1.2%). The stronger positive associations are for the financial participation in R&D firms and the hire of R&D personnel. R&D outsourcing does not seem to be positively associated to coopetition.

Exhibit 8. Contingency Indicators of Association between Coopetition and Access to External Knowledge

	Financial participation in R&D firms	Personnel hired with private R&D experience	Personnel hired with public R&D experience	R&D outsourcing
Chi-square Pearson	185,261***	121,217***	107,270***	6,688*
Continuity Correction	180,706***	117,519***	101,796***	5,035*
Likelihood Ratio	100,190***	70,136***	51,113***	4,629*
Phi Statistic	0.166***	0.135***	0.127***	-0.032*

+p<0.1 *p<0.05 **p<0.01 ***p<0.001

Exhibit 9 assesses the association between coopetition and the use of different flexible production technologies: Computer-Aided Design (CAD), Local Area Networks (LAN), Numerically Controlled Machine Tools (NCMT), Robots, and Flexible Manufacturing Systems (FMS). The percentage of coopetition firms that use these technologies is higher, and all the differences are statistically significant (p<0.001): CAD (68.75% vs. 37.92%), LAN (59.09% vs. 24.41%), NCMT (68.6% vs. 49.22%), Robots (58.52% vs. 27.82%), and FMS (54.54% vs. 24.51%).

Exhibit 9. Contingency Indicators of Association between Coopetition and Flexible Production Technology

	CAD	LAN	NCMT	Robots	FMS
Chi-square Pearson	68,581***	108,937***	25,171***	78,997***	81,693***
Continuity Correction	67,289***	107,111***	24,401***	77,502***	80,112***
Likelihood Ratio	66,571***	92,451***	25,752***	70,101***	70,111***
Phi Statistic	0.102***	0.128***	0.062***	0.109***	0.111***

Finally, Exhibit 10 shows the results of the logistic regression that tests the hypotheses. The percent-age of temporary employment is positively related to coopetition (â= 1.331; p<0.05) which supports hypothesis H1; the hire of R&D employees is only marginally related to coopetition (â= 0.395; p<0.1) which does not support hypothesis H2; R&D outsourcing is not related to coopetition (â= -0.783; p>0.1) which does not support hypothesis H3; the financial participation in R&D firms is positively

related to coopetition (â= 0.537; p<0.05) which supports hypothesis H4; and the technological cooperation with customers (â= 1.097; p<0.01) and suppliers (â= 1.507; p<0.01) are positively related to coopetition which supports hypotheses H5a & H5b.

Exhibit 10. Logistic Regression of Technological Cooperation with Competitors (Panel Data 2003-2006)

	Logit regression
Control variables	
Firm size	0.351*** (39.179)
R&D effort	5.857*** (32.197)
Firm's performance	-0.007 (0.212)
Identity ownership-control	-0.186 (0.558)
Industry	0.043* (5.734)
Year 2003	0.337 (1.958)
Year 2004	0.380 (2.545)
Year 2005	0.189 (0.664)
Temporary employment (H1)	1.331* (5.400)
Hire of R&D employees (H2)	0.395^{+} (3.545)
R&D outsourcing (H3)	-0.783 (2.682)
Financial participation in R&D firms (H4)	0.537* (6.594)
Technological cooperation with customers (H5a)	1.097*** (23.927)
Technological cooperation with suppliers (H5b)	1.507*** (35.217)
Model statistics	Chi-square = 494.15*** 2 Log likelihood = 1108.51 R^2 Nagelkerke = 0.335

Wald statistics between parentheses +p<0.1 *p<0.05 **p<0.01 ***p<0.001

DISCUSSION AND CONCLUSION

Scholars suggest that coopetition is an intriguing phenomenon and deserves scholarly attention (Lado et al., 1997), and the managerial trend shows increased tendency to form cooperative ties with competitors and network-based competition among firms. Yet, little empirical research has addressed the determinants of technological coopetition and its implications (Ketchen et al., 2004). By empirically examining how external workplace and technology flexibilities are related to technological coopetition, we believe that this study advances our understanding of coopetition and suggests several possibilities for future research and managerial practice.

Two points are noteworthy based on our theory and data. First, external workplace flexibility is positively related to coopetition. One direct implication is that firms that have access to external sources of

knowledge are in a better position to cooperate with competitors because they may perceive less risk involved in knowledge access and deployment in the network relationship. Second, technological flexibility from networking in the supply chain is also positively related to coopetition. Then, firms able to access technological advances in new technology-based firms and cooperate with customers and suppliers are also better prepared to deal with the uncertainty of technological developments with competitors. Executives need to consider how the different components in the organisational structure interface with the external environment, and they also need to understand the implications of different flexible dimensions for competitive behaviour.

Our result that coopetition only produces significant differences for the type of product innovation based on new functions contributes to the literature that finds a lesser impact of coopetition on the degree of product innovation novelty. Some studies find that different types of partners (except competitors) affect this degree of product innovation novelty. For instance, Nieto and Santamaría (2007) reveal that competitor collaboration has a negative impact on the degree of innovation. Management analysts do not view competitor collaboration as an appropriate instrument to achieve more novel innovations due to lack of trust and the fear of helping a rival. However, Tsai and Wang (2009) suggest that, depending upon the firm's internal R&D investment, collaborating with competitors is a good choice for a firm's innovation performance. Firms with more efforts in internal R&D usually exhibit stronger absorptive capacity (Cohen and Levinthal, 1990), enabling them to better incorporate and use new knowledge from collaboration with competitors for their own ends.

This study is exploratory but opens new venues for research. We do not claim for causality in the flexibility-coopetition relationship. Longitudinal studies should provide directions for causality because some flexibility dimensions could be caused by coopetition. The study of moderator effects could also focus the analysis on the impact of other flexibility dimensions on coopetition.

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