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Insights from N-Helix to practitioners. How many helices are enough, and who are the best partners?

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Introduction

Collaborative business models are a good source for creating value for the firm and developing strategic advantages using knowledge, capacity, and assets to obtain mutual benefits for agents in partnerships (Gyimóthy, 2017; Tajeddini & Ratten, 2020). Moreover, research has demonstrated that collaborative innovation contributes to business performance and economic growth (Christensen, 1998; Diamond & Vangen, 2017; Yström & Agogué, 2020). However, not all firms can monetize their innovation and collaboration activities (Ibáñez et al., 2020; Kurdve et al., 2020). Appropriating the revenues that produce the collaborative business models is the central concern for firms involved in a collaborative relationship, and is a strong motivator for maintaining and expanding these alliances (Najafi-Tavani et al., 2018). Two questions remain unanswered in research on the cooperative business model. First, how many members in a partnership are adequate to obtain better performance? Second, who are the best partners to collaborate with? These issues are relevant to practitioners since the answers could guide managers' decisions about better configurations for collaborative strategies.

Literature review

The Triple Helix model proposes that the industry-university-government collaboration is the basis of a knowledge-based society, improving the innovation and technology transfer between agents (Etzkowitz, 2003; Galvao et al., 2019). Universities produce new knowledge

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in the scientific and technological fields; the government develops mechanisms for adapting and applying this new knowledge to introduce it to industry; and the firms in industry seek to exploit the innovation to improve their performance and competitiveness (Bărbulescu & Constantin, 2019; Jeong, 2014). The N-Helix model extends Triple Helix to include other relevant actors, such as social agents and communities, generating partnerships between *n* partners (helices) (Lew & Park, 2021). N-Helix actors can benefit from knowledge/technology transfer through the partnership by accessing better resources to significantly impact their initiatives (Ibáñez et al., 2021). However, some firms are reluctant to collaborate, and most firms in the market are not involved in a partnership (Mascarenhas et al., 2020).

A firm may be involved in a collaborative relationship for many reasons, such as new product development, process innovation, to sell new products, and to improve distribution systems (Jeong, 2014; Mascarenhas et al., 2020). However, collaborative relationships are exposed to various risks, such as opportunism and power asymmetries; and increasing the number of partners increases these risks in collaborative relationships (Costello, 2013; Eeckhoudt et al., 2005; Lo & Hung, 2017; Williamson, 1985). The basis for a cooperative alliance is trust and reputation since firms should be willing to share knowledge and engage strategic resources for mutual benefit (Rybnicek & Königsgruber, 2019). In this vein, searching and selecting with who collaborates is a strategic decision for the business, and which activities may be shared is a critical concern (Billitteri et al., 2013; Ibáñez, 2021).

Methods

The data for this research is retrieved from the 10th Business Innovation Survey (Instituto Nacional de Estadísticas, 2018), which provides information on the structure of companies' innovation processes in Chile, considering all types of businesses. The sample includes 1,317 Chilean firms, of which 311 firms (24%) collaborate with other entities. A Poisson treatment-effects estimation by regression adjustment is used to obtain the average treatment effects estimator for data analysis. Two models are specified, first to estimate the number of partners collaborating that show the highest impact on firms' sales. Second, identifying which partners have a better effect on sales of firms involved in a collaborative relationship, considering the companies' sizes. For both models, the dependent variables are the percentage of sales for innovations new to the market, the percentage of sales for innovations new to the firm, and the percentage of sales for products not affected by innovation.

In the first model, the total sample is used (1,317 firms). The selection (or treatment) variable is the dimension of the N-Helix partnership; this is a categorical variable that takes the following values: 1 if the firm is not involved in a collaborative relationship (baseline), two

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if the firm has one partner, three if it has two partners, four if it has three partners, and five if it has four partners. For this analysis, the partners available are industry (related companies, suppliers, and competitors), university, government, and society (consumers and independent R&D labs). In the second model, the subsample of firms involved in a collaborative relationship is used (311 firms). The selection (or treatment) variables are a binary for each type of partner: related companies, suppliers, consumers, competitors, independent R&D labs, universities, and the government. The analysis is conducted by size groups: small, medium, and large firms. Descriptive statistics are shown in Table 1.

	Total Sample (N=1,317)		Subsample (N=311)	
	Perc./Mean	Stand. Dev.	Perc./Mean	Stand. Dev.
Small firms	24.37		17.68	
Medium firms	21.64		18.65	
Large firms	53.99		63.67	
Non-cooperate	76.39			
N-Helix 1 partner	8.43		35.69	
N-Helix 2 partners	7.29		30.87	
N-Helix 3 partners	3.80		16.08	
N-Helix 4 partners	4.10		17.36	
Sales for innovations new to the market	3.48	14.900	4.43	16.100
Sales for innovations new to the firm	8.45	22.050	8.59	21.832
Sales for products not affected by innovation	29.60	41.446	41.77	45.273
*Partners**				
Related companies			44.37	
Suppliers			50.48	
Consumers			39.23	
Competitors			25.40	
Independent Labs			42.44	
University			46.95	
Government			29.90	

Note. Perc. = Percentage. Stand. Dev. = Standard Deviation. * Each partner is a binary variable.

Table 1. Descriptive statistics

Results

The results are reported in Table 2. The findings suggest from the first model that the N-Helix collaboration only impacts the percentage of sales for products not affected by innovation. The cooperation with three partners has the greatest effect on the percentage of sales for products not affected by innovation (ATE = 27.225, $\rho = 0.01$), followed by the collaboration with four

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partners (ATE = 18.610, $\rho = 0.01$). The second model's findings reveal that the best partner for small firms in sales of products new to the market is the consumers (ATE = 13.648, $\rho = 0.05$). For medium-sized businesses, the best partner to sell non-innovative products is competitors (ATE = 29.942, $\rho = 0.05$). Finally, large-sized companies benefit from collaborating with suppliers to sell new products to the market (ATE = 4.646, $\rho = 0.05$) and with competitors to sell products new to the firm (ATE = 8.908, $\rho = 0.01$).

	Sales for innovations new to the market		Sales for innovations new to the firm		Sales for products not affected by innovation	
	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.
N-Helix dimension						
1 partner	-0.534	1.142	-0.413	2.092	12.527***	4.414
2 partners	0.365	1.505	0.862	2.516	12.465***	4.731
3 partners	4.901	3.231	2.490	3.279	27.225***	6.396
4 partners	3.052	2.727	-1.936	2.689	18.610***	6.396
Partners' impact						
Small firms						
Related companies	-1.873	5.434	2.420	7.588	2.179	9.844
Suppliers	2.379	6.300	6.061	6.686	5.197	9.179
Consumers	13.648**	6.592	8.589	6.863	-0.328	9.149
Competitors	3.053	7.092	-2.337	6.730	-1.644	9.844
Independent Labs	6.493	7.149	1.996	6.850	-22.214***	7.681
University	7.900	6.334	-2.620	6.461	-8.613	8.999
Government	3.867	6.251	1.047	6.515	-0.913	9.173
Medium firms						
Related companies	-2.030	3.009	-5.086	6.295	5.524	12.743
Suppliers	-5.268	3.200	-3.107	6.617	-23.284**	11.512
Consumers	0.492	3.067	2.463	7.653	10.296	12.769
Competitors	5.968	6.892	-8.451*	4.598	29.942**	13.991
Independent Labs	-2.244	2.671	10.981	8.898	21.422	13.071
University	-3.548	3.070	0.030	6.834	1.443	12.233
Government	-0.882	2.421	-10.974***	3.995	21.662	16.116
Large firms						
Related companies	1.512	2.026	1.708	2.798	-6.281	6.571
Suppliers	4.646**	1.855	-2.934	2.895	12.487*	6.570
Consumers	4.017*	2.301	-0.630	2.806	4.700	6.647
Competitors	1.019	2.271	8.908***	4.567	-3.707	7.634
Independent Labs	2.177	2.084	1.064	2.839	8.286	6.565
University	1.355	2.049	-2.894	2.789	4.521	6.574
Government	1.640	2.612	1.878	3.176	8.374	7.256

Note. Coef. = Coefficient. Std.Err. = Standard Error. */**/*** significance level at 0.10/0.05/0.01.

Table 2. Average treatments effects

Conclusions and discussion

This research proposes that the partnership configurations for the best business performance differ depending on the goals for collaboration and the firm's size. Although many studies have emphasized the positive effects of collaboration strategies on firm performance, these benefits can be captured under specific conditions (Kurdve et al., 2020; Tajeddini & Ratten, 2020). These particular conditions reflect the complex nature of partnership decisions since different firms and goals may demand specific collaborative strategies (Mascarenhas et al., 2020). The

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findings of this research are compiled in figure 1. The matrix shows the number and type of partners that produce the best performance, considering the firm's size and collaboration goals.

Large-size firms	Suppliers	Competitors	*Three partners*
Medium-size firms	Undefined	Undefined	*Three partners* Competitors
Small-size firms	Consumers	Undefined	*Three partners*
	Sales for innovations new to the market	**Sales for innovations new to the firm**	**Sales for products not affected by innovation**

Figure 1. Results matrix

Overall, to sell existing products, in all dimensions of N-Helix, firms have better performance compared with firms that do not collaborate. The best structure to collaborate to sell existing goods and services is to associate with three partners, i.e., cooperate with three of the available agents (industry, government, university, and society). This finding suggests that the companies that collaborate for innovation goals cannot monetize the benefits of partnerships, since the differences in performance between all dimensions of N-Helix and non-collaboration strategies are not significant for selling new products. Regarding the sales of new products to the market, the small firms that choose consumers as partners show better performance than the rest of the collaborators. Also, the large-sized firms cooperating with suppliers have better performance than those who collaborate with others types of partners. Concerning the sales performance for products new to the firm, large companies benefit from cooperating with competitors over other collaborators. Finally, when the firm collaborates to promote their existing products, medium-sized companies show better performance cooperating with competitors than other partners. This research has several implications for practitioners since it offers a realistic view of the different dimensions of N-Helix cooperation and suggests the best partners depending on the firm's size and collaboration goals. The practitioners can benefit from these findings for designing, assessing their collaborative strategies, and guiding the search and selection of the most adequate partners according to the firm's goals and size. Future

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research may explore the specific collaboration strategies implemented for firms in different industries, considering the innovation intensity and a resource-based view.

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