Size matters: When small and large firms look for the best partners to innovate

Abstract

This article aims at studying who the best partners to innovate are for small and large firms. Considering the contradicting results of the literature on alliances and product innovation, we study the role of the size of the focal partner on these relationships. Using the French CIS04 database, we study the impact of cooperation with various partners on product innovation for small and large firms. Our results highlight that, for small firms, customers and competitors are the only partners increasing the likelihood of developing product innovation. If public research institutions are not significant, it appears that cooperation with suppliers is actually harmful for small firms. Regarding large firms, customers and public research institutions are the most attractive partners in terms of product innovation potential. The other partners (competitors and suppliers) do not increase or decrease significantly the likelihood of developing product innovation. Our results contribute thus to the emerging literature that emphasizes the specificities of alliances for small and large firms.

Keyword : Alliance; Innovation; Partner selection; Size ; Small firms ; Large firms

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INTRODUCTION

It is harder and harder for firms to conduct purely individual strategies to be innovative. They need to cooperate with partners to have access to specific resources or knowledge they do not own internally (Dyer and Singh, 1998). In fact, as they try to access more and more resources, firms multiply their alliances and find themselves at the center of a real alliance portfolio (Wassmer, 2010) or innovation network (Chesbrough, 2006). Several types of organizations are usually distinguished in these networks: cooperation with research organizations, vertical cooperation with customers or suppliers; and horizontal cooperation with competitors (Belderbos et al., 2006). Focusing on these different partners, many contributions have studied whether collaborating with these partners was increasing product innovation (Belderbos et al., 2004; Neyens et al., 2010; Nieto and Santamaria, 2007). Nevertheless, whatever the type of partner studied, the literature shows contrasted results. It is thus essential to understand why we do not observe clear relationships between these different collaborations and product innovation.

Among different explanations, we decided to focus our attention on the impact of the size of the focal on the link between these various collaborations and product innovation. Indeed, a recent literature has highlighted that alliances could be a double-edged sword for small firms (Bae and Gargiulo, 2004; Vandaie and Zaheer, 2014; Yang et al., 2014). A first set of contributions underlines that as small firms have few resources, using alliances is a good leverage to create synergies and develop new resource combinations (Ahuja, 2000; Baum et al., 2000; Gomes-Casseres, 1997; Rindova et al., 2012). However, recent contributions have shown that in some circumstances small firms may actually suffer from their interactions with larger firms (Vandaie and Zaheer, 2014). It appears thus that some alliances might be more beneficial than others for small firms (Yang et al., 2014). We thus seek to understand if the various partners in an innovation network have the same impact on product innovation for small and large firms.

Building on various literatures (alliances, SMEs, exploration/exploitation), we elaborate a theoretical framework and formulate a set of hypotheses. We test them using

logistic regressions on the French CIS04 database with a sample of 3935 firms (with 2346 small business from 10 to 249 employees and 1558 large firms with more than 250 employees).

Our study shows that the impact of partnership on innovation is not the same for small and large firms. Large firms benefit more from partnership focused on exploration alliance than partnership focused on exploitation alliance. In this perspective, large firms benefit more from partnership with universities than small firms, and small firms benefit more from partnership with customers and competitors than large firms. Alliance partner for innovation must thus be chosen carefully depending the size of the firm. Our results contribute thus to the emerging literature that emphasizes the specificities of alliances for small firms.

1. THEORETICAL BACKGROUND

1.1. COOPERATE TO INNOVATE

Companies face more and more difficulties to conduct purely individual strategies to be innovative. They have to cooperate with each other (Fey and Birkinshaw, 2005) and have a clear interest in multiplying their partnerships (Dyer and Singh, 1998: Wassmer, 2010). Cooperation becomes a necessary mode for the emergence of technical innovations and economic performance. The benefits of cooperation are multiple (Belderbos et al., 2004; Cassiman and Veugelers, 2006; Fey and Birkinshaw, 2005). This type of relationship can reduce the uncertainty in the environment in which businesses operate, ensuring the transfer of knowledge between the different parties (Cassiman and Veugelers, 2006). Cooperation reduces the time and costs and achieves economies of scale. Finally, it provides opportunities for knowledge transfer, exchange of resources and organizational learning.

Most companies looking to innovate need to build their "innovation networks" with other actors in their environment (Belderbos et al., 2004; Brandenburger and Nalebuff, 1996; Chesbrough, 2006; Neyens et al. 2010; Nieto and Santamaria, 2007; Tomlinson, 2010; Yami et al, 2010). These networks provide a link with a range of partners with the aim to develop and disseminate innovation. Having a network reaching heterogeneous partners increases the ability to develop an innovation project (Belderbos et al., 2006; Greve et al., 2014). Several types of alliance or inter-organizational cooperation can be distinguished: cooperation with research organizations, vertical cooperation (i.e. with customers or suppliers) and horizontal cooperation with competitors. These types of cooperation are different from each other and it

is necessary to distinguish theoretically and empirically the impact of cooperation on product innovation depending on the nature of each of them (Belderbos et al., 2004; Brandenburger and Nalebuff 1996; Chesbrough, 2006; Neyens et al, 2010; Nieto and Santamaria, 2007; Tomlinson, 2010; Yami et al, 2010).

In addition, a growing literature has identified that firms didn't draw the same benefits from their alliances depending on their size (Bae and Gargiulo, 2004; Gomes-Casseres, 1997; Vandaie and Zaheer, 2014; Yang et al., 2014). A first set of authors underlines that as small firms have fewer resources, using alliances is a very good way for them to create synergies and develop new resource combinations (Ahuja, 2000; Baum et al., 2000; Rindova et al., 2012). Such resource combinations help them developing new products or the legitimacy to interact with their stakeholders. However, recent contributions have shown that in some circumstances small firms may actually suffer from their interactions with larger firms (Vandaie and Zaheer, 2014). Smaller firms have to deal with asymmetric alliances in which the larger partner tries to extract as much value as possible from the alliance due to the lower bargaining power of the small firm (Alvarez and Barney, 2001; Doz, 1988). It appears thus that some alliances might be more beneficial than others for small firms. For instance, Yang et al. (2014) highlight that exploitation alliances tend to bring more revenues to small firms than exploration alliances in which the value created is captured by larger partners.

While no one disputes over the value of cooperation and innovation networks, the question now is to determine who the best partners are to develop a new product. Moreover, it is crucial to understand if the partners are the same for small and large firms.

1.2. SMALL FIRM NATURE

Regarding small firms, Torres and Julien (2005) underlines that two main approaches have coexisted regarding small firms. A first approach – the *"intensity" approach* - consists in considering that small firms can be distinguished from large firms mainly regarding their size (in terms of employees, turnover, etc.). Following this approach, small firms should present the same results as large firms but with a different intensity. For instance, regarding alliances, one can reasonably state the larger the size of the focal firm, the more power it has over its partners (Gomes-Casseres, 1997; Huxham and Beech, 2008).

A second approach – the *"specificity approach"* - highlights however the specificities of the nature of small firms and go beyond the question of the size. As it is highlighted by

Dandridge (1979) or Welsh and White (1981), "small firm[s] are not little big business[es]". Under this approach, one should observe some specific results for small firms, even sometimes contradicting the main results regarding large firms. For example, in the specific case of alliances, Yang et al. (2014) show that if exploration alliances tend to benefit more to large firms, small firms get more revenues from exploitation alliances in which they are able to appropriate more value. It is clear that this result highlights studying small firms is not only about investigating the moderating role of size, but also underlining the different relationships that can exist for small firms.

We adopt here the "specificity approach" and we note that cooperation does not always work in a consistent way for small and large firms. As we focus our attention on innovation networks, it appears essential to understand how these multiple relationships aim at balancing exploration and exploitation needs (Gilsing and Nooteboom, 2006; Lavie and Rosenkopf, 2006; Santamaria and Surroca, 2011; Stettner and Lavie, 2014). More precisely, we build on Yang et al. (2014) to understand how these different exploration and exploitation alliances benefit differently to small and large firms. We thus state that large firms are more likely to develop new products from exploration alliances whereas small firms are more likely to innovate using exploitation alliances.

1.3. COOPERATION WITH PUBLIC RESEARCH INSTITUTIONS

Cooperation with research organizations has been growing very strongly in recent years, particularly as a result of government actions. Cooperation with public research institutions can take very different forms. Monjon and Waelbroeck (2003) show that companies can decide to simply try to capture knowledge informally or otherwise may want to establish a formal collaboration with universities. The informal approach is relevant for companies who are engaged in an imitation of technology strategy and looking for incremental innovations. On the opposite, the formalization of cooperation seems a necessity for companies aiming to develop more radical innovation research.

At first sight, previous research on the impact of cooperation with research organizations leads to consistent results. Overall, they show that this impact is rather positive. For instance, Miotti and Sachwald (2003) show that cooperation with public institutions increases the ability of firms to conduct research to the technological frontier and patents. Belderbos et al. (2004) confirm that cooperation with universities and research institutes have

a positive impact on the growth of innovative sales per employee. Similarly, Nietoa and Santamaria (2007) show how cooperation with research organizations has a positive impact on the ability to achieve a high degree of novelty in product innovation. Finally, Neyens et al. (2010) show a positive relationship between continuous strategic alliances with universities and research institutes and the performance of radical innovation.

However, some research have shown that cooperation with public research institutions may also reduce product innovation performance (Caloghirou et al., 2004; Ledwith and Coughlan, 2005; Monjon and Waelbroeck, 2003). Indeed, cooperation strategies with universities do not impact in the same way all economic actors (Mohen and Hoareau, 2003). Large firms are often treated better than smaller companies. Indeed, large firms have greater economic legitimacy. They also have more resources to devote to the formalization of contracts or to seek public support. These are large companies that receive government support for their patents. In contrast, cooperation between SMEs and universities is rare, enjoys less public support and the effect on innovation by SMEs is much lower (Mohen and Hoareau, 2003).

Regarding public research institutions, they are considered as large partners that are mainly exploration oriented (Mohen and Hoareau, 2003; Monjon and Waelbroeck, 2003). Consequently, small firms are unlikely to find complementarities and compatibilities in terms of resources with such institutions. On the opposite, large firms will be able to draw an advantage from their large size to develop new products in exploration alliances with public research institutions. We thus set the following hypothesis:

Hypothesis 1. Cooperation with public research institutions has no impact on product innovation for small firms and a positive impact for large firms

1.4. COOPERATION WITH SUPPLIERS AND CUSTOMERS

The first vertical partners are located upstream and are the suppliers of the company. At first sight, previous research on the impact of vertical cooperation on product innovation is relatively consistent and shows that the overall impact is rather positive. Miotti and Sachwald (2003) show that vertical cooperation positively influences the willingness of the company to introduce new products. For Arranz and Arroyabe (2008), vertical cooperation has a positive impact on the likelihood of introducing new products. Nieto and Santamaria (2007) show that cooperation with suppliers and customers (in order of importance) has a positive impact on

the ability to achieve a high degree of novelty in product innovation. Tomlinson (2010) shows that vertical cooperative ties have a positive impact on the level of innovation performance of the company. Neyens et al. (2010) show that there is a positive association between discontinuous strategic alliances with suppliers and customers and the performance of innovation. Finally, Santamaria and Surroca (2011) point in the same direction as they show that vertical alliance with partners increase the frequency of product innovation.

However, when zooming in at the supplier or customer level only, the results are much more mixed. In general, the results obtained in the literature on the effects of cooperation with suppliers are more mitigated than for cooperation with clients (Belderbos et al., 2004; Nieto and Santamaria, 2007; Santamaria and Surroca, 2011; Tomlinson, 2010; Neyens et al, 2010). While some studies show a positive impact, other studies show no impact or even a negative impact. The authors explain the zero or negative impact of cooperation with suppliers by the fact that when a firm cooperates with its supplier, it mainly improves the supplier's products and not the focal firm's own product. Indeed, a company that cooperates with its suppliers committed its resources, knowledge, etc., that will actually improve the products of these suppliers and not his own.

Agreements with suppliers should be considered more like exploration alliance than exploitation alliance. Working with a supplier permits to include in its own product innovation coming from the supplier. But these innovations of the supplier are not directly innovation of the product of the firms. They permit to explore new direction for innovation but not develop exploitation innovation. As we consider than exploration alliance are efficient mainly for large firms, we deduce than small firms should benefit less from these coopetition with suppliers. We think that cooperation with suppliers might actually be harmful for small firms. Concerning large firms, exploration alliances tend to be more profitable than exploitation ones. We conclude that cooperation with suppliers might be beneficial for large firms. We thus set the following hypothesis:

Hypothesis 2. Cooperation with suppliers has no impact on product innovation for small firms and a positive impact for large firms

The impact of cooperation with customer on innovation depending the size of the firm will be different than the impact of cooperation with suppliers. For small or large companies, cooperation with customers allows companies to develop innovations that they could not

develop alone (Brockhoff, 2003; Fritsch and Lukas, 2001; Gupta et al., 2000). Partnering with clients brings original ideas that can be incorporated into products (Freel and Harrison, 2006). But this positive effect should be even stronger when the company is small. In fact, small businesses have by nature of knowledge and more limited than large firms resources (Torres and Julien, 2005). So they should benefit more from cooperation than large enterprises and divergences should appear in the data.

Cooperation with customers permits to develop products or services that should be directly used by customers. They can thus be classified as exploitation alliances. Regarding small firms, exploitation alliances are supposed to bring more revenue. Concerning large firms, an exploitation alliance increases less the chance of developing new products. The following hypothesis is thus proposed:

Hypothesis 3. Cooperation with customers has a higher positive impact on product innovation for small firms than for large firms

1.5. COOPERATION WITH COMPETITORS

Horizontal alliances are forged between companies that are in competition. It is so special that it has generated a neologism: "coopetition" (Bengtsson and Kock, 2014; Brandenburger and Nalebuff, 1996; Yami et al, 2010). Coopetition is a behavior combining a cooperative and a competitive dimension between companies that offer the same type of products to the same type of customers (Gnyawali and Park, 2011). This neologism expresses the fact that entering in cooperation with a competitor does not imply a reduction of competition between the two coopetitors. These coopetitors develop cooperative projects while continuing to compete (Fernandez et al, 2014; Pellegrin-Boucher et al, 2013, Von Hippel, 1987). Horizontal alliances or coopetition generates a risk that cannot be found in alliances between non-competitors. The risk is to actually strengthen your competitor while weakening yourself. This risk cannot be reduced to zero since it is consubstantial to the alliance between competitors. The more a company wants to advance the common innovation project, the greater the need to cooperate and thus to expose itself to losing its knowledge and resources (Fernandez et al, 2014.).

Previous research on the impact of coopetition on innovation leads to mixed results. Some research shows zero (Miotti and Sachwald, 2003; Santamaria and Surroca, 2011) or a negative impact (Nieto and Santamaria, 2007; Un et al., 2010). Other research shows a positive impact of cooperation between competitors on product innovation. Belderbos et al.

(2004) show that cooperation with competitors has a positive impact on the growth of innovative sales per employee. Similarly, the results of Tomlinson (2010) show that horizontal cooperative links are a significant factor in explaining a firm's innovation performance. Consistently, the results of Neyens et al. (2010) show that there is a positive impact of "continuous strategic alliances" with competitors on the performance of radical innovation.

Finally, a new set of contributions has tried to understand these mixed results insisting on moderating variables. Ritala (2012) highlights that market uncertainty and network externalities strengthen the positive impact of coopetition on innovation. Ritala (2013) also shows how absorptive capacity and appropriability strengthen or moderate the impact of coopetition on innovation. Wu (2014) puts forward the existence of a bell-shaped curve between the level of coopetition and product innovation. Le Roy et al. (in press) show that coopetition has a positive impact on product innovation when the coopetitor is distant geographically.

Regarding cooperation with competitors, most contributions show that alliances with competitors aim at exploiting complementarities or at developing economies of scales (Dussauge et al., 2000; Bengtsson and Kock, 2000) and can thus be classified as exploitation alliances. As small firms benefit more from exploitation alliances, one can reasonably expect that coopetition is very likely to generate positive outcomes for small firms. For large firms, such exploitation-oriented alliances are less beneficial than exploration-oriented ones. We thus state the following hypothesis:

Hypothesis 4. Cooperation with competitors has a positive impact on product innovation for small firms and no impact for large firms

2. RESEARCH METHODS

2.1. DATABASE

To test our hypothesis we used the CIS database (Community Innovation Survey) resulting from the INSEE survey on innovation in France for the period 2002 to 2004 (CIS-04). This approach has become the standard method of gathering and analyzing information on innovation (Arranz and Arroyabe, 2008; Belderbos et al., 2004; Belderbos et al., 2006; Miotti and Sachwald, 2003). The main themes are the frequency and nature of innovation, degree of innovation, costs and barriers to innovation and the level of decision making for innovation

projects. It allows distinguishing between firms that innovate and those that do not. It is therefore particularly suited to analyze the relationship between innovation and the different types of cooperation strategies. The administration of the survey and data collection have been performed according to the "Oslo Manual" written under the OECD authority. The unity of the collection is the firm. For all sectors, the survey is conducted every four years. The scope of the survey covers all companies with more than ten employees. In line with the work of Fritsch and Lukas (2001) and those of Santamaria and Surroca (2011), we include all the companies for which the information is complete, without distinguishing between those who innovate and those that do not innovate to avoid some bias. Our research is focused on a final sample of 3935 firms. In addition, our study identifies the different types of firms by size, in order to distinguish cooperation for SMEs and for large companies. To this end, we divided the sample into two sub-samples: the small businesses (2347) with between 10 and 249 employees and large firms (1558) with more than 250 employees.

Finally, our study deliberately focuses on data from 2002 to 2004 from the CIS survey 04. We wanted to use data that was not impacted by the economic crisis starting in the middle of 2007. Data from the Community survey CIS -08, covering the period 2006-2008, were not suited to our object of study. Meanwhile, the CIS-06 survey did not allow for a representative sample of the population of French companies as it was carried out only for industrial companies.

2.2. VARIABLES AND MEASURES

2.2.1. Dependent variable

Our approach has been to collect information directly on innovation of enterprises through the survey CIS 04 according to numerous studies on innovation. Literature dealing with innovation shows that product and process innovations are measured in various ways (Becheikh et al., 2006) and many authors argue that measuring innovation is always a thorny task for researchers (Archibugi and Pianta, 1996; Archibugi and Sirilli, 2001). Early literature often approaches innovation through two indirect measures: R&D expenditure and number of patents. However, this conducted to a distorted measurement of innovation because all innovations are not necessarily patented. Moreover, R&D expenditure does not systematically lead to innovation. In consequence more direct indicators appeared in literature.

The current trend consists in collecting information on innovation directly from firms through surveys, such as the CIS, and/or interviews (Michie, 1998; Becheikh et al. 2006). Hence, for our work, we use direct innovation measures stemming from the CIS04 survey. In question 2.1 of the CIS04 survey the respondents had to indicate whether they introduced product (good or service) innovations. These innovations can be new to the market or to the firm. This variable takes a value of 1 if the firm has implemented an innovation and 0 if not (cf. table 2).

2.2.2. Independent variables

Usually, one can identify three different measurements of the cooperation. Two types of measures are at the opposite while the third is a middle way.

The first approach uses only three variables aggregating cooperation because it distinguishes only three possible types of cooperation: horizontal cooperation, vertical and institutional (Cassiman and Veugelers, 2002; Huergo, 2006; Leiponen and Byma, 2009; Santamaria and Surroca, 2011). Horizontal cooperation is measured through cooperation with competitors. Vertical cooperation measures whether a company has cooperated with its customers and/or its suppliers or not. Similarly, institutional cooperation is measured by a dummy variable if companies announce their cooperation with universities and/or research organizations (private and public).

The second approach distinguishes more cooperation partners (De Faria et al., 2010; Tether, 2002). Internal partners (companies from the same group or network) are distinguished from external partners (competitors, consumers, suppliers, universities, private R&D organizations, public R&D agencies). It therefore describes many more different types of cooperation. For this, it does not use aggregated cooperation variables as the first approach. It uses up to seven variables to measure the types of business cooperation.

The third approach can be seen as a middle way. Unlike the first approach, it separates cooperation with customers and cooperation with suppliers while having a less intensive level of detail that the second approach. In this framework, empirical studies use four cooperation variables: competitors, customers, suppliers, public research institutions (Belderbos et al, 2004; Belderbos et al, 2006; Fritsch and Lukas, 2001; Nieto and Santamaria, 2007; Tomlinson, 2010; Tsai, 2009). As with the two previous approaches, each cooperation

variable equals 1 when companies indicate at least one cooperation agreement with a partner, and is 0 if no cooperation agreement was made.

In accordance with the third approach mentioned above and the authors cited above, we take into account the cooperation with the various partners competitors thanks to the six following questions in the survey CIS04: "Have you done a:

- Cooperation with suppliers
- Cooperation with customers
- Cooperation with public universities, higher education institutions or public institutions of R & D
- Cooperation with competitors

To measure the effects of different types of cooperation, conventional binary variables are used. They take the value of 1 if the company claimed to have worked with a partner and 0 otherwise (cf. Table 2).

2.2.3. Control variables

Consistent with the literature, we included control variables related to the specific characteristics of the company: the number of employees, the geography of the firm's markets, membership in an enterprise group, membership in a company network, absorption capacity and acquisition effort of external knowledge and technology.

The company size is measured by the logarithm of the number of employees in the company in 2004 as done by Santamaria and Surroca (2011), Nieto and Santamaria (2007) and Tsai (2009).

The geography of the firm's markets is measured through 4 dummy variables (regional, national, European and others) taking the value 1 if the firm operates in this zone and zero otherwise. Previous research has shown that the geographical proximity between partners was impacting innovation (Le Roy and al., in press).

The membership in an enterprise group is measured using a dummy variable that takes the value 1 if a company claims to be a member of the group (De Faria et al., 2010; Vencatachellum and Versaevel, 2008).

The membership in a network is also measured with a binary variable taking the value 1 when the company belongs to a network and 0 otherwise.

The absorption capacity of information is measured with the ratio of internal R&D expenditure to firm's turnover in 2004 (Becker and Dietz, 2004; Nieto and Santamaria, 2007; Tsai, 2009). Caloghirou et al. (2004) show that firms with a high level of absorptive capacity are more suited to create and exploit linkages with other firms. This variable describes a proportion and ranges between 0 and 1 for almost all firms, but for few firms the proportion exceeds 1 (in this case, the amount of internal R&D investment exceeds the turnover).

Finally, we assess the intensity of external activities of innovation through the acquisition effort of external R&D, of machinery and of knowledge for innovation. We measure this innovation effort using the ratio of technologies and/or external knowledge expenditure to the 2004 firm's turnover. As for the previous variable, this variable also describes a proportion and ranges between 0 and 1 for almost all firms, but for few firms the proportion exceeds 1.

Table 1. Variables

Type of variables	Name of variables	Value
Dependent variables		
Product innovation	"ProdInnov"	0/1
Independent variables		
Cooperation with public research institutions		
Cooperation with public R&D institutions and Public University/higher education	"CoPubR"	0/1
Vertical Cooperation		
Cooperation with suppliers	"CoSupp"	0/1
Cooperation with customers	"CoCust"	0/1
Horizontal Cooperation		
Cooperation with competitors	"CoComp"	0/1
Control variables		
Number of employees[a]	"Employ"	>1
Membership in an enterprise group	"MemGroup"	1/0
Membership in a network	"MemNet"	1/0
Absorption capacity of information[b]	"AbsorpCap"	Proportion
Use of technologies and/or external knowledge[c]	"ExTech"	Proportion
Local/regional Market	LocalMarket	0/1
National Market	NationalMarket	0/1
European Market	EuropMarket	0/1
Ohter Market	OtherMarket	0/1

[a]natural logarithm of number of employees
[b]ratio of internal R&D expenditure/total turnover
[c]ratio of technologies and or external knowledge/total turnover

2.3. DATA ANALYSIS AND STATISTICAL TESTS

The most appropriate statistical method is the logit model (Aldrich and Nelson, 1984; Greene, 2000) as the dependent variable is dichotomous. Using logistic regression, we can identify the explanatory variables related to the development of innovation in French companies. The properties of the logit model (resp. Probit) are particularly useful for the interpretation of the parameter estimates associated with the explanatory variables. This explains the high use of the logit model in the empirical literature on cooperation between actors in an innovation context (Fritsh and Lukas, 2001; Tether, 2002). This technique is also widely used in the literature on innovation performance (Huergo, 2006; Mention, 2011).

First, logistic regression will lead to estimate the regression coefficients. They indicate the direction (positive/negative) and strength (between 0 and 1, denoted β) of the influence of these variables on the probability of occurrence of innovation. In a second step, logistic regression allows us to test our hypotheses. To test hypotheses 1 to 4, the analysis is to observe whether the β regression coefficients are significantly different from zero. To test the hypotheses 5 and 6, we compare the odds ratio of the different explanatory variables (Tether and Tajar, 2008; Mention, 2011). These odds ratio appear under the symbol Exp (β) in Tables 3 and 4. The odds ratio measures the impact of the change of one unit (marginal effects) of each explanatory variable on the probability of product innovation. It is then possible to prioritize the marginal impact of each cooperation variable by directly comparing the values of the odds ratio. The higher the value, the higher the explanatory variable is strongly linked to product innovation. A value greater than 1 indicates how many times the probability of innovation (that of not innovating) increases in the presence of the explanatory variable. A value less than 1 indicates how many times the probability of innovation decreases.

Logistic regression, as all varieties of multiple regressions, is sensitive to the strong correlation between the explanatory variables constituting the vector X. However, in the multivariate analysis, the correlation matrix shows no mutlicollinearity problem (Tabachnik and Fidell, 2001). This result is confirmed by the multicollinearity test performed using the VIF factors (Variance Inflation Factors). Therefore, we can use the estimates from this regression to interpret the results.

3. RESULTS

3.1. RESULTS FOR THE COOPERATION WITH PUBLIC RESEARCH INSTITUTIONS

The tables 2 and 3 show that cooperation with public research institutions presents contrasted results depending on the size of the focal firm. Indeed, regarding small firms, Table 2 shows no significant link of cooperation with public research institutions on the likelihood of generating product innovation. However, regarding large firms, Table34 allows us to identify a positive and significant link of collaborations with public research institutions on the likelihood of developing a product innovation (β= 0.573, p<0.001). We thus validate our Hypothesis 1: cooperation with public research institutions has a positive impact on product innovation for big firms and no impact for small firms.

Table 2. Results for small firms

	β	Sig.	Exp (β)
CoPubR	0.116	n.s.	1.123
CoSupp	-0.590	***	0.554
CoCust	0.919	***	2.507
CoComp	0.274	**	1.316
Control variables			
Employ	0.010	n.s.	1.010
MemGroup	0.121	n.s.	1.129
MemNet	-0.036	n.s.	0.964
AbsorpCap	0.051	n.s.	1.052
ExTech	-0.034	n.s.	0.967
LocalMarket	-0.047	n.s.	0.954
NationalMarket	0.577	***	1.781
EuropMarket	0.170	n.s.	1.185
OtherMarket	0.645	***	1.905
Constant	-0.240	n.s.	0.786

* p <0.05, ** p <0.01, *** p <0.001

3.2. RESULTS FOR THE COOPERATION WITH SUPPLIERS

Regarding collaborations with suppliers, the tables 2 and 3 do not show any consistent result for small and large firms. For small firms, Table 2 allows us to note that cooperation with suppliers reduces significantly the likelihood of generating product innovation (β= -0.590, p<0.001). For large firms, table 3 shows that cooperation with suppliers doesn't have any significant link on the likelihood of product innovation. We thus reject Hypothesis 2: cooperation with suppliers has no impact on product innovation for big firms and a negative impact for small firms.

Table 3. Results for large firms

	β	Sig.	Exp (β)
CoPubR	0.573	***	1.773
CoSupp	0.217	n.s.	1.242
CoCust	0.845	***	2.329
CoComp	0.232	n.s.	1.261
Control variables			
Employ	0.062	n.s.	1.064
MemGroup	0.443	n.s.	1.558
MemNet	-0.034	n.s.	0.967
AbsorpCap	0.280	n.s.	1.323
ExTech	-0.081	n.s.	0.923
LocalMarket	0.104	n.s.	1.110
NationalMarket	0.543	*	1.722
EuropMarket	0.700	***	2.015
OtherMarket	0.303	n.s.	1.354
Constant	-1.414	*	0.243

*p <0.05, ** p <0.01, *** p <0.001

3.3. RESULTS FOR THE COOPERATION WITH CUSTOMERS

Regarding small firms, Table 2 shows that cooperation with customers increases significantly the likelihood of generating product innovation (β=0.919, p<0.001). For large firms, Table 3 highlights a positive and significant link of collaboration with customers on the likelihood of developing product innovation (β=0.845, p<0.001). The Exp (β) is higher for small firms (2.507) than for large firms (2.329). This validates our Hypothesis 3: if cooperation with consumers impact positively innovation of small and large firms, the impact is higher for small firms than for big firms.

3.4. RESULTS FOR THE COOPERATION WITH COMPETITORS

Concerning collaborations with competitors, the impact on the likelihood of generating product innovation defers depending on firm size. Table 2 indicates that cooperation with competitors increases the likelihood of developing product innovation for small firms (β=0.274, p<0.01). Nevertheless, regarding large firms, Table 3 shows no significant link on the likelihood of developing product innovation. This confirms our Hypothesis 4: cooperation with competitors has a positive impact on product innovation for small firms and no impact for big firms.

3.5. RESULTS REGARDING THE RELATIVE IMPORTANCE OF PARTNERS

Using the Odds ratio in the tables 2 and 3, we can rank the partners according to their likelihood of generating product innovation. Concerning small firms, Table 2 shows that customers are the partners increasing the most the likelihood of product innovation, whereas suppliers are the partners reducing the most product innovation. For large firms, Table 3 indicates that customers are the most attractive partners followed by public research institutions.

4. DISCUSSION

4.1. THE IMPORTANCE OF SIZE ON THE IMPACT OF COOPERATION ON INNOVATION

Our results confirm the need to take into account the size of the focal firm when analyzing alliance strategies. Our analysis reveals that for all partners the link between the cooperation with a given partner and the likelihood of developing product innovation differs for small and large firms. In other words, similar partners do not generate the same outcome (in terms of product innovation) depending on the size of the focal firm.

This intriguing result sheds new light on the puzzling results of the literature on alliances and innovation. Based on our results, we think that these size effects can explain the contradictory results of the existing literature. Indeed, in the previous contributions, most samples tended to put together firms with very different sizes. By clearly separating small and large firms in the sample, one should be able to identify clearer relationships between alliances and innovation. This result goes along with the recent literature showing that small firms do not benefit in the same way as large firms from alliances (Vandaie & Zaheer, 2014; Yang et al., 2014).

4.2. FINDING THE BEST PARTNER FOR SMALL FIRMS

Regarding small firms, our results tend to confirm the existing literature highlighting that alliances are a double-edge sword (Vandaie and Zaheer, 2014; Yang et al., 2014).

Regarding public research institutions, we expected no impact of the collaboration with small firms on innovation and the results confirm our hypothesis. Concerning suppliers; we expected no impact of collaboration on innovation. Results show that collaborations with suppliers reduce significantly the likelihood of developing product innovation. Such a result

can be explained by the relative small size of the focal firm compared to the suppliers. As a consequence, when launching an R&D project, it is very likely that the larger partner (i.e., the supplier) will take advantage of its higher bargaining power and capture the potential innovation for its own profit. Small firms cooperating with suppliers are thus very likely to see their innovation potential being reduced.

Our analysis shows that cooperation with customers increases the most the likelihood of developing product innovation for partners. For small firms, customers are thus the best partners to innovate. The cooperation with customers allows firms to develop innovations that they could not develop alone (Brockhoff, 2003; Fritsch and Lukas, 2001; Gupta et al., 2000). In addition, partnering with clients brings original ideas that can be incorporated into products (Freel and Harrison, 2006). In fact, the positive effect is even stronger for small firms than for large firms as smaller firms have more limited resources (Torres and Julien, 2005).

Finally, concerning competitors, we found a positive impact of cooperation for small firms. This result confirms our intuition according to which exploitation-oriented collaborations would be beneficial for small firms. This result sheds new light on the literature on coopetition and innovation that was not finding any clear relationship between the concepts (Le Roy et al., in press; Ritala, 2012). Our distinction between small and large firms shows that coopetition is very beneficial for small firms because they use their cooperation with a competitor as leverage to get access to specific resources or competencies belonging to their competitors.

4.3. FINDING THE BEST PARTNER FOR LARGE FIRMS

It is striking to observe that except for customers, large firms offer different results from small firms. A global look at our results show that contrary to small firms, large firms usually benefit from their alliances with impacts that are either positive or non-significant (but never negative). Whereas alliances might be harmful for small firms, it appears that alliances are always worth trying for larger firms.

Our results show that collaboration with suppliers and competitors do not have a significant impact on the likelihood of developing product innovation. Even if we expected a positive relationship in both cases, our results seem to highlight that large firms tend to give too much importance to these partners while the room for improvement (in terms of innovation) is often marginal. This partly explains why both literatures on coopetition and

suppliers didn't have consistent results regarding the cooperation with these partners and innovation.

Considering public research institutions, as expected, we find a positive link between cooperation with such institutions and product innovation. Large firms benefit from strong complementarities with public research institutions with which they launch exploration-oriented projects while enjoying a balanced bargaining power.

Finally, as for small firms, collaborations with customers increase the most the likelihood of generating a product innovation. These exploration-oriented projects are very profitable to large firms who benefit from a very high bargaining power over customers. Nevertheless, it appears that, *ceteris paribus* collaboration with customers is more profitable for small firms than for large firms. This result confirms our intuition according to which the lack of resources for small firms makes alliances with customers more attractive and profitable for small firms than for large firms.

4.4. MANAGERIAL IMPLICATIONS

Based on our result, we can observe that the best partners for small and large firms are not the same. If customers play a central role for both types of firms, it appears that public research institutions are good partners for large firms while having no impact for smaller firms. The same reasoning works for competitors that are quite attractive for small firms while having no impact on innovation for large firms. One of the main implications of this article for alliance managers and policy makers relies in taking into account the size of the focal firm when looking for potential partners for product innovation.

So far, in our results, a firm was categorized either as a small or as a large firm. However, as firms grow, they may switch from one category to the other. A small firm may grow and actually become a large firm. As a recent literature has focused its attention on alliance portfolio evolution (Hoffmann, 2007; Lavie and Singh, 2011; Rindova et al., 2012), our results allow us to bring some additional insights. We can state that in the early phases of their life cycle, firms should cooperate more with customers and competitors. However, as they get bigger, firms should terminate their alliances with competitors and replace them by alliances with public research institutions. This result goes along with the resource or alliance orchestration literature (Sirmon et al., 2011) according to which firms must proactively manage their portfolio of resources and partners over time.

5. CONCLUSION

This article aimed at understanding if small and large firms benefit in the same way from alliances with various partners regarding their likelihood of developing product innovation. Building on various literatures (alliances, SMEs, exploration/exploitation), we elaborated a theoretical framework and formulated a set of hypotheses. We tested them using the CIS04 database and reached the following conclusions. For small firms, customers and competitors are the only partners increasing the likelihood of developing product innovation. If public research institutions are not significant, it appears that cooperation with suppliers is actually harmful for small firms. Consequently, alliance partners must be chosen carefully for small firms. Concerning large firms, customers and public research institutions are the most attractive partners in terms of product innovation potential. The other partners (competitors and suppliers) do not increase or decrease significantly the likelihood of developing product innovation. Our results contribute thus to the emerging literature that emphasize the specificities of alliances for small firms.

Inevitably, this study has a number of limitations. First, this study is based on a survey so that the information available is only the information declared by the respondents. Even if the CIS survey has been extensively used in the innovation literature, the use of a dummy variable to code the emergence of product innovation could hide differences in terms of intensity or quantity of innovation. Using for instance "the share of the turnover generated by innovation" as the dependent variable could be a promising lead for future research. Second, we focused our attention on the French CIS survey. Even if we do not think there is a French specificity in terms of alliances, it could be interesting to test our conclusions in other countries. Third, our model doesn't explain explicitly the process leading to the development of product innovation. The integration of more variables focusing on the innovation process, using structural equations, could lead to interesting results. Fourth, in our theoretical framework, we have investigated independently the impact of various collaborations on product innovation. However, various contributions (Belderbos et al., 2006; Wassmer & Dussauge, 2012) have highlighted the possible interactions between partners regarding productivity or stock market reactions. Maybe, such results could be confirmed regarding product innovation too.

To conclude, we are confident that our study provides a useful perspective on cooperation and product innovation for small and large firms. We think that studying differently small and large firms regarding their alliance strategies could be a promising research avenue.

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