Chapter 9
Coopetition and Open Innovation: An Application to KIS vs. Less-KIS Firms

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Abstract This paper tackles in an innovative way the issue on coopetition, by making use of service firms' behavior in generating innovative services, to reveal their innovative performance and the dynamics of coopetition targeted at open innovation. For this purpose, we use a dataset of 1,221 service firms that participated in the European Community Innovation Survey (CIS), 2008. A probit analysis is conducted for "knowledge-intensive service (KIS) firms" and "less-KIS firms" and, the results reveal that coopetition arrangements between competing firms and scientific community, and also firms' capacity to introduce innovations into the market, have a positive and significant influence on service firms' behavior to generate service innovations. Furthermore, this study also reveals that the effects of introducing process innovations inside the firm and the existence of internal R&D activities are of major significance for influencing positively the innovative behavior of service firms.

Keywords Absorptive capacity • Coopetition • Innovation • Knowledge-intensive services

9.1 Introduction

As a means of fostering innovation, firms, and other institutions make use of the so-called coopetition, this being a compound of strategic cooperation and competition among rivals (Rusko 2011). When dealing with emerging technologies, characterized by uncertainty regarding market opportunities, firms opt for strategic coopetition (Garraffo 2002).

Several authors analyzed the strategic use of coopetition by firms dealing with emerging technologies (Brandenburger and Nalebuff 1996; Gomes-Casseres 1996;

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Harbison and Pekar 1998). Others focused on the benefits of coopetition (Bagshaw and Bagshaw 2001; Garraffo 2002; Chien and Peng 2005; Rusko 2011).

The risks of opportunistic behavior emerging from coopetition were the object of analysis (Nieto and Santamaria 2007), as well as the importance of coopetition, especially when it comes to developing incremental innovations in high-tech industries (Abernathy and Clark 1985; Fjelstad et al. 2004; Ritala and Hurmelinna-Laukkanen 2009). The risks of appropriability regarding intellectual property (IP) and knowledge ownership in coopetition alliances were studied by a set of scholars (Seung and Russo 1996; Rammer 2002; Blomqvist et al. 2005; Dagnino and Rocco 2009; Escribano et al. 2009).

This article presents a contribution to previous studies, by using service firms' behavior in generating innovative services, to unveil their innovative performance and the impact of the dynamics of coopetition targeted at open innovation. In this vein, we conduct a probit analysis to the determinant factors of service firms' behavior to generate innovative products/services influenced by policies targeted at driving innovative behavior among firms, scientific community and competitors, spurring firm's absorptive capacity and forming collaboration schemes with competitive partners increasing the pace of innovative performance.

It contributes to the empirical literature on research and development (R&D) management by adopting a different perspective from prior work and complementing earlier studies deepening the understanding of the behavioral process of creating innovation, under the framework of coopetition and open innovation. A set of service firms is analyzed, since this economic activity sector is considered an adequate laboratory for assessing the role played by coopetition in fostering open innovation in highly turbulent and competitive environments, especially by contrasting "knowledge-intensive service (KIS) firms" and "less-knowledge-intensive services (LKIS) firms."

Authors like Muller and Zenker (2001), Miozzo and Grisham (2006) refer that KIS firms are gaining an important position in the market, assuming to be one of the major forces of the economic activity. Previously, and according to Boden and Miles (2000) and Wood (2006), these firms were grouped on "other services," but due to several changes in their production processes, the role of ICT technologies, the human capital force in economic growth, and the implementation of the knowledge-based society, the role of these firms is increasingly taking a central position in economy.

Regarding Merino and Rubalcaba (2012), as KIS firms are considered one of the major sources of structural change in the advanced economies, they have increased their relative share of importance in the European economy by 30 % since 1979, achieving 33 % of the employment force (37 % in the United States) in 2004 and 35 % of value added (39 % in the United States). The impact of KIS firms is derived from their capacity to generate and diffuse localized knowledge, to facilitate and adopt technological, organizational, social, and other typologies of innovation.

The determinant factors of the innovative behavior of service firms are analyzed, by making use of the data available in the European CIS Survey, 2008.

The remainder of this article is structured as follows. Section 9.2 develops the theoretical underpinnings, drawn from the literature on coopetition and open innovation

and innovative products and services. Section 9.3 presents the empirical approach. Section 9.4 refers to the analysis, main results, and discussion. Finally, the article concludes and presents limitations, implications for policy-makers, and guidelines for practitioners engaged in strategic cooperation oriented to create innovation.

9.2 Theoretical Framework and Hypotheses

9.2.1 From Coopetition to Open Innovation: Is It Important to Implement Process Innovations?

According to Luo et al. (2007), the coopetition concept was introduced in the 1980s by Raymond Noorda and became the subject of several studies during the 1990s, namely the issue of dyadic coopetition (Bengtsson and Kock 2000, 2003) or multi-faceted coopetition (Amburgey and Rao 1996; Tsai 2002; Luo and Slotegraaf 2006).

Brandenburger and Nalebuff (1996) consider coopetition as an alternative way to perform in business, as distinct from competition, strategically used by firms that deal with emerging technologies in innovation networks.

In the view of Bagshaw and Bagshaw (2001) coopetition allows better performance for the firms involved than competitive arrangements, as by strategically managing cooperation and competition, the relationship can evolve through controlled behavior by partners and rivals.

Coopetitive relations call our attention for the concept of open innovation, which, according to Chesbrough (2003), derives from the process of ideas that appear from internal and/or external sources as well as technology can enter in the process at different stages and projects can flow to the market in multiple ways (through outlicensing, cooperative arrangements, a spin-off company or through the marketing and sales channels of the firm). Chesbrough et al. (2006), present the concept of open innovation which can be understood as the use of inflows and outflows of knowledge in order to foster internal innovation and to develop the markets for external use of innovation. In this sense, firms can and should make use of external knowledge and internal and external paths to the market while developing their own technology.

9.2.2 From Coopetition to Open Innovation: The Role of Absorptive Enablers

Achieving higher absorptive capacity increases the pace of engaging in coopetition and enables innovativeness (Ritala and Hurmelinna-Laukkanen 2009). Cohen et al. (2000) studied this process using the framework based on the concept of firm's absorptive capacity. This concept refers to the identification of valuable knowledge in the environment, the capacity to assimilate it and align it with existing knowledge stocks and finally exploit it in internal R&D activities to achieve successful innovation.

Zahra and George (2002) analyzed the concept of absorptive capacity as a dynamic capability, creating a model of the components, antecedents, contingencies, and outcomes of absorptive capacity. Their model was innovative because they substituted the component of "recognizing the value" with "acquisition" and relocated the influence of appropriability regimes. Additionally, these scholars enlarged the model with the transformation concept that follows the assimilation component, activation triggers, and social integration mechanisms, and divided absorptive capacity into "potential" absorptive capacity and "realized" absorptive capacity. The process of transformation gives firms the capacity to develop changes in existing processes to be able to absorb new knowledge, assimilating it by means of interpretation and comprehension within existing cognitive structures.

Regarding that statement, Todorova and Durisin (2007) proposed that firms cannot transform their knowledge assets when they are not able to assimilate them. Furthermore, Zahra and George (2002) distinguish between potential absorptive capacity and realized absorptive capacity. The first has to do with acquisition and assimilation of new external knowledge by reconfiguring the resource base and deploying capacities, while the second deals with transformation and exploitation of new external knowledge by developing new products and processes. Potential absorptive capacity without realized capacity does not produce an effect on the firm's competitive advantage.

In addition, the authors identified the activation triggers, social integration mechanisms, and appropriability regimes acting as key contingencies. Social integration mechanisms help to lower the barriers between assimilation and transformation, increasing absorptive capacity, which is understood, by the proposed model, as being a dynamic capacity involving a set of organizational routines (e.g., social interactions) and processes. The ability to learn and absorb depends on the capacity to value external knowledge (Zahra and George 2002).

According to Rothaermel and Alexandre (2009), the greater the firm's absorptive capacity the greater its ability to fully capture the benefits resulting from flexibility in technology sourcing. Furthermore, the ability to recognize and exploit knowledge flows varies from one firm to another, resulting in unequal benefits acting as a competitive advantage. This absorptive capacity varies according to the firm's existing enablers, like knowledge stock embedded in its processes, people, and products.

Several authors point out that the main benefit derived from collaboration between competitors is the creation of completely new products (Tether 2002; Quintana-Garcia and Benavides-Velasco 2004).

Ritala and Hurmelinna-Laukkanen (2009) state that coopetition helps to develop incremental innovation in current products and services, being an effective mode of generating new innovations especially in high-tech industries. Furthermore, patents are used, as stated by Carayol and Roux (2007) and Ma and Lee (2008), to establish collaborative technological relationships between firms and their stakeholders.

The studies of Brandenburger and Nalebuff (1996), Dussauge et al. (2000) and Tether (2002) deal with the association between firms' innovative capacity and the coopetition arrangements they enter to generate value added and increase productivity.

Several scholars (Zahra and George 2002; Todorova and Durisin 2007; Rothaermel and Alexandre 2009; Kostopoulos et al. 2011) devoted their studies to analyze the impact of introducing process innovations inside the firm, which can be either in the production process or in the organizational structure, embracing R&D positioning, such as fostering open innovation channels and absorptive capacity on the firm's behavior to generate innovations. Thus:

H1: The introduction of process innovations inside the firm has a positive and significant impact on the firm's behavior to generate product/service innovations.

As Cohen and Levinthal (1989) defend, the firm's knowledge base plays the role of both innovation and absorption, since its tendency to assimilate external knowledge creates an incentive to invest in R&D. Gambardella (1992) also states that firms with better in-house R&D programs are more able and prepared to absorb external scientific information. Other authors analyzed the determinant role of the firm's absorptive capacity in exploiting the alliances it establishes (Arora and Gambardella 1994; Zahra and George 2002). In this line, having an internal R&D strategy makes the firm more prone to deal with coopetition relations and to get involved in open innovation channels and mechanisms.

The positive and significant impact of firms' investment in R&D activities performed inside the firm was also the subject of multiple studies, such as those of Cassiman and Veugelers (2006) and Li (2011). These authors point to the major importance of the firm's investing in its basic R&D intensity, and of increasing the firm's in-house R&D performance. In coopetition, controlling knowledge flows during joint R&D activities involves some risk, this being a critical issue in reaching success in strategic alliances oriented towards innovation activities embracing competitors. The risks of appropriability in a strategic alliance can be higher when partners are direct competitors (Park and Russo 1996). Appropriability methods can be of two types, formal and informal (Rammer 2002). Formal methods are the legal forms of protection such as patents, copyrights, and trademarks, to prevent others from using the firm's patents and knowledge embedded in them, despite allowing the competing firm to access patent knowledge and learn from it. Informal methods include secrecy, complex design, and lead time. In this sequence, we present the following hypothesis:

H2: The performance of R&D activities inside the firm has a positive and significant impact on the firm's behavior to generate product/service innovations.

Bergek and Bruzelius (2010) point out the interest of patent data as an indicator of collaborative technological activity. The association of several international inventors suggests the existence of international cooperation (Carayol and Roux 2007; Ma and Lee 2008). In addition, patents can indicate the emergence of an international trend in a certain technological field, which in turn can contribute to reveal the evolutionary pathway in terms of collaborative development oriented to technological innovation (Archambault 2002).

Chen and Chen (2011) state that patents protecting product/service innovations are one of the firm's important intangible assets, in the sense that they can provide additional revenue to be generated towards product commercialization.

The introduction of innovations into the market was also subject of several studies, for instance Tether (2002) and Quintana-Garcia and Benavides-Velasco (2004) that concluded that the main benefit derived from collaboration between competitors is the creation of completely new products. Belderbos et al. (2004) analyzed the relation between cooperative R&D and firm performance, focusing on the gains for the competitiveness of the firm derived from efficiency improvements. Ritala and Hurmelinna-Laukkanen (2009) focused on the significant effect of introducing innovations in the market on the innovative capacity of the firm, stating that coopetition develops incremental innovation in current products and services, being an effective mode of launching innovations in the market, especially in high-tech industries. In this vein, we formulate Hypothesis 3 as follows:

H3: The introduction of innovations into the market has a positive and significant impact on the firm's behavior to generate product/service innovations.

9.2.3 From Coopetition to Open Innovation: The Role of Coopetion Schemes

Belderbos et al. (2004) defend that R&D cooperation between competitors generates incremental efficiency gains. On the contrary, Nieto and Santamaria (2007) argue that coopetition does not favor innovation, since it can promote opportunistic behavior and minimize trust among rivals.

Establishing strategic partnerships between different firms in innovation projects to share risks, costs, and expertise has also become an important pattern in innovation management, of interest to both scholars and practitioners (Chesbrough 2003; Huston and Sakkab 2006; Enkel et al. 2009; Gassmann et al. 2010). This pattern results in coopetition, funded on strategic cooperation with competitors in innovation initiatives. Achieving higher absorptive capacity and forming collaboration schemes with competitive partners increase the pace of engaging in coopetition and imitation, especially when dealing with incremental innovations, being fundamental here the emphasis on protection (Ritala and Hurmelinna-Laukkanen 2009).

The area of patent protection is extremely important in achieving competitive advantage, since it protects patent assignees from imitation and supports the internal use of technologies (Aoki and Schiff 2008). Thus, strategic management of the patent portfolio is also important to achieve benefits and obtain competitive advantage (Grindley and Teece 1997).

Li (2011) examined the sources of external technology, absorptive capacity, and innovation capacity in Chinese state-owned high-tech firms, analyzing three types of investment to acquire technological knowledge in determining firms' innovation capacity, namely: in-house R&D; importing foreign technology; and purchasing domestic technology. He concluded that importing foreign technology only promotes innovation if in-house R&D is also conducted. Nevertheless, domestic technology purchases, such as patent licensing, have a favorable direct impact on innovation. The study also finds that absorptive capacity is determined by the source or nature of the external knowledge.

Kostopoulos et al. (2011) explore the role of absorptive capacity as a mechanism to identify and translate external knowledge inflows into tangible benefits, and also as a vehicle to achieve greater innovation and time-lagged financial performance. The authors suggest that external knowledge inflows, by using coopetition arrangements and collaborative relationships, are directly related to absorptive capacity and indirectly related to innovation.

The determinant factor of establishing coopetition arrangements between competing firms for the firm's capacity to create innovations, either in products or in services was analyzed by multiple scholars. Brandenburger and Nalebuff (1996) and Garraffo (2002) studied the establishment of strategic cooperation arrangements with competitors in firms of emerging technologies. Bengtsson and Kock (2000, 2003) focused on the dyadic coopetition as being a dyadic relationship, since competition is related to output activities such as distribution, services, product development and marketing, and cooperation deals with input activities, like R&D, buying, logistics and processing raw materials. In between the two, there are midstream activities, like production. Bagshaw and Bagshaw (2001) state that coopetition allows better performance for the firms involved than competitive arrangements, as by strategically managing cooperation and competition, the relationship can evolve through controlled behavior by partners and rivals. Belderbos et al. (2004) defend that R&D cooperation between competitors generates incremental efficiency gains. Also, Chien and Peng (2005) state that interorganizational relationships evolve into a social structure of coopetition, becoming a tool for cooperation and also for competition, acting at multiple levels, such as firms, strategic business units, departments, and task groups.

Jong and Marsili (2006) proposed a typology of coopetition arrangements, namely: (1) exchanges of patents and knowledge; (2) collaborative R&D activities; (3) strategic alliances for setting new standards; and (4) collaborative agreements to integrate established firms. These types of coopetition arrangements determine the firm's ability to compete in the marketplace and to implement the portfolio of a firm's coopetition activities that evolves over time. In addition, the authors refer that when dealing with firms that work on radical innovations, definition of new standards, or new converging technologies, coopetition is carried out for sizing market opportunities related to radical innovations, setting new standards, and/or integrating established firms through converging technologies.

Ritala and Hurmelinna-Laukkanen (2009) state that coopetition helps to develop incremental innovation in current products and services, being an effective mode of generating new innovations, especially in high-tech industries. Rusko (2011) defends that one of the main motivations for competitors to engage in strategic cooperation arrangements is based on the creation of greater value or benefit, in order to improve economic performance. Vasudeva and Anand (2011) studied firms facing technological discontinuities and their use of alliance portfolios to gather knowledge flows. They subdivide absorptive capacity into "latitudinal" and "longitudinal" components. The first corresponds to the use of diverse knowledge and the second is distant knowledge. Their findings suggest that a firm with a moderate latitudinal absorptive capacity, which is equivalent to medium diversity in its portfolio, has a high propensity for optimal use of knowledge. Thus we hypothesize:

H4: The set of coopetition relationships established between the firm and competing firms has a positive and significant impact on the firm's behavior to generate product/service innovations.

As mentioned by Dagnino and Rocco (2009), when coopetition occurs between public and private competitors, for instance between universities and industrial partners, in the challenging task of knowledge production, two critical situations can arise: coopetition for publications and coopetition for IPRs. To overcome these problematic issues, the previous authors suggest three strategies to mitigate the competitive pressure between university and industry, namely the sequencing and sanitizing of data and joint patents. The first implies the strategic management and sequential processes of first patenting and then publishing. The second concerns the removal of data that shall not be published, in order to avoid risks when patenting. The third corresponds to the collaborative patenting of knowledge, sharing rights and duties in the patent process. Firms usually regard this type of coopetition strategy as disadvantageous, preferring exclusive rights in order to commercialize technology freely.

The impact of relationships with the scientific community as being of major importance in generating firms' innovative performance has warranted the attention of several researchers, for example, Cockburn and Henderson (1998), Li (2011), Kostopoulos et al. (2011) and Vasudeva and Anand (2011). Thus, we formulate the following hypothesis:

H5: The set of coopetition relationships established between the firm and scientific community has a positive and significant impact on the firm's behavior to generate product/service innovations.

Based on the literature review, a conceptual model is proposed, to explore the relationships between the firm's behavior to generate product/service innovations and the determinant factors, namely, the introduction of process innovations inside the firm, the performance of R&D activities inside the firm, the introduction of innovations into the market, the coopetition relationships established between the firm and competing firms, and the coopetition relationships established between the firm and scientific community as shown in Fig. 9.1.

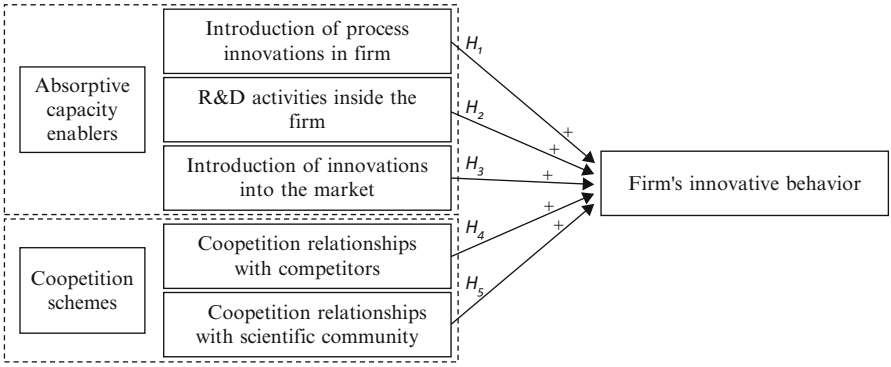

Fig. 9.1 Innovative behavior of firms and coopetition and open innovation strategies: conceptual model. *Source*: Authors

9.3 Methodology

9.3.1 Dataset, Method, and Dependent Variable

The present paper intends to analyze the determinant factors of the service firms' behavior to generate product and service innovations, by making use of the data available in the European CIS Survey, 2008, for Portuguese firms. For the present study we only gathered data from Portuguese firms, for which it was granted access from the Portuguese Science and Technology Foundation.

The data available is used to produce two subsamples related to service firms. Following the standard OECD sector classification based on NACE, the total sample is divided into "KIS firms" and "LKIS firms."

The sample has 1,221 respondent service firms, considering all firms in the analysis since they are all statistically valid. The subsamples of "KIS firms" and "LKIS firms" are submitted to a probit regression to estimate the probability associated with the different determinant factors of service firms' innovative behavior.

The dependent variable used is product/service innovation (1 for a firm that has carried out product/service innovation and 0 otherwise), which refers to the firm having generated and introduced into the market a new or improved product or service, with respect to its capacities or potential ease of use, parts or subsystems. The binary dependent variable suggests the use of a probit model for estimation purposes. The dependent variable was used as a proxy to assess the innovative behavior of firms, revealing pro-innovation behavior, according to the data available on the CIS survey. In addition, all the independent variables are also binary.

9.4 Empirical Findings

9.4.1 Descriptive Statistics

In the Figs. 9.2 and 9.3 we present a set of descriptive statistics for the dataset consisting of 1,221 service firms, which is a large sample and is a real asset for achieving representativeness. Approximately 60 % of firms are KIS firms, and almost 92 % are large firms. In Fig. 9.2 it may be observed that 26 % of the service firms have developed product/service innovations, authorship percentages for process innovations being distributed as follows: 30 % by the firm itself; 16 % by the firm in cooperation with other firms, and the remaining by other forms.

Almost 35 % of the service firms perform inside R&D activities and approximately 20 % acquire outside R&D activities. About 17 % acquire other external knowledge (such as patents, copyrights, and other unprotected knowledge) and 17 % introduce new products/services into the market (see Fig. 9.3).

9.4.2 Probit Estimation Results

Probit regressions were run on the service dataset separately, by considering two subsamples according to the NACE Eurostat classifications classification for "KIS firms" and "LKIS firms."

In accordance with Rubalcaba and Kox (2007) and compatible with NACE, KIS includes various business service activities, having as main input the highly sophisticated knowledge of its workforce, namely computer services, R&D services, and management consultancy, which can include telecommunications and financial, transport, or professional services.

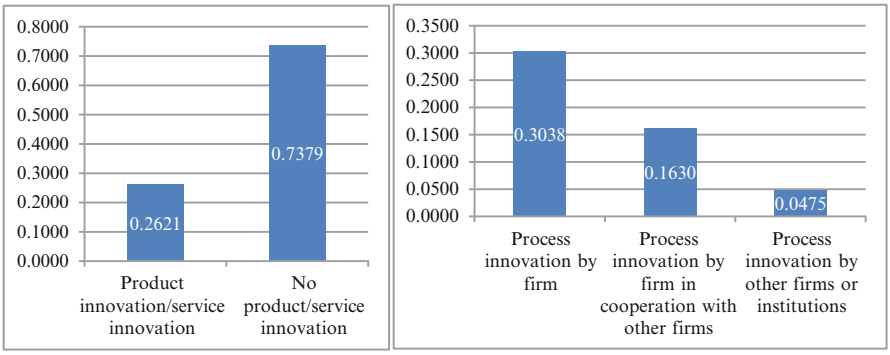

Fig. 9.2 Composition of service sample by product innovation performance and process innovation authorship

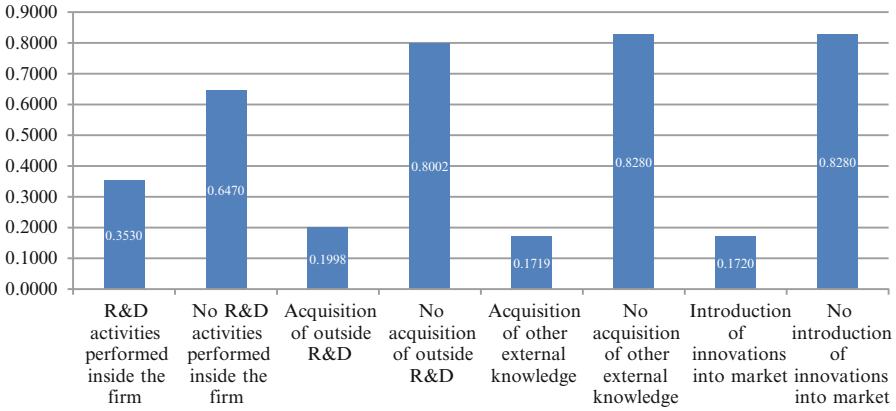

Fig. 9.3 Composition of service sample by R&D activities

Regarding the set of results presented in Table 9.1, and particularly the "all firms" column, we conclude that for the 1,221 service firms under analysis, the likelihood ratio chi-square of 356.21 with a *p*-value of 0.0000 confirms that our model as a whole is statistically significant. The last two columns show the probit regressions disaggregated into service subgroups—"KIS firms" and "LKIS firms."

The introduction of process innovations into the firm, either by the firm itself (a) or the firm in cooperation with others (b), presents a positive and significant association with the behavior to generate innovation (at 1 % significance). Besides this, the set of R&D activities performed inside the firm (c) has also a positive and significant impact on the dependent variable (at 1 % significance).

The fact that the service firm does not introduce innovations into the market (d) has a negative and significant effect on the behavior to generate product/service innovation (at 1 % significance), giving an association between the generation of innovation and its subsequent market introduction.

Also negative is the impact of the inexistence of cooperative relationships in terms of R&D (e) on the dependent variable (at 1 % significance), a public partner (f) being the preferred type of partner in cooperative relationships, this dummy variable having a positive and significant impact (at 1 % significance).

Cooperative relationships between the service firm and European competitors (g) and European universities (h) present a positive and significant association with the firm's behavior to generate innovation (the first at 1 % significance and the second at 5 % significance).

The set of cooperation agreements with a significant, though negative, impact on the firm's behavior to generate innovations, either product type or service type, are with American competing firms (i) and European laboratories (j).

The dummy variable of SME (k) has a negative and significant impact on the "LKIS firm's" behavior to generate innovations, meaning that the fact that this type of firm is a SME, impacts in a negative way on its capacity to generate innovations.

Table 9.1 Results of probit regressions for service firms

Product/service innovation	All firms	KIS firms	LKIS firms
Large firm	0.2917284[a]	–	–
SME	–	−0.024813	−0.71954[b] (k)
Process innovation by firm (a)	0.6788217[b]	0.6425258[b]	0.8003994[b]
Process innovation by firm in cooperation with other firms (b)	0.4931047[b]	0.579551[b]	0.5354501[b]
Process innovation by other firms or institutions	0.4324939[b]	0.314317	0.4787559
R&D activities performed inside the firm (c)	0.5340988[b]	0.4726756[b] (c1)	0.6925766[b] (c2)
Acquisition of outside R&D	–	0.2268566	–
No acquisition of outside R&D	−0.2870978[b]	–	−0.0354656
Introduction of innovations into market (m)	0.5200406[b]	–	–
No introduction of innovations into market (d)	–	−0.8073311[b] (d1)	0.0673119
Firm did not cooperate in R&D (e)	−0.8041166[b]	−1.037.318[b] (e1)	−0.5045445
Public partner (f)	−3.605.851	0.7028044[b] (f1)	−4.005.418
Private partner	4.071.048[b]	–	4.335.834[b] (l)
Firm cooperated with competitors in EU (g)	0.5535745[a]	1.375.734[b] (g1)	0.7578617
Firm cooperated with competitors in US (i)	−1.003.039[c]	−1.929.241[b] (i1)	−1.308.725
Firm cooperated with laboratories in PT	0.3690016	0.318485	0.9656868[a] (n)
Firm cooperated with laboratories in EU (j)	−1.708.198[c]	−2.208.943[b] (j1)	–
Firm cooperated with universities in EU (h)	0.7373061[a]	1.217.358[c] (h1)	0.2346324
Observations	1,221	746	475
Log likelihood	−526.22295	−318.34736	−190.09896
Pseudo R^2	0.2453	0.2957	0.1907

Note: The table only contains variables with values of significant impact
[a]Significant at 10 %
[b]Significant at 1 %
[c]Significant at 5 %

R&D activities carried out inside the service firm (e) also show a positive and significant association with the firm's generation of innovations (at 1 % significance), adding the fact that for "LKIS firms," private partners (l) show a positive and significant association with the firm's product/service innovations (at 1 % significance).

The major considerations to be pointed out when comparing results for the subsamples of "KIS firms" and "LKIS firms" are the fact that introduction of process innovations in the firm, either by the firm itself (a) or the firm cooperating with other firms (b) presents a positive and significant association with the firm's behavior to generate innovations.

Carrying out R&D activities inside the service firm (c) reveals a positive and significant effect on the firm's behavior to generate innovations, also for both subsamples (c1 and c2).

Considering the introduction of innovations into the market (m), it has a positive and significant effect on the dependent variable for the "all firms" sample and in the opposite direction, the non-introduction of innovations (d) has a negative and significant impact on the dependent variable, for the subsample of "KIS firms" (d1), assuming to be of extreme importance for KIS firms to generate and diffuse innovations into the market.

Another important effect on the behavior of "KIS firms" to generate innovation is derived from the R&D cooperation of these firms, justified in the present study by the significant and negative impact of the KIS firms' non-cooperation in R&D (e1) in their capacity to generate product/service innovation. For "KIS firms," the major positive and significant effect of R&D cooperation comes from public partners (f1). Nevertheless, for "LKIS firms" this effect is due to private partners (l).

The major impacting scientific community stakeholders for "KIS firms" on their innovative capacity comes from EU competitors (g1) and EU universities (h1), in a positive way, and US competitors (i1) and EU laboratories, in a negative manner (j1). As for "LKIS firms" the Portuguese laboratories (n) are the only external scientific community stakeholders that affect positively the innovativeness of these type of firms.

9.4.3 Research Hypotheses and Discussion

Taking into consideration Hypothesis 1, proposing a positive and significant effect of the introduction of process innovations in the service firm on its behavior to generate innovation, we find a significant and positive association for both subsamples under analysis. Thus, we fail to reject H1. These results are aligned with previous studies, for instance Zahra and George (2002), Todorova and Durisin (2007), Rothaermel and Alexandre (2009) and Kostopoulos et al. (2011) whose works concluded for a positive influence of introducing process innovations inside the firm on the firm's behavior to generate innovations, either in the form of innovative production processes, differentiated organizational schemes, or strategic redefinition of R&D positioning.

In what concerns Hypothesis 2 proposing a significant and positive impact of performing R&D activities inside the service firm on its behavior to generate product/service innovation, we confirm a positive and significant effect, failing to reject H2. This is also coherent with previous literature. As so, Cohen and Levinthal (1989) and Gambardella (1992) stated that in-house R&D programs and internal investment in R&D activities performed inside the firm are beneficial for generating an innovative capacity in firms. Other scholars also in line with these findings are Arora and Gambardella (1994), Zahra and George (2002), Cassiman and Veugelers (2006) and Li (2011).

For the Hypothesis 3, which defends a positive and significant impact of the introduction of innovations into the market on the firm's behavior to generate innovation, we verified a positive and significant effect, when considering the "all firms"

sample, and so, we fail to reject H3. For the "KIS firms" and "LKIS firms" subsamples such effect is not observed. This positive effect was also found in previous studies of Tether (2002), Quintana-Garcia and Benavides-Velasco (2004), Belderbos et al. (2004) and Ritala and Hurmelinna-Laukkanen (2009) which denoted a positive impact of firms that introduce innovative products/services on the market and their innovative behavior. Nevertheless, the present study goes further and found that when disaggregating the sample for "KIS" and "LKIS firms," the impact effect is not significant, being only detected for "all firms." However if we look at the effect of not introducing innovations into the market, such effect reveals to be negative for "KIS firms," which justifies that this type of firms' innovative capacity is affected when they don't launch new products/services.

Considering Hypothesis 4 arguing for a positive and significant association between the set of coopetition relationships with service firm's competitors and its behavior to generate product/service innovation, we obtained a positive and significant effect for European competitor relationships, for the "all firms" sample and the "KIS firms" subsample, leading us to fail to reject H4. In addition, we can point out a significant, though negative, impact of US coopetition relations on the service firm's behavior to generate innovations, both in the "all firms" sample and the "KIS firms" subsample, and so we partially fail to reject H4. Previous scholars (Brandenburger and Nalebuff 1996; Bengtsson and Kock 2000, 2003; Bagshaw and Bagshaw 2001; Garraffo 2002; Belderbos et al. 2004; Chien and Peng 2005; Jong and Marsili 2006; Ritala and Hurmelinna-Laukkanen 2009; Rusko 2011; Vasudeva and Anand 2011) also defended a determinant effect of the establishment of coopetition arrangements between competing firms and their capacity to generate innovative products and services. As we go beyond these studies and disaggregate the coopetition relationships in national (i.e., Portuguese), European, and American competitors we found particular discrepancies between "KIS firms" and "LKIS firms," being "KIS firms" capacity to generate innovations significantly affected by European coopetition arrangements in a positive manner and by US parties, although negatively.

Finally, for Hypothesis 5, proposing a positive and significant effect of coopetition relationships among firms and the scientific community on the service firm's behavior to generate product/service innovation, we confirm a positive and significant impact of European universities for the "all firms" sample and the "KIS firms" subsample, and so we fail to reject H5. Furthermore, we also detect a significant but negative effect of coopetition relationships, particularly analyzing the impact of European laboratories in the "all firms" sample and the "KIS" subsample, on the dependent variable. Therefore, we also partially fail to reject H5 for the "all firms" sample and the "KIS firms" subsample. In this scenario, we are aligned with other studies, namely the ones of Cockburn and Henderson (1998), Li (2011), Kostopoulos et al. (2011) and Vasudeva and Anand (2011) which concluded for a positive and significant impact of settling relationships with the scientific community to spur the firms' innovative performance. It's important to stress the disaggregated effects of "KIS firms" and "LKIS firms" and typology of partner (laboratories, consultants, and universities), for which the impacting effect of cooperating with scientific

community is significant and positive for "KIS firms" only when considering European universities and negative when dealing with European laboratories. For "LKIS firms" the only effect is seen in the positive and significant impact of relations with Portuguese laboratories.

9.5 Concluding Remarks, Implications, Limitations, and Future Research

The introduction of process innovations in the firms' internal organization and procedures and the practice of internal R&D activities are of major importance for the service firm's behavior to create new products/services, for the "all firms" sample and for "KIS firms" and "LKIS firms" subsamples.

Regarding the dummy variable of introduction of innovations into the market, this only reveals a significant and positive effect in the service firms' dataset as a whole.

Moreover, in what concerns the set of coopetition relationships between the service firms and competitors, only European competitors show a positive and significant impact on the dependent variable. However, for "LKIS firms" this effect is not observed.

Taking into consideration the impact of the set of coopetition relationships between firms and the scientific community, the major finding is related with the significant effect of coopetition agreements with European laboratories on the innovative behavior, although it is revealed to be negative both for the "all firms" sample and the "KIS firms." For its turn, a positive and significant effect is also detected but with European universities, in what concerns the "all firms" sample.

As concluded above, all the three hypotheses concerning the absorptive capacity enablers are determinant factors for the firm's capacity to generate innovations. Summing up, both hypotheses linked with coopeting schemes reveal that it's of extreme importance for firms to get involved in coopetition arrangements in order to perform better in generating innovations. For both and regarding "KIS firms," we confirmed the importance of coopetition schemes with European competing firms and European universities, fact that is possibly related with public policies targeted at promoting cooperation platforms supported by European frameworks in order to boost innovativeness of firms.

Since public policies play a crucial role in fostering innovative capacities, it is important that policy-makers understand the determinants of service firms' behavior to generate innovative products and services, and their effects on innovative performance, the generation of net value added and economic benefits.

In terms of policy implications arising from the present study, it is suggested that public policies should be guided towards the creation and consolidation of open innovation flows and towards fostering coopetition strategies between service firms and the scientific community, securing formal channels and mechanisms targeted at minimizing appropriability risks.

By making use of firms' behavior to generate innovation in order to reveal their innovative performance and the dynamics of coopetition public policies oriented to open innovation, the present study can give insights to those who manage innovation policy orientations, since knowledge of the set of determinant factors of firms' innovative behavior can be helpful in drawing up guidelines to foster and properly manage the open innovation workflows between service firms and their stakeholders, and then developing the capacity to generate and transfer new products to market.

Overall, the results of this analysis may provide helpful starting points for practitioners (either in service firms or coopetition stakeholders) who wish to estimate the directions of their organization's R&D projects, through coopetition arrangements with partners, in order to enhance the efficiency of technology transfer flows, and consequently stimulate the creation, diffusion, and regulation of defensive mechanisms to be used as routines by the service firms involved.

The main limitation of the present study is the lack of information on firms' innovative capacity when trying to access data on patenting behavior and other IP rights, such as copyrights and trademarks. This is also the main limitation of the database used in this study, the European CIS Survey, 2008, with the quasi-inexistence of data regarding firms' IP performance, considering additional data on patents, copyrights, and other IP rights, since the only reference to innovative products or services generated inside and by the firm that can or cannot be protected via IP formal mechanisms is the variable of product/service innovation.

In this connection, avenues for future research should be focused on the factors that motivate service firms to behave alternatively by implementing R&D corporate strategies, based on coopetition patenting initiatives, technological surveillance, or forecasting projects. This way, the service firms' behavior based on patenting strategies and their characteristics, which influence their coopetition arrangements, deserve to be further explored, by examining the entrepreneurial profile of the founder and management team.

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