Coopetition and Open Innovation Strategies of KIS & Less-KIS Firms

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Abstract

This paper tackles in an innovative way the issue on coopetion, by making use of service firms' behaviour 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 1221 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 to the market, have a positive and significant influence on service firms' behaviour 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 behaviour of service firms.

Keywords: Absorptive Capacity; Coopetition; Innovation; Knowledge Intensive Services.

Resumo

Este paper aborda de forma inovadora o tópico de coopetição, tendo por foco o comportamento das empresas de serviços para gerar serviços inovadores, em termos de performance inovadora e dinâmica de coopetição orientada para a inovação aberta. Faz-se uso de uma base de dados com 1221 empresas de serviços que participaram no European Community Innovation Survey (CIS), 2008. Estima-se um modelo probit, considerando duas sub-amostras: empresas intensivas em conhecimento; e empresas menos intensivas em conhecimento. Os resultados revelam que os acordos de coopetição entre empresas concorrentes e a comunidade científica e a capacidade das empresas para introduzir inovações no mercado, têm uma influência positiva e significativa sobre o comportamento das empresas para gerar serviços inovadores. Revela-se ainda que os efeitos da introdução de inovações de processo dentro da empresa e a existência de atividades internas de investigação e desenvolvimento têm uma influência positiva e significativa sobre o comportamento inovador das empresas de serviços.

Palavras-chave: Capacidade de Absorção; Coopetição; Inovação; Serviços Intensivos em Conhecimento.

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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 analysed the strategic use of coopetition by firms dealing with emerging technologies (Brandenburger & Nalebuff, 1996; Gomes-Casseres, 1996; Harbison & Pekar, 1998). Others focused on the benefits of coopetition (Bagshaw & Bagshaw, 2001; Garraffo, 2002; Chien & Peng, 2005; Rusko, 2011).

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

This article presents a contribute to previous studies, in an innovative way, by using service firms' behaviour 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' behaviour to generate innovative products/services influenced by policies targeted at driving innovative behaviour among firms, scientific community and competitors, spurring firm's absorptive capacity and forming collaboration schemes with competitive partners increases 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 behavioural process of creating innovation, under the framework of coopetition and open innovation. A set of service firms is analysed, 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 & Zenker (2001), Miozzo & 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 & 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 & Rubalcaba (2012), as KIS firms are considered one of the major sources of structural change in the advanced economies, these firms increased their relative share of importance in the European economy by 30% since 1979, achieving 33% of the employment force (37% in the US) in 2004 and 35% of value added (39% in the US). The impact of KIS firms is derived from their capacity to

generate and diffuse localised knowledge, to facilitate and adopt technological, organizational, social and other typologies of innovation.

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

The remainder of this article is structured as follows. Section 2 develops the theoretical underpinnings, drawn from the literature on coopetition and open innovation and innovative products and services. Section 3 presents the empirical approach. Section 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.

2. Literature review and hypotheses

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 & Kock, 2000; 2003) or multifaceted coopetition (Amburgey & Rao, 1996; Tsai, 2002; Luo & Slotegraaf, 2006).

Brandenburger & 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 & 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 behaviour by partners and rivals.

Coopetitive relations call our attention for the concept of open innovation, which, according to by 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.

2.1 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 & Hurmelinna-Laukkanen, 2009). Cohen & Walsh (2000) studied this process using the framework based on the concept of the firm's absorptive capacity. This concept refers to 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 & 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 & Durisin (2007) proposed that firms cannot transform their knowledge assets when they are not able to assimilate them. Furthermore, Zahra & 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 & George, 2002).

According to Rothaermel & 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 & Benavides-Velasco, 2004).

Ritala & 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 & Roux (2007) and Ma & Lee (2008), to establish collaborative technological relationships between firms and their stakeholders.

The studies of Brandenburger & 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 (Zahara & George, 2002; Todorova and Durisin, 2007; Rothaermel & Alexandre, 2009; Kostopoulos *et al*., 2011) devoted their studies to analyse 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 behaviour to generate innovations. Thus:

H_1: The introduction of process innovations inside the firm has a positive and significant impact on the firm's behaviour to generate product/service innovations.

As Cohen & 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 analysed the determinant role of the firm's absorptive capacity in exploiting the alliances it establishes (Arora & Gambardella, 1994; Zahra & 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 by Cassiman & 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 & 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:

H_2: The performance of R&D activities inside the firm has a positive and significant impact on the firm's behaviour to generate product/service innovations.

Bergek & 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 & Roux, 2007; Ma & 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 & 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 the subject of several studies, for instance Tether (2002) and Quintana-Garcia & 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) analysed the relation between cooperative R&D and firm performance, focusing on the gains for the competitiveness of the firm derived from efficiency improvements. Ritala & 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:

H_3: The introduction of innovations into the market has a positive and significant impact on the firm's behaviour to generate product/service innovations.

2.2 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 & Santa-Maria (2007) argue that coopetition does not favour innovation, since it can promote opportunistic behaviour 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 & 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 increases the pace of engaging in coopetition and imitation, especially when dealing with incremental innovations, being fundamental, here, the emphasis on protection (Ritala & 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 & Schiff, 2008). Thus, strategic management of the patent portfolio is also important to achieve benefits and obtain competitive advantage (Grindley & Teece, 1997).

Li (2011) examined sources of external technology, absorptive capacity and innovation capacity in Chinese state-owned high-tech firms, analysing 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 favourable 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 analysed by multiple scholars. Bradenburger & Nalebuff (1996) and Garraffo (2002) analysed the establishment of strategic cooperation arrangements with competitors in firms of emerging technologies. Bengtsson & Kock (2000, 2003) focused 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 & Bagshaw (2001) states 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 behaviour by partners and rivals. Belderbos *et al*. (2004) defend that R&D cooperation between competitors generates incremental efficiency gains. Also, Chien & Peng (2005) state that inter-organizational 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 & Marsili (2006) proposed a typology of coopetition arrangements, namely: (i) exchanges of patents and knowledge; (ii) collaborative R&D activities; (iii) strategic alliances for setting new standards; and (iv) 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 & 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 & 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:

H_4: The set of coopetition relationships established between the firm and competing firms has a positive and significant impact on the firm's behaviour to generate product/service innovations.

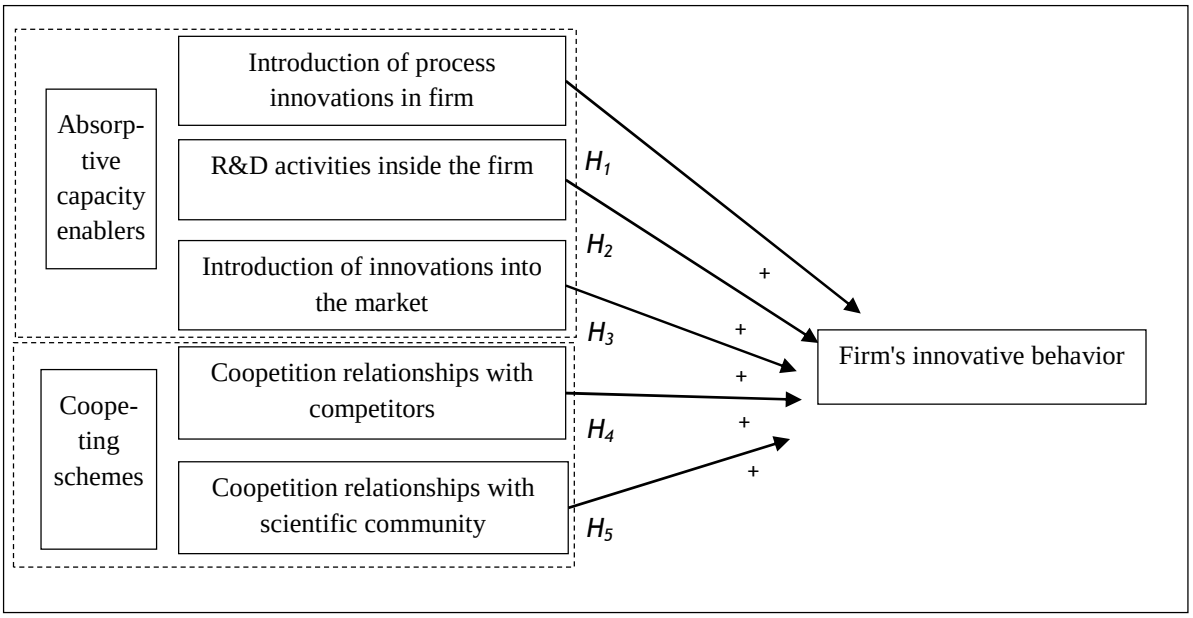
As mentioned by Dagnino & Rocco (2009), when coopetition occurs between public and private competitors, for instance between universities and industrial partners, in the challenging task of knowledge production, two critical situations can arise: coopetition for publications and coopetition for IPRs. 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 & Henderson (1998), Li (2011), Kostopoulos *et al*. (2011) and Vasudeva & Anand (2011). Thus, we formulate the following hypothesis:

H_5: The set of coopetition relationships established between the firm and scientific community has a positive and significant impact on the firm's behaviour 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 Figure 1.

Fig. 1 Innovative behavior of firms and coopetion and open innovation strategies: Conceptual Model



3. Methodology

3.1 Dataset, method and dependent variable

The present paper intends to analyse the determinant factors of the service firms' behaviour 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 national Science and Technology Foundation.

The data available is used to produce two sub-samples 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 1221 respondent service firms, considering all firms in the analysis since they are all statistically valid. The sub-samples 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 behaviour.

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 to 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 behaviour of firms, revealing pro-innovation behaviour, according to the data available on the CIS survey. In addition, all the independent variables are also binary.

4. Empirical findings

4.1 Descriptive statistics

In the next figures we present a set of descriptive statistics for the dataset consisting of 1221 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 Figure 1 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.

[Insert Figure 2 About Here]

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 to the market (see Figure 2).

[Insert Figure 3 About Here]

4.2 Probit estimation results

Probit regressions were run on the service dataset separately, by considering two sub-samples 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.

Regarding the set of results presented in Table 1, and particularly the 'all firms' column, we can conclude that for the 1221 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 2 columns show the probit regressions disaggregated into service sub-groups - 'KIS firms' and 'LKIS firms'.

[Insert Table 1 About Here]

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 behaviour to generate innovation (at 1% significance). Besides, 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 behaviour 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 behaviour 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 behaviour 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’ behaviour 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.

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 sub-samples 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 behaviour to generate innovations.

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

Considering the introduction of innovations into market (m), this 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 sub-sample 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 behaviour 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.

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 behaviour to generate innovation, we find a significant and positive association for both sub-samples under analysis. Thus, we fail to reject H_1. These results are aligned with previous studies, for instance Zahara & George (2002), Todorova and Durisin (2007), Rothaermel & 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 behaviour 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 behaviour to generate product/service innovation, we confirm a positive and significant effect, failing to reject H_2. This is also coherent with previous literature. As so, Cohen & Levinthal (1989) and Gambardella (1992) stated 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 & Gambardella (1994), Zahra & George (2002), Cassiman & 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 behaviour to generate innovation, we verified a positive and significant effect, when considering the 'all firms' sample, and so, we fail to reject H_3. For the 'KIS firms' and 'LKIS firms' sub-samples such an effect is not observed. This positive effect was also found in previous studies by Tether (2002), Quintana-Garcia & Benavides-Velasco (2004), Belderbos *et al*. (2004) and Ritala & Hurmelinna-Laukkanen (2009) which achieved a positive impact of firms that introduce innovative products/services on the market and their innovative behaviour. Nevertheless, the present study goes further and founds 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 behaviour 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' sub-sample, leading us to fail to reject H_4. In addition, we can point out a significant, though negative, impact of US coopetition relations on the service firm's behaviour to generate innovations, both in the 'all firms' sample and the 'KIS firms' sub-sample, and so we partially fail to reject H_4. Previous scholars (Bradenburger & Nalebuff, 1996; Bengtsson & Kock, 2000, 2003; Bagshaw & Bagshaw, 2001; Garraffo, 2002; Belderbos *et al*., 2004; Chien & Peng, 2005; Jong & Marsili, 2006; Ritala & Hurmelinna-Laukkanen, 2009; Rusko, 2011; Vasudeva & 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 coopeting 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 scientific community on the service firm's behaviour to generate product/service innovation, we confirm a positive and significant impact of European universities for the 'all firms' sample and the 'KIS firms' sub-sample, and so we fail to reject H_5. Furthermore, we also detect a significant but negative effect of coopetition relationships, particularly analysing the impact of European laboratories in the 'all firms' sample and the 'KIS' sub-sample, on the dependent variable. Therefore, we also partially fail to reject H_5 for the 'all firms' sample and the 'KIS firms' sub-sample. In this scenario, we are aligned with other studies, namely the ones of Cockburn & Henderson (1998), Li (2011), Kostopoulos *et al*. (2011) and Vasudeva & 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.

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 behaviour to create new products/services, for the 'all firms' sample and for 'KIS firms' and 'LKIS firms' sub-samples.

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 scientific community, the major finding is related to the significant effect of coopetition agreements with European laboratories on the innovative behaviour, 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', 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' behaviour 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' behaviour 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 behaviour 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 behaviour 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' behaviour 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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FIGURES

Figure 1 Innovative behaviour of firms based on open innovation enablers and coopetition scheme: A conceptual model proposal

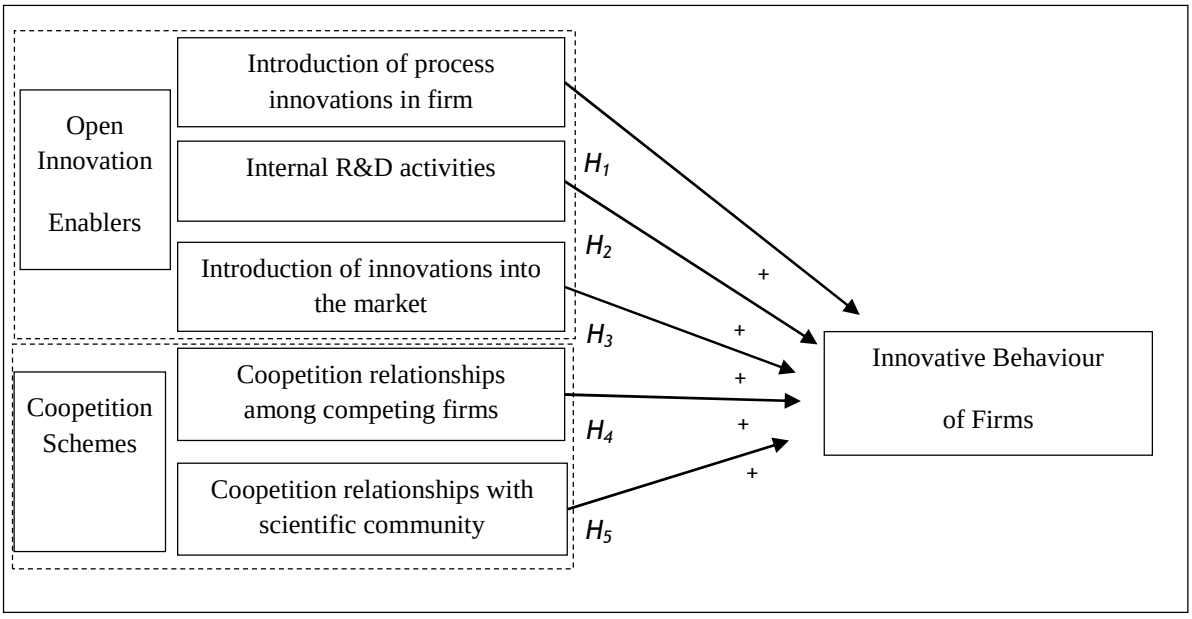


Figure 2 Composition of service sample by product innovation performance and process innovation authorship

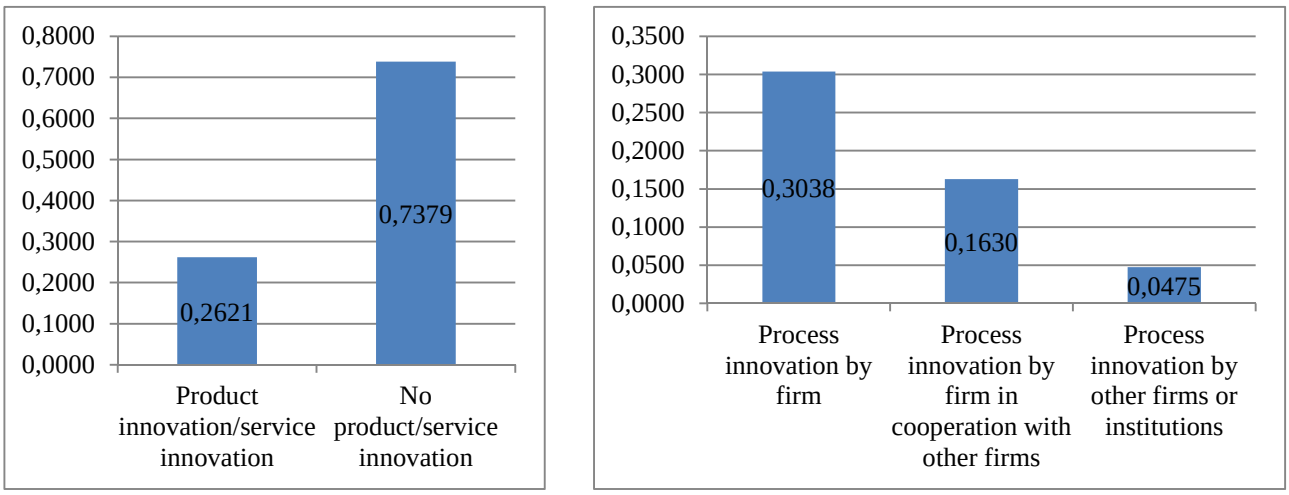
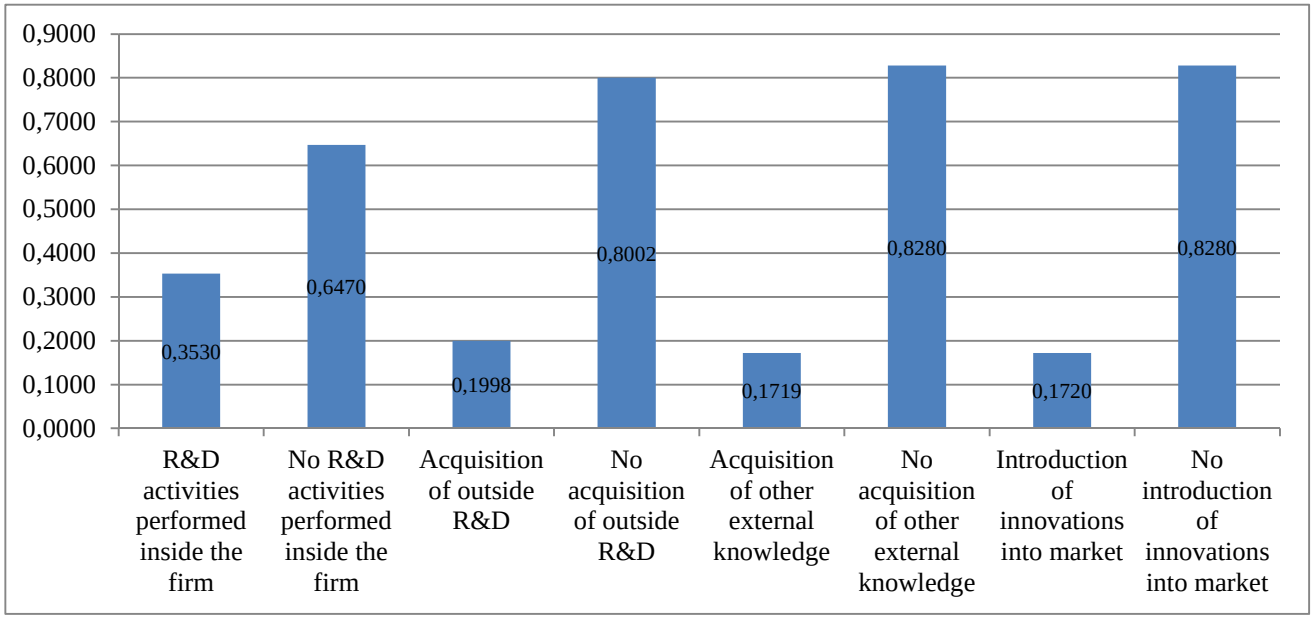


Figure 3 Composition of service sample by R&D activities



TABLE

Table 1 Results of probit regressions for service firms

Product/service innovation	All firms	KIS firms	LKIS firms
Large firm	0.2917284*	-	-
SME	-	-0.024813	-0.71954***(k)
Process innovation by firm (a)	0.6788217***	0.6425258***	0.8003994***
Process innovation by firm in cooperation with other firms (b)	0.4931047***	0.579551***	0.5354501***
Process innovation by other firms or institutions	0.4324939***	0.314317	0.4787559
R&D activities performed inside the firm (c)	0.5340988***	0.4726756***(c1)	0.6925766***(c2)
Acquisition of outside R&D	-	0.2268566	-
No acquisition of outside R&D	-0.2870978***	-	-0.0354656
Introduction of innovations into market (m)	0.5200406***	-	-
No introduction of innovations into market (d)	-	-0.8073311***(d1)	0.0673119
Firm did not cooperate in R&D(e)	-0.8041166***	-1.037.318***(e1)	-0.5045445
Public partner(f)	-3.605.851	0.7028044***(f1)	-4.005.418
Private partner	4.071.048***	-	4.335.834***(l)
Firm cooperated with competitors in EU(g)	0.5535745*	1.375.734***(g1)	0.7578617
Firm cooperated with competitors in US(i)	-1.003.039**	-1.929.241***(i1)	-1.308.725
Firm cooperated with laboratories in PT	0.3690016	0.318485	0.9656868*(n)
Firm cooperated with laboratories in EU(j)	-1.708.198**	-2.208.943***(j1)	-
Firm cooperated with universities in EU(h)	0.7373061*	1.217.358**(h1)	0.2346324
Observations	1221	746	475
Log Likelihood	-526.22295	-318.34736	-190.09896
Pseudo R^2	0,2453	0.2957	0.1907
*significant at 10%|**significant at 5%|***significant at 1%			

Note: The table only contains variables with values with significant impact.