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Determinants of innovation capacity: Empirical evidence from services firms

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ABSTRACT: *This research aims to analyze the degree of importance of investment and expenditure on innovation activities for innovation capacity, in the scope of Portuguese services firms. The literature review considers three main approaches regarding service innovation: Assimilation, demarcation and synthesis. A conceptual model was proposed and several research hypotheses were empirically tested using secondary data, belonging to the 4th CIS 4, supervised by EUROSTAT. A data set from 1306 services firms was studied. The method used was the logistic regression model. According to the results obtained, the greater the financial investment in acquisition of machinery, equipment and software, in internal research and development, in acquisition of external knowledge, in marketing activities and other procedures, the greater the propensity for firms to innovate in terms of services. This study highlights the contributions that innovation activities can provide in what regards the development of innovation process, giving special emphasis to their service innovation.*

KEYWORDS: innovation, services, KIBS, innovation capacity, CIS

In the last decades we have seen an evolution of the service sector's role in the economy, its relevance increasing in innovation, competitiveness, employment and economic growth (de Jong, Bruins, Dolfma, & Meijaard, 2003; Hauknes, 1998; Howells & Tether, 2004; Tether, 2005). A study carried out in the European Union corroborates these facts, since in 2004, the service sector, on average, accounted for 39.9% of total employment in the EU-25 and for 46.2% of added value (Arundel, Kanerva, Cruysen, & Hollanders, 2007). From the growing importance of this sector, it becomes important to analyze the determinant factors of innovation capacity in firms in general and services firms in particular.

This study aims to analyze the degree of importance of investment and expenditure on innovative activities for the innovation capacity of services firms. Other studies (Moreira, Silva, Simões, & Sousa, 2012; Silva, 2003; Silva & Leitão, 2009), analyzed some determinants that presented a significant impact on industrial firms' innovation capacity, but for services the factors stimulating and restricting innovation capacity have yet to be identified and analyzed.

The paper takes as reference the approaches to innovation in service. Considering this conceptual framework, this investigation intends to elaborate an empirical support to allow identification and analysis of the factors that affect innovation activity and performance in Portuguese services firms.

To test empirically the hypotheses formulated, use is made of secondary data supplied by the 'Higher Education and Science Observatory' (Observatório da Ciência e do Ensino Superior, OCES), belonging to the 4th Community Innovation Survey (CIS 4). This questionnaire was implemented under the supervision of EUROSTAT. To the data obtained, we apply the model of generalized linear regression, namely the logistic regression model.

The study is structured as follows: Point two reviews the relevant literature on the subject of innovation in services and, based on this, formulates the hypotheses we intend to test empirically in the statistical model. Point three defines the sample and goes on to describe and characterize the variables used in the empirical study, with presentation of the logistic regression model. Point four analyzes the data. The final point presents final considerations and suggests that future investigations are carried out.

LITERATURE REVIEW

The importance of the innovation process in services is widely recognized, both theoretically and empirically, but the heterogeneity of the service sector and the lack of an innovation typology that allows integration of that diversity make theoretical teaching and empirical analyses difficult.

The literature demonstrates a growing interest in the study of innovation in services. The service sector covers a wide range of different activities with greatly differentiating characteristics (Drejer, 2004; Hauknes, 1998; Hipp & Grupp, 2005; Mainardes, Silva, & Domingues, 2010; Mas-Verdú, 2007; Miles, 2005a; Vries, 2006).

According to Miles, 2005b, 'despite services being defined differently by different authors, common characteristics are pointed out in the literature on innovation in services'. Many services are characterized by intangibility, inseparability, interactivity and variability, as well as weak protection of intellectual property.

Theoretical approaches to innovation in services have developed rapidly in recent decades (Grönroos, 2000; Miles, 2008; Miozzo & Soete, 2001; Sundbo, 1997) and can be grouped in the

following approaches: Negligence, assimilation, demarcation, and later, the synthesis approach (Coombs & Miles, 2000; Drejer, 2004; Freeman & Louçã, 2001; Gallouj, 1998, 2002; Hauknes, 1998; Howells & Tether, 2004; Miles, 2005a; Sundbo & Gallouj, 1998; Vries, 2006). Studies about innovation in services are relatively new and were categorized in four groups according to their respective approaches. Table 1 makes a summary of the approaches considered to be most relevant in the literature on innovation in services.

These approaches reveal that innovation in services differs from innovation in products. According to Sundbo (1997) and Tether and Hipp (2002), the many characteristics of services (intangibility, heterogeneity, perishability and simultaneity of production and consumption) which distinguish them from physical products, bring difficulties and restrictions to the importing of management programs and models directed toward innovation in the industrial sector. Services have such particularities that they require specific innovation models for the sector, something which is still scarce in the literature (Barras, 1986, 1990; Gallouj, 1998, 2002; Pires, Sarkar, & Carvalho, 2008).

TABLE 1: SYNTHESIS OF APPROACHES TO INNOVATION IN SERVICES

Approach	Period	Key concepts and arguments	Authors
Negligence	Until 1980 (20th Century)	Very little investigation about innovation in services and services in general. In this period innovation is very much associated with material technology and equipment	Bell (1973), Pavitt (1984)
Assimilation	Early 1980s to late 1990s	Approached from a manufacturing sector perspective, and so innovation in services is studied using conceptual tools developed to understand innovation in industry. These studies are more numerous and tend to be centered on the impact of technology on services	Barras (1986), Barras (1990), Gallouj (1998), Evangelista (2000), Uchupalanan (2000), Miozzo and Soete (2001), Freeman and Louçã (2001), Gallouj (2002)
Demarcation	Late 1990s to the present	This approach is guided from the notion that the service sector is quite different from manufacturing industry, and so the study of innovation in services requires new approaches due to the intrinsic characteristics of these services.	Gallouj and Weinstein (1997), Sundbo and Gallouj (1998), Sundbo and Gallouj (2000), Coombs and Miles (2000), Drejer (2004)
Synthesis	The present day	In this approach, there is integration of previous approaches. Therefore, it is recognized that innovation should focus attention on services and on elements of innovation which are relevant for both services and industry	Coombs and Miles (2000), Drejer (2004), Davies and Brady (2004), Miles (2005a), Vries (2006)

Some innovations have a never-ending impact on the continued existence of the enterprise and, hence, are termed ‘strategic innovations’. These innovations may pounce on the field of new technology, like Information Technology; discovery of new location, like in retailing. They can emerge in the form of fresh, raw materials or the unearthing of new sources of raw material, alloys or new oil fields, in the shape of products or services like new credit cards or mobile phones, new forms of organizations like flat organizations and in marketing practices like customer management relations. The massive enterprises suffer from fulfillment, a disease that kills most of them, whereas the start-ups are actively engaged with their customers, an imperative for the existence of the enterprise, committed to growth through innovation (Joshi, 2010).

From a approach of services as a not very innovative sector that ‘absorbed’ innovation from the manufacturing sector, various authors and organizations have considered services as possessing their own forms of innovation, and in some cases, with high levels of innovation (Brax, 2007; Evangelista, 2006; OECD, 2007). The increased interest in investigating the service sector has been obvious in recent decades, aiming to develop the necessary knowledge to increase productivity and innovation in this sector (den Hertog, van Ark, & Broersma, 2003; Grönroos, 2000).

According to Manual de Oslo (OECD, 2005) the results of the innovation process integrate the various components arising from the process of firm innovation, namely product innovation, process innovation, organizational innovation and marketing innovation. In this study, the results of the innovation process are called innovation capacity. Therefore, this investigation is restricted to innovation capacity in terms of product or service. Therefore, the firm has innovation capacity if, in the period 2002–2004, it introduced any new or technologically improved product or service. Product or service innovation is defined as ‘the market introduction of a new good or a significantly improved good or service with respect to its capabilities, such as improved software, user friendliness, components or sub-systems’ (CIS 4, 2005, p. 9). In sum, in this

study, we define innovation capacity as the firm propensity to innovate at the level of products and services.

The literature review made in the area of firm innovation stresses that innovation capacity varies from one firm to another, and is determined by a vast and complex number of factors, which both stimulate and limit the process of firm innovation. Factors explaining innovation are not limited to the factors referred to here. However, intending to analyze the process of entrepreneurial innovation and considering the literature review carried out, this study highlights factors related to innovation activities. Other factors were taken into account, such as: firm size and sector of activity, considering the various service sub-sectors. The innovation activities and expenditure to be studied in this investigation arise from those defined by the Innovation Survey CIS 4 (2005, p. 5), as presented in Table 2.

The importance of *investment and expenditure on innovation activities in firms* such as machinery, and equipment, software and external knowledge, is demonstrated in the studies by Mansfield (1988), Shields and Young (1994), Archibugi, Evangelista, and Simonetti (1995), Weiss (2003), Camacho and Rodríguez (2005), Canepa and Stoneman (2008), Elche and González (2008) Un, Romero-Martínez, and Montoro-Sánchez (2010) and Moreira et al. (2012). According to these authors, firms that invest more in investigation and development and in improving structures and collaborators’ competences acquire greater technological capacity, and consequently have the capacity to produce more innovations. Therefore, they argue that firms that invest in

TABLE 2: INVESTMENT AND EXPENSES ON INNOVATION ACTIVITIES

Internal R&D activities
External activities of R&D
Acquisition of machinery, equipment and software
Acquisition of other external knowledge
Acquisition out training
Acquisition out marketing activities
Other procedures

Source: CIS 4 (2005, p. 11).

better structures, technology and qualified staff show greater innovation capacity.

The literature review made in the area of firm innovation stresses that innovative capacity varies from one firm to another, and is determined by a vast and complex number of factors, which both stimulate and limit the process of innovative capacity. Factors explaining innovation are not limited to the factors referred to here. However, intending to analyze the process of entrepreneurial innovation and considering the literature review carried out, this study highlights factors related to investment and expenditure on innovative activities, firm size, sector of activity considering the various service sub-sectors. Considering the underlying CIS 4 (2004, p. 5), the investment and expenditure on innovation activities can integrate as follows: (i) Carrying out internal activities of research and development (R&D), (ii) external acquisition of R&D (iii) acquisition of machinery, equipment and software, (iv) acquisition of other external knowledge, (v) Training, (vi) marketing activities, and (vii) other procedures. The relationship between investment and expenditure on innovation activities and innovative capacity of the firms is established below.

H1: Investment and expenses on innovation activities is positively related to services firms' propensity to innovate in terms of products/services.

According to Pavitt (1982), investments in R&D demonstrate that an organization has a tendency to innovate. The R&D activities may be performed internally or externally to the organization (Berchicci, 2013). Both one and the other, when properly managed, lead the organization to innovate in products/services. According to Almus and Czarnitzki (2003), R&D activities are traditionally focused on the development of new products and/or services and they are not widely used in other types of innovation (organizational process, marketing). In services firms, this type of formalized activity has been usual in companies classified as Knowledge-Intensive Business Services (KIBS). Yet, in other types of services, formalization of R&D is rarer (Chun & Mun, 2012). However, regardless of the type of

service, literature considers that R&D activities lead to innovation in services (Bas & Sierra, 2002; Dunning & Narula, 1995). Therefore, we set up the following hypothesis:

H11: Investments and expenses of carrying out internal R&D activities are positively related to services firms' propensity to innovate in terms of products/services.

The external acquisition of R&D considers the R&D activities, with the purpose of enhancing the internal knowledge base within the company, but that executed externally by other public or private firms or institutions of R&D (CIS 4, 2005). According to Freeman (1987), Chesbrough (2003) and Harris and Li (2009) the external sources of knowledge have an important role in the innovation of the firm, and is even linked to its performance. Supported in these findings, the following hypothesis is presented:

H12: Investments and expenses of carrying out external activities of R&D are positively related to services firms' propensity to innovate in terms of products/services.

Another factor that facilitates innovation is the investment in new technologies, which may be new equipment, machinery or software (Santamaría, Jesús Nieto, & Miles, 2012). In this case, innovation can be not only on products/services, but also in processes, organizational or even marketing (D'Este, Iammarino, Savona, & von Tunzelmann, 2012). It appears in the literature of innovation that the acquisition of new technologies increases the innovative capacity of firms, whether manufacturing or service ones (Evangelista, 2000; Heidenreich, 2009; Sirilli & Evangelista, 1998). Considering this, we can establish the following hypothesis:

H13: Investments and expenses in the acquisition of machinery, equipment and software are positively related to services firms' propensity to innovate in terms of products/services.

The acquisition of other external knowledge, specifically related to patent property rights, non-patented innovations, know-how, etc. (CIS 4, 2005) is an indicator which has a strong influence on innovation, as referred by Millot (2009) and

by Moreira et al. (2012). Given these facts, the following hypothesis is set up:

H14: Investments and expenses in the acquisition of other external knowledge are positively related to services firms' propensity to innovate in terms of products/services.

According to the CIS 4 (2005), training can occur at the internal or external level in firms, with the sole purpose of developing or introducing new or improved product or services. The firms more are empowered in terms of skilled human resources and training have a greater propensity to innovate (Silva, 2003). In accordance with the above and according to Romijn and Albaladejo (2002), firms with highly skilled labor and with higher levels of training are more receptive to the absorption and reproduction of new knowledge, therefore, showing, a greater capacity in developing innovations. To innovate, an organization needs to develop knowledge (Thornhill, 2006). This knowledge can be acquired outside the organization, or it can be internally developed through training teams (Zhou & Li, 2012). Such investments extend organizational learning and foster innovation in their various types (Caloghirou, Kastelli, & Tsakanikas, 2004). New knowledge acquired externally or developed internally show up as one of the main factors to increase the innovation capacity of a company, regardless of what the company does (Chadee & Raman, 2012; Escribano, Fosfuri, & Tribó, 2009). Thus, it is possible to establish the following hypothesis:

H15: Investments and expenses in carrying out training are positively related to services firms' propensity to innovate in terms of products/services.

Although rarely addressed in the literature, marketing activities have been playing a major role in the development of innovations in companies of products and/or services (Moenaert, Souder, De Meyer, & Deschoolmeester, 1994). According, Chou (2009) and Moreira et al. (2012) the marketing activities are directed toward the introduction of new products or services in the market, helping to differentiate the firm, emphasizing that the activities that are geared primarily through the study of the needs expressed in the market. As its

main objective is to identify and meet the needs and desires of consumers, marketing has been a key driver of innovation (Danaher, Hardie, & Putsis, 2001). In this context, it is clear that companies that have well-developed marketing activities, make appropriate readings of market trends and innovate to meet unmet needs and desires (Atuahene-Gima & Ko, 2001). Thus, investments in marketing have encouraged innovation in manufacturing and/or services companies; after all, they seek to occupy spaces not filled by market competition (Knight & Cavusgil, 2004). In this sense, we can establish the following hypothesis:

H16: Investments and expenses in carrying out marketing activities are positively related to services firms' propensity to innovate in terms of products/services.

Finally, one can consider that the mentioned factors do not include all the possibilities of investment and expenses that drive innovation in services firms (Berchicci, 2013). So the following relationship between other investment and expenditure on innovation activities and innovative capacity of the firms, is established as follows:

H17: Investment and expenses in other procedures are positively related to services firms' propensity to innovate in terms of products/services.

The relationship between the factor of *firm size* and innovation capacity is widely discussed in the literature, and two perspectives are found. On one hand, Schumpeter (1942) and Vrande, Jong, Vanhaverbeke, and Rochemont (2009) found a positive association between firm size and innovation capacity. The results show that large firms have advantages in terms of innovation compared to small firms, in that they possess more knowledge and more qualified resources. On the other hand, studies made by Sengenberger and Pyke (1992), Rothwell and Dodgson (1994) and Tidd, Bessant, and Pavitt (1997) identified negative effects of firm size on innovation capacity. Kim, Lee, and Marschke (2009) add to this, stating that small firms, due to greater proximity and contact with the market, have a greater propensity to develop innovation activities. It seems important, therefore, to clarify the relationship between firm size and innovation capacity, and so the following hypothesis is formulated:

H2: Larger services firms have a greater propensity to innovate in terms of services when compared to smaller firms.

The factor of *sector of activity* is a classic in studies of firm innovation. The influence of the sector of activity on the innovation capacity of the firms is highlighted in various studies (Bayona, Garcia-Marco, Huerta, 2001; Fritsch & Lukas, 2001; Kaufmann & Tödtling, 2001; Romijn & Albaladejo, 2002; Tether, 2002; Tsai, 2001). It is expected that firms belonging to sectors of activity based on technology, such as electronics and computing, innovate more than firms belonging to other sectors of activity. In this investigation, the basis for analysis of sector of activity follows the classification proposed by NACE (Nomenclature of Economic Activities in the European Community). Based on the division made by Furrer and Sollberger (2007), the services with a technological basis are considered those such as communications, computing and related activities, R&D, architectural and engineering activities, and technical testing and analysis. These services are referred to in the literature as KIBS, i.e., sectors that are characterized by services that require intensive knowledge and mostly provide services to other organizations. (Gotsch & Hipp, 2012; Hertog, 2000; Miles, 2005a; Muller & Doloreux, 2009). The remaining services, such as hotel and catering, transport, banks and insurance are services where the main agent is the individual. Being so, the following hypothesis is presented:

H3: Firms in service sub-sectors based on technology (KIBS) have a greater propensity to innovate in terms of services, when compared to firms belonging to other sectors.

The hypotheses formulated here were tested empirically bearing in mind the investigation design presented below.

RESEARCH DESIGN

Population, sample and data

The data used in this research are secondary data, collected between June and November

2005, through a survey that consisted of a questionnaire named CIS 4. In Portugal, the survey was conducted by OCES, in collaboration with National Institute of Statistics (Instituto Nacional de Estatística, INE), according to EUROSTAT'S methodological specifications, and concerning innovation activities of Portuguese firms during the period 2002–2004.

The population contemplates all services firms according to the classification of economic activities CAE – Rev. 2.1. (CAE, 2003). The sample considered 4.815 firms replied to the questionnaire, giving a 74.3% response rate (OCES, 2006). From the firms in the sample, only 1306 firms belonging to the services sector are considered, as presented in Table 3.

Thus, service sector firms will be considered to have innovation in their firms, if they introduced new or technologically improved products or services during the period 2002–2004.

Description and data characterization
Dependent and independent variables

In this study, innovation capacity is measured from the information collected in terms of product or service innovation, which is considered as the dependent variable. This dimension is presented as a dichotomic binary variable with the value of 0 if the firm did not innovate and 1 for those that innovated. Independent variables are *internal R&D activities, external acquisition of R&D, acquisition of machinery, equipment and software, acquisition of*

TABLE 3: CLASSIFICATION OF SERVICES

Services typology	Service sector activity	NACE codes	N
SI – services based on individuals	Hotels and catering	55	28
	Transport	60–63	298
	Banking/insurance	65–67	105
ST – services based on technology	Communications	64	46
	Computer and related activities	72–73	140
	Research and development		
	Architectural and engineering activities	74	689
	Technical testing and analysis		
Total			1306

other external knowledge and other procedures. Based on the data referring to the variable, the value of '1' is adopted when firms undertake any of the R&D activities specified and the value of '0' otherwise. It should be noted that these variables were also used in the studies by Kaufmann and Tödtling (2001), Silva (2003), Silva, Leitão, and Raposo (2008), Harris and Li (2009), Millot (2009).

Control variables

Just as in other studies (Moreira et al., 2012; Nieto & Santamaria, 2007; Silva & Leitão, 2009), this investigation used some control variables directly linked to business characteristics, such as firm size and sector of activity. Concerning the second variable, this investigation uses the Service activity sub-sector. For that variable, the typology of Furrer and Sollberger (2007) is used, creating two variables corresponding to levels of intensity: Technologically based services and services centered on the individual. The value of one of the two categories is attributed to each firm, according to the service activity sub-sector it belongs to.

To measure Firm Size, four variables were created: (1) Micro-firm: 5–9 collaborators; (2) small firm: 10–49 collaborators; (3) medium-sized firm: 50–249 collaborators and (4) large firm: With 250 or more collaborators.

Method: Logistic regression model

From the theoretical literature review, it was found that a firm's capacity to innovate is a complex phenomenon influenced by a wide range of factors. Since it is necessary to explore the relationship between these factors and innovation capacity, the intention is to study, more specifically, the statistical relationship of a dependent variable in relation to more than one explanatory variable; therefore, one decided on the logistic regression model (Logit Model). In the dimension of services' innovation capacity, there is a correspondent regression model where the dependent variable is dichotomic, so according to Hair, Babin, Money, and Samouel, (2003) the best application model is the Logit regression model. This has been the most widely used model in empirical studies carried out (Kaufmann & Tödtling, 2001; Silva, 2003), and it is presented as an appropriate analytical

technique for proposed conceptual models, since these include a dependent categorical variable (binary or dichotomic) and several independent variables. The estimation process is based on the maximum likelihood procedure and takes into consideration the following model specification:

$$\begin{aligned} IS_i = & \beta_0 + \beta_{11}Adi_1 + \beta_{12}Adi_2 + \beta_{13}Adi_3 \\ & + \beta_{14}Adi_4 + \beta_{15}Adi_5 + \beta_{16}Adi_6 \\ & + \beta_{17}Adi_7 + \beta_{21}Dim_1 + \beta_{22}Dim_2 \\ & + \beta_{23}Dim_3 + \beta_{62}Dim_4 + \beta_{31}S_i \\ & + \beta_{32}S_2 + \epsilon_i \end{aligned}$$

where: IS = services innovation, ϵ_i = error term; β = coefficients; Adi_1 = investment and expenses on innovation activities; what Adi_1 = investments and expenses carrying out internal R&D activities; Adi_2 = external activities of R&D; Adi_3 = acquisition of machinery, equipment and software; Adi_4 = in acquisition of other external knowledge; Adi_5 = acquisition out training; Adi_6 = acquisition out marketing activities; Adi_7 = other procedures; Dim_1 = micro-firms; Dim_2 = small firms; Dim_3 = medium-sized firms; S_i = activity sector.

RESULTS AND DISCUSSION

At this stage of the research, logistic regression models were applied to the CIS, to test the proposed model. The Wald statistic was used as the testing statistic to analyze the behavior of variables and the adjustment quality of the proposed model. Logistic regression results for the service innovation model are presented in Table 4.

Logistic regression results for the model (Table 4) show that not all regression parameter estimates are statistically significant at a level of 5%. Regarding the adjustment quality of the model, the results show that the predictive capacity of the model is 84.9%, which results from the comparison of the values of the variable response predicted by the model and those observed. The χ^2 statistic test has a value of 531,35 with proof value less than the significance level of 0.05. The log-likelihood statistics, with a value of 703,24, corroborate the global significance of the model.

Concerning the generic hypothesis H_1 , which aimed to test the effects of investment in

TABLE 4: LOGIT REGRESSION FOR SERVICE INNOVATION MODEL

Model	Model A		Final model			EXP (B)
	Parameter estimator	Estimated coefficient	S.E.	Wald	Sig.	
Independent variables						
Investment and expenditure on innovation activities						
Intramural (in-house) R&D (Adi ₁)	1.535**	1.606	0.213	56.923	0.000**	4.985
Extramural R&D (Adi ₂)	0.010					
Acquisition of machinery, equipment and software (Adi ₃)	1.650	1.860	0.255	53.067	0.000**	6.425
Acquisition of other external knowledge(Adi ₄)	0.510	0.561	0.240	5.451	0.020*	1.752
Training (Adi ₅)	0.384					
Marketing activities (Adi ₆)	0.917	0.941	0.229	16.944	0.000**	2.563
Other procedures (Adi ₇)	0.705	0.748	0.216	11.950	0.001**	2.113
Control variables						
Firm size						
Micro firm	0.166	0.170	0.393	0.187	0.666	1.185
Small firm	0.545	0.530	0.315	2.823	0.093	1.699
Medium firm	0.735	0.754	0.356	4.488	0.034	2.126
Large firm	Exclude	Exc.				
Activity sector	0.034	0.034	0.018	3.597	0.058	1.034
Constant	−6.296	−1.780	1.256	24.760	0.000	0.169
Model summary						
Correct predict (%)		84.9				
χ ²		531.35			0.000**	
Log-likelihood		703.24				
Number of cases		1306				

Note: The reported parameter estimates are statistically significant at the 1% level or better (**) or at the significance level 5% (*).

innovation and on the propensity to innovate in terms of services, a positive relationship with significance under 0.05 was found. When a service firm makes investment in internal investigation and development activities (variable Adi₁), acquisition of machinery, equipment and software (Adi₃), acquisition of external knowledge (Adi₄), in marketing activities (Adi₆), and other procedures (Adi₇), it presents a greater propensity to innovate in terms of services. The other factors (external acquisition of R&D and training) are not seen to be significant at 0.05 level. Considering the results obtained and those presented in column Exp(B), it is observed that by investing in the acquisition of machinery, equipment and software (6,425), and internal investment in innovation (4,985), as well as implementing marketing activities (2,563),

and other procedures for developing new products (2,113) and also acquiring external knowledge (1,752), services firms are seen to be more likely to innovate in terms of services. From the significance of the values obtained, the results show that investments in acquisition of machinery, equipment and software and internal investment in innovation are those which stimulate the propensity for services firms to innovate most.

Hypothesis H₂, established an association between firm size and the propensity for firms to innovate in terms of services. Four classifications were considered for the sample firms, namely: micro, small, medium-sized and large. Firms considered as large (Dim₄) were excluded from the analysis, as there were very few cases carrying out logistic regression interactions. Testing the micro,

small and medium-sized firms showed that the first (Dim_1) did not present statistically significant results. However, small firms (Dim_2) and medium-sized firms (Dim_3) were positively related to the propensity for firms to innovate in terms of services (lower significance, respectively 0.1 and 0.05). Therefore, observing the values of $Exp(B)$, it seems we can state that the bigger the firm, the greater the propensity to innovate in terms of services.

Hypothesis H_3 related innovation in terms of services to service activity sectors, differentiating services firms based on high technology (KIBS) from low technology firms. This hypothesis was seen to be significant at a level under 0.1 and with a positive effect. Therefore, according to the division made by Furrer and Sollberger (2007), services firms classified as KIBS (communications, computing, investigation and development, architectural and engineering activities, and technical testing and analysis) have a greater propensity to innovate in terms of services than firms connected to other sectors.

CONCLUSIONS

The aim of this study was to investigate the degree of importance of factors determining innovation capacity, in the context of Portuguese services firms. With the purpose of improving comprehension of innovation in services and identifying the main determinants of innovation in the service sector in the area of innovation activities, various hypotheses for investigation were formulated based on the literature review about innovation in services that was carried out. The literature review identified three fundamental approaches in the sphere of service innovation: assimilation, demarcation and synthesis.

This investigation highlights several factors that stimulate and limit the innovation capacity in firms: Investment in innovation activities, firm size and sub-sector of service in the sector of activity. It was in relation to these factors that the various hypotheses tested empirically were formulated.

The results of the model indicate that services firms based on technology are more likely to innovate in products/services than firms providing other types of services. According to the results

obtained, some investments in innovation present positive and significant effects in service innovation; therefore, the greater the financial investment in acquisition of machinery, equipment and software, in internal R&D, in acquisition of external knowledge, in marketing activities and other procedures, the greater the propensity for firms to innovate in terms of services. The results of the model show that size has a positive and increasing effect on service innovation, despite large firms not being included in the interaction process of the logit model. According to the results, we can say that medium-sized firms have a greater propensity to innovate in services than small firms.

The main contribution of this research lies in the inclusion in the study of factors that determine the innovation capacity of services firms, seeking to increase comprehension of innovation in services and identify the main factors stimulating innovation in this sector. The investigation proposed an empirical study based on a logit model, for joint analysis, which provided measurement of the direct and indirect effects of a selected set of explanatory variables of the innovation capacity of Portuguese services firms.

The main limitations of this study arise from the limited data obtained, through lack of access to all the results of CIS 4, for example, the number of employees per firm. Nor was it possible to draw up a comparison of results, with previous CIS, so as to assess evolutionary tendencies in the area of innovation activities and expenditure.

With reference to policy implications, it is important to highlight that the relevance of the innovation and services for the development of countries suggests the development of public policies to enhance innovation in services. First, it is necessary to stimulate innovation in small services firms because they tend to develop fewer innovations than large firms. Furthermore, this study demonstrated that, to encourage innovation in services, it becomes necessary to develop public policies mainly aimed at facilitating the acquisition of machinery, equipment and software, and the development of R&D centers within the service companies. Encouraging the development of marketing in these organizations and the acquisition of external knowledge can also be factors

that may favor the development of innovations in services. These determinants should receive the attention of the rulers, as such determinants can contribute to the development of a nation.

To continue this investigation, in future work it is proposed to repeat the empirical study with data from other European countries where the CIS 4 was carried out. In addition, a new study will be developed with the proposed conceptual model, with the aim of contrasting empirically data from the CIS 2006. From this perspective, it is considered that the repetition of the investigation in Europe, more precisely in countries that responded to the same questionnaires, could also enrich the study of the phenomenon of entrepreneurial innovation, and specifically the approach to service sector innovation.

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