Innovation in services: how different from innovation in manufacturing?

Francisco João Martins Sequeira

Instituto Superior Técnico

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Abstract

Services sector has been gaining importance over the years since economies are increasingly service based. This research work aims to make a comparison between innovation in the service and manufacturing sector, drawing data from CIS-2016 for Portugal. The differentiation between sectors innovation was studied by researching various subjects which arouse interest and were discussed in the literature review being the basis to create the research hypotheses, such as the size of the company, the skill of the employees, the engagement in cooperation activities and the R&D investment. These subjects were dealt by creating a common model for the two sectors and then separate models for each sector (services and manufacturing) which were built using a logit regression and were used to make a comparison between sectors behavior towards innovation. The results highlight differences between both sectors such as revenue being quite more important for manufacturing innovation and being part of a group significant only for services, the skills of the employees having a higher positive influence for services but having a college degree, engaging in cooperation and the expenditure in R&D playing a more important role in manufacturing. The two sectors also present similarities since only the revenue and being part of a group impact innovation on only one sector, the other differences impact both sectors only with different intensities corroborating the suitability of the integrative approach for understanding how differently the two sectors behave.

Key words: Services Innovation; Manufacturing innovation; Innovation determinants; Integrative approach; CIS

1. Introduction

This dissertation aims to study the differences between innovation in the service sector and manufacturing sector by using data on Portuguese companies from the Community Innovation Survey (CIS) between 2014 and 2016 which is the most recent one. The comparison of the two sectors and the understanding of their differences comes with the fact that manufacturing and services are different sectors which have their own particularities, yet they are somehow related. The main reason for the increasing importance of studying services is its growing significance in the world economy as written by Teixeira and Bezerra (2016), even though the service sector is growing in importance in developed countries the research of innovation in the service sector has only gained impetus for the past 20 years. This new focus on services is due mainly because of the shifting of the workforce from the manufacturing sector to the service sector. As Pires *et al.* (2008) stated the scarcity of studies in services is possibly justified due to the many specificities of this sector, for instance its heterogeneity since this sector is composed by many sub-sectors with different levels of technology input and whose characteristics are very different. These authors also indicate that the intangible nature of most services, the overlap of the moment of production and consumption, non-storability, low tradability, and the strong user–producer links are some of the features that render measurement studies in services extremely difficult. This shows the difficulty in studying services innovation and since the two sectors are somehow related the starting point should be comparing it with manufacturing which has already been largely studied, then comprehend the knowledge from manufacturing that can be used for services too and what should be

studied from scratch to services. The world is turning its attention towards innovation in services, since innovation in this sector is being acknowledged as an important matter to be studied and not seen as having a secondary role on this increasingly innovative world but as being one of the main characters as there is a growth in service companies and competition is focused on the services they provide to the customer. Nowadays, the problem relates to the lack of consensus about the subject and its definition as Witell *et al*. (2015) declared, to share knowledge a precise definition and label is fundamental. These authors also affirm that the different approaches contribute to development of the research of service innovation but the lack of consensus in the definition creates confusion as different perspectives lead to different actions and use different methods. The three main perspectives study service sector the same way as manufacturing (assimilation perspective), as completely different subject (demarcation perspective) and more recently the interest turned to study services innovation not as a completely different area but by understanding that there are some similarities and some differences when comparing with manufacturing (integrative perspective) and so integrating some research on manufacturing which can be used on services and research about services only. This leads to a question "What are the differences and similarities between these two sectors?". "Are services more innovative than manufacturing?" There is research trying to answer these questions, yet the conclusions are somehow vague and forward more robust conclusions to future studies showing that there is still much research to do on this topic and since the services sector is the engine of our economy is of greater importance understand as best as possible its behavior and more precisely its behavior related with innovation which is too a significant matter in the modern world.

2. Literature Review

2.1 Innovation

Innovation is probably one of the words read and listened the most in current days. The world is living the fourth revolution, revolution based in the search for new technologies which are considered innovations. Portugal strives to be an important player on this fourth revolution it has invested heavily in new technologies making this word even more spoken. However, these innovations are often related with technology and the word innovation has a much more embracing meaning. The OECD created a definition widely accepted.

"*An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations*." (OECD, 2005: p. 46). Decades passed in order to get to a consensus since the first author to present a definition was Joseph Schumpeter, he defined in 1930's five types of innovation (OECD, 1997, p. 28):

- Introduction of a new product or a qualitative change in an existing product
- Process innovation new to an industry
- The opening of a new market
- Development of new sources of supply for raw materials or other inputs
- Changes in industrial organization

2.2 Types of Innovation

According to OECD (2005), innovation is divided in four types, three of these come from the very first definition of innovation by Joseph Schumpeter, product, process, organizational, more recently marketing innovation was added. A product innovation is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics" (OECD, 2005: p. 48). Zucoloto and Nogueira (2016) declare as product innovation, a product whose fundamental characteristics significantly differs of all products previously produced by the company. "A process innovation is the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software" (OECD, 2005: p.49). Sedkaoui (2019) stated that is establishing a new production or distribution method, or significantly improving an existing one, involving significant changes in techniques, material, and/or software. The implementation of a new organizational method in the firm's business, workplace organization and external relations (OECD, 2018). Eraso and Gosálbez (2015) understood organizational innovation as involving processes leading to the establishment or adoption of new production and management models, not only for production but also for tangible and intangible

resources. “A marketing innovation is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing” (OECD, 2005: p. 49). Naidoo (2009) defined marketing innovation as improvements in product design, placement, promotion or pricing, and the likelihood of survival.

2.3 Services Innovation

Grönroos (1990) identified innovation in services as the new service product, the new procedure for producing or delivering a service, the new organizational form, and the introduction of a new technology; services in most cases cannot be stored and must be produced in the moment of consumption. Then services innovation was defined by Sundbo and Gallouj (1999) as more an incremental innovation based on small adjustments of procedures, and these are rarely radical and dimensional. The own definition of service innovation is biased, where some say that a small change may be considered an innovation and others require significant changes to regard it the same way. Some definitions of service such as the ones from Sundbo and Gallouj (1999) or Enz (2012) who said that services innovation is based in more continuous improvement, which is not even in agreement with the most accepted definition for innovation itself since for OECD (2005) to be an innovation it must be new or significantly improved. Nonetheless as years past by researchers are getting to a consensus, where services innovation is based on small adjustments and less of technologically based and more organizational. However, getting to a completely consensual definition on this topic will be challenging because, as mentioned by Álvarez *et al*. (2015), significant amount of research has shown service sector as being much more heterogeneous than manufacturing and the way innovation occurs is different from traditional technological innovation.

2.4 Reasons to innovate and barriers to innovation

Enterprises on the XXI century are very competitive and always looking for advantages relative to competitors since they are aware that it could be the difference between thriving or disappearing and in a fast-paced world like today´s companies can easily miss the opportunity. Even though the main goal of companies either from the services sector or manufacturing when innovating is to maintain a competitive advantage against the competitors, as Michel *et al*. (2008) affirmed their target is completely different as services innovate in order to create value for the customer by enhancing the user’s experience. When trying to innovate, the two sectors share some barriers, Gault (2018) revealed in-house and external research and development (R&D), capital expenditure, human resource development, design and market development as activities which require financial efforts and training that some companies might have difficulty on fulfilling. Becheikh *et al.* (2006) concluded that the results of their study seem to suggest a positive correlation between firm size and innovativeness, making it a barrier for small firms to compete, Firm age can be a barrier, younger firms are expected to be more innovative, older firms often get entrenched in established procedures that create a resistance to the integration of major external advances and thus represent a barrier to innovation (Freel, 2003). However, older firms may have benefits when entering new market or when trying to obtain finance or even by the know-how they gained over the years Pires *et al. (2008)*. Barriers identified, such as the lack of implementing good measures to improve innovation performance, the difficulty in employing an effective process to develop innovation, the difficulty in protecting service innovations with patents, or developing ideas not easy to be copied appear to be related with services and its intangibility. However, companies which recognize the difficulty of having an effective innovation process as a barrier, tend to have better innovation performance (Oke, 2004). As mentioned by Djellal *et al.* (2013), the obstacle of protecting services intangible innovation using IPR mechanisms like patents making sometimes the innovation not worth it, however creating some tangibility to the product (loyalty cards, media platforms) may be helpful.

2.5 Innovation Drivers

Innovation drivers are factors either internal or external which have influence on innovations development. There are almost infinite external factors and those are normally uncontrollable, the ones that a company can control are the internal, the focus will be on those. Knowing why you are innovating is what defining drivers is all about, which is a necessary condition for success (Baporikar, 2014). For Baporikar (2014) enterprises are driven to innovate when they need to get out of a crisis or respond to a threat which are straightforward drivers, threats that can be a new competitor entering the market, or the company losing some important personnel. Hauknes (1998) affirmed that two market forces shape innovation patterns, client

intensity and participation and cost/price competition. Stating too that four actors define the market possibilities and are also sometimes involved in the development of the innovation, the customers are of major importance, the competitors creating pressure to innovate, suppliers are an important source of innovation too and lastly the public sector and public policy agents which play a multiplicity of roles, such as being competitor, customer, supplier and carrying out its role as a regulating authority. According to OECD (2018) the drivers for innovation are divided in competition, demand, and markets in which are inserted reasons such as products phasing out, increasing range of goods and services, increase or maintain market share or enter new markets. Production and delivery which is divided in improving the quality, the flexibility of production and capacity of production of goods or services and reduce costs. In the workplace organization segment, the drivers include improving the interaction between business, increase sharing knowledge, ability to adapt to clients demand or improve relationship with customer and improve working conditions.

2.6 Services Innovation Approaches

The first three approaches used by Gallouj *et al.* (2013) are taken into account by Álvarez *et al*. (2015), Castro *et al*. (2011) and Witell *et al.* (2016). The first approach is the "assimilation approach" which considers services as being innovative, however this approach considers services innovation as being done in similar ways as manufacturing innovation making many of the knowledge from manufacturing innovation transposable to services. The second approach is the "demarcation approach" which is based on the intangible and interactive nature of services, arguing that services innovation is quite distinct to manufacturing innovation leading to a need of new theories, instruments and measurements studying its features independently to manufacturing to better understand innovation in the service industry. These two approaches have evolved into the "synthesis approach" or "integrative approach" which is the least developed, stating that these two sectors do not follow completely different paths and so there is no need to look at them by two completely distinct perspectives, however there are some differences between the innovation activities of each of them and so what has been studied concerning manufacturing can be analyzed and integrated with studies regarding services innovation from the "demarcation perspective". This perspective is seen to be of great importance in a world where manufacturers are "servicising" and service firms "productizing" where major economic project and social functions involve combinations of goods and services, of technological and organizational change.

2.7 Empirical Evidence

Andersen *et al.* (2019) got to the conclusion that nine out ten are companies in Europe are keen to increase their budget in innovation. However, Deloitte found that businesses are focusing too much on technological innovation. The multidimensionality of innovation is something worrying Deloitte since only 10% of companies in Europe are using the four different types of innovations Pires *et al.* (2008) found that more recent surveys have been paying more attention to services innovations which has been happening from survey to survey, just like on CIS-3 where the focus shifted from technological innovation and started focusing on a more embracing definition of innovation, closer to the one used today. Hipp *et al*. (2005) showed based on CIS that German market was lacking in skilled personnel which they concluded it was going to hinder the move towards a service society. Teixeira and Bezerra (2016) found when studying the Portuguese economy that human capital was an important determinant of innovation in services but only up to undergraduates. Gallouj and Savona (2008) said, the service sector represents the core engine of a knowledge-based economy, but their most important analytical problem is the fuzzy nature of their products due to its intangibility. They concluded that for them the integrative approach is the most promising in terms of theoretical advancement because of the boundaries between products and services which have been becoming more subtle, this has been happening with tangible and intangible products too. Van Ark *et al.* (2003) agreed with the subtleness of the boundaries since they mentioned that the distinction between the two sectors is increasingly disappearing. When comparing manufacturing with services there is evidence from developed and some developing economies that service sector is as innovative as the manufacturing (Zahler *et al*., 2014). The objective of both innovation strategies consists of improving service/product quality, increase market share and reduce costs (Sirilli and Evangelista, 1998). There are some differences concerning innovation between them such as what Hauknes (1998), Van Ark *et al.* (2003), Tether (2005) and Castro *et al.* (2010) stated that service innovations were less of technological than manufacturing but more innovative on organizational aspect. Tether (2005) and Aboal

et al. (2015) testified that services are often oriented to continuous change instead of a series step wise jump. Size is one of the most studied variables as a determinant of innovation, finding a positive correlation between firm size and innovativeness. Pires *et al*. (2008) concluded that only larger firms with market power can get the return for the investment in R&D which is very risky for small and medium firms. These authors also found that being part of a multinational group has an impact mainly in product innovation on services showing for a multinational group is easier to service innovations to its subsidiaries. Zahler *et al*. (2014) said the size of the service firm has little correlation with the propensity to innovate due to the dependency of services on skills rather than scale. Alvaréz *et al.* (2015) claimed too that size seems to be less important in the service sector than in manufacturing to engage in innovation. When engaging in cooperation for innovation activities Faria *et al.* (2010) affirmed that companies from either services or manufacturing which take advantage of knowledge generated elsewhere improve the probability to be a successful innovator and show on average a higher level of performance. Camacho and Rodriguez (2005) stated that cooperation between companies and between other partners such as customers, suppliers, universities, and research institutes must be taken into account since cooperation is key for success in the innovative process due to the extreme complex environment and the demand for knowledge. Hsueh *et al.* (2010) And Vermeulen *et al*. (2005) also declared that cooperation with suppliers and competitors was most relevant. Schmidt and Rammer (2006) claimed that companies that kept cooperating with external partners were more likely to introduce innovation. Pires *et al.* (2008) and Teixeira and Bezerra (2016) found for services, internal R&D has a bigger impact on innovation compared to manufacturing, cooperative R&D as being more important for pioneering innovation in services and acquisition of machinery and equipment as being relevant for internal and external R&D on both sectors. In opposition for Tether (2005) manufacturing was more likely to source advanced technologies through in house R&D to acquire advanced machinery and equipment yet still sourcing technologies through cooperation. Services place more emphasis on R&D from cooperation and less emphasis on acquired technologies being the skills and professionalism of the workforce crucial. The capacity of the firm to absorb knowledge created elsewhere as Freel (2005) stated depends on the quality of the human resources stating too that companies that present novel innovation in product tend to employ more technicians' engineers and scientists even more in the case of services where training is greatly associated with the process of innovation. Pires *et al.* (2008) use the number of higher educated employees as a measure of the absorptive capacity of the firm, expecting it to affect the probability of the company being an innovator. As they do with training activities, expecting the effect of the absorptive capacity and human capital to be stronger on service firms. On CIS-3 Portugal had already a higher service innovation rate than some countries and when comparing to manufacturing even though at that time the definition of innovation was almost solely related to technology which was then proven to be narrow.

2.8 Hypotheses

Following the previous the comparison of the two target sectors will depend on testing different hypotheses which will use CIS 2016 for the creation of new variables joining variables already existing on the database which will give answers closer to what is needed to then test the hypotheses. Knowing the objective of this dissertation four hypotheses were created to be tested: Hypothesis 1 will test if on each sector the size of the company has some impact in the propensity to innovate.

Hypothesis 1 (H1): Size positively influence innovation activities.

Hypothesis 1a (H1a): Size positively influence innovation activities in services companies.

Hypothesis 1b (H1b): Size positively influence innovation activities in manufacturing companies.

Hypothesis 2 will test how the level of education of employees impacts each sector, and which one is more dependent on human graduated employees to innovate.

Hypothesis 2 (H2): Higher percentage of graduated employees positively influence innovation.

Hypothesis 2a (H2a): Higher percentage of graduated employees positively influence innovation in service companies.

Hypothesis 2b (H2b): Higher percentage of graduated employees positively influence innovation in manufacturing companies.

Hypothesis 3 will test the influence of engaging in cooperation activities on the innovativeness of a company.

Hypothesis 3 (H3): Engagement in cooperation activities positively influences innovation.

Hypothesis 3a (H3a): Engagement in cooperation activities positively influences innovations in service companies.

Hypothesis 3b (H3b): Engagement in cooperation activities positively influences innovation in manufacturing companies.

Hypothesis 4 will be tested based on the expenditure in R&D of companies which will lead to a conclusion on the impact of this department on the innovativeness of a firm.

Hypothesis 4 (H4): Expenditure in R&D positively influence innovation.

Hypothesis 4a (H4a): Expenditure in R&D positively influence innovation in service companies.

Hypothesis 4b (H4b): Expenditure in R&D positively influence innovation in manufacturing companies.

3. Data and methodology

From the 6775 valid answers 4526 (66,8%) Portuguese companies developed some innovation activity between the 2 years of the survey, these include the 4 types of innovation (product, process, organizational and marketing) and the unfinished or abandoned innovation activities count to this number. 3957 (58,4%) presented some product and/or process innovation but only 2195 (32,4%) presented organizational innovation and 2520 (37,2%) marketing innovation. According to data from innovation activities in CIS 2016 service firms implement more innovation than industry ones 70.8% comparing to 64%. The Portuguese economy is mostly a service-based economy like most developed countries, 73% of all the Portuguese firms belong to the service sector 74,6% of the workforce belongs to services and 65% of the GDP comes from the service sector this shows the importance of better understanding how to approach innovation in services. In order to test the hypotheses, models have to be created, those need variables, dependent, independent and control to be tested. Table 1 shows which variables were used to create the models and then test the hypotheses.

Table 1 Description of Variables

Description
Dependent variable
Implemented innovation
Independent variables
In-house or bought R&D
In-house R&D expenditure
External R&D expenditure
Innovation developed exclusively by the company
External Innovation modified by the company
Intellectual Property
Acquisition of advanced equipment/technologies
Innovation developed in cooperation
Yearly Revenue
Large Companies
International Orientation
College graduate
Employees
Services
Control variables
Part of a group
Services Subsector
Training Activities

The chosen model was logit since the two-output identical and accurate results and as Peng *et al.* (2002) mentioned logit regression model is superior since it can accept both discrete and continuous variables. For a better and more organized understanding of the dissertation the independent variables will be compiled in different equations using different vectors:

Λ_1 (Research and development)→ B_1(HBRD) +B_2(HRDE)+B_3(BRDE)+B_4(IDEC)+B_5(EIMC)+B_6(IP)+B_7(AET)+B_8(IDIC)

Λ_2(Company Characteristics)→ B_9(YREV)+B_{10}(LRG)+B_{11}(ITO)+B_{12}(CGE)+B_{13}(SERV)

Λ_3(Control variables)→B_{19}(POG)+B_{20}(SST)+ B_{21}(TRNA)

The equations all revolve around identifying if the company implemented any kind of innovation understanding the different approaches used to get there:

$$IIN= \lambda_1+ \lambda_2+ \lambda_3+\varepsilon$$

4.Results

4.1 Regression results and Marginal effects

The methodology used will be based firstly by making a base model with a logit regression between the dependent variable and four control variables. Then models for each of the four hypotheses will be created by adding variables specific to each hypothesis to the previous model. After running the logit regressions models, the marginal effects will be used to differentiate manufacturing from services. to understand the magnitude of that influence, increase or decrease (depending on signal). The results show that every tested model has p-values of 0 meaning the results are significant the correct predictions have high values all above 79% meaning the models correctly predict the outcome, however only on model 4 the Pseudo R^2 has values around the extremely good fit interval of 0.2-0.4 0.2015 (manufacturing) and 0.1954 (services). Model 1 which tests H1 related with the size of the company presents a major difference between the two sectors as manufacturing depends on the yearly revenue for implementing innovation and services have no proven dependency on the revenue. Other difference found on this model is the significance of being part of a group for services and not for manufacturing. When analyzing model 2 to test H2 college graduated employees and training activities show significance for both sectors, yet the first with a slightly higher marginal effect for manufacturing and the latter with a higher marginal effect for services. The cooperation hypothesis is tested by model 3 which shows that both sectors innovativeness depends on cooperation however, manufacturing presents a slightly higher dependency as the marginal effect is higher. When testing H4 the fourth model shows that from the five variables directly related with expenditure on R&D only three present significances, the three for both sectors. The differences shown are subtle as in-house R&D expenditure, Innovation developed by the company and external innovation changed by the company present higher marginal effects for manufacturing and are more important for this sectors innovativeness.

4.2 Summary of the results

The Pseudo R2 values of the common models (manufacturing and services together) tend to be between the upper and lower Pseudo R2 values of the comparison models (manufacturing vs services) since these models are using all the same data and variables but using the variable ASEC to distinguish between sectors this metric which is normally used to compare between similar models to understand which one has a better fit, when varying some variables. On this case taking into account the main topic of this thesis, the differentiation between services and manufacturing, its purpose can be too related to the comparison of fitness between each sector. By looking at the dependent variable, the findings suggest that for services the percentage of graduated employees, the engagement in cooperation activities and the expenditure in R&D positively influence the implementation of innovation. Yet Size (H1) cannot be considered to have a positive effect on innovation mainly due to the fact that the two main determinants of size have no impact on innovativeness. The four hypotheses also positively influence manufacturing. However, when looking closer to H1 model, only one of the main determinants, revenue, plays a role in manufacturing and so the H1b is valid but timidly making the rejection of H1 the most plausible answer. After testing twelve hypotheses ten were validated, H1b with some reservations, H1 and H1a were the rejected ones. When the results are scrutinized differences between sectors standout the more evident are the ones where the variable is significant for one sector but not for the other such as the revenue, on the first model which is important for the innovativeness of a manufacturing company but not for services which is in line with Pires et al. (2008), Alvaréz (2015) and Hipp and Grupp (2005) who stated that size has greater impact in manufacturing companies and Zahler et al. (2014) who found that in services size has little correlation with innovation. However, the number of employees which is the other main determinant of the size of a company has no proven correlation with the innovativeness of a company. The second clear difference is the importance of being part of a group for services in contrast to manufacturing which shows no significant results for this variable contrary to what was expected since Pires et al. (2008) affirmed that being part of a group impacted innovation for both sectors. By looking at the marginal effects other differences can be observed such as for model 2 the even though timid, higher importance of having college graduated employees in manufacturing yet engaging in training activities and so investing in the skills of the employees being more important for services innovation. Pires et al. (2008) and Schmidt and Rammer (2006) found human resource training as being positive and significant for pioneering and Zahler et al. (2014) affirmed that services had a greater dependency on skills which is in accordance with the higher influence of the engagement on qualification activities in services innovations. Another difference is related to the engagement in cooperation activities since the marginal effects are higher for manufacturing meaning

this sector benefits more from cooperation than services, yet both are positively influenced by cooperation activities. These results validate the statements of Camacho and Rodriguez (2005), Vermeulen et al. (2005), Schmidt and Rammer (2006), Hsueh et al. (2010) and Teixeira and Bezerra (2016) which declared that cooperation has a positive effect on innovation. The marginal effects results show that In house R&D expenditure, innovation developed by the company and external innovation changed by the company are more impactful on manufacturing innovation than on services. Tether (2005) wrote that manufacturing is more likely to source advanced technologies through in house R&D the latter and Aboal et al. (2015) affirmed that services tend not to require formal R&D due to incremental nature of their innovations. Teixeira and Bezerra (2016) and Zahler (2014) declared services companies investing more in R&D as being more innovative than those that do not invest.

5.Conclusions

The study about innovation in the service sector is still a relatively new theme in comparison with manufacturing. Yet, since the market is becoming more and more service based more attention has been given to services. Many studies focus on the behavior of services innovation comparing to manufacturing leading to three different possible approaches, the assimilation approach that considers service innovation as done in similar ways as manufacturing, then there is the demarcation approach that considers innovation in the two sectors as completely different and so studies them as different matters. The last one is the integrative approach which studies the two sectors as comparable with each other, looking for some similarities and some differences between them. This was the focus on this thesis, since its goal was to compare the two sectors and understand how different service innovation is from manufacturing innovation. The results go in accordance with the "integrative approach" since services and manufacturing share many similarities when looking at the size of the company, the percentage of graduated employees, innovation developed in cooperation and on the expenditure in R&D. However, some differences can be found by focusing on the specific needs to achieve innovation, such as services innovation depending on being part of a group and manufacturing depending on the revenue, or services innovation depending slightly less on graduated employees but more on skilled employees since training activities affects more this sector. Other results show that manufacturing innovation depends more on the cooperation with other entities and the R&D expenditure. These results are in line with Pires *et al.* (2008), Hipp and Grupp (2005) and Álvarez (2015) who concluded size has more impact on manufacturing innovativeness than on services, which can be considered true if we take into account that one of the major indicators of the size of a company is the revenue which has influence in manufacturing innovativeness but not in services. Andersen *et al.* (2019), Teixeira and Bezerra (2016) and Zahler *et al*. (2014) argued that services would benefit from more skilled employees which is in accordance with the obtained results since having a higher percentage of graduated employees influences both sectors but having other skills influences more services. The results related with cooperation and the expenditure in R&D are in accordance with Teixeira and Bezerra (2016) since they stated for them cooperation has a positive effect in innovation and that services companies which continuously invest on R&D are more innovative than those that do not invest. As expected, this research like all has its limitations. Firstly, it only covers a small percentage of the number of Portuguese companies (6775) and on that universe of companies some would choose not to answer to certain questions making the number of observations even smaller, only 2 years (2014-2016) were considered and only considers the time the company answered the questions and not the time interval. The analysis of various CIS surveys would benefit the study of innovation since it would be possible to better understand the evolution of the companies. However, this would only be possible if the survey between iterations stayed similar maintaining the same questions to make feasible a comparison between iterations. Even though a lot of progress has been made to include and collect more accurate and realistic data about the increasingly important services sector some progress updates to the survey have still to be made since the last surveys were very different from CIS 2016. Other limitation has to do with the heterogeneity of the services sector, since each sector has distinct characteristics from the other, this was considered in the variables with the variable Services subsectors but the lack of observations after creating the model made it extremely inaccurate and not trustworthy. The first solution would be the increase of the number of observations. Other solution would be the segregation of services subsectors as perhaps KIBS and no KIBS to aggregate observations. The study of the differences of the

services sector alone could serve as the subject for a future study since it has shown to be of extreme complexity. Comparing portugal's innovativeness with other EU countries would be of interest. Deepening the subject of cooperation activities could also be a topic of research to understand which are the entities with whom cooperation is more advantageous towards innovation, yet there is another limitation with the number of observations when looking specifically into this subject. The last limitation has to do with the lack of studies regarding the Portuguese market since only André *et al.* (2002), Pires *et al.* (2008) and Teixeira and Bezerra (2016) wrote about this country's specificities making it difficult to compare the already written literature about this country and the results based in CIS 2016 for Portugal. With these results the conclusion is that further and deeper research can be made to better refine the results such as studying the subject of each hypothesis on its own, which may result in finding more differences or similarities between the two sectors characterizing better each one. This better characterization of each sector mainly focusing on the least studied, the services would highly benefit companies of that sector on the decision-making process and on how to approach innovation in the future since the different subsectors are highly differentiated.

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