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COOPERATION, INNOVATION AND ENVIRONMENTAL SUSTAINABILITY: PORTUGUESE FIRMS RESEARCH

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Abstract

Purpose–Reasons/aims of paper: Innovation is essential to increase the competitive advantages of firms, thus allowing the development of new ideas (Ingram, 2011). This study aims to understand the influence of cooperation on innovation, the relationship of these variables with eco-innovation and the factors that contribute to the decision-making of firms in the adoption of eco-innovations.

Research–Methodology: The database used is the CIS 2014 (Community Innovation Survey) applied to a sample of 7083 Portuguese firms in the period 2012-2014, the sample was analyzed through univariate and multivariate techniques, in particular, MANOVA, association between variables and multiple linear regression models.

Findings-Conclusions: The results of this study show that cooperation has an influence in the at least three types of innovation, therefore, the more cooperation there is, the greater the existing innovation in firms. Cooperation, innovation and eco-innovation are interrelated, and the results shows there is significant correlations between them. Lastly, the factors that most contribute to the adoption of eco-innovations are essentially the current or expected demand in the market for environmental innovations, the improvement of the firm reputation and the high costs of energy, water or materials.

Research limitations: The database CIS 2014, has few questions that allow answers on an ordinal scale, i.e., most of the questions are for "Yes" and "No" answers, which is not conducive to the analysis, being essential the creation of other variables.

Practical implications-Applications to practice: – This study suggests thar the managers must be aware that cooperating with different stakeholders are better able to innovate and therefore have access to new opportunities in the market. At the same time that these new possibilities (cooperation and innovation) open up, they will be in a position to adopt eco-innovations. Finally, firms that are concerned with introducing eco-innovations associate them with purely strategic motivations, namely in terms of reputation, costs and demand.

Originality: This study allows us to understand the influence that cooperation has on innovation ideas, as well as to understand the importance that both cooperation and innovation provide for the adoption of eco-innovation practices. It also allows to know what the most important factors in the decision-making of firms are to adopt acts of innovation directed towards sustainability (eco-innovation).

Keywords: Innovation; Cooperation; Eco-innovation; CIS.

1. Introduction

The increase in globalization has led to greater competitiveness, forfirmsto be successful they need to increase their competitive advantages, i.e., develop new strategies to remain competitive in the market. Therefore, innovation is essential for the performance of firms(Ingram, 2011).

Innovation can be defined as the "new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)" (OECD/Eurostat, 2018, p.20).

In the innovation process, cooperation plays an important role. It helps to release internal restrictions on innovation, facilitating access to knowledge sources that facilitate the entire innovation process (Miotti & Sachwald, 2003).

According to Freel and Harrison (2006), product innovations are influenced by cooperation with customers and institutions, while process innovations are driven by cooperation with suppliers and universities.

Cooperation then serves as a mechanism to maximize the firm value because the greater the collaboration with partners, the greater the chance of obtaining more innovative products (Belderbos, Carree & Lokshin, 2004).

Taking into account the constant degradation of the environment, it is necessary that firms adopt major innovations in an environmentally sustainable way to be able to respond to the growing consumer demand for sustainable products and services (Hojnik, Ruzzier & Manolova, 2018).

For eco-innovations to be successful, they need cooperation, as they need more partnerships than are available within the organization(Calik, Badurdeen & Bal, 2020). In addition, firms need to learn how to manage the knowledge they acquire from cooperation with other partners to obtain new ideas for innovation, otherwise they are unable to develop eco-innovations (Ayuso, Rodríguez, García-Castro & Ariño, 2011).

The Oslo Manual (2009), defines eco-innovation as being the same as other types of innovation but represents an innovation that results in a reduction of the environmental impact(OECD, 2009).

Eco-innovation is a way of addressing future environmental problems, taking into account the reduction of energy / resources / waste / consumption, through sustainable economic activities (Hellström, 2006).

In addition to the concern for the environment, firmscan adopt eco-innovation practices to improve their firm reputation, achieve cost savings, respond to market demand, enter new markets, act correctly or simply, to meet regulatory requirements (Kesidou & Demirel, 2012; Berrone, Fosfuri, Gelabert& Gomez-Mejia, 2013; Severo, Guimarães & Dorion, 2017; Hojnik et al., 2018).

Therefore, the main goal of this study is to understand the influence of cooperation on innovation, the relationship of these variables with eco-innovation and the factors that contribute to the decision-making of firms in the adoption of eco-innovations.

To answer the objective of the study, a statistical analysis is used using two multivariate techniques applied to the CIS 2014 database, which has information related to the innovation of Portuguese firms, in a period from 2012-2014.This database allowed the measurement of a significant number of variables pointed out in the literature, inherent to a group of 7083 Portuguese firms.

This study is divided into five parts, the first part an introduction to the study is presented,the second part presents a literature review on the main variables under study, as well as the hypotheses to be studied. In the third part presents the adopted methodology (MANOVA, correlation between variables and multiple linear regression models) for the treatment of the data. Then, the main results are presented, as well as their discussion. Finally, the study's conclusions are presented, as well as the main limitations and possible future investigations.

2. Innovation, Cooperation and Eco-innovation – a literature review

According to Porter (1990:74), “companies achievecompetitive advantages through acts of innovation. They approach innovation in its broadest sense, including both new technologies and new ways of doing things”.

Schumpeter (1939) was one of the first authors to direct his studies on innovation and defines it as a new production function. For this author, innovation is a historic and irreversible change in the way of doing things and has great importance for long-term profitability.

Schumpeter (1950) is considered by several authors as the "father" of studies in innovation, developing the concept of "creative destruction" (Tidd, Bessant & Pavitt, 2005). According to this author, the phenomenon of “creative destruction” mentioned in his book, is characterized as a form or method of economic transformation, a constant search for the creation of something new that, simultaneously, will destroy the bases establishing new rules for the model.

Freeman and Soete (1997)states that innovation departs from the invention, for them the invention is the creation of a new product or process in relation to the existing ones and the innovation portrays the use of a non-trivial change and the improvement in a process, product or system that it is new to the organization that developed this same change.

However, Buse, Tiwari and Herstatt (2010)consider innovation as the invention and commercialization of new products, processes and / or services.

The OSLO Manual states that innovation is a continuous process from which firms constantly change products and processes and seek new knowledge (OECD, 2005). Innovation is not

something that firms do only once and forget, it is a capacity that needs to be developed and practiced frequently.

In general, innovation can be defined as the “new or improved product or process (or combination thereof) that differs significantly from the unit’s previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)” (OECD/Eurostat, 2018, p.20).

According to Beaini (2015), detaining innovation as an organizational competence is considered a driving force for business success, being therefore a determining factor for the competitiveness of firms and should be a strategy for those looking to acquire a long-term sustainable advantage.

The Oslo Manual specifies four types of innovation, namely product, process, organizational and marketing innovation(OECD, 2005). Product innovation (goods and services) corresponds to"new or improved good or service that differs significantly from the firms previous goods or services and that has been introduced on the market"(OECD/Eurostat, 2018, p. 21).

Process innovation is the "implementation of a new or significantly improved production process, distribution method, or supporting activity” (CIS, 2014).

For CIS (2014), organizational innovation is a “new organisational methodin your enterprise’s business practices (including knowledge management), workplace organization or external relations that has not been previously used by your enterprise”.

Marketing innovation is the “process of implementation of new marketing methods, involving significant improvements in product design, price packaging, distribution and promotion” (Correia, Machado, Braga, Braga & Almeida, 2017).

Cooperation is understood as an essential element in the innovation process of firms, it is not a new phenomenon, however, the term cooperation only gained prominence in the 1980s (Bayona, García-Marco, & Huerta, 2001).

Cooperation between firms can be defined as the establishment of relationships based on an association of forces that make it possible to share resources, reduce risks and facilitate common projects, through stable commitments, in order to achieve a set of general or specific objectives(Sánchez & Pérez, 2003).

Cooperation helps to release internal restrictions on innovation, facilitating access to external sources of knowledge that allow firms to benefit from work in the innovation process(Miotti & Sachwald, 2003).

Freel and Harrison (2006)found empirical evidence that product innovations are influenced by partnerships with customers and public sector institutions, while process innovations are driven through cooperation with suppliers and universities.

Carvalho, Madeira, Carvalho, Moura and Duarte (2018) who quaote (Belderbos, Carree, Diederen, Lokshin & Veugelers, 2004; Aschhoff & Schmidt, 2008), confirm that cooperation with competitors increases the capacity for innovation or the performance of firms.

Cooperation serves as a mechanism to maximize the firm value, which effectively combines the resources of it is partners, exploiting their complementarities(Hagedoorn, Link & Vonortas, 2000;Belderbos, Carree & Lokshin, 2004). Thus, it is possible to assume that firms that

collaborate more, have access to information from their partners and, consequently, have a better position to reach more innovative products.

Taking into account the approaches presented, it is thus possible to formulate the following hypothesis:

- **H_1:** Cooperation positively influences innovation.

Due to the constant degradation of the environment, it is necessary that firms adopt major product, organizational, and technological innovations, so that they operate in an environmentally sustainable way, responding to the consumer´s growing demand for sustainable products and services and complying with regulatory requirements(Hojnik et al., 2018).

An innovative firm has a greater capacity to create sustainable competitive advantages(Camisón & López, 2010). Eco-innovation is a special type of innovation (Bossle, Barcellos, Vieira & Sauvée, 2016)and has several denominations in the literature, such as "sustainable", "green", "eco" or "environmental" innovation(Schiederig, Tietze & Herstatt, 2012; Xavier, Naveiro, Aoussat & Reyes, 2017). In this study, we will use the name "eco-innovation" to refer to this type of innovation.

Error! Reference source not found. shows the different definitions of eco-innovation taking into account the literature.

Literature	Definition
Fussler and James (1996)	Process of developing of new products, processes or services which provide customer and business value but significantly decrease environmental impacts.
Rennings (2000)	Develop new ideas, behavior, products and processes, apply or present them and contribute to the reduction of environmental burdens or to ecologically specified sustainability goals.
Kemp and Foxon (2007)	Production, assimilation or exploitation of a product, production, service ormanagement or business methodi.e. novel to the organization (developing or adopting it) and which results, throughout its life cycle, in a reduction of environmental risk, pollution and theother negative impacts of resources use (including energy use) compared to relevant alternatives.
Oltra and Jean (2009)	Innovations that consists of new or modified processes, practices, systems and products which benefit the environment and so contribute to environmental sustainability.
Carrillo-Hermosilla, Río and Könnölä (2010)	Innovation that improves environmental

	performance.
European Commission (2013)	The introduction of any new or significantly improved product (good or service), process, organizational change or marketing solution that reduces the use of natural resources (including materials, energy, water and land) and decreases the release of harmful substances across the whole life-cycle.
CIS (2014)	Is a new or significantly improved product (good or service), process, organizational method or marketing method that creates environmental benefits compared to alternatives.
Calik, Badurdeen and Bal (2020)	Any new or significant improvement of products, technological or organizational processes and systems commercialized or internally implemented successfully, that not only provide economic benefits but also generate positive social and environmental impacts.

For eco-innovations to be successful they need cooperation, as they need more partnerships than are available within the limits of an organization (Calik, Badurdeen & Bal, 2020).

The functions of a firm when working together with other external actors are crucial for the development of successful product eco-innovation(Medeiros, Ribeiro & Cortimiglia, 2014), as cooperation between eco-innovation partners increases their number and impact and offers opportunities to compensate for the lack of resources (Bos-Brouwers, 2010).

In addition, organizational factors, such as culture and management, influence the relationship between cooperation and eco-innovation (Calik et al., 2020). Firms need to learn how to manage the knowledge acquired from cooperation to obtain new ideas for innovation. If they do not have enough capacity to absorb this knowledge and integrate it in the innovation processes, they are not able to develop eco-innovations (Ayuso et al., 2011).

Taking into account the mentioned approaches, it is possible to formulate the following hypotheses:

- **H_2**: There is a relationship between:
  - **H_{2a}**: Innovation and cooperation;
  - **H_{2b}**: Innovation and eco-innovation;
  - **H_{3c}**: Cooperation and eco-innovation.

Hypotheses	Authors	Method	Variables	Acronym and their designation	Questionnaire Question
H_1: Cooperation positively influences innovation	Bayona et al., (2001); Miotti and Sachwald (2003); Freel and Harrison (2006); Carvalho et al. (2018).	MANOVA	**Total Cooperation** (Sánchez & Pérez, 2003)	**Types of cooperation partner[1]:** C011, C012, C013, C014, C015 – Other enterprises within your enterprise group; C021, C022, C023, C024, C025 - Suppliers of equipment, materials, components, or software; C0311, C0312, C0313, C0314, C0315 - Clients or customers from the private sector; C0321, C0322, C0323, C0324, C0325 - Clients or customers from the public sector; C041, C042, C043, C044, C045 - Competitors or other enterprises in your sector; C051, C052, C053, C054, C055- Consultants or commercial labs; C061, C062, C063, C064, C065 - Universities or other higher education institutes; C071, C072, C073, C074, C075 - Government, public or private research institutes.	7.2

H_2: There is a relationship between innovation, cooperation and eco-innovation	Ayuso et al. (2011); Calik et al., (2020).	Association between variables	**Total innovation** (Schumpeter, 1939; Buse et al., 2010; OECD, 2005; OECD/Eurostat, 2018; CIS, 2014; Correia et al., 2017)	**Product innovation:** INPSPD – Goods innovation; INPDSV – Service innovations. **Process innovation:** INPSPD – Innovation in manufacturing; INPSLG – Innovation in logistics, delivery or distribution methods; INPSSU – Innovation in supportive activities for processes. **Organizational innovation:** ORGBUP – Innovation in business practices**.** ORGWKP – Innovation in organizing work responsibilities and decision making; ORGEXR - Innovation in organizing external relations. **Marketing innovation:** MKTDGP – Innovation in packaging**;** MKTPDP – Innovation in distribution**;** MKTPDL – Innovation in promotion; MKTPRI - Innovation in price.	2.1 3.1 8.1 9.1

H_3: The factors that positively influence firms to implement eco-innovations are: **H_{3a}**: Voluntary actions or initiatives for good practices; **H_{3b}**: High energy, water and material costs; **H_{3c}**: Improved firm reputation; **H_{3d}**: Existence of environmental regulations; **H_{3e}**: Existence of environmental taxes, charges or fees; **H_{3f}**: Future environmental regulations or taxes; **H_{3g}**: Current or expected market demand; **H_{3h}**: Need to accomplish the requirements for concluding public contracts.	Severo et al., (2017); Hojnik et al., (2018); Ghisetti and Rennings (2014); Hellström (2006); Sarkar (2013); Luan et al., (2016); Kesidou and Demirel (2012).	Multiple linear regression models	**Eco-innovation** (Fussler& James, 1996; Rennings, 2000; Kemp & Foxon, 2007; Oltra& Jean, 2009; European Commission, 2013; CIS, 2014; Calik et al., 2020) **Factors to eco-innovation**	ECOMAT - Reduced material or water use per unit of output; ECOENO - Reduced energy use or CO_2 'footprint'; ECOPOL - Reduced air, water, noise or soil pollution; ECOSUB - Replaced a share of materials with less polluting or hazardous substitutes; ECOREP - Replaced a share of fossil energy with renewable energy sources; ECOREC - Recycled waste, water, or materials for own use or sale; ECOENU - Reduced energy use or CO_2 'footprint'; ECOPOS - Reduced air, water, noise or soil pollution; ECOREA - Facilitated recycling of product after use; ECOEXT - Extended product life through longer-lasting, more durable products. See the Table 4	13.1 13.3

The Oslo Manual (2009), defines eco-innovation as being the same as other types of innovation but represents an innovation that results in a reduction of the environmental impact(OECD, 2009).

Eco-innovation refers to innovation directed towards sustainability(Bossle, Barcellos,Vieira & Sauvéec, 2016; Kiefer, Carrillo-Hermosilla, Río & Barroso, 2017; Hojnik et al., 2018), being a type of innovation that causes new products that use clean energy, are less polluting and have less impact on the environment(Peng & Liu, 2016; Severo, Guimarães & Dorion, 2017).

These approaches collaborate to create a new hypothesis:

- **H_3:** The factors that positively influence firms to implement eco-innovations are:
  - **H_{3a}:** Voluntary actions or initiatives for good practices;

The definitions of eco-innovation highlight the reduction of the environmental impact caused by production and consumption activities, but they may or may not consider the environment as the main motivation for its creation and implementation. Several firms have already proven that it is possible to add value while reducing environmental damage by reducing the consumption of materials and / or energy(Ghisetti & Rennings, 2014).

According to Bos-Brouwers (2010), eco-innovations that occur in small and medium-sized firms, for example, are basically incremental, as they fall on the improvement of technological processes to reduce production costs.

Eco-innovation is a way of addressing future environmental problems, taking into account the reduction of energy / resources / waste / consumption, through sustainable economic activities(Hellström, 2006; Cai & Zhou, 2014; Hojnik et al., 2018).

According to the approaches presented, it is possible to formulate the following hypothesis:

- **H_{3b}:** High costs of energy, water and material;

Sarkar (2013)states that the benefits that come from eco-innovation can be classified into direct and indirect. Direct payments are the operational advantages resulting from the most effective use of resources. Indirect ones include the improvement of the firm image, better relations with suppliers / customers / authorities and a greater capacity for innovation in general terms.

The adoption of eco-innovation practices by several firms may result from their desire to build or improve their reputation(Berrone, Fosfuri, Gelabert& Gomez-Mejia, 2013; Hojnik et al., 2018).

It is possible to develop a new hypothesis:

- **H_{3c}:** Improvingthe firm reputation;

Porter and Linde (1995)defend the need for more stringent and flexible environmental regulation, so that firms can find adjusted solutions to their innovation processes.

Several studies show that environmental regulations significantly influence investment in eco-innovations(Demirel & Kesidou, 2011; Luan, Tien & Chen, 2016; Hojnik et al., 2018).

New hypotheses can be formulated:

- **H_{3d}:** Existence of environmental regulations;
- **H_{3e}:** Existence of environmental taxes, charges or fees;
- **H_{3f}:** Future environmental regulations or taxes;

Kesidou and Demirel (2012) identified innovation, stakeholders, technology, the organizational capabilities of firms and the needs of the market / customers, as being the main factors that contribute to the introduction of eco-innovations.

From this last approach it is possible to elaborate two more hypotheses:

- **H_{3g}:** Current or expected market demand**;**
- **H_{3h}:** Need to meet requirements for public procurement contracts**.**

In order to facilitate the understanding of the presented literature, Figure 1 shows the conceptual model of this study.

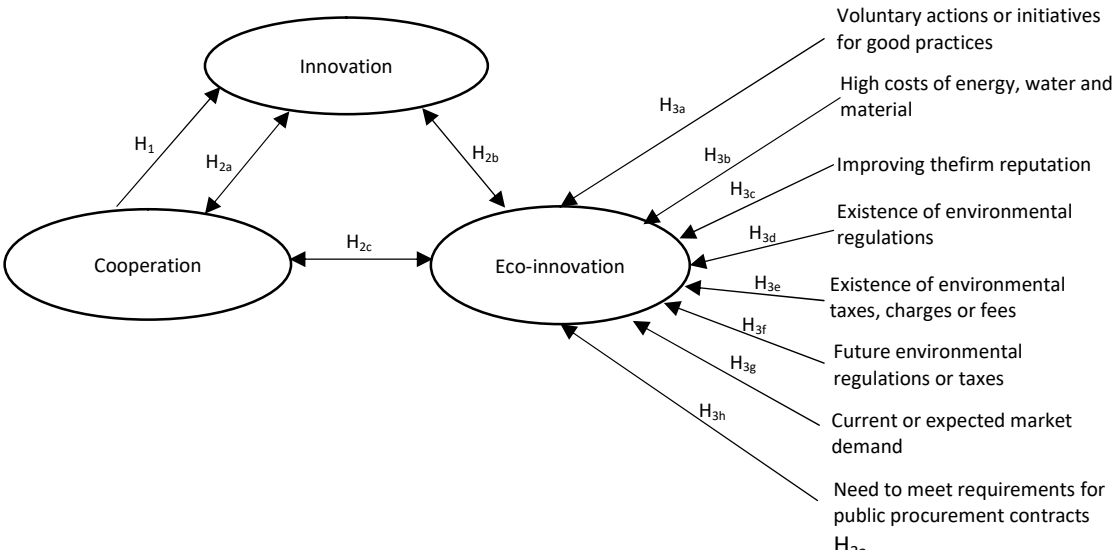


Figure 1- Conceptual model of this study

1. Research Metodology

1.1. Data and Sample

This study is based on data from CIS 2014 (Community Innovation Survey)[2, 3], which collects information on the four types of innovation, product, process, organizational and marketing activities and this edition presents new issues related to eco-innovation(DGEEC, 2016a).

The target population of CIS 2014, corresponds to a group of firms, based in Portuguese territory with more than 10 people employed.The CIS sample is a stratified sample, with it is target

[2] *Link to CIS 2014 questionnaire in English - https://circabc.europa.eu/ui/group/47133480-29c1-4c23-9199-72a631f4fd96/library/32ab7d19-446e-404c-9ea5-e2524065b2a0/details*

[3] *Link to CIS 2014 questionnaire in Portuguese - https://www.dgeec.mec.pt/np4/207/%7B$clientServletPath%7D/?newsId=113&fileName=Sum_rios_Estat_sticos_CIS2014_30092016.pdf*

population divided into subgroups structured by firm size (considering the number of employees), by CAE and by regional distribution (NUTS II) (DGEEC, 2016b).
The initial sample consisted of 9455 firms (distributed over 888 strata) based on a census combination (for firms with 250 or more employees). At the end of the data collection period, between 9th October 2014 and 8th June 2016, 7083 responses were considered valid, out of 8735 firms in the corrected sample, corresponding to a rate of 81%.
Error! Reference source not found.presents the synthesis of the hypotheses i.e. used for this study and the variables taken from the questionnaire (CIS 2014) that are used in their study.

2.1. Measures

To test the hypotheses developed in chapter2, our variables of study were created using the existing variables in CIS 2014, similarly to what was done by Correia et al., (2017):

- **Total Cooperation:**Total_Coop = [C011, C015] + [C021, C025] + [C0311, C0315] + [C0321, C0325] + [C041, C045] + [C051, C055] + [C061, C065] + [C071, C075]. This variable range from 1- did not implement any of the cooperation items and 28- implemented all cooperation items. The mode value is 1, i.e., of the 891 firms that responded to the cooperation questionnaire, about 248 (3.5%) answered type of cooperation 1, i.e., they have only one type of collaboration partners. Regarding asymmetry and kurtosis, it can be said that we are in the presence of a positive asymmetric and leptokurtic distribution because the values are greater than 1.96 (**Error! Reference source not found.**[4]).
- **Product Innovation:**P_S_Inov = INPDGD + INPDSV. This variable range from 0 - the firm does not implement any innovation in terms of products and / or services and 2 - the firm has implemented innovation in terms of both products and services.The value of mode is 0, this means that there are more firms that do not innovate in products and services than those that innovate (**Error! Reference source not found.**[4]).
- **Process Innovation:**Proc_Inov = INPSPD + INPSLG + INPSSU. This variable range from 0-the firm has not implemented any of the innovation items and 3- the firm has implemented all of the innovation items.The value of mode is 0, this means that there are more firms that do not innovate in process innovations than those that innovate (**Error! Reference source not found.**[4]).
- **Organizational Innovation:**Org_Inov = ORGBUP + ORGWKP + ORGEXR. This variable range from 0-the firm has not implemented any of the innovation items and 3- the firm has implemented all of the innovation items.The value of mode is 0, this means that there are more firms that do not innovate in organizational innovations than those that innovate (**Error! Reference source not found.**[4]).
- **Marketing Innovation:**Mark_Inov = MKTDGP + MKTPDP + MKTPDL + MKTPRI. This variable range from 0- the firm has not implemented any of the innovation items in terms of marketing and 4- the firm has implemented all of the innovation items in terms

[4]*Appendix 1*

of marketing.The value of mode is 0, this means that there are more firms that do not innovate in marketing than those that innovate (**Error! Reference source not found.**[4]).

- **Total Innovation:**Total_Inov = P_S_Inov + Proc_Inov + Org_Inov + Mark_Inov. This variable rangefrom 0- did not implement any of the innovation items and 12- implemented all types of innovation. The value of mode is 0, this means that there are more firms that do not innovate than those that innovate, in at least one type of innovation.Regarding asymmetry and kurtosis, we are in the presence of a symmetrical and mesokurtic data distribution, since they are between [-1.96, 1.96], i.e., it has an approximately normal distribution (Table 15[4]).
- **Eco-innovation:**Eco_Inov = ECOMAT + ECOENO + ECOPOL + ECOSUB + ECOREP + ECOREC + ECOENU + ECOPOS + ECOREA + ECOEXT.This variable range from0- did not implement any of the eco-innovation items and 10- implemented all of the eco-innovation items. The mode value of this variable is 0, i.e., of the 7083 firms, about 1433 (20.2%) do not introduce any type of eco-innovation.Regarding asymmetry and kurtosis, we are in the presence of a symmetrical and mesokurtic data distribution, since they are between [-1.96, 1.96], i.e., it has an approximately normal distribution (**Error! Reference source not found.**[4]).

The methods used to test the hypotheses defined in chapter 2–Innovation, Cooperation and Eco-innovationare mentioned in**Error! Reference source not found.**.

2.2. Descriptive statistics

Descriptive statistics consists of the collection, analysis and interpretation of numerical data through the creation of appropriate instruments such as tables, graphs and numerical indicators (Reis, 1996), i.e., first, descriptive statistical research and later, an inductive statistical study.

Throughout this article, three variables stand out, namely Total Innovation, Total Cooperation and Eco-innovation. These variables were defined from the CIS 2014 database, according to the procedure defined in sub-chapter2.1-Measures.

When analyzing **Error! Reference source not found.**[4], it appears that of the 7083 firms, 3142 (44.4%) do not carry out any type of innovation, be it in products or services, process, organizational or marketing.

The Total Innovation variable has a minimum value of zero (0-did not implement any of the innovation items) and a maximum of twelve (12- implemented all types of innovation) As previously mentioned, it presents a symmetrical and mesokurtic distribution since the values of asymmetry and kurtosis are comprised between[-1.96, 1.96]. The mean for Total Innovation is 2.29 with s.d≈ 2.9(Table 15[4]).

With regard to the Total Cooperation variable of the 891 firms, about 248 (27.8%) had only one type of cooperation (1), i.e., they have only one type of collaboration partners (Table 16[4]).

This variable has a minimum value of one (1 - did not implement any of the cooperation items) and a maximum value of twenty-eight (28 - implemented all cooperation items). The mean for Total Cooperation is 3.7 with s.d≈3.5 as illustrated in**Error! Reference source not found.** in the

appendix. As mentioned, it presents a positive asymmetric and leptokurtic distribution because the values are greater 1.96 (**Error! Reference source not found.**[4]).

Other variable of this study is Eco-innovation, and of the 4167firms, about 1433 (34.4%) do not introduce any type of innovation with concerns for the environment (**Error! Reference source not found.**[4]).

This variable has a minimum value of zero (0 - did not implement any of the eco-innovation items) and a maximum value (10 - implemented allthe eco-innovation items). The mean for Eco-innovation is 2.75 with s.d≈2.9. As mentioned, it presents a symmetrical and mesokurtic distribution since the values of asymmetry and kurtosis are comprised between [-1.96, 1.96] (**Error! Reference source not found.**[4]).

1. Results and Discussion

1.1. Influence of Cooperation on Innovation

In order to study whether the level of Total Cooperation (Total_Coop) influences product innovation (P_S_Inov), process innovation (Proc_Inov), organizational innovation (Org_Inov) and marketing innovation (Mark_Inov), MANOVA (Multivariate Analysis of Variance) is used.

With this, it is intended to know if there are significant differences in the means of these innovation variables when changes occurs in the level of cooperation. First the assumptions of normality, homogeneityand existence of correlations between variables were tested.

Regarding Normality, taking into account that the sample is large using the central limit theorem (CLT) normality can be assumed, besides that normality tests were performedand some results justifies this assumption, however the sample dimension is a limitation for normality tests.

In terms of homogenity of variances, the Box Test, which tests the equality of the covariance matrix between the groups, has a p-value of 0.671 (greater than 0.05) so that, for a 5% significance level, the null hypothesis is not rejected and the groups do not have significant differences.

The Levene Test, which studies the equality of variances, allows considering the presence of univariate homogeneity of the variables, for a 5% significant level, since the corresponding p-values are greater than 0.05.

In terms of the correlation between the dependent variables, the Bartlet's sphericity test, whose null hypothesis is the proportionality of the covariance matrix to the

Regardless the multivariate tests, independent of the statistics to be used (**Error! Reference source not found.**), we conclude that it appears that the factor (or independent variable) level of Total Cooperation (Total_Coop) has a significant effect on at least one of the four dependent variables (P_S_Inov;Proc_Inov; Org_Inov; Mark_Inov).This mean that, at least one type of innovation depend on the level of cooperation.

After identifying the significant effects of the factor on the dependent variables under study, the analysis follows through 2 ANOVAS to see what kind of cooperation has an effect on the innovation(Table 1).

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter
Total_Coop	P_S_Inov	28,033	21	1,335	3,074	**0,000**	0,069	64,556
	Proc_Inov	73,931	21	3,521	4,330	**0,000**	0,095	90,924
	Org_Inov	104,626	21	4,982	3,750	**0,000**	0,083	78,742
	Mark_Inov	138,892	21	6,614	3,602	**0,000**	0,080	75,639

Table 1- ANOVA Tests

The analysis of the p-values illustrated inTable 1, are less than 5%, which leads us to reject the null hypothesis, of equality of means and to conclude that the factor (level of cooperation) has a significant effect on the four dependent variables(P_S_Inov; Proc_Inov; Org_Inov; Mark_Inov). This mean that there is at least one of the averages in groups defined by cooperation level that differs from the others.Thus, is possible to conclude that, there are statistically evidences that cooperation influences innovation in firms.

In order to find out which levels of Innovation are significantly different,a multiple comparison of means (post hoc tests) is performed. Analyzing the first line inTable17[5], it appears that for a 5% significant level the average of P_S_Inov for a level of Total_Coop=1 is different from the average ofP_S_Inov for a level of Total_Coop = 28, since the corresponding p-value is less than 5%.

Taking into account the values in Table17[5] for P_S_Inov from a level of Total_Coop = 2 and Total Coop = 15 when compared to Total_Coop = 28, there is 5% statistical evidence to consider the equality of P_S_Inovaverages, since p-value is greater than 5%. Observing the confidence internal for the mean, can be observed that Lower and Upper Bounds are negative, i.e.P_S_Inov for Total_Coop = 1 and Total_Coop = 15 are less than P_S_Inov for Total_Coop = 28, which indicates that higher levels of cooperation imply higher levels of innovation in products and services.

In the case of Proc_Inov the average of the level of Total_Coop = 1 is different from the average of the level of Total_Coop = 28 since the p-value is less than 5%.

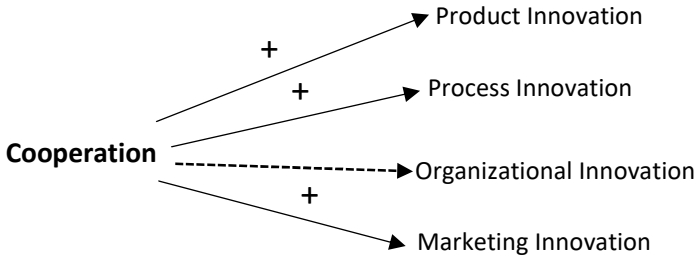
[5]*Appendix 2*

In general, it can be seen in Table17[5] that from a level of Total_Coop = 1 to a level of Total_Coop = 4 and for a level of Total_Coop = 11, 14 and 19 when compared to a level of Total_Coop = 28 there is statistical evidence to consider the inequality of the means in Proc_Inov, since the p-values are greater than 5%.Observing the confidence internal for the mean, can be observed that Lower and Upper Bounds are negative, i.e.Proc_Inov for Total_Coop = 1 and Total_Coop = 19 are less than Proc_Inov for Total_Coop = 28, which indicates that higher levels of cooperation imply higher levels of innovation in processes.

In relation to Org_Inov, it can be seen in Table17[5] that all p-values are greater than 5%, so that the equality of means is considered, so cooperation does not influence innovation in organizational terms.

The type of innovation that has the most differences is Mark_Inov. There is only statistical evidence to consider the equality of means for a level of Total_Coop = 9, 10, 12, 13, 20 e 23 when compared to Coop- Total = 28. All other levels have differences in means since p values are less than 5% (Table17[5]).Observing the confidence internal for the mean, can be observed that Lower and Upper Bounds are negative, i.e.Mark_Inov for Total_Coop = 1 and Total_Coop = 23 are less than Mark_Inov for Total_Coop = 28, which indicates that higher levels of cooperation imply higher levels of innovation in marketing.

The results are in line with the theory, so $\mathbf{H_1}$ is verified in at least three types of innovation (P_S_Inov, Proc_Inov and Mark_Inov).**Error! Reference source not found.** presents the synthesis of these results.



1.1. Relationship between innovation, cooperation and eco-innovation

To study the relationship between innovation, cooperation and eco-innovation, an association between variables is used.

According to Marôco (2011), the verification of the correlation between the variables is essential to qualify the direction and the intensity of association between them.The most appropriate method to apply, depends on the nature of the variables to be analyzed / studied, these can be nominal, quantitative or ordinal.

In order to verify the correlation between Total Innovation (Total_Inov), Total Cooperation (Total_Coop) and Eco-innovation (Eco_Inov), the respective tests were carried out. For this

purpose, in view of quantitative variables, Pearson's r coefficient is used.For comparison Spearman test is also done (if we consider variables as ordinal).
One of the assumptions of this method is that the variables have a normal distribution, although it is not necessary to check the normality of these variables, since the sample is large(CLT), the K-S test is performed (Table 2).

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Total_Coop	0,217	891	**0,000**	0,743	891	0,000
Env_Inov	0,136	891	**0,000**	0,909	891	0,000
Total_Inov	0,118	891	**0,000**	0,960	891	0,000

Table 2- Normality Testes (association between variables)

Analyzing Table 2, it appears that the variables do not follow a normal distribution, since the p-values have approximately null values, i.e., less than 5%. However, according to CLT, because the sample is large, a normal distribution is assumed.
Once the assumptions have been tested, Pearson's r test is implemented between variables

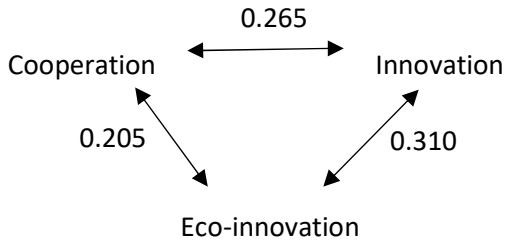
		Total_Coop	Eco_Inov	Total_Inov
Total_Coop	Pearson Correlation	1	**0,205**	**0,265**
	Sig. (2-tailed)		**0,000**	**0,000**
	N	891	891	891
Eco-Inov	Pearson Correlation	**0,205**	1	**0,310**
	Sig. (2-tailed)	**0,000**		**0,000**
	N	891	4167	4167
Total_Inov	Pearson Correlation	**0,265**	**0,310**	1
	Sig. (2-tailed)	**0,000**	**0,000**	
	N	891	4167	7083

Table 3- Correlations

AnalyzingTable 3, there is a weak,but significant,correlation ($r < 0.25$) between Total Cooperation (Total_Coop) and Eco-innovation (Eco_Inov) because the $r = 0.205$, but significant. As the correlation is positive, it means thereif total cooperation increases, eco-innovation also tends to increase.
Regarding the relationship between Total Cooperation and Total Innovation, there is a moderate correlation ($0.25 \leq r < 0.5$) since the $r = 0.265$, but significant, and being a positive correlation it is also possible to say that if total cooperation increases, the trend for total innovation is also increasing.

Taking into account the relationship between Total Innovation and Eco-innovation,there is also a moderate and significant correlation, since the r = 0.310, a positive correlation, so if total innovation increases, eco-innovation also increases.

In all cases, the p-value is approximately null (sig ≈0.000), therefore less than the significance level, i.e., the null hypothesis is rejected, thus having a significant correlation between the variablesleading to the $\mathbf{H_2}$ defined in the literature to be confirmed.The following scheme summarizes the results of the association between the variables (**Error! Reference source not found.**).



2.3. What drives eco-innovation?

According to Freitas, Correia, Braga and Braga (2017), multiple linear regression models is a multivariate technique that allows a set of factors to establish relationships between a dependent variable (metric) and a set of independent variables (metric or non-metric).

With this technique, it is intended to observe which are the factors that influence the decision-making of firms to introduce eco-innovations.

In addition to the variables found in the literature, it was necessary to add another one that was present in CIS 2014 that may be relevant to the study, formulating a new hypothesis:

- **H_{3i}:** One factor that influences firms to implement eco-innovations is government grants, subsidies or other financial incentives.

Variables	Description
ENEREG	Existence of environmental regulations
ENETX	Existing environmental taxes, charges or fees
ENREGF	Existing environmental regulations or taxes expected in the future
ENGRA	Government grants, subsidies or other financial incentives for environmental innovations

ENDEM	Current or expected market demand for environmental innovations
ENREP	Improve the firm reputation
ENAGR	Voluntary actions or initiatives for environmental good practice within your sector
ENCOST	High cost of energy, water or materials
ENREQU	Need to meet requirements for public procurement contracts

Table 4 shows the independent variables taken from CIS 2014 and their description.

Table 4- Description of variables

It starts by using the Enter estimation method, i.e., including all variables in the analysis.

Model Summary					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0,395	0,156	**0,154**	2,43193	**2,057**

Table 5- Enter model summary

Since R^2 is adjusted in the model to approximately 15.4%, it means that the independent variables, which are the factors underlying the implementation of eco-innovations, explain 15.4% of the total variance of the dependent variable, i.e., the eco-innovation (Table 5).

In addition, the Durbin-Watson value is close to 2 values, which means that there is no evidence to consider that the residuals are correlated.The ANOVA test is analyzedto test whether at least on independent variable has an effect onthe dependent variable.

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2986,286	9	331,810	56,103	**0,000**
	Residual	16110,516	2724	5,914		
	Total	19096,802	2733			

Table6- ANOVA

Taking into account the data in Table6, it appears that the p-value is approximately null (sig≈0.000), i.e., the null hypothesis is rejected, therefore there is at least one independent variable with significant effect on the dependent variable “Eco_Inov”.

Coeficients						
Model		UnstandardizedCoefficients		StandardizedCoefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1,558	0,137		11,381	0,000

ENEREG	0,133	0,069	0,051	1,931	0,054
ENETX	0,040	0,069	0,016	,579	0,563
ENREGF	0,178	0,074	0,069	2,402	0,016
ENGRA	**-0,134**	**0,057**	**-0,052**	**-2,348**	**0,019**
ENDEM	**0,345**	**0,058**	**0,134**	**5,946**	**0,000**
ENREP	**0,371**	**0,065**	**0,132**	**5,665**	**0,000**
ENAGR	0,144	0,058	0,054	2,477	0,013
ENCOST	**0,255**	**0,056**	**0,094**	**4,576**	**0,000**
ENREQU	0,121	0,050	0,048	2,388	0,017

Table7- Coeficients

Analyzing the absolute values of the standardized coefficients in Table7, it appears that the variables ENDEM, EMREP and ENCOST are the ones that have greater contributions to explain what leads firms to adopt eco-innovations. Therefore, it is safe to say that what is most important for firms to adopt eco-innovation is the market demand for environmental innovations, improving the firm reputation and the high costs of energy, water or materials.

It can also be seen from the model that the variable ENGRA, i.e., public administration support, subsidies and other financial incentives, negatively influences firms to adopt eco-innovation. As not all variables are significant, the Stepwise method discussed below is performed.In this method the variables are introduced step by step, according to their contribution to the model.

Model	Variables Entered	Designation
1	ENEREP	Improve the firm reputation
2	ENDEM	Current or expected market demand for environmental innovations
3	ENCOST	High cost of energy, water or materials
4	ENREGF	Existing environmental regulations or taxes expected in the future
5	ENAGR	Voluntary actions or initiatives for environmental good practice within your sector
6	ENEREG	Existence of environmental regulations

Table 8- Variables chosen by the Stepwise method

Table 8 shows that only six of the eight existing variables entered to the model, this means that the existence of environmental taxes, charges or fees (ENETX) and public administration support, subsidies or other financial incentives for environmental innovations (ENGRA) probably do not contribute to the model.

ModelSummary						
Model	R	R Square	Adjusted Square	R	Std. Error of the Estimate	Durbin-Watson

6	0,392	0,154	**0,152**	2,43465	**2,057**

Table9- Stepwisemodelsummary

In the model, the adjusted R^2 is approximately 15.2%, which means that the independent variables explain about 15.2% of the total variance of the dependent variable. Compared to the Enter method, a similarity of values can be seen, which may mean that the variables that were removed from the model did not contribute to explain the dependent variable (Table9).

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
6	Regression	2932,490	6	488,748	82,454	**0,000**
	Residual	16164,312	2727	5,928		
	Total	19096,802	2733			

Table10- ANOVA Stepwise

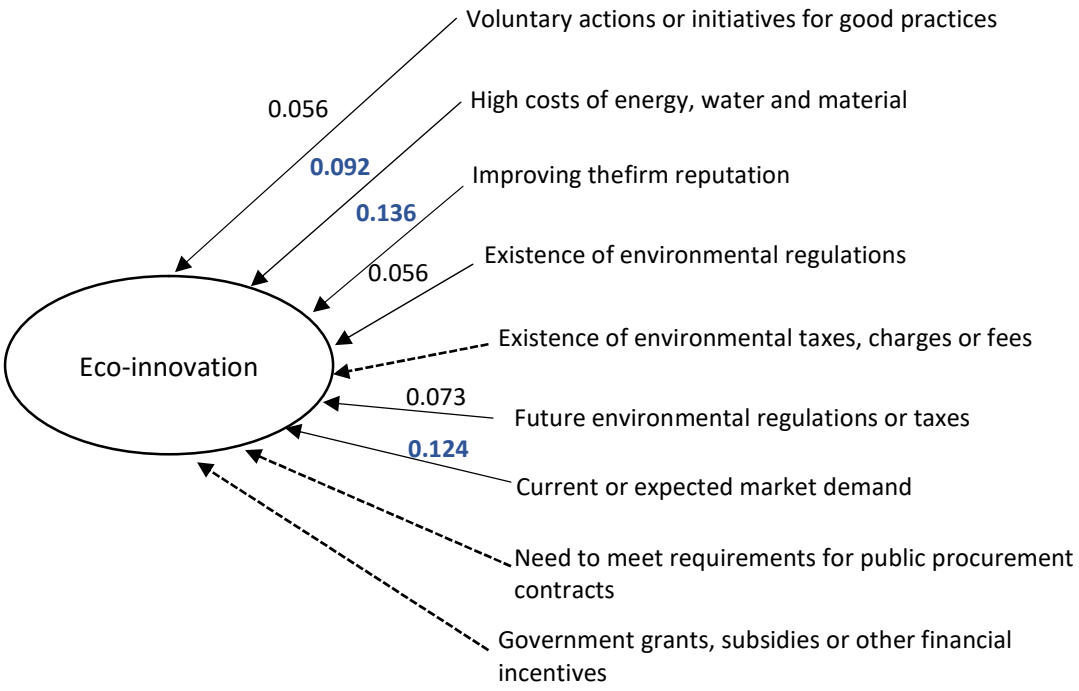
As in the Enter method, it is verified that the p-value is approximately null (sig≈0.000), i.e., the null hypothesis is rejected, therefore there is at least one independent variable with significant effect on the dependent variable "Eco_Inov" (Table10).

Coeficients								
Model		UnstandardizedCoefficients		StandardizedCoefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
6	(Constant)	1,562	0,137		11,411	0,000		
	ENREP	**0,384**	**0,065**	**0,137**	**5,888**	**0,000**	**0,571**	**1,751**
	ENDEM	**0,321**	**0,055**	**0,124**	**5,860**	**0,000**	**0,689**	**1,452**
	ENCOST	**0,250**	**0,055**	**0,092**	**4,539**	**0,000**	**0,748**	**1,336**
	ENREGF	0,189	0,066	0,073	2,861	0,004	0,477	2,095
	ENAGR	0,150	0,058	0,056	2,592	0,010	0,665	1,504
	ENEREG	0,148	0,066	0,056	2,243	0,025	0,498	2,007

Table 11- Stepwise Coeficients

The results obtained through this method (Table 11) go against the Enter method, verifying once again that the variables ENDEM, ENREP and ENCOST are the ones that most contribute for

firms to adopt eco-innovation, i.e., the demand current or expected in the market for environmental innovations, the improvement of the firm reputation and the high costs of energy, water or minerals.These results lead to **H_{3b}, H_{3c}** and **H_{3g}** being confirmed.The hypotheses **H_{3a}, H_{3d}**and**H_{3e}**have been confirmed, however, they are not the ones that most contribute to the decision-making of firms to adopt eco-innovation practices.On the other hand, the hypotheses **H_{3f}** and **H_{3h}**have not been confirmed(Scheme 1).



CollinearityDiagnostics										
Model	Dimension	Eigenvalue	ConditionIndex	VarianceProportions						
				(Constant)	**ENREP**	**ENDEM**	**ENCOST**	**ENREGF**	**ENAGR**	**ENEREG**
6	1	**6,178**	**1,000**	0,00	0,00	0,01	0,00	0,00	0,00	0,00
	2	**0,251**	**4,966**	0,05	0,00	0,78	0,03	0,01	0,02	0,01
	3	**0,198**	**5,579**	0,01	0,03	0,07	0,01	0,32	0,13	0,10
	4	**0,130**	**6,901**	0,06	0,02	0,05	0,46	0,03	0,44	0,01
	5	**0,097**	**7,995**	0,48	0,05	0,02	0,48	0,05	0,20	0,04
	6	**0,078**	**8,874**	0,23	0,8	0,05	0,01	0,00	0,22	0,00
6		0,392	0,154	**0,152**			2,43465		**2,057**	

	7	**0,068**	**9,551**	0,16	8 0,0 1	0,03	0,01	0,59	0,00	0,84

Scheme 1*- Linear Regression results (Blue values are the most important factors for firms to adopt eco-innovations; Dashed are the hypotheses that have not been statistically confirmed*

Analyzing the tolerance and VIF's values present in Table 11, the absence of multicollinearity is verified, since the tolerance values are not close to 0 and the VIF's are less than 5.
Table 12- Multicollinearity Tests

Looking at the values in Table 12, there is no multicollinearity since the Eigenvalues are relatively far from 0 and the Condition Index values are less than 15.

The adjusted R^2 value remains the same as the previous model and the Durbin-Watson value also remains close to 2, so there is no evidence to conclude that the residues are correlated (**Error! Reference source not found.**).

Table13- Multicollinearity ANOVA

Since the p-value in ANOVA teste in Table13 remains approximately null, the model remains highly significant.
In order to verify that the model meets the assumptions, the analysis of the residuals is considered. This analysis begins with the study of the normality of the residuals, for this purpose

CollinearityDiagnostics										
Model	Dimension	Eigenvalue	ConditionIndex	VarianceProportions						
				(Constant)	**ENREP**	**ENDEM**	**ENCOST**	**ENREGF**	**ENAGR**	**ENEREG**
6	1	**6,178**	**1,000**	0,00	0,00	0,01	0,00	0,00	0,00	0,00
	2	**0,251**	**4,966**	0,05	0,00	0,78	0,03	0,01	0,02	0,01
	3	**0,198**	**5,579**	0,01	0,03	0,07	0,01	0,32	0,13	0,10
	4	**0,130**	**6,901**	0,06	0,02	0,05	0,46	0,03	0,44	0,01
	5	**0,097**	**7,995**	0,48	0,05	0,02	0,48	0,05	0,20	0,04
	6	**0,078**	**8,874**	0,23	0,88	0,05	0,01	0,00	0,22	0,00
	7	**0,068**	**9,551**	0,16	0,01	0,03	0,01	0,59	0,00	0,84

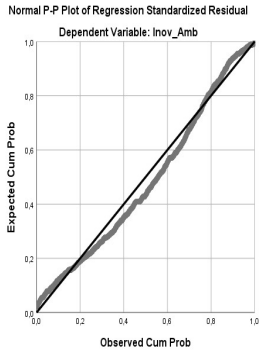
the One-Sample Kolmogorov-Smirnov test is performed.

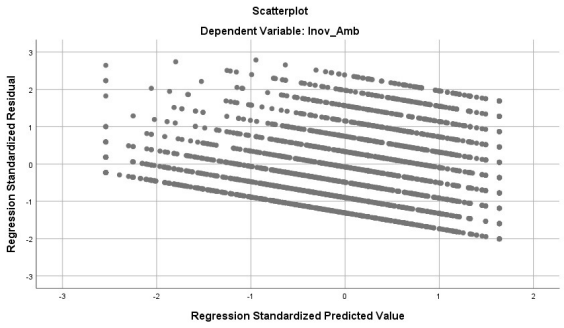
One-Sample Kolmogorov-Smirnov Test		
		Eco_Inov
N		4167
Normal Parameters	Mean	2,7507
	Std. Deviation	2,92415
Most Extreme Differences	Absolute	0,182
	Positive	0,182
	Negative	-0,173
Test Statistic		0,182
Asymp. Sig. (2-tailed)		**0,000**

Table 14- One-Sample Kolmogorov-Smirnov Test

When analyzing this test, shown in

Table ***14***, it appears that the p value is approximately null, so the null hypothesis is rejected, i.e., the normality of the residuals is not verified. However, as the sample is large, it is assumeda normal distribution using CLT.



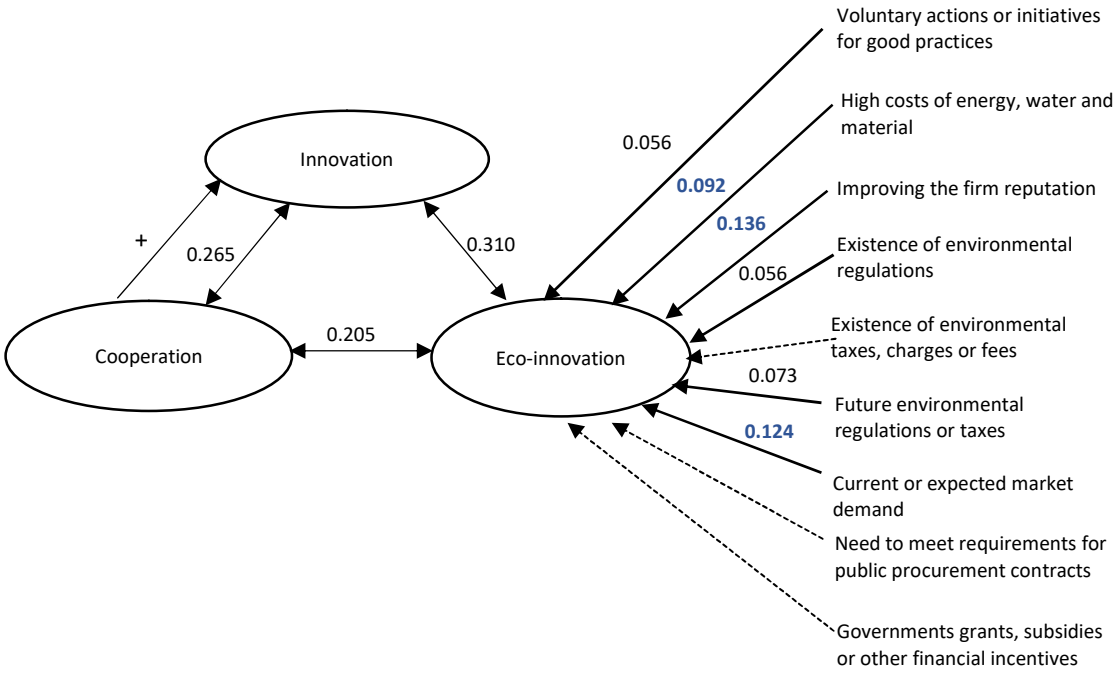


Graphic 1- Normal probability of residuals**Graphic 2**- Scatterplot

In addition, looking at the PP-Plot in Graphic 1, it appears that the residuals approximately follow a normal distribution, since the points are close to the diagonal.

alsGraphic 2 shows horizontal lines due to the errors obtained when rounding up the values predicted by the regression model. However, the dispersion of residuals around the average value (zero) is more or less random.

Thus, the model generally fulfills the assumptions, so it can be considered that it is a valid model.**Error! Reference source not found.** summarizes the results inherent to the research hypotheses.



1. Conclusion

According to the Oslo Manual, innovation consists in the implementation of a product (good or service), process, marketing method or organizational method, whether new or improved (OECD, 2005).

Bearing in mind the objectives of this study, and through statistical analyzes it was possible to verify that the variables contained in the literature are relevant, but insufficient to explain all the effective environmental benefits with innovation.

In view of the MANOVA statistical analysis, it was possible to verify that the cooperation variable has a significant influence on at least three types of innovation in line with (Miotti & Sachwald, 2003).This means that as cooperation in firms increases, there is a greater likelihood of increasing product, process and marketing innovations.

The literature stated that there was a relationship between cooperation, innovation and eco-innovation, and for that we used an association between variables to verify this relationship.

Regarding the association of variables, it can be seen that total innovation, total cooperation, and eco-innovation, despite having weak to moderate correlations, all of them were significant, so it can be statistically stated that there is a relationship between these variablesaccording with the

literature, for exampleAyuso et al., (2011).This means that as cooperation increases in firms, as was seen in MANOVA, the tendency to increase innovation is higher and, in turn, the likelihood of firms adopting eco-innovations increases.

In relation to the factors that most contribute for firms to opt for eco-innovations used in the multiple linear regression models it was possible to verifiedthat theyare the current or expected demand in the market for environmental innovations (Kesidou & Demirel, 2012), the improvement of reputation of the firm(Hojnik et al., 2018)and the high costs of energy, water and materials (Ghisetti & Rennings, 2014), in line with the authors studding this theme.With this, it is possible to verify that the firms direct the adoption of eco-innovation for purely strategic motivations and not exactly to the environmental concern.

This study presents several contributions, both from a theoretical and practical perspective.In theoretical terms, cooperation with partners increases the innovation in products / services, processes and marketing in firms. A firm that cooperates and that simultaneously innovates is more willing to adopt eco-innovations. Finally, eco-innovation ends up being related to organizational objectives, for example the current or expected market demand, the firm reputation and the high costs of energy, water and materials.

In practical terms, managers must be aware that cooperating with different stakeholders are better able to innovate and therefore have access to new opportunities in the market. At the same time that these new possibilities (cooperation and innovation) open up, they will be in a position to adopt eco-innovations. Finally, firms that are concerned with introducing eco-innovations associate them with purely strategic motivations, namely in terms of reputation, costs and demand.

Although it is possible to draw conclusions about this study, it has several limitations.The database chosen, CIS 2014, has few questions that allow answers on an ordinal scale, i.e., most of the questions are for "Yes" and "No" answers, which is not conducive to the analysis, being essential the creation of other variables.

For future research, since eco-innovation is a topic with greater relevance, a relative study applied at international level is suggested in order to make a comparison between Portugal and other cultures. Since the questions related to eco-innovations correspond to dummy variables on the survey used on this study, it will be interesting to apply a new questionnaire involving variables on a 7-point Likert scaleto explore if there is a big difference in the results.

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Appendix 1- Sample description

Statistics		
Total_Inov		
N	Valid	7083
	Missing	0
Mean		2,2908
Median		1,0000
Mode		**0,00**
Std. Deviation		2,90548
Skewness		**1,314**
Std. Error of Skewness		0,029
Kurtosis		**0,979**
Std. Error of Kurtosis		0,058
Minimum		**0,00**
Maximum		**12,00**

Table 15- Total Innovation descriptive statistics

Total_Inov

		Frequency	Percent	ValidPercent	Cumulative Percent
Valid	0,00	**3142**	**44,4**	44,4	44,4
	1,00	660	9,3	9,3	53,7
	2,00	787	11,1	11,1	64,8
	3,00	578	8,2	8,2	72,9
	4,00	476	6,7	6,7	79,7
	5,00	355	5,0	5,0	84,7
	6,00	335	4,7	4,7	89,4
	7,00	210	3,0	3,0	92,4
	8,00	176	2,5	2,5	94,9
	9,00	132	1,9	1,9	96,7
	10,00	102	1,4	1,4	98,2
	11,00	77	1,1	1,1	99,3
	12,00	53	0,7	0,7	100,0
	Total	7083	100,0	100,0	

Statistics		
Total_Coop		
N	Valid	891
	Missing	6192
Mean		3,70
Median		2,00
Mode		**1**
Std. Deviation		3,455
Skewness		**2,456**
Std. Error of Skewness		0,082
Kurtosis		**9,030**
Std. Error of Kurtosis		0,164
Minimum		**1**
Maximum		**28**

Total_Coop					
		Frequency	Percent	ValidPercent	Cumulative Percent
Valid	**1**	**248**	**3,5**	27,8	27,8
	2	202	2,9	22,7	50,5

	3	106	1,5	11,9	62,4
	4	106	1,5	11,9	74,3
	5	48	0,7	5,4	79,7
	6	39	0,6	4,4	84,1

Statistics		
Eco_Inov		
N	Valid	4167
	Missing	2916
Mean		2,7507
Median		2,0000
Mode		**0,00**
Std. Deviation		2,92415
Skewness		**0,876**
Std. Error of Skewness		0,038
Kurtosis		**-0,327**
Std. Error of Kurtosis		0,076
Minimum		**0,00**
Maximum		**10,00**

	28	2	0,0	0,2	100,0
	Total	891	12,6	100,0	

Table 16- Frequency table for the variable Total Cooperation

Eco_Inov					
		Frequency	Percent	ValidPercent	Cumulative Percent
Valid	**0,00**	**1433**	**20,2**	34,4	34,4
	1,00	472	6,7	11,3	45,7
	2,00	459	6,5	11,0	56,7
	3,00	397	5,6	9,5	66,3
	4,00	306	4,3	7,3	73,6
	5,00	283	4,0	6,8	80,4
	6,00	230	3,2	5,5	85,9
	7,00	198	2,8	4,8	90,7
	8,00	141	2,0	3,4	94,0
	9,00	132	1,9	3,2	97,2
	10,00	116	1,6	2,8	100,0

	Total	4167	58,8	100,0

Statistics					
		P_S_Inov	**Proc_Inov**	**Org_Inov**	**Mark_Inov**
N	Valid	7083	7083	7083	7083
	Missing	0	0	0	0
Mean		0,45	0,67	0,5382	0,6295
Median		0,00	0,00	0,0000	0,0000
Mode		**0**	**0**	**0**	**0**
Std. Deviation		0,685	0,927	0,94186	1,09296
Minimum		**0**	**0**	**0**	**0**
Maximum		**2**	**3**	**3**	**4**

Appendix 2- MANOVA

Dependent Variable	**Parameter**	**B**	**Std. Error**	**t**	**Sig.**	**95% Confidence Interval**	
						LowerBound	**UpperBound**
P_S_Inov	Intercept	2,000	0,466	4,292	0,000	1,085	2,915
	[Total_Coop=1]	-1,109	0,468	-2,370	0,018	-2,027	-0,191
	[Total_Coop =2]	-0,866	0,468	-1,850	0,065	-1,785	0,053
	[Total_Coop =3]	-0,868	0,470	-1,845	0,065	-1,791	0,055
	[Total_Coop =4]	-0,774	0,470	-1,645	0,100	-1,697	0,150
	[Total_Coop =5]	-0,708	0,476	-	0,13	-1,642	0,225

			1,489	7		
[Total_Coop =6]	-0,769	0,478	-1,610	0,108	-1,707	0,168
[Total_Coop =7]	-0,694	0,479	-1,451	0,147	-1,634	0,245
[Total_Coop =8]	-0,741	0,483	-1,534	0,125	-1,689	0,207
[Total_Coop =9]	-0,560	0,484	-1,156	0,248	-1,510	0,390
[Total_Coop=10]	-0,500	0,503	-0,993	0,321	-1,488	0,488
[Total_Coop=11]	-0,750	0,521	-1,440	0,150	-1,772	0,272
[Total_Coop=12]	-0,429	0,528	-0,811	0,418	-1,466	0,608
[Total_Coop=13]	-0,600	0,551	-1,088	0,277	-1,682	0,482
[Total_Coop=14]	-1,000	0,538	-1,859	0,063	-2,056	0,056
[Total_Coop=15]	-1,400	0,551	-2,539	0,011	-2,482	-0,318
[Total_Coop=16]	-0,750	0,571	-1,314	0,189	-1,870	0,370
[Total_Coop=18]	-1,000	0,807	-1,239	0,216	-2,584	0,584
[Total_Coop=19]	-1,000	0,807	-1,23	0,216	-2,584	0,584

				9			
	[Total_Coop=20]	-1,000	0,807	-1,239	0,216	-2,584	0,584
	[Total_Coop=22]	-1,000	0,807	-1,239	0,216	-2,584	0,584
	Total_Coop=23]	-6,586E-14	0,807	0,000	1,000	-1,584	1,584
	[Total_Coop=28]	0	.	.	.	.	.
Proc_Inov	Intercept	3,000	0,638	4,705	0,000	1,749	4,251
	[Total_Coop =1]	-1,762	0,640	-2,752	0,006	-3,019	-0,506
	[Total_Coop =2]	-1,406	0,641	-2,194	0,028	-2,664	-0,148
	[Total_Coop=3]	-1,396	0,644	-2,169	0,030	-2,659	-0,133
	[Total_Coop =4]	-1,330	0,644	-2,067	0,039	-2,593	-0,067
	[Total_Coop =5]	-1,146	0,651	-1,761	0,079	-2,423	0,131
	[Total_Coop=6]	-1,128	0,654	-1,726	0,085	-2,411	0,155
	[Total_Coop=7]	-1,167	0,655	-1,781	0,075	-2,452	0,119
	[Total_Coop=8]	-1,296	0,661	-1,962	0,050	-2,593	0,001
	[Total_Coop=9]	-0,760	0,663	-1,14	0,252	-2,061	0,541

				7			
	[Total_Coop=10]	-0,750	0,689	-1,089	0,276	-2,102	0,602
	[Total_Coop=11]	-1,500	0,713	-2,104	0,036	-2,899	-0,101
	[Total_Coop=12]	-1,000	0,723	-1,383	0,167	-2,419	0,419
	[Total_Coop=13]	-0,600	0,754	-0,795	0,427	-2,081	0,881
	[Total_Coop=14]	-1,667	0,736	-2,264	0,024	-3,112	-0,222
	[Total_Coop=15]	-1,200	0,754	-1,591	0,112	-2,681	0,281
	[Total_Coop=16]	-0,500	0,781	-0,640	0,522	-2,033	1,033
	[Total_Coop=18]	-2,000	1,104	-1,811	0,070	-4,168	0,168
	[Total_Coop=19]	-3,000	1,104	-2,716	0,007	-5,168	-0,832
	[Total_Coop=20]	-1,000	1,104	-0,905	0,365	-3,168	1,168
	[Total_Coop=22]	-2,000	1,104	-1,811	0,070	-4,168	0,168
	[Total_Coop=23]	-7,810E-14	1,104	0,000	1,000	-2,168	2,168
	[Total_Coop=28]	0	.	.	.	.	.
Org_Inov	Intercept	2,000	0,815	2,45	0,01	0,400	3,600

			4	4		
[Total_Coop=1]	-1,060	0,818	-1,296	0,195	-2,667	0,546
[Total_Coop=2]	-0,723	0,819	-0,882	0,378	-2,330	0,885
[Total_Coop=3]	-0,623	0,823	-0,757	0,449	-2,237	0,992
[Total_Coop=4]	-0,840	0,823	-1,021	0,308	-2,454	0,775
[Total_Coop=5]	-0,500	0,832	-0,601	0,548	-2,133	1,133
[Total_Coop=6]	-0,308	0,836	-0,368	0,713	-1,948	1,333
[Total_Coop=7]	-0,444	0,837	-0,531	0,596	-2,088	1,199
[Total_Coop=8]	-0,407	0,845	-0,482	0,630	-2,065	1,251
[Total_Coop=9]	-0,120	0,847	-0,142	0,887	-1,783	1,543
[Total_Coop=10]	-0,250	0,880	-0,284	0,777	-1,978	1,478
[Total_Coop=11]	-0,750	0,911	-0,823	0,411	-2,539	1,039
[Total_Coop=12]	0,571	0,924	0,618	0,537	-1,243	2,385
[Total_Coop=13]	0,800	0,964	0,830	0,407	-1,093	2,693
[Total_Coop=14]	-0,500	0,941	-0,53	0,595	-2,347	1,347

	[Total_Coop=15]	-0,200	0,964	-0,207	0,836	-2,093	1,693
	[Total_Coop=16]	1,000	0,998	1,002	0,317	-,959	2,959
	[Total_Coop=18]	-5,557E-14	1,412	0,000	1,000	-2,771	2,771
	[Total_Coop=19]	-2,000	1,412	-1,417	0,157	-4,771	0,771
	[Total_Coop=20]	1,000	1,412	0,708	0,479	-1,771	3,771
	[Total_Coop=22]	-2,000	1,412	-1,417	0,157	-4,771	0,771
	[Total_Coop=23]	1,000	1,412	0,708	0,479	-1,771	3,771
	[Total_Coop=28]	0	.	.	.	.	.
Mark_Inov	Intercept	4,000	0,958	4,175	0,000	2,119	5,881
	[Total_Coop=1]	-3,161	0,962	-3,286	0,001	-5,049	-1,273
	[Total_Coop=2]	-2,515	0,963	-2,612	0,009	-4,405	-0,625
	[Total_Coop=3]	-2,623	0,967	-2,712	0,007	-4,521	-0,724
	[Total_Coop=4]	-2,566	0,967	-2,653	0,008	-4,464	-0,668
	[Total_Coop=5]	-2,479	0,978	-2,535	0,011	-4,399	-0,560
	[Total_Coop=6]	-2,385	0,982	-2,42	0,015	-4,313	-0,456

			7			
[Total_Coop=7]	-2,444	0,984	-2,483	0,013	-4,377	-0,512
[Total_Coop=8]	-2,593	0,993	-2,611	0,009	-4,542	-0,644
[Total_Coop=9]	-1,760	0,996	-1,767	0,078	-3,714	0,194
[Total_Coop=10]	-1,833	1,035	-1,771	0,077	-3,865	0,198
[Total_Coop=11]	-2,500	1,071	-2,334	0,020	-4,603	-0,397
[Total_Coop=12]	-1,714	1,086	-1,578	0,115	-3,847	0,418
[Total_Coop=13]	-1,600	1,134	-1,411	0,159	-3,825	0,625
[Total_Coop=14]	-2,333	1,106	-2,109	0,035	-4,505	-0,162
[Total_Coop=15]	-2,400	1,134	-2,117	0,035	-4,625	-0,175
[Total_Coop=16]	-2,250	1,174	-1,917	0,056	-4,553	0,053
[Total_Coop=18]	-4,000	1,660	-2,410	0,016	-7,257	-0,743
[Total_Coop=19]	-4,000	1,660	-2,410	0,016	-7,257	-0,743
[Total_Coop=20]	-1,000	1,660	-0,603	0,547	-4,257	2,257

[Total_Coop=22]	-4,000	1,660	-2,410	0,016	-7,257	-0,743
[Total_Coop=23]	-2,000	1,660	-1,205	0,228	-5,257	1,257
[Total_Coop=28]	0	.	.	.	.	.

Table17- Post Hoc Tests