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Circular Economy in firm's strategies - What are the determinants of eco-innovation for companies in a Circular Economy context?

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November, 2021

BUSINESS SCHOOL

CIÊNCIAS SOCIAIS E HUMANAS

Department of Economics

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I dedicate this dissertation to my great-uncles Eduardo Ribeiro and Maria da Palma Brito Ribeiro who have always supported me in my academic path.
For all the strength, care and love they have always shown me, especially in these last 5 years, this is for you "Tios Pampos".

Acknowledgement

First of all I want to thank my parents for everything they have done and given up for me. For everything they are to me, and for everything they have provided me so far to get where I am and to be the person I am now. This is all thanks to them, who have always been and will always be my pillars. For always guiding me to the right path and for always believing in me, even when I am not able to. Thank you mom and dad.

Secondly, I want to thank my teachers Mónica Meireles and Mara Madaleno, for having embraced this theme with me and for all the support they gave me during this dissertation. Special thanks to Professor Mara who provided the necessary data for the development of this investigation.

Third, I want to thank all those with whom I shared these last two years of master's degree, from those who were mere classmates to those who became friends, like Marco, Patrícia and Margarida, but I want to leave a very special thanks to my dear friend Mariana, who was always by my side, at all times and never let my days of weakness speak louder.

I want to thank all my family and friends, who accompanied me during this season of work and who always respected and helped me in whatever was possible.

Finally, I want to thank all those who crossed my path during this journey and who contributed in some way to this chapter of my life, even if it was only with a friendly word.

To all, my best wishes!

Resumo

A sustentabilidade é um tema em crescimento na sociedade e associado a este surge o conceito de economia circular (EC) que tenta reaproveitar os produtos de forma a terem uma maior durabilidade, contribuindo assim para a redução do desperdício. Um agente bastante importante neste tema são as eco-inovações (EI) que podem ser criadas em prol do crescimento deste novo conceito de economia.

Este estudo pretende determinar os impulsionadores mais significativos de EI para as empresas portuguesas, considerando a sua evolução em relação à economia circular.

Através de um modelo Tobit, testaram-se todas as variáveis que foram apuradas ao longo da revisão da literatura, de modo a tentar compreender o seu impacto no desempenho da empresa, através do turnover growth (TG), recorrendo-se a dados provenientes do CIS, de onde foram escolhidas as questões mais adequadas.

Não foi possível verificar o efeito de todas as variáveis, por nem todas se terem manifestado significativas e nem todos os determinantes que aparentavam ter impacto positivo no TG, o tiveram. Isto vem demonstrar que nem todos os potenciais impulsionadores de eco inovação o são na verdade, podendo representar impactos negativos para a empresa, contrariamente ao que seria de prever. De salientar o efeito negativo que ainda é notório relativamente aos custos que as empresas têm associados à implementação destas novas medidas, pois este é um fator que se apresenta como um dos maiores inibidores para que as empresas integrem mais este tipo de ações nas suas estratégias internas.

Palavras-chave: Eco-inovações, Economia Circular, Impulsionadores, Sustentabilidade, Crescimento, Desempenho da Empresa

Sistema de Classificação JEL: F64; O30

Abstract

Sustainability is a growing theme in society and associated with it, comes the concept of circular economy (CE) that tries to reuse products to have greater durability, thus contributing to the reduction of waste. A very important agent in this theme is the eco-innovations (EI) that can be developed to promote the growth of this new economy concept.

This study intends to determine the key drivers of EI for Portuguese companies, considering their evolution towards a circular economy.

Through a Tobit model, all the variables that were identified throughout the literature review were tested, to understand their impact on firm performance, through turnover growth (TG), using data from the CIS, from where the most appropriate questions were chosen.

It was not possible to verify the effect of all variables, because not all were significant. It was also found that not all drivers that appeared to have a positive impact on the TG, do have, which shows that not all potential drivers of eco-innovation are in fact and that they may represent negative impacts for the company, contrary to what one would predict. The negative effect that is still notorious regarding the costs that companies have with the implementation of these new measures should be highlighted, since this is a factor that presents itself as one of the biggest inhibitors for companies to integrate this type of action in their internal strategies.

Keywords: Eco-innovations, Circular Economy, Drivers, Sustainability, Growth, Firm Performance

JEL Classification System: F64; O30

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CHAPTER 1

Introduction

1.1. Contextualization and definition of the research problem

Just like Antoine-Laurent Lavoisier once said, “In Nature, nothing is lost, nothing is created, everything is transformed”. Everything that surrounds us, in our days and routines is growing more and more into a culture where it is necessary to transform our consumption patterns and the way that we treat the material and the processes into a more environmentally friendly situation. With a high demand on materials, that mostly will generate a big amount of waste (Piscicelli & Ludden, 2016), we are taking natural resources (such as raw materials, energy, or water) to exhaustion, jeopardizing the life of the planet (Geissdoerfer et al., 2017) through our inconsequential attitudes, and sooner or later it will collapse.

Gaustad et al. (2018) argue that the bigger the competition between industries, the bigger the demand for products and consequently for the various types of materials that these products will contain, but the supply of these same materials will be increasingly limited which may give rise to socio-political problems that compromise the supply of materials altogether (Gaustad et al., 2018). It should also be noted that all this demand for scarce resources will naturally increase their prices, which will not be positive for companies (Piscicelli & Ludden, 2016). The use of resources that cannot regenerate can have a major impact not only on the environment but also on society, something that will leave marks and may be irreversible (Ritzén & Sandström, 2017).

Furthermore, some authors claim that most of the material that is taken from nature does not go into the final product and the only solution for a sustainable economy is a radical dematerialization (Lettenmeier et al., 2009). In representation of the "lost value" during the production of any kind of product, Schmidt-Bleek, in the 1990s, created the concept of the "ecological backpack", which serves as a guide to represent all that is taken from nature and then actually used in the final product, which usually means only about 10%. This is a concept that will serve as a support for eco-innovation when thinking about new products and adopting new measures (Lettenmeier et al., 2009).

Besides this being an epoch initially characterized by the fluctuations in the prices of products and services, it can also be said that it is a time when greater concern is being shown regarding the use that can be given to materials and the transformation of processes, from

recycling to waste reduction, for example, adapting business models to more sustainable development and allowing them to be innovative and competitive. This is only possible because customers are more sensitive to this kind of environment-related causes, as well as the concept of environmental sustainability that has been growing over the years and is being introduced more and more into the management of companies (Maldonado-Guzmán et al., 2020).

The companies that are inserted in the pollution industries are the ones that mostly contribute to the environmental problem (He et al., 2018 & Pinget et al., 2015) and overuse public resources that are accessible to everyone, such as water or air, without paying the proper price. These are very valuable resources that are immeasurable, most of the time. In an attempt to reverse this situation, and to alert these same polluting entities, governments began to adopt regulatory measures, through taxes or even allowing pollution only up to a certain level (Stefan Ambec and Paul Lanoie, 2008). All this pressure from governments has forced companies to reinvent themselves and innovate to achieve harmony between economic and environmental returns (He et al., 2018). To reinforce this idea, it is then that Porter's hypothesis arises, which agrees with the adoption of more specific measures related to the environment, intending to make the use of resources more efficient, make room for innovative methods to emerge, and to counter the thought that it will only be possible with increased costs (Stefan Ambec and Paul Lanoie, 2008). Yet, this sense of sustainability was also represented as being a risk to the level of competitiveness of the companies, due to the associated costs it had and they might not be able to covering it (Stefan Ambec and Paul Lanoie, 2008).

Sustainability comprises three major areas: environmental, social, and economic (Martins, 2016), initially referred to as the triple bottom line, that suggested specifically to people, profit and planet (Geissdoerfer et al., 2017). These three starting points are interconnected to contribute to a common goal, but they can be adapted to vast fields of action, in different contexts, never forgetting that due to their strong relationship, any activity developed in one area will consequently affect the others (Geissdoerfer et al., 2017). The concept of a Circular Economy (CE) meets all of these areas and still represents a strong sustainability method because, unlike the neoclassical linear concept, it allows for a greater view of materials in terms of new applicability, rather than being easily replaceable (Martins, 2016) in such a way that its value is extended as much as possible (Vence & Pereira, 2018).

Initially, there began to be a greater concern with the environment (with the publication of the Brundtland Report in 1987 (He et al., 2018)), and later the Earth Summits in Rio de Janeiro in 1992), by encouraging the adoption of more sustainable development (Stefan Ambec and Paul Lanoie, 2008). Even though studies on this subject started as early as the 1960s and the

linear economic model began to be questioned, it was not until the year 2000 that CE was effectively accepted as a new concept of economic model (de Jesus & Mendonça, 2018) and began to be imposed through the implementation of the first measure in China in 2002 (in the Cleaner Production Promotion Law of 2002) and later in 2009 (with Circular Economy Promotion Law of 2009). Years later this method of action was brought to Europe and its implementation started through the EU Action Plan for the Circular Economy (de Jesus & Mendonça, 2018).

The role of the circular economy comes in to help in this transformation of attitude towards the lifestyles of communities, combined with a greater affirmation of what is beneficial for the environment and future life on planet earth, based on a sustainable economy (Geissdoerfer et al., 2017). In most sectors, there is an emphasis on technological innovation as a transition point to a more sustainable economy, which even with finite resources seeks its smart growth. This emphasis is noticeable through the application of key concepts, such as eco-innovation or green innovation, which refer to the intention of sustainable development within each company and is becoming a matter of interest by those who study these areas and the ones that make the measures to be implemented according to the common goal (Colombo et al., 2019).

For better performance of the Circular Economy, it is important to understand how eco-innovation (EI) can successfully contribute to this development. De Jesus et al. (2018) thus suggest the concept of "clean congruence" to try to make the most of the combination of these two concepts, correcting some mistakes of past economic models and trying to overcome the problems generated by them in the environment, through the combination of technological, social and institutional advancement. As one of the greatest boosters of CE appears the concept of Eco-Innovation (EI). This will allow companies to reinvent themselves and start innovatively developing their activities and with greater ecological awareness, both within the internal environment of the companies and in their processes of development and/or manufacture of new products. To combat this problem and to go in search of eco-efficiency, there are certain key points to take into account, as mentioned by the World Business Council for Sustainable Development, which is: reducing the use of materials, products, and services, as well as the energy associated with them, for their extraction or production; reducing toxic disposal; greater acceptance of recycled products and increasing the use of recovered materials; trying to give products a longer life cycle and increasing the intensity of the service related to these products (Stefan Ambec and Paul Lanoie, 2008).

1.2. Research objective

For a greater and better understanding of this area, comes this study which attempts to answer the research question of *"What are the determinants of eco-innovation for companies in a Circular Economy context?"* using a statistical method applied at the micro-level in Portugal. This study will try to complement some gaps that emerged during a more in-depth literature review and will also try to better understand their connection and the importance of the influence of EI for CE on firms' actions, applied to a country where this theme has only been studied in recent years. In Portugal, EI is not yet treated as a driver for circular economy or at least does not appear in the studies done (EIO, 2019) on the development of circular economy in Portugal, so it is a case to investigate. Perhaps because there is still no statistical data and because it is difficult to evaluate, it is a topic that has not yet been very deepened at the national level related to CE. More studies, based on company data, are needed to start getting some real feedback, not only based on assumptions but also to make it easier to conclude the topic and to encourage other companies to follow the examples of those that have taken the initiative and risked applying this new concept. This study tries to understand the behavior of Portuguese companies towards the implementation of environmentally positive measures, specifically the EI, to contribute to a CE, delving into what will be the drivers for a better company performance after the adoption of new measures and how they react to this progression in terms of performance.

1.3. Dissertation Structure

Chapter 2 presents a literature review about the circular economy and its position in the Portuguese economy. There is also an analysis of the eco-innovation concept, as so it's drivers that will guide to the formulation of the argument of this study and there is still another approach about the relationship of the two previous concepts and the application of the two definitions on companies' routine. Chapter 3 presents data and the methodology, chapter 4 the empirical results and chapter 5 concludes this work.

CHAPTER 2

Literature Review

2.1. Circular Economy

2.1.1. Purpose

In the adoption of a more sustainable economic development emerges the concept of Circular Economy (CE). This is a concept that comes in trying to counteract what is known as the linear model of the economy, "take-make-use-dispose" (Demirel & Danisman, 2019), in which materials are extracted, used in the production of goods, distributed, consumed and finally thrown away, without having any future proposal and thus ending its life cycle (Piscicelli & Ludden, 2016; de Jesus et al., 2018). The goal of CE is to redirect the end of the product life cycle, in a closed way, unlocking a new application for it, thus reducing waste, energy use (de Jesus et al., 2018), and also the speed with which resources are taken from nature. This is a method that will force industries to rethink their processes and strike a balance between what is environmentally acceptable in their production and the growth of their economy (Maldonado-Guzmán et al., 2020), which will also depend on the change of consumption habits of consumers (de Jesus & Mendonça, 2018), who will also have to adapt to this new thought of reuse with help of marketing strategies (Lieder et al., 2017). CE has the advantages of creating new business models, new products, and new services, as well as ensuring the permanence of resources, materials, or even products in the economic cycle for a longer time, reducing reliance on fossil fuels and carbon emissions, thus protecting natural capital, minimizing waste, and helping to combat climate change (Azevedo & Matias, 2017). The CE is related to several Sustainable Development Goals (SDGs), but it shows a stronger connection with goal 12 - "Responsible Consumption and Production" (Demirel & Danisman, 2019).

The concept of CE does not have a clear origin, it is known that it started to be more emphasized in the 70s (Macarthur, 2020), but only later, in the 90s, start to appear in books as it was in the book of Pearce and Turner in 1990 and has been developed since then (Harris et al., 2021; Geissdoerfer et al., 2017; Gaustad et al., 2018; Prieto-Sandoval et al., 2018). There are a vast amount of authors who define CE in their way (Gaustad et al., 2018), so because it is a relatively new concept and under continuous study it is difficult to have a certain definition of what CE is, but from the vast number of definitions that exist (Harris et al., 2021) all have key points in common that can be held as common sense regarding this concept. These are, the

identification of a regenerative system where it is possible (Geissdoerfer et al., 2017; Wastling et al., 2018) the minimization and efficient use of resources and energy, the extension of the product life cycle through repair, reuse, recycling, or even remanufacturing (Gaustad et al., 2018), and to this end can take advantage of design (Wastling et al., 2018) by moving from a traditional design to one with an orientation towards increasing the product life cycle, opening doors to new types of economic models, which consequently will have a strong impact on minimizing waste and thus enhancing the reduction that will be felt in terms of output (de Jesus et al., 2018). All this can be seen in one of the most recent definitions devised by Prieto-Sandoval et al. (2018, p.610) that defined CE as *"an economic system that represents a change of paradigm in the way that human society is interrelated with nature and aims to prevent the depletion of resources, close energy and materials loops, and facilitate sustainable development through its implementation at the micro (enterprises and consumers), meso (economic agents integrated in symbiosis) and macro (city, regions and governments) levels. Attaining this circular model requires cyclical and regenerative environmental innovations in the way society legislates, produces and consumes."*

The evolution towards CE has a focus on the matter of products and how, through their design, one can take advantage of this transition, having as one of the fundamental points the consumer's action, acceptance and contribution to this new type of economy (through an innovation system focused on product design) (Wastling et al., 2018)**.** The performance of product design is especially striking at the micro-level (de Jesus et al., 2018) and may be associated with different types of cycles (Piscicelli & Ludden, 2016). Still, authors are arguing that this is not a perfect process and that like all others it will have its weaknesses and that it will be dependent on classical economic thinking, which calls into question the true meaning of sustainability (de Jesus et al., 2019).

2.1.2. Main Drivers

When introducing this new model, as more common practice within companies and in the economy in general, there will always be factors that push and encourage the development of CE (drivers), as well as the opposite, factors that serve as inhibitors (barriers) and cause decision-makers in the companies to step back when applying CE.

Starting with the drivers, de Jesus et al. (2019) divide the theme into four domains: the Technical, the Economic/Financial/Market, the Institutional/Regulatory, and also the Social/Cultural. The first two are focused on a specific part of the adaptation of the industry,

the company itself and its processes, while the last two appeal to the critical sense of consumers, their preferences, and how the company can encourage consumers to adhere to its new sustainable attitude, always taking into account the existing regulatory measures and taking advantage of that as well, being the two domains that will have more impact on CE and will require enhanced support from public agents (de Jesus & Mendonça, 2018). The Economic/Financial/Market advantages are essentially related to the fact that companies will have the opportunity to be the first to act since it is something still under development, which will consequently bring them advantages in terms of costs and competitiveness (Piscicelli & Ludden, 2016). This also refers to the Technical part, where those who manage to develop better technologies that will allow them to improve their processes, will guarantee future success in the area. It is also possible to take advantage of existing legislation that protects sustainable development and reinforces the importance of waste management and can help in the development of measures that are also beneficial to the economic growth of the company, which will fall under the Institutional/Regulatory part. Finally, in the Social/Cultural part, it is worth pointing out the social awareness that society is already having concerning environmental problems and taking advantage of this, making people even more aware to join causes that refer to this problematic or to prefer institutions with the same concerns. Another opportunity is also reinforced regarding the development of networks between companies, in order to enhance value chains and a greater agility in processes (de Jesus et al., 2019).

2.1.3. Major Barriers

Because this is an economic method that is still being implemented, its flaws and what prevents its adoption, the so-called barriers, are much more easily detected. They are very close to those existing in the implementation of actions around sustainability since it is a process that arises from there (Ritzén & Sandström, 2017).

Just like the drivers, the barriers are divided into areas where they are more sharply focused, such as the economic, political, and cultural aspects (Piscicelli & Ludden, 2016). The economic aspects are essentially related to the fact that this is a high-cost method and that there is no assurance that the large investment required will effectively have some return (de Jesus et al., 2019; Ritzén & Sandström, 2017). Harris et al. (2021) add that EC is generally measured by indicators that give rise to concrete values but that there is no relationship to the environmental benefits that such measures do, or do not, bring. This is also greatly encouraged by the fact that political and regulatory aspects most of the time, do not make a positive force in these cases.

Neither on a legal nor institutional level is there a structure prepared to support this type of actions, largely due to lack of information (de Jesus et al., 2019; Ritzén & Sandström, 2017) and because responsibilities are not well defined within companies (Ritzén & Sandström, 2017), which can sometimes even lead to incentives that are not aligned with the objective (de Jesus & Mendonça, 2018). Still, within the company structure, the technical side is fundamental to develop products that meet the CE focus, which sometimes becomes very difficult due to the lack of appropriate technology (de Jesus et al., 2019; Ritzén & Sandström, 2017), lack of technical support and training, or even the delay that exists between the creation/design and the sale of the products (de Jesus & Mendonça, 2018), which can also be aggravated by the adjustment that is still needed in the product design (Ritzén & Sandström, 2017). In terms of cultural aspects, there is still a lack of awareness, which is reflected in more defensive behavior by consumers (de Jesus et al., 2019), also because they are risk averse and due to the lack of sensitivity to situations that promote sustainability (Ritzén & Sandström, 2017). The disinterest in embracing a product or service originated from a CE is a big concern that must be overcomed. It is very important to pay close attention to consumer preferences in conjunction with the technological capabilities that companies have for production and also the expertise to sell the result of remanufactured products (Azevedo & Matias, 2017).

Although the economic models created to turn the economy into a closed-loop focus a lot on the aspect of changing consumer attitudes and their consumption patterns, this is a section with some lack of information and studies, because it is not yet clear to society that this will have to be a joint process and that the role of consumers will be central to a better adaptation of the CE (Piscicelli & Ludden, 2016).

Eco-Innovation comes in to play a key role to help overcome all these identified difficulties (de Jesus & Mendonça, 2018). It will focus on the development of strategies that reveal how products, processes, and even economic models can be adapted to a circular concept, through an innovation system (systemic innovation or technology-based innovation are the most commonly mentioned), something that should be maintained after the transition (de Jesus & Mendonça, 2018). It will serve as a boost for change, but it will not be enough, as it is a method that requires a whole adaptation on the part of the market, production, consumer practices, and also political measures that support it (Prieto-Sandoval et al., 2018).

2.1.4. Portugal's current context

As a way of trying to overcome the barriers identified in the four major spheres of action, the European Commission adopted certain strategies fitted to the needs of each country. In the case of Portugal, in the social sphere, continued the work done so far on green reforms and how to create additional incentives for more sustainable behavior. In the institutional sphere, it was essentially an attempt to comply as much as possible with the EU objectives, as well as the reorientation of the country's economic development, with a sustainable growth strategy (Green Growth Commitment), something that would be supported by the economic sphere, which would bring not only EU funding but would help in the adoption of more effective measures for this growth through operationalization programs of strategies (e.g. POSEUR). Finally, the technical sphere is concerned with the efficiency of the industry and the products themselves, through adopted measures, such as eco-innovation, which can serve as a model for future case studies within this circular economy environment and also promote this new idea and the prosperity it will bring (de Jesus & Mendonça, 2018).

In a general overview of the Action Plan for Circular Economy in Portugal, it is possible to infer some conclusions about the performance of the circular economy, through some fulcrum elements (because there is still no possible way to measure it concretely). Portugal has a greater tendency to accumulate materials, extracting and importing more than what should be exported. Regarding productivity, it was a country that in 10 years (2005-2015) did not evolve as aggressively (23%) as some countries that were at its level, remaining still below the EU average (30%). Regarding the efficient use of water, there is still a loss of about 35% of what is extracted and effectively used, and this percentage is even lower when we talk about reusing this loss. In terms of energy, there was a big bet on renewable energies, but Portugal is still ruled mostly by the use of imported fossil fuels. There was a significant decrease in GHG emissions, as well as in the waste produced by the different sectors. The former was based on the development of technologies that helped in the prevention and control of a less polluting production and to encourage improvements in processes and the latter was based on the reduction in consumption and consequently in production, but the sector that still has a big impact is the construction one. Changes are necessary and incentives are needed, because not all sectors are on an equal footing and can adhere to these measures and adapt their strategies in the same way. For this, it is important to define regional agendas to promote a collaboration network and also to establish a vision for Portugal in 2050, using action programs, with the support of the Government (top-down actions), companies, and citizens (bottom-up actions).

This national vision for 2050 was defined using some goals that are strongly related to the barriers described above, trying to overcome them, with the development of a more resource-efficient economy, a strong focus on research and innovation to boost knowledge, the achievement of a carbon-neutral economy, economic development in all sectors showing inclusive economic prosperity and also the stimulation for a more informed, collaborative and responsible society. This will be possible with the management of explicit tools to leverage results both at the macro (actions in structural terms), meso (actions at sectoral level), and micro (actions at the regional and local level) (República Portuguesa - Ambiente, 2017).

2.2. Eco-Innovation

2.2.1. Evolution of the concept

The concept of innovation is based on creating value for customers, inspired by the implementation of ideas that try to capture the customers' attention and create a relationship with them through the transactions that are performed by the company (Ritzén & Sandström, 2017). What distinguishes the traditional concept of innovation with eco-innovation are essentially the externalities and drivers (Pinget et al., 2015), because the latter is not only concerned with adding value for the consumer, but tries to do so in a way that contributes positively to the environment, either by avoiding certain types of actions or by creating products that favor both areas (business and the environment) with the introduction of new technologies that will facilitate innovation systems (Curto, 2018).

The study of EI is a key point for the success of the CE (Prieto-Sandoval et al., 2018) because it is an element that meets the basic components of sustainable development, the triple bottom line (He et al., 2018). Indeed, some studies help companies reorder their strategies towards these approaches, either through corporate social responsibility (CSR) policies or through environmental management systems (EMS) increasing the investment in eco-innovation (Cai & Zhou, 2014).

Eco-Innovation is a concept that has not yet stabilized and therefore one can find several valid definitions for it. Deconstructing the word, it’s possible to understand that the root word "eco" derives from the Greek oĭko2 (oikos) which has meanings such as "home" or even "family" and "planet" more broadly, while the word "innovation" follows from the Latin "in-novare", which as explained above, translates as adding value through the invention of something new or the recreation of something already existing (Colombo et al., 2019).

This is a theme that only began to be given greater importance around the 90s (Vence & Pereira, 2018), when innovation began to be associated with environmental challenges (de Jesus & Mendonça, 2018), to try to overcome them, through the initial definition of Fussler and James (1996, p.xi): *"the process of developing new products, processes or services which provide customer and business value but significantly decrease environmental impact"* (He et al., 2018; Bitencourt et al., 2020), and was complemented later by Klemmer Lehr and Lobbe (1999) who stressed that this would be a goal that would contribute to some sustainability focus with the help of stakeholders, from companies to associations or political unions (Colombo et al., 2019). In 2011, the European Commission defined EI with a strong focus on environmental repercussions and in 2018, once again, outlined elements regarding this concept, but now with an emphasis on the opportunities, it would bring to businesses and introducing the idea of technology in these processes *"... all forms of innovation—technological and non-technological—that creates business opportunities and benefits the environment by preventing or reducing their impact, or by optimizing the use of resources"* (Demirel & Danisman, 2019). This shows a connection with the management and the business environment, in combining the economic efficiency with existing resources and energy use reduction, still trying to make it competitive in the market (Bitencourt et al., 2020).

Some authors argue that the EI in favor of CE should be treated in a capitalist context since innovation itself is one of the drivers of this type of economy, the EI would do the same, but adapting capitalism to more eco-friendly activities always focusing on the main objective, the search for profits. Nevertheless, other authors argue that this would not be enough and that there would have to be an entire replacement of the capitalist system, not just an adjustment to new practices (Vence & Pereira, 2018).

In terms of EI, typologies are a somewhat difficult topic to explore as there are many different formulations in the literature. In 2009, the OECD defines three variants of EI as targets, mechanisms, and impacts, which refer to the types of innovation (product/service, process, marketing, organizational) (Prieto-Sandoval et al., 2018; Bitencourt et al., 2020; Curto, 2018) that exist, the nature of the innovation, and the results that this will bring (de Jesus et al., 2018; Vence & Pereira, 2018). Taking in consideration the Measurin eco-inovation project (MEI), four other EI typologies were highlighted, including environmental technologies, organizational innovations, product/service innovation offering positive ecological aspects, and innovation through green schemes (Vence & Pereira, 2018; Arundel & Kemp, 2009).

2.2.2. Drivers

Still, from past studies, it is possible to conclude that the major boosters in this field are the combination of technology-push and market-pull, with a strong influence of regulation and company-specific aspects (Cai & Zhou, 2014), such as the strategies developed, organizational or even technological capacity (Pinget et al., 2015). Although we are already starting to notice a great willingness of companies to start adopting this type of initiative, highlighting them for their innovation, it is always easier to motivate them when there are government incentives, which may also guide them to more attractive market alternatives (Lopes, 2019).

For a company to perform well at the eco-innovative level, this is generally derived from an integrative capacity that the company can develop and reconfigure through internal and external drivers (Di Stefano et al., 2012; Cai & Zhou, 2014) and also in conjunction with an external network that leverages these drivers towards better integration of innovative strategies in the company. This standpoint is based on the conceptual model of eco-innovation drivers, proposed by Cai and Zhou (2014), that tried to better explain the behavior of EI in firms routine through the different types of factors (internal and external).

The integration capacity depends not only on internal factors such as technological (Di Stefano et al., 2012; Cai & Zhou, 2014) or organizational innovation capacity, which the higher it is, the better the EI's performance will be, but it also depends (Rennings, 2000), as mentioned earlier, on external factors such as environmental regulation, a greener demand by consumers (Di Stefano et al., 2012; Cai & Zhou, 2014), and it also takes into account the competitiveness that there will be with other companies in the same environment. The internal determinants are also related to the environmental management system (EMS) (Pinget et al., 2015; Cai & Zhou, 2014) and corporate social responsibility (CSR), which reinforce the importance of introducing structural management measures, setting goals and programs to achieve the objectives or even the establishment of internal policies that require a commitment by the company to reorder and readjust its strategies to greener ones, that will contribute to the evolution of the company's image as being environmentally friendly. The combination of these factors serves as a link between the external factors and the interactive capacity of the company. One of the three external factors, regulation, is in line with Porter's Hypothesis (Mazzanti, 2018; Cai & Zhou, 2014) that says that EI would be much more easily pursued by companies if there were stricter environmental regulations, forcing companies to come up with more eco-innovative solutions adapted to their business (Silva, 2014; Pinget et al., 2015). The other two external factors serve as a motivator for the company to achieve a higher correlation with a greener performance when

faced with a green demand that gives much importance to environmentally friendly products, as well as when it sees its competitors joining this type of initiative, it will also have to run behind and try to meet the greener demand in the best way they can, to be able to face the competition (Mazzanti, 2018). The network outside the company with "qualified partners" (Pinget et al., 2015) has a great influential role in that it stimulates the start of more and more eco-innovative activities in companies, and managers can always take even more advantage of this by establishing links between universities and industry (Cai & Zhou, 2014; Pinget et al., 2015). It should be noted that these authors, also mention a determining factor for obtaining greater profits as being the image that the company passes on, a greener image that shows concern for the environment and society, consequently, and that will be a message easily captured by those who also demonstrate a greener demand (Cai & Zhou, 2014) a message that is more easily conveyed when there is a close relationship between the organization and the consumer (Pinget et al., 2015).

The structural characteristics of the company such as its size or sector are more likely to raise doubts as to whether they generate drivers for EI or even be seen as barriers (Mazzanti, 2018). Larger companies have greater viability in establishing proactive measures. They also have a higher financial backing than smaller companies, such as SMEs, but the latter find it easier to adjust their strategies with reactive measures due to their flexibility. Older companies tend to have more knowledge, more experience, and more means, but for the younger ones, it is easier to adapt to new realities (Pinget et al., 2015).

2.2.3. Barriers

In a global analysis of what EI involves, some factors were also discovered that are considered barriers to the implementation of EI. These are roughly based on the costs involved, lack of knowledge, market behavior, the effect generated by company size (Pinget et al., 2015), and regulations (Arundel & Kemp, 2009). Costs come as an inhibitor to the development of projects involving EI because often companies do not have the financial capacity to support the necessary investments and have no internal or external funding available for this, and the uncertainty that exists regarding the return on this investment is also a strong element for this barrier (Pinget et al., 2015; Curto, 2018; Arundel & Kemp, 2009). The lack of knowledge greatly limits the development of this type of innovation, as does the lack of access to information (Pinget et al., 2015) and the lack of skilled labor (Curto, 2018) generated by restricted research efforts (Arundel & Kemp, 2009). It is necessary to reverse this situation with

the exploration of new technologies that promote the environment through the management and incorporation of innovation in the companies' strategies, thus making them more competitive (Pinget et al., 2015) and if necessary, seeking research partners willing to cooperate in this area (Curto, 2018). The behavior of the market also has a great influence in that sometimes there may not be the expected demand (Arundel & Kemp, 2009) or even a lack of acceptance of the product (Curto, 2018). This barrier is largely related to technology-push and demand-pull because only if an opportunity arises between a technical evolution and a market opportunity will the innovation make sense and be beneficial (Pinget et al., 2015). Another factor that can sometimes be adverse to the evolution of EI is related to the size of the companies, as explained before (Pinget et al., 2015) and also their main business (Curto, 2018). Finally, the regulation also reveals itself as a possible unfavorable factor when it is not explicit and can have the opposite effect to what is intended (Arundel & Kemp, 2009; Curto, 2018). To be effective, these measures have to be targeted regarding the type of EI, concerning the barriers they want to fight, or even the type of driver they want to reinforce (Kiefer et al., 2018).

2.2.4. Portugal's position on the topic

Over the years Portugal has been adapting to this new reality with a greater emphasis on environmental concern and over the years it has evolved both in its measures, programs, and instruments for implementing more sustainable actions and in the results, it has obtained through the success and gradual improvement of these measures. This is only possible, of course, with the joint work of society, in which companies commit themselves to comply with certain measures suggested by the Government, which are often emphasized through incentives (EIO, 2019).

All these developments were largely thanks to the definition of regional circular economy-oriented agendas and the creation of centers for collaboration and sharing of knowledge learned from R&D in this area. Another major boost in recent times has been the solid business partners that show up (Curto, 2018) and the interest shown by some investment funds to support the adoption of EI measures in companies, as seen, for example, in the creation of the Environmental Fund (Fundo Ambiental), which is a policy instrument that serves as a stimulator for the implementation of public or private projects oriented towards CE and EI, and these projects have been growing. It is also noteworthy that the regulation and financial mechanisms to support these measures also had a great weight in this performance improvement at the national level (EIO, 2019).

Most of these enablers could be estimated through an EI index composed of five components, the EI inputs, EI activities, EI outputs, resource efficiency outcomes, and socio-economic outcomes. In 2019, these components were measured, for the period between 2018 and 2019, through 16 indicators that are specific to each component, and the weakest for Portugal are those related to the EI inputs (below the EU average), which refer very much to the R&D part. The indicators related to EI activities (above the EU average) are essentially marked by actions in SMEs through the Implementation of Sustainable Products and Resource Efficient Actions. The remaining components were in line with the EU average, with strong relevance for the indicator revealing the existing Academic Publications related to the topic, which refer to the EI outputs component, for Energy Productivity related to the resource efficiency outcomes component, and also the indicator revealing a high propensity for Employment in the Eco-Industry. Still, it is necessary to reflect on the only indicator that did not reveal any value, the one that reveals Water Productivity (EIO, 2019).

Even so, and as was evident from this general analysis, there is room for improvement, because the Portuguese economy still faces some barriers in the quest for success in this economic growth. This is due to the lack of specific programs directed to the promotion and control of EI, the lack of involvement and investment in EI by the private sector, the lack of balance between the patents that are registered and the high number of existing researchers, the increased perception of risk that these measures imply for those who invest in them, revealing insecurity in market demand (Curto, 2018), the lack of perception of existing environmental problems by the population and also the small size of companies that realize that resource-efficient measures can reduce production costs (EIO, 2019).

To encourage the development of best practices and address these barriers, Portugal has adopted several programs and action measures to promote the use of CE by taking advantage of one of its major drivers, the EI. This has helped a lot in increasing exports and lowering the costs of energy and materials. Going back to the activity programs, in 2019 a Roadmap for Carbon Neutrality with a vision for 2050 was defined; a National Agenda oriented towards Research & Development for the Circular Economy, with medium and long-term challenges (2030); a National Plan for Waste Management and a Strategic Plan for Municipal Solid Waste (PERSU2020 that has already been updated with the revised measures for PERSU2020+). The beginning of the Innovation, Technology and Circular Economy Fund (FITEC) or the creation of the Circular Economy Voucher, a voucher that like the Fund tends to encourage companies to specialize in this area and subsequently adopt innovation criteria and develop a spirit of cooperation with other institutions (with the academy, for example). A measure was also

developed that tracks waste, Waste Tracking Notes (Guias Electrónicas de Acompanhamento de Resíduos), and another that fosters rivalry among companies, GovTech competition, by encouraging the adoption of measures that are in line with the Sustainable Development Goals (SDGs). Also worth mentioning is the SIFIDE Program, which promotes R&D investment with incentives through fees, which despite being old (1997), can still be applied, and the program supported by the European Economic Area Financial Mechanism that highlights the Environment, Climate Change and a Low Carbon Economy (EIO, 2019).

2.3. The connection between Circular Economy and Eco-Innovation

EI is considered to be a significant enabler in the transition to a CE and can be related to it in different ways, through business models, supply chain (Gente & Pattanaro, 2019), sharing platforms or products as a service, and even at all levels, micro, meso, and macro (de Jesus et al., 2019). For this transition to a more sustainable economy, changes in consumption and production patterns are required, which, for some authors, can only be achieved through the aforementioned radical or systemic innovations (Vence & Pereira, 2018). Some argue that the EI may be a way to assess the relationship between sustainable development and CE in a more quantitative way. Derived from this, it is understood that these are two concepts that are the result of the combination of several study disciplines (multidisciplinary) that have a common goal, the integration of environmental aspects, considering the common EI one of the main determinants, even if this is a long-term path (Maldonado-Guzmán et al., 2020).

A "win-win" situation is identified considering that the harmonization of economic growth with environmental concern towards a more circular economy can be adapted by companies through various strategies (Demirel & Danisman, 2019). One of the strategies very easily identified is the adaptation of cleaner production and the readaptation of product design for more ecological purposes (eco-design, green design, or design for the environment) (Demirel & Danisman, 2019)**,** which essentially consist in the introduction of eco-innovative processes that reuse the products, giving them new characteristics, to extend their life cycle (Vence & Pereira, 2018) or even through the introduction of new materials, less harmful, also counting on the help of this type of production that tends to operationalize these processes (remanufacturing, for example) (Vence & Pereira, 2018), reducing materials and energy, making them eco-efficient (Demirel & Danisman, 2019).

This transition also requires the adaptation of EI technologies, to give space for processes to evolve and reinvent themselves in an increasingly innovative way, always counting on a

positive contribution to the environment (de Jesus et al., 2019). Another important aspect that CE requires for its better integration is also the redefinition of social regimes, covering strategic rules, as well as the adjustment of society's behavior giving room for the emergence of new economic models (de Jesus et al., 2019; Maldonado-Guzmán et al., 2020). This can all be further boosted with government intervention through priority policies, with EI being a major factor in solving environmental challenges through resource efficiency (de Jesus et al., 2019) or by taking advantage of both the demand and supply side to better redefine processes and products, while also benefiting from the momentum and readjusting companies' activities and regulatory structures (de Jesus et al., 2019).

EI and CE are very related concepts but require some complementarity with, for example, research development in the area special in the EI scope, that has higher deficits concerning past research, to understand how best to act together and accordingly (Gente & Pattanaro, 2019). This relationship of concepts contributes not only to a forgetting of the connotation attributed to the EU as having weak sustainability, making room for a more eco-centric economy, but also contributes to a greater opportunity for the third sector, such as NGOs, to start contributing to these kinds of innovation-related initiatives and policies in the EU (Colombo et al., 2019). The importance of EI for the development of CE is especially identified, but it should also be noted that for these same innovations to be successful it is necessary to know how to apply them at the commercial level, hence these are very complementary concepts (Prieto-Sandoval et al., 2018).

There are also some types of EI, identified in the EIO (2016), with actions directed particularly to CE, which include product design, process, organizational, marketing, social, and system eco-innovation. Roughly speaking, in this dependency relation between EI and CE, we distinguish two domains of activities, one that focuses on a more technical part ("harder elements") related to products and investment in new processes and cost reduction and the other that focuses more on a structural part ("softer" elements) related to organizational redesign, business model, behavior trends or even marketing strategies (Maldonado-Guzmán et al., 2020; Vence & Pereira, 2018).

2.4. Effects of Eco-Innovation related to Circular Economy in firm's performance

The CE implies adaptation at various levels (Prieto-Sandoval et al., 2018) and has EI as an indispensable factor (Maldonado-Guzmán et al., 2020). At the macro level, it covers a national

or even global scale that gives strong relevance to regulation, with schemes defined for waste reduction, for example, or even with the reordering of society's practices, through socio-technological action plans involving EI (de Jesus et al., 2018). The meso level recognizes a network relationship between companies, where there is a sharing of eco-innovative services to maximize the value of resources, giving a strong emphasis at the industrial level (de Jesus et al., 2018). At the micro-level, individual performers are highlighted, these being companies in particular, who have to adhere to a whole readjustment of services and product design, the way these are produced, to incorporate cleaner and less environmentally damaging production, combined with the efficient use of resources and a more sustainable supply and demand, all through the transition from a linear economy to a circular economy, consequently adapting economic models to others that meet the current needs of business, with crucial help from EI (Prieto-Sandoval et al., 2018; de Jesus et al., 2018).

Focusing on the micro-level, there is a strong influence of EI when it comes to the economic growth of the company, showing a better performance when it presents activities related to EI than unrelated ones, which subsequently will also be contributing to an increase in employment (Madaleno et al., 2020; Demirel & Danisman, 2019). Even so, there are authors who argue quite the opposite, identifying a negative relationship between the previous variables (Demirel & Danisman, 2019). But it should be noted that the effects of EI on a firm's economic growth depend a lot on the firm's characteristics, as well as its structure or even the industry (Demirel & Danisman, 2019), likewise, the policies implemented will only work properly if they are targeted to the types of companies (Silva, 2014).

The policy measures are essential to avoid negative market externalities (Mazzanti et al., 2016) and can more easily influence the use of EI-related practices when these represent financial rewards, as most companies are not able to distinguish between economic and environmental returns (Silva, 2014). What may contribute to this distinction is the use of radical EI, because they promote substantial changes in these practices and are easier to perceive than incremental EI, which have a slower pace of implementation and are not as noticeable at first (Silva, 2014).

However, this economic growth that is sought through the use of EI in the transformation of the economy curiously is obtained in those sectors that are the most polluting and energy consumer (manufacturing, electricity, transportation are examples from Madaleno et al. (2020) investigation), especially when measures are taken on their initiative that does not have to be subject to restrictions (as when political measures are present), through the adoption of green technologies, thus adjusting traditional industry (Demirel & Danisman, 2019). Another aspect

that drives the implementation of EI towards economic growth is the possibility of entering new markets, with new products and services (Silva, 2014) or even the cost reduction in its activity, which may increase demand for cheaper products or increase the marginal income (Mazzanti et al., 2016), although there are still some authors who argue the opposite (Madaleno et al., 2020). An additional positive factor is about the competitiveness that EI generates (Mazzanti et al., 2016) between the companies, pushing them to achieve more innovative products and services, that will help them to distinguish from their competitors. Otherwise, it opens doors to other new competitors to show up with new ideas, that will permit them to enter the market (Madaleno et al., 2020). Interestingly, and contrary to what one might expect and what would be more likely, EI has greater competitive advantages in countries with more environmental problems and therefore lower Human Development Index (HDI) (Bitencourt et al., 2020). Additionally, there is also the factor of the company's reputation, which will be provided by the adoption of greener/sustainable practices, and will enhance the company's image before stakeholders (Bitencourt et al., 2020; Madaleno et al., 2020).

The beginning of this type of environmental awareness on companies' side is strongly influenced by what the interested parties think about this issue, which leads companies to adopt measures that satisfy the stakeholders, thus making it a more promising scenario, or at least one that will better justify the costs that come associated with these measures, in favor of the sustainable development of the company that at the same time seeks to meet the needs of the costumers (Madaleno et al., 2020).

Regarding the performance of the company itself when there is the implementation of actions related to EI usually a positive relationship is presented (Bitencourt et al., 2020). This performance evaluation consists of assessing whether all the company's objectives are met, whether tangible or intangible, and also relates strongly to economic (cost reduction and the search for the highest possible return on investment), social (employment, human relations, and ethics), environmental (reducing negative environmental impacts by reducing waste and through the efficient use of resources.) and financial performance (Bitencourt et al., 2020). There should be noted that the relations between economic and environmental performance can, not only, be marked by the reduction of costs (materials, energy, services, capital, and labor) or even due to risk management and the relationship with external parties, but it can also be marked by the chance to increase profit with better access to certain markets, with the sale of pollution control systems and with differentiated products (Stefan Ambec and Paul Lanoie, 2008). Having said that, it should be noted that a very important factor is also the investment

and management of knowledge, for the application of EI in the companies' practices, through interactions with various stakeholders to improve the performance (He et al., 2018).

CHAPTER 3

Data & Methodology

3.1. Hypotheses and Structural Model

This section presents a structural model that was developed with the focal points under study. This structural model aims to combine the key points taken from the literature, to help develop hypotheses that attempt to answer the research question. These hypotheses will be tested through econometric methods that will assess whether they are appropriate. This is a model that aggregates internal factors - technological innovation capacity, organizational innovation capacity, structural management measures, structural characteristics (size, sector or age) - and also external company factors - financial mechanisms, environmental regulation, greener demand, competitiveness - which, combined with the existence of an external network with qualified partners, are taken into account as the EI drivers that will have the largest impact on the company's performance towards a more circular and environmentally friendly economy.

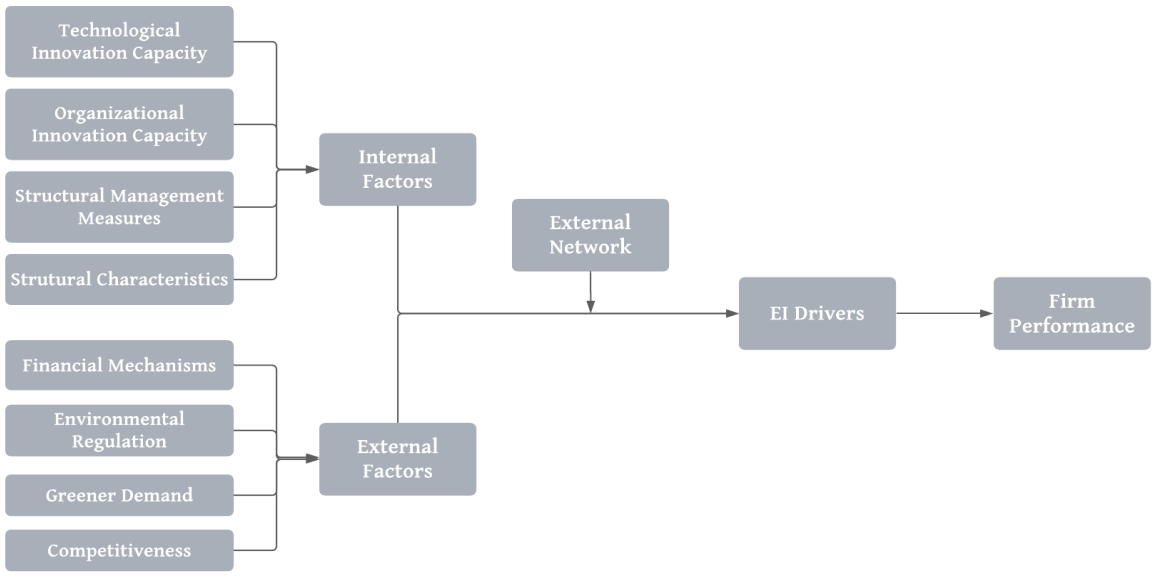

Figure 3.1: Structural Model

(Own elaboration based on the study of Cai & Zhou, 2014)

As a starting point for the empirical investigation, the following hypotheses were formulated. They derive from what was gathered during the literature review and try to constitute the foundation of the research, through observations (data) that, after being worked on, will serve as support for a better understanding of the theme. These hypotheses try to make

a connection between what is obtained in theory and what may be obtained in practice, after the analysis of the results that will be obtained (Silva, 2014).

Table 3.1: Hypothesis Description

Hypothesis	Description of hypothesis
H1	There is an influence of Internal Factors on firm's performance.
H1.a	There is an influence of Technological Innovation Capacity on firm's performance.
H1.b	There is an influence of Organizational Innovation Capacity on firm's performance.
H1.c	There is an influence of Structural Management Measures on firm's performance.
H1.d	There is an influence of Structural Characteristics on firm's performance.
H2	There is an influence of External Factors on firm's performance.
H2.a	There is an influence of Financial Mechanisms on firm's performance.
H2.b	There is an influence of Environmental Regulation on firm's performance.
H2.c	There is an influence of Greener Demand on firm's performance.
H2.d	There is an influence of Competitiveness on firm's performance.
H3	There is an influence of External networks on firm's performance.

Source: Own elaboration

To measure H1 it was selected the variables that are more related to the internal part, concerning the technological, organizational, and structural capabilities of the company. To verify H2, it was chosen indicators that are external to the company but that have an impact on its performance, as well as H3, where it was selected the indicators that relate the company to other qualified entities.

3.2. Data & Methodology

3.2.1. Data

The data used in this study comes from the Community Innovation Survey (CIS) between 2012 and 2014, selecting those that are specific to the Portuguese companies, as it is the country under study. The CIS is carried out by the European Commission, following the methodology recommended by EUROSTAT and based on principles established in the Oslo Manual (Silva, 2014) and is directed to all EU members, allowing a comparative evaluation among them (Mazzanti et al., 2016). It generally highlights companies by sector of activity, according to the

CAE (Classificação Portuguesa das Atividades Económicas - CAE-Rev. 31) (Silva, 2014), by the number of workers in the companies, and also by the region in which they operate. In general, this questionnaire intends to obtain information about the innovative development of companies in each country, highlighting, for example, the objectives that are imposed to them or the public funding that they can choose to when they intend to develop activities related to innovation (Azevedo & Matias, 2017; Mazzanti et al., 2016).

This is a biennial survey, so the information was treated considering a cross-section analysis, since it does not focus on observations over time, but rather on the analysis of the behavior of companies (individuals) when faced with innovation factors, in a given period (Azevedo & Matias, 2017). The survey used is not very recent, (CIS 2014), since there is only a report of two years (CIS 2008 and CIS 2014), which emphasizes environmental issues (Madaleno et al., 2020), trying to understand the importance given by companies and their relations with innovations involving environmental benefits, thus the need to use the CIS 2014. Still, this is the first survey to address the issue of EI in the EU, and therefore it has been very useful and relevant to further deepen the subject, regarding what are its determinants, the political support to which it is subjected or even the economic impacts that EI can cause, besides focusing on the environmental consequences (Mazzanti et al., 2016).

This sample is composed of a total of 7083 Portuguese companies that validly answered the survey, which led to an adjusted sample of 1638 companies that introduced or in some way had a relation with EI in their companies, influencing their performance, and considering only the survey questions to which there was access to complete data, disregarding those with incomplete answers. The CIS is a mandatory questionnaire, that is a National Statistical System rating tool (Silva, 2014), which collects these data through an electronic platform intended for this purpose. It should be noted that this sample is then refined, according to the values of the turnover growth (TG), the dependent variable, that were limited between 0 and 1 (0% to 100%) to reduce biases in the results.

3.2.2. Variables

To conduct this study, several variables were selected according to the literature review. Table 3.2 presents the description of all the variables in the way they were used next, during the empirical application.

Table 3.2: Variables Description

Variable	Variable description	Measure Index	Value Range	Authors
Dependent Variable				
Firm Performance	Logarithm of Turnover Growth	TG	[0,1]	(Madaleno et al., 2020)
Independent Variables				
Internal Drivers:				
Technological Innovation Capacity	Reduction of material or water used per unit produced	ECOMAT	0= No; 1=Yes	(Cai & Zhou, 2014), (Madaleno et al., 2020), (Pinget et al., 2015), (Di Stefano et al., 2012), (Silva, 2014)
	Reduction of energy used or CO2 produced by the company (reduce total CO2 production)	ECOENO	0= No; 1=Yes	
	Reduction of air, water, noise, or soil pollution (environmental benefits within the company)	ECOPOL	0= No; 1=Yes	
	Total or partial replacement by less polluting materials or hazardous substitutes	ECOSUB	0= No; 1=Yes	
	Replacing a share of fossil energy with a renewable energy source	ECOREP	0= No; 1=Yes	
	Recycling of waste, water, or materials	ECOREC	0= No; 1=Yes	
	Reduction of energy used or CO2 produced	ECOENU	0= No; 1=Yes	
	Reduction of air, water, noise, or soil pollution (environmental benefits for the final consumer during the use of the product)	ECOPOS	0= No; 1=Yes	
	Easy recycling of the product after use	ECOREA	0= No; 1=Yes	
	Extended product life through longer-lasting or stronger products	ECOEXT	0= No; 1=Yes	
Organizational Innovation Capacity	Product (goods or services) innovations	ECOPRD	0= No; 1=Yes	(Cai & Zhou, 2014), (Madaleno et al., 2020)
	Process innovations	ECOPRC	0= No; 1=Yes	

	Organizational Innovation	ECORG	0= No; 1=Yes	
	Marketing innovations	ECOMKT	0= No; 1=Yes	
Structural Management Measures	Voluntary actions or initiatives for good environmental practices within your sector	ENAGR	0=Irrelevant; 1=Low; 2=Medium; 3=High	(Cai & Zhou, 2014)
Strutural Characteristics	A factor with 3 levels, depending on the number of employees.	SIZE	1= < 50; 2= 50 - 249; 3= > 250	(Madaleno et al., 2020), (Pinget et al., 2015)
External Drivers:				
Financial Mechanisms	Existence of environmental taxes, charges or fees	ENETX	0=Irrelevant; 1=Low; 2=Medium; 3=High	(Madaleno et al., 2020), (Silva, 2014)
	Public Administration support, subsidies, or other financial incentives for environmental innovations	ENGRA	0=Irrelevant; 1=Low; 2=Medium; 3=High	
	High costs of energy, water or materials	ENCOST	0=Irrelevant; 1=Low; 2=Medium; 3=High	
	Need to meet the requirements for public procurement contracts	ENREQU	0=Irrelevant; 1=Low; 2=Medium; 3=High	
Environmental regulation	Existence of environmental regulations	ENEREG	0=Irrelevant; 1=Low; 2=Medium; 3=High	(Cai & Zhou, 2014), (Silva, 2014)
	Environmental regulations or taxes planned in the future	ENREGF	0=Irrelevant; 1=Low; 2=Medium; 3=High	
Greener demand	Current or expected market demand for environmental innovations	ENDEM	0=Irrelevant; 1=Low; 2=Medium; 3=High	(Cai & Zhou, 2014), (Silva, 2014)

Competitiveness	Improve the company's reputation	ENREP	0=Irrelevant; 1=Low; 2=Medium; 3=High	(Cai & Zhou, 2014)
External Network	In 2014, the company was part of a group of companies	GP	0= No; 1=Yes	(Cai & Zhou, 2014), (Pinget et al., 2015)
	During the period from 2012 to 2014, the company cooperated within the scope of innovation activities with other companies or organizations	CO	0= No; 1=Yes	

Source: Own elaboration

These were the selected variables to conduct the study. TG was chosen as the dependent variable to assess the company's performance when faced with EI-related measures that contribute to progress towards a more circular economy for the company. It was also chosen as the dependent variable because the turnover is one of the most important measures to be considered when evaluating the company's performance, as it allows the appreciation of the company's behavior in financial terms, reflecting the sales of products (goods and services) placed on the market, covering taxes, apart from VAT. The dependent variable (TG) is presented as a growth rate and is expressed in monetary values, so it was operated with a log to allow relating to the other variables. This is an advantageous transformation since it converts a variable that proves to be biased into more standardized elements. Still, when working with this type of variable, where linear interactions are not verified, the possibility of negatively biased errors cannot be ruled out. Another variable that also resorted to the log for its normalization was the variable that refers to the size of the company, in which the log of the total number of employees existing in each company was used.

The independent variables were broadly decomposed into internal factors, external factors, and the external network. Each group of variables was subdivided into several components that were associated with the measure index that came from the questions asked in the CIS, which gave rise to the data obtained and that will be analyzed as described in the Table 3.2.

3.2.3. Estimation Model

Given the type of data used to analyze the main question that has been developed throughout this research, it was stipulated that the Tobit model would be the most appropriate for assessing the veracity of the proposed hypotheses, because it is a limited dependent variable model that

fits this situation due to the type of cross-sectional data (Lee & Maddala, 1985) and because its easiness in studying a database with a high number of zeros so that they are useful for testing the model, as they are a representative part of the sample. It is a model that allows testing the dependent variable within certain limits (upper and/or lower bounds), in this case between 0 and 1, and does not necessarily have to be a binary variable. The turnover growth has a mean value of 0.2118 and to be modeled it is necessary to consider the portion of about 26% (0.2557998) that is not despicable and has zero as value, so it could be possible to make an evaluation of the model closer to reality, since there is not only positive TG, but there could also occur a null TG. To test the regression that has been adapted to this study, the R program was used.

Tobit is a model that presents a normal distribution, and the β coefficients translate the effect of the various independent variables on the latent dependent variable, TG* (internal and external factors affecting turnover growth) and the latent variable, should meet the requirements of the classical linear model.

The model was used to determine the impact of these EI drivers on firms' performance through their TG. Test whether the variables are good drivers of EI (significant or not) which will consequently lead to a good firm performance or not.

$$y^* = x\beta_0 + u, u|x \sim Normal\ (0, \sigma^2) \tag{1}$$

$$y = max(0, y^*) \tag{2}$$

$$y = \begin{cases} y^*, & y^* > 0 \\ 0, & y^* \leq 0 \end{cases} \tag{3}$$

$$\begin{aligned} TG^* = {} & \beta_1 ecomat + \beta_2 ecoeno + \beta_3 ecopol + \beta_4 ecosub + \beta_5 ecorep + \beta_6 ecorec \\ & + \beta_7 ecoenu + \beta_8 ecopos + \beta_9 ecorea + \beta_{10} ecoext + \beta_{11} ecoprd \\ & + \beta_{12} ecoprc + \beta_{13} ecorg + \beta_{14} ecomkt + \beta_{15} enagr + \beta_{16} enetx \\ & + \beta_{17}\, engra + \beta_{18}\, encost + \beta_{19}\, enrequ + \beta_{20}\, enereg + \beta_{21} enregf \\ & + \beta_{22} endem + \beta_{23} enrep + \beta_{24} gp + \beta_{25} co + \beta_{26}\, size + u \end{aligned}$$

Where:

- TG – dependent variable
- TG^*– latent dependent variable
- $\beta_1, \dots, \beta_{26}$ - the regression parameters associated with each independent variable
- u - error term, $u|x \sim Normal\ (0, \sigma^2)$

Different specifications are assumed for the model to test the validity of the raised hypothesis.

CHAPTER 4

Empirical Results

4.1. Result analysis

The model was tested in several ways, assuming different regression specifications, to try to obtain the best possible outputs, validating them with what was predicted in the literature review chapter. Table 4.1 presents the results of the multiple types of tests that were done, through the marginal effect of the model that measures the actual effect on the latent dependent variable (Martins, 2013), the Turnover Growth (TG). This is a type of testing that evaluates the effect on the mean, i.e., the midpoint of the variable. All results are to be presented in Table 4.1.

From the descriptive analysis it can be ascertained that, considering the standard errors and the p-values, when all variables were tested simultaneously, only 5 (ecorea, ecoext, endem, gp and size) out of the 26 independent variables were significant, and nothing could be determined regarding the behavior of the remaining 21 variables (ecomat, ecoeno, ecopol, ecosub, ecorep, ecorec, ecoenu, ecopos, ecoprd, ecoprc, ecorg, ecomkt, enagr, enetx, engra, encost, enrequ, enereg, enregf, enrep, co) against the TG, as these did not show enough significance for this, in this first regression specification. In other words, the variable that represents the facility to recycle a product after its use (ecorea) and the one that defines whether the firm belonged to a group of companies at the time of the survey (gp), presented a negative impact on the TG with a 10% significance,, contrary to what would be expected, especially in relation to the ecorea variable. This result contrasts with the literature because the adoption of new strategies to adjust the product design to be used until the end of its useful life or to help in the transformation of the processes (Vence & Pereira, 2018) with an orientation towards cleaner production (Demirel & Danisman, 2019), is not found to be simultaneously beneficial for both the company's growth and the adoption of a circular economy, but only for the latter. This would be easily explained by the fact that companies might have to spend more money-making products that could be reused later, than the profit they would make by implementing this type of strategy.

It is important to keep in mind that this is a sample that includes a large number of small companies (more than medium and large companies combined) and that for these companies it is more manageable to adopt strategies with reactive measures (Pinget et al., 2015) as proven in the literature because, according to the EI index, in Portugal the SMEs are those that show more positive results in terms of adopting eco-innovative measures (EIO, 2019). Nevertheless,

they do not have as much flexibility in financial terms as larger companies and so, they could experience some difficulties in including themselves within a group of companies, to meet the necessary requirements and at the same time to promote good firm performance including at the environmental level.

Table 4.1: Results of the regression specifications

TG	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
ecomat	0,004	0,006	0,009	0,004						
ecoeno	-0,003	-0,002	-0,002	-0,014						
ecopol	-0,018	-0,018	-0,018	-0,021'						
ecosub	0,014	0,013	0,015	0,019'						
ecorep	0,005	0,006	0,008	0,002						
ecorec	0,006	0,004	0,005	0,002						
ecoenu	0,003	0,005	0,007		0,009					
ecopos	-0,011	-0,014	-0,013		-0,016					
ecorea	-0,023'	-0,021'	-0,019		-0,015					
ecoext	0,022'	0,024'	0,03*		0,033**					
ecoprd	0,007	0,012				0,014				
ecoprc	0,01	0,009				0,007				
ecorg	0,011	0,012				0,01				
ecomkt	0,016	0,017				0,013				
enagr	-0,01	-0,004								
enetx	-0,001						0,000	0,004		
engra	0,006						0,006	0,005		
encost	0,002						0,001	-0,004		
enrequ	-0,006						-0,006	-0,003		
enereg	0,001						-0,001	-0,005		
enregf	-0,013						-0,012	-0,016*		
endem	0,013*					0,009'	0,013*	0,014*	0,012*	
enrep	0,01						0,008	0,008		
gp	-0,021'					-0,024*	-0,023'			-0,025*
co	0					0,001	0,005			0,008
size	0,042***	0,048***	0,048***		0,047***	0,043***	0,042***		0,048***	0,041***

Signif. codes: *** 0.001; ** 0.01; * 0.05; ‘ 0.1

The remaining three variables that, in this first regression, presented themselves as favorable to turnover growth, reflected that the larger the company is (size) if there is a greater focus on increasing the life of the product, by manufacturing it with more resistance and durable materials (ecoext), in combination with a current or expected market demand for environmental innovations (endem) this will cause an increasing effect on turnover growth and consequently

a better firm performance, as expected, through the implementation of EI standards in association with a favorable behavior of the consumer.

Also worth noting is the regular behavior of the size variable which, in all the regression specifications that are presented, proves to be the most significant variable in the model, with a significance level of 0,01% and always with a positive effect on the latent dependent variable (TG*). This will contribute to better firm performance overall, as larger firms are much easier to adapt to the market, take proactive measures or introduce new strategies due to their market power and because they exhibit greater financial capacity, as argued by Pinget et al. (2015), which will help when supporting additional expenses, so they are not as vulnerable to market changes. Therefore, it is important to include this as a control variable, to serve as a term of comparison between different types of firms. It is also possible to realize that this is a variable that inhibits so many others from proving to be significant and being able to explain the model, because it is possible to observe that in certain cases when the variable related to company size is not integrated, some factors that were not significant before would now be expressive of their position concerning the dependent variable.

This last variable (size) is followed by the variable gp, which determines whether the firm was part of a group of firms in the year in which the survey was carried out and is also the one that always proves to be significant in all the regression specifications where it appears. It may be more or less significant depending on the presence of the size variable, being mostly at a level of 5% or 10% of significance when size was also part of the specification, and at 0,01% significance level when it did not appear, with the small difference that this variable had the opposite effect of the previous one. This is a variable that always showed a negative sign regarding the TG because, even if the relationship with qualified partners reflected a greater influence in the adoption of EI measures, as argued by Cai and Zhou (2014) and Pinget et al. (2015). This is an attempt to demonstrate that being part of a group of companies would not always be a favorable factor for the development of a good firm performance since, to be within this nucleus, perhaps the conditions to be met would be too demanding for what the company proposed itself, which would not be beneficial to them and the success of the established objective. In other words, the group's policy could impose high costs to the companies (for the small ones, for example, since they are the most representative in the sample), and most likely they would not have the capacity to respond to this type of group demands, which means that belonging to a group is not always advantageous in terms of TG.

The different specifications of the regressions were determined according to the groups that had been previously defined and specified in Table 3.2 with the description of the variables,

trying to test the behavior of the internal and external drivers among themselves and with each other, always having as a control variable the size of the companies measured through the logarithm of the total number of employees existing in the company, and the external network factors that would allow us to understand if the company were part of a group of companies during 2014. Whether this would have a positive or negative impact on its performance, as well as whether having cooperated with other companies within the scope of innovation activities during the period from 2012 to 2014 would bring any benefit within the framework of the study.

Table 4.2: Results of the regression specifications (continued)

TG	**Coef.**	**Coef.**	**Coef.**	**Coef.**	**Coef.**	**Coef.**	**Coef.**	**Coef.**
ecomat	0,000		0,004		0,011	0,004	0,011	0,011
ecoeno	-0,015		-0,009		0,000	-0,015	0,002	0,003
ecopol	-0,016		-0,025*		-0,021'	-0,02'	-0,021'	-0,021'
ecosub	0,015		0,012		0,02'	0,021'	0,018	0,019'
ecorep	0,000		0,002		0,005	0,000	0,008	0,008
ecorec	0,008		-0,001		0,004	0,003	0,002	0,003
ecoenu	0,004			-0,001			-0,003	
ecopos	-0,009			-0,019			-0,025*	
ecorea	-0,016			-0,012			0,008	
ecoext	0,031			0,032**			0,042***	
ecoprd		0,008	0,017	0,010				
ecoprc		0,000	0,007	-0,004				
ecorg		0,012	0,011	0,01				
ecomkt		0,022	0,018	0,025				
enagr	-0,012'	-0,014*			-0,004		-0,003	
enetx	0,002	0,003			-0,006	-0,006		
engra	0,005	0,005			0,009	0,008		
encost	0,000	-0,003			0,006	0,002		
enrequ	-0,004	-0,003			-0,005	-0,003		
enereg	-0,002	-0,003						0,002
enregf	-0,016'	-0,016'						-0,006
endem	0,014*	0,015*						
enrep	0,012'	0,011						
gp			-0,047***		-0,024'		-0,025*	-0,025*
co			-0,008		0,007		0,008	0,008
size					0,043***		0,042***	0,041***

Signif. codes: *** 0.001; ** 0.01; * 0.05; ‘ 0.1

Analyzing the factors defined as Internal Drivers of eco-innovation for firms' strategies, several inferences can be made. These factors, when jointly tested, present the same results in terms of signs and significance levels as when tested together with all independent variables,

as explained earlier. Even so, this set of factors can be subdivided and tested through the groups of variables that were initially attributed to them (Table 3.2). When isolated from the remaining variables, those belonging to the Technological Innovation Capacity category, only ecoext shows a significance of 5% and will be the only factor, in this case, that can explain the model in the way that was previously described. This category may also comprise two other distinct paths, developed by the questionnaire reviewers, which comprise the environmental benefits obtained within the company and those that may be obtained by the final consumer during the use of the product or service. When comparing these two paths, it is possible to determine that about the latter, the positive effect of the ecoext variable is maintained, only increasing its level of significance, while concerning the environmental benefits obtained within the company, two other variables arise, with an opposite sign, ecopol and ecosub. The results associated with these variables reveal that the reduction of air, water, noise, or soil pollution (ecopol) within the company will have a diminishing effect on the TG because what it will cost the company to make this type of reduction may not compensate with the kind of results it will bring. This fact is in line not with the drivers of EI, but with one of the barriers of CE, that points to the high costs associated with the adoption of these measures as an unfavorable condition for their application (de Jesus et al., 2019; Ritzén & Sandström, 2017), a fact that may be verified in the majority of the results when showed a negative impact on TG. The reverse is possible to infer concerning the total or partial replacement by less polluting materials or hazardous substitutes (ecosub), which reveals an incremental impact on the turnover effect, and this may be a beneficial measure to be adopted by companies. This goes along with what is said by Vence and Pereira (2018), who advocate that the adoption of less harmful types of materials contributes to the development of a more eco-innovative culture within the company. Furthermore, we also have the statement of Piscicelli and Ludden (2016) who warns that if these scarcer materials start to have a high demand, it will cause their prices to increase because of their limited supply and may no longer be so beneficial for the growth of the company, because it will have to start spending more money on these types of materials.

Regarding the Organizational Innovation Capacity, which is related to the type of innovation with environmental benefits (eco-innovations) that the company could adopt within its organization, which could be summarized as Product (goods or services) innovations (ecoprd), process innovations (ecoprc), organizational innovation (ecorg) and marketing innovations (ecomkt) it was not possible to conclude anything because they did not present significantly relevant values to justify the model, in any of the regression specifications.

As for Structural Management measures, which can be summarized as voluntary actions or initiatives for good environmental practices within the company sector (enagr), it was only possible to extract some information on its behavior when the specifications for comparison between Technological Innovation Capacity, Structural Management Measures and External Drivers were imposed, or even when Organizational Innovation Capacity was compared with Structural Management Measures and External Drivers. In this case, they did not contribute favorably to growth, and consequently to the good development of the company's performance, contrary to what was expected by some authors, who referred that the introduction of this type of approach, where internal objectives and programs were established, to reach greener strategies within the company, improved its overall performance and its image towards environmental action (Pinget et al., 2015; Cai & Zhou, 2014). Possibly this can be explained by the difficulty that companies encountered in implementing these new ideas and environmentally beneficial actions so, the expected results in the short term, would not compensate for all the effort involved, which could perhaps be contradicted by a possible future study of the behavior of this variable in the long term. This meets with what was mentioned earlier and is predicted in the literature, in terms of the negative influence that the costs related to these types of initiatives will have on the company (de Jesus et al., 2019; Ritzén & Sandström, 2017).

In these last two regression specifications, it is also possible to examine how other variables such as ecoext and enrep, in the first one, and enregf and endem, in both, proceed. The extended product life through longer-lasting or stronger products (ecoext) once again proves its constant behavior throughout all the tests that were done and where it was included, affirming its positive relationship with turnover growth, as previously exposed, varying only its significance level, which in this case is 5%. The other variable that also proved to be significant (at 10% level), but only in this type of regression specification, was the one that reveals the company's competitiveness in the market, and the factor of improving the company's reputation (enrep) should have been an important aspect when deciding to implement innovation actions with the associated environmental benefit feature which could have had a positive impact on the company's TG. This is a conjuncture that reinforces what is mentioned in the literature, where it is pointed out that the greater the concern shown by the company regarding environmental issues and the closer it is to this type of action, the more associated with a green image the company will be, which will attract those who have a greener demand and that will contribute to the TG (Cai & Zhou, 2014; Bitencourt et al., 2020; Madaleno et al., 2020). It is also to reinforce the positive effect that competitiveness can have on the market, because with the

existence of several companies working for the same, they will have to work even harder to obtain the element of differentiation from the others, making the level of the type of EI increasingly high and varied, which consequently may be appealing to other companies and then they can enter this market with other types of innovative ideas (Madaleno et al., 2020).

Table 4.3: Results of the regression specifications (continued)

TG	**Coef.**	**Coef.**	**Coef.**	**Coef.**	**Coef.**	**Coef.**
ecomat	0,008	0,006				
ecoeno	0,000	-0,009				
ecopol	-0,022'	-0,024*				
ecosub	0,015	0,016				
ecorep	0,006	0,004				
ecorec	0,002	0,001				
ecoenu			0,008	0,01	0,006	0,008
ecopos			-0,015	-0,015	-0,017	-0,018
ecorea			-0,014	-0,015	-0,017	-0,017
ecoext			0,031**	0,032**	0,029*	0,03*
ecoprd						
ecoprc						
ecorg						
ecomkt						
enagr						
enetx			-0,005			
engra			0,008			
encost			0,004			
enrequ			-0,004			
enereg				0,003		
enregf				-0,006		
endem	0,011*				0,012*	
enrep		0,008				0,009
gp	-0,025*	-0,048***	-0,022'	-0,023'	-0,023'	-0,023'
co	0,007	-0,002	0,006	0,007	0,006	0,006
size	0,042***		0,043***	0,041***	0,042***	0,042***

Signif. codes: *** 0.001; ** 0.01; * 0.05; ‘ 0.1

It is becoming more and more clear the consumers' concern in acquiring products (goods or services) that do not harm the environment. Consequently, these products come from companies that have a well-defined environmental vision and that defend it as one of their main causes. Thus the importance for companies to demonstrate their activist attitude and introduce this type of concern into their company’s management strategies (Maldonado-Guzmán et al., 2020), to meet consumer preferences while taking advantage of its technological capabilities

(Azevedo & Matias, 2017). Still, it is necessary to keep in mind that these are actions that will only be beneficial if the technological development is complemented with a market opportunity (Pinget et al., 2015).

Following this panorama, there is another variable that has also proven to be advantageous whenever it was understood in the regression specifications, including these last two tests, which is the constant Greener Demand, through the current or expected market demand for environmental innovations (endem) that reinforces the idea defended previously. It is essential for companies to attend this demand model with an offer that matches this type of needs, which is revealed as one of the important factors for the adjustment of companies to these new actions and the adoption of new strategies within them (Mazzanti, 2018), always bearing in mind that the greater the demand for these products, the bigger the competitiveness among companies and vice versa.

Another explanatory variable in these two model specifications is the existence of environmental regulations or taxes planned in the future (enregf), which was shown to be unfavorable for the implementation of new EI measures within companies, since this is a circumstance that conditions the adoption of these strategies, in the sense that, later on, they may be reflected in costs for the company, through taxes or regulations to which they will be subjected (something that did not occur before) and that may represent a negative effect on the company's growth, not rewarding the investment on the adoption of this type of action. This is precisely in line with what is advocated by Arundel and Kemp (2009); and Curto (2018) who says that regulation can have the reverse effect to the one initially intended, instead of encouraging companies to adopt eco-innovation measures, if it is not clearly described, it can make them give up adopting them. This may be reflected because no political and regulatory structure is prepared to support this type of action, much due to the lack of information (de Jesus et al., 2019; Ritzén & Sandström, 2017). These results come to contradict what is supported by those who describe that with government intervention (de Jesus et al., 2019) through the establishment of public policies or any other type of regulation in favor of the environment, companies would have an incentive to more promptly establish these eco-innovation measures in their strategies (Silva, 2014; Pinget et al., 2015; He et al., 2018; Cai & Zhou, 2014), which is understood as something to be investigated so that there is more information on how to act more effectively in these situations.

As for the regression specifications that compare the External factors to the company among themselves, it is possible to confirm the results previously revealed, witnessing the positive effect on TG when faced with endem, enrep, and the negative effect when faced with

enregf, as mentioned above, only differing their significance levels, depending on the presence of the control variables, size, and gp, with these levels decreasing when they occurred in the regression specification.

It was also possible to determine, with a significance level of 5%, in a regression specification in which Internal Drivers (except Organizational Innovation Capacity) were compared with External Network factors, in which the performance of the variable that allowed the final consumer to benefit from a product (good or service) that had a positive implication in the reduction of air, water, noise or soil pollution (ecopos) during or after its use, was demonstrated as having a negative effect on the dependent variable, perhaps explained by what the implementation of strategies with this purpose would cost the company, and this could mean higher values than the benefit that such a measure would bring to the company, in terms of TG, even if this would contribute to saving the environment, concerning the aggressive and complacent attitudes of industries. Once again, the issue of high costs when implementing these measures is highlighted and also corroborated in the literature, by those who are the barriers to the implementation of EI. This is understandable because as argued by several authors, many times companies do not show enough financial capacity to keep up with technological advances and invest when, the uncertainty before what they will be able to gain from it, is still very high (Pinget et al., 2015; Curto, 2018; Arundel & Kemp, 2009). It should also be noted that this inference is in line with what was previously mentioned about small businesses since this is a very representative sample of them.

In this estimation of the model, it was also possible to prove the negative impact on TG of the implementation of measures related to the reduction of air, water, noise, or soil pollution (ecopol) regarding the environmental benefits obtained within the company and also the disadvantage that it may bring if the firm in question belongs to a group of companies (gp) - with 10% and 5% significance, respectively - as had been justified earlier. The adverse effect can be observed, as previously presented, concerning the adoption of measures that promote extended product life through longer-lasting or stronger products (ecoext) and the relationship between the company's size and its market response power (size), both with 0,01% significance.

It is important to reinforce that in general, whatever the specification of the regression, the variable maintains its behavior when compared to other variables (ecoext and endem), whether in small or large groups and, in most cases, the ones that have a higher significance level are the ones that are more consistent throughout the analysis (size and gp), maintaining their positive or negative impact, depending on what defines the coefficient associated to the variable. There are always exceptions to the rule which, on the contrary, are only shown to

explain the model according to certain specification criteria (ecopol, ecosub, ecopos, ecorea, enagr, enregf, enrep). Still, as they never proved to be significant under the previous conditions there are variables that remain to be studied, such as: the impact of reduction of material or water used per unit produced (ecomat), reduction of energy used or CO_2 produced by the company (ecoeno), the replacement of a share of fossil energy with renewable energy source (ecorep), recycling of waste, water or materials (ecorec), the reduction of energy used or CO_2 produced (ecoenu), the effect of product (ecoprd), process (ecoprc), organizational (ecorg) or marketing innovations (ecomkt), the existence of environmental taxes, charges or fees (enetx) or the existence of a public administration support, subsidies or other financial incentives for environmental innovations (engra), the impact of high costs of energy, water or materials (encost), the need to meet the requirements for public procurement contracts (enrequ), the existence of environmental regulations (enereg) and effect of cooperation within the scope of innovation activities with other companies or organizations (co).

Having said this, it is possible to infer that the hypotheses that referred to the existence of an influence of internal factors on firm's performance (H1) and external factors on firm's performance (H2) were verified, under certain conditions. The same could be upheld for the hypotheses that mentioned the influence of Technological Innovation Capacity on firm's performance (H1.a), the influence of Structural Characteristics on firm's performance (H1.d), the influence of Greener Demand on firm's performance (H2.c) and the influence of Competitiveness on firm's performance (H2.d), with the latter hypothesis representing a positive influence, while H1.a showed both positive and negative impact on the outcome and was only verified under certain circumstances. The hypotheses concerning the influence of Organizational Innovation Capacity on firm's performance (H1.b) and the influence of Financial Mechanisms on firm's performance (H2.a) were not possible to be validated due to the inconclusive results that were obtained. The remaining hypotheses, concerning the influence of Structural Management Measures on firm's performance (H1.c), the influence of Environmental Regulation on firm's performance (H2.b) and the influence of External networks on firm's performance (H3) were also proven, but not with the impact that was expected according to the literature, showing in fact an influence on firm’s performance, but in this case it would be a negative influence, due to the controversial results they revealed.

CHAPTER 5

Conclusions

After this in-depth study and in an attempt to provide an answer to the major question on which this study is based, *"What are the determinants of eco-innovation for companies in a Circular Economy context?"*, using a Tobit model that tested the selected data from the CIS, from Portuguese firms, it was possible to conclude several inferences. One of them is that not all the drivers that were determined in the literature review were likely to present a concrete answer for the investigation of the hypotheses imposed. In other words, and according to the results obtained, not all variables defined were explanatory of the model and even some that were found to be significant did not have the expected effect, i.e., for these same variables, at each additional value, there was no increase in TG, but rather a decrease in the latent dependent variable, meaning that the higher the variable, the lower the TG would be. Still, for other variables, it was possible to conclude what was predicted regarding their behavior towards TG, showing a positive relationship with the latent dependent variable, meaning that when there was an increase in the same variables, there would be, consequently, an increase in TG.

This is a representative sample of small companies, and they show to be very receptive when faced with market changes and the need to react quickly and adapt their strategies. Even so, these companies generally show greater difficulty in financial terms, which does not allow them to advance much further in their process of adopting the new measures, because adjusting them to the company's economy will mean a great weight in financial terms, which they will have some difficulty in bearing, not compensating the benefits in terms of growth and firm performance that this would bring. Although the controversial impact in negative terms, that some variables demonstrated, since this is a sample mostly of small companies, the results obtained are understandable due to the financial limitations that they may often present.

The main aspects to ascertain when comparing the literature review to the performed model are that not all EI drivers, according to the associated variables, behaved as predicted. Taking the Internal Drivers into consideration, it was not possible to prove the Technological Innovation Capacity by all the variables defined to represent it. This is a driver that can only be proven under certain conditions where the variable that represents the total or partial replacement by less polluting materials or hazardous substitutes (ecosub) and the one related with the extension of product life through longer-lasting or stronger products (ecoext) are referenced. If, in contrast, we consider the technological innovations that are related to the

reduction of air, water, noise, or soil pollution, both in the view of the environmental benefits obtained within the company (ecopol) and for the final consumer during the use of the product (ecopos) and the easy recycling of the product after use (ecorea), these have already proved to be contradictory as an EI driver, given its negative effects on firm performance. For the Organizational Innovation Capacity driver, it was not possible to determine any kind of veracity in what was described in the literature, because with the data and the methodology used there was no possibility to verify their behavior towards TG, which would reflect the influence of variables on the company's performance, so nothing can be concluded about this driver. Regarding the Structural Management Measures driver, it was possible to prove the opposite effect to what was described by other authors, in which this would be a good driver because according to the variable that represents it, the one that illustrates the voluntary actions or initiatives for good environmental practices within the company's sector (enagr), there was a negative influence on TG. The driver related to Structural Characteristics, was in a way, the most consistent with the literature. Represented by the size of the company in the number of employees, it revealed what was expected, which was that the larger the company, the higher would be the TG, associated with the adaptation of new EI strategies and the company's positive behavior towards them.

Regarding the External Drivers, as in the Organizational Innovation Capacity driver that is related to the Financial Mechanisms it was also not possible to verify any type of representative relationship between the variables that defined it and the company's performance, neither neither proving nor denying what is assumed in the literature. The same cannot be said about the Environmental regulation driver, represented by the variable that revealed the existence of environmental regulations or taxes planned in the future (enregf), which presents a controversial behavior in relation to what was portrayed in the literature, not proving to be a good driver for EI. As argued by Arundel & Kemp (2009) and Curto (2018), this type of regulations could emerge as barriers and not as drivers, when poorly specified and not properly implemented, which was the case according to the results obtained through econometric testing. Still, under certain conditions, it was possible to prove that Greener Demand, through the current or expected market demand for environmental innovations (endem), and Competitiveness, represented by the variable that exposed the improvement of company's reputation (enrep), are two good drivers of EI, according to the results obtained, as predicted in the literature.

It should be noted the negative effect of the variable representing the External Network contrary to what was expected from the literature. Differently from what had been previously proposed, the connection with other qualified entities within the area, if not made in a

coordinated and accessible way to the company, is shown as not being favorable for the company's turnover growth, within the terms of a large part of the inquired companies.

Worth mentioning that in this study, most of the predefined determinants of EI, did not corroborate other authors due to a major factor that is still defined by many as a barrier to EI. This factor is related to the costs associated with the implementation of these new EI measures in companies, which reveals that this is an element that still has a strong influence when making decisions on the introduction of this type of measures related to the environment, limiting certain types of drivers, no matter how consistent they may be.

It was possible to verify that this study served to confirm some of the previously defined discoveries and was also important to understand that there are certain areas related to this theme that should be better studied in the future, in order to confirm what is found in the literature, possibly through other more specific studies and with a different type of data.

This is an analysis that, like many others, has its limitations, such as not having a temporal verification of the results that are obtained or the existence of the simultaneity problem due to the use of cross-sectional data. If another type of data had been obtained, with more observations over time, it might have been easier to better evaluate the behavior of the variables, since some of them could indeed demonstrate a positive effect on the company's performance if they were studied over a longer period. Another limitation that was noted was the fact that this is still a very recent theme studied for the chosen country.

For future research, it is recommended to try to obtain more current data and to repeat the observations for a longer period in order to demonstrate greater precision in the estimation of the coefficients of the independent variables, not limiting the study to only one type of isolated observation in a short period of time, as it is the present case. Another suggestion for future research would be to further explore the topic in terms of EI typologies, as this is something that still appears as quite confusing in the literature. It would also be interesting to conduct another study like this one but differentiating the companies by other types of structural characteristics, such as the sector in which they operate, or even by the regions of the country to which they belong, comparing regional circular economy-oriented agendas by which they should be guided.

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