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# Drivers and barriers addressing italian SMEs toward eco-innovations. An interpretative model



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## Abstract

### Abstract

The need to pursue a model of sustainable development has become a keyword of all Western countries, related to the greater sensitivity of citizens towards environmental and social issues. Consequently, companies must adapt their products and production processes according to new logics. This adaptation, however, is no longer considered only a source of costs for companies, but also and especially an economic opportunity linked to the introduction of eco-innovations (EIs). They allow, at the same time, both to respect increasingly rigid parameters with reference to the consumption and protection of the resources used, or the emissions generated, and to pursue competitive advantages over companies that are slower to adapt to the new criteria.

For two to three decades, therefore, scholars have been interested in the phenomenon of eco-innovations, evaluating both the consequences of such EIs, and the factors encouraging companies to eco-innovate: the determinants. So far scholars paid their attention primarily on large consolidated manufacturing companies with a greater environmental impact, while less attention has been paid to SMEs; which even constitute up to 99% of the overall companies of the above contexts. In particular, the propensities to eco-innovate of innovative SMEs have not been analysed; but these SMEs are considered to have the greatest potential for the future competitiveness of an economic context.

With this in mind, this Report aims to investigate the determinants encouraging the adoption of EIs into a sample of young innovative SMEs placed in Italy. After a literature review and by applying the PLS methodology, also an interpretative model collecting and systemising determinants has been proposed.

Results are twofold. On the one hand the most relevant determinants have been pointed out (such as economic performances, regulations, incentives and subsidies, suppliers and so on). On the other side, strengths, weakness, opportunities and threats about the capacity of Italian innovative SMEs to exploit EIs were underlined. Lastly, policy and practical implications for executives and insiders were pointed out.

## Sommario

### Sommario

La necessità di perseguire un modello di sviluppo sostenibile è diventata una parola chiave di tutti i Paesi occidentali, legata alla maggiore sensibilità dei cittadini verso le questioni ambientali e sociali. Di conseguenza, le aziende devono adattare i loro prodotti e processi produttivi secondo nuove logiche. Questo adattamento, però, non è più considerato solo una fonte di costi per le aziende, ma anche e soprattutto un'opportunità economica legata all'introduzione di eco-innovazioni (EI). Esse permettono, allo stesso tempo, sia di rispettare parametri sempre più rigidi in riferimento al consumo e alla protezione delle risorse utilizzate, o alle emissioni generate, sia di perseguire vantaggi competitivi rispetto alle aziende più lente ad adattarsi ai nuovi criteri. Da due o tre decenni, quindi, gli studiosi si sono interessati al fenomeno delle eco-innovazioni, valutando sia le conseguenze di tali EI, sia i fattori che spingono le imprese a eco-innovare: le determinanti. Finora gli studiosi hanno rivolto la loro attenzione principalmente alle grandi aziende manifatturiere consolidate e a maggior impatto ambientale, mentre minore attenzione è stata dedicata alle PMI; che addirittura costituiscono fino al 99% del totale delle aziende dei contesti sopra citati. In particolare, non sono state analizzate le propensioni all'eco-innovazione delle PMI innovative, che però sono considerate quelle che hanno il maggior potenziale per la competitività futura di un contesto economico. In quest'ottica, il presente Rapporto si propone di indagare le determinanti che favoriscono l'adozione delle IE in un campione di giovani PMI innovative collocate in Italia. Dopo una revisione della letteratura e applicando la metodologia PLS, è stato proposto anche un modello interpretativo che raccoglie e sistematizza le determinanti. I risultati sono duplici. Da un lato sono state evidenziate le determinanti più rilevanti (come le performance

economiche, le normative, gli incentivi e i sussidi, i fornitori e così via). Dall'altro lato, sono stati sottolineati i punti di forza, di debolezza, le opportunità e le minacce sulla capacità delle PMI innovative italiane di sfruttare le IE. Infine, sono state evidenziate le implicazioni politiche e pratiche per dirigenti e addetti ai lavori.



Drivers and barriers addressing Italian SMEs toward eco-innovations. An interpretative model

## 1. Introduction

### 1. Introduction

The need of companies to pursue sustainable development paths has now established, at least in Western countries, as a new paradigm from which to derive new managerial, organizational and production criteria that should distinguish the operations and decision-making process of the economic units of various orders and degrees. In line with the Schumpeterian approach, the aforementioned elements of change have their roots in the implementation of innovations; in particular of innovations labelled in the economic literature as clean, ecological, environmental, green, lean, responsible, sustainable... and defined as changes aimed at dropping the consumption of resources (energy and raw materials), the impact of production activities on the environment (pollution, waste...), and improving working conditions.

The final purpose is to increase the value of goods and services intended for final consumers according to their changed expectations and sensitivity towards the external context (value appropriation).

In this view, a flourishing debate has arisen for some years around the factors (determinants or drivers) that support, stimulate, guide, direct or force companies to invest in these innovations, as well as on the subjects who should supervise the processes of adoption of the determinants with the most appropriate indications of policies.

Having said that, this contribution aims to propose an analysis of the determinants favouring the interest of companies in introducing the aforementioned innovations, which can be summarized in the most convenient and widespread acronym of eco-innovations (henceforth EIs). Specifically, the focus of the contribution is explicitly focused on small and medium-sized enterprises (SMEs); precisely SMEs of innovative natures located in Italy. The reasons for this choice are many, and derive from the scarce attention that SMEs currently find in the specialist literature. In particular, there are just few surveys already carried out with reference to the national situation, and none explicitly examining the innovative SMEs.

Generally speaking, although SMEs exhibit on average a lower environmental impact than large manufacturing companies focused on traditional productions (for instance oil, steel, cement ...), SMEs represent, in many Western countries, even 99% of all existing companies. In addition, the specific type of innovative SMEs, thanks to the high content of technology and knowledge, operate mainly in the service sectors. From this point of view, the weak attention that scholars have so far reserved to them from the environmental perspective is justified. However, as stated by seminal contributions from eminent managerial scholars (e.g. Acs et al., 2009; Storey and Greene, 2010; Audretsch et al., 2014), the development of these companies is crucial for the future competitive capacity of whole economies. Thanks to the innovative content of the production



## 1. Introduction

processes and output, in fact, these companies are the ones most likely to expand rapidly becoming gazelles, scale-ups, high-growth firms... and to favour territorial fertilization, and knowledge sharing processes (e.g. Henrekson and Johansson, 2010). Knowledge-intensity activities are indispensable to guarantee a net employment absorption and to favour the transition of the sectors of activity that today can be defined as traditional towards new sectors with still unexplored potential, and less exposed to competition from the countries called new-comers, which often benefit from differentials in the costs of production inputs.

Scholars agree to sustain that only a high content of know-how and qualitative aspects consistent with the renewed intrinsic expectations of consumers will be able to ensure the future competitiveness of companies and their economic success; therefore, acting as a driving force for entire economies. Conversely, the risk already nowadays evident is to be engulfed by increasingly intense international competition, and to relegate both companies and their external context to marginal positions in the world economy, with a further loss of well-being for the entire community.

Subsequently, the necessity of making an effort, above all cognitive, to understand how to best support the category of business in question in light of their expectations, difficulties, ambitions and potential comes to light. Moreover, despite the willingness of entrepreneurs to set out on paths of innovation, the availability of tangible and intangible resources is required, and changes in consolidated production models are assumed. All aspects that introduce elements of uncertainty in the governance of the companies, increase difficulty, and hinder the decision-making process. One more reason that underlines the importance of being able to identify, with high precision, the drivers or determinants (conversely barriers) that explain the reasons underlying the choices for implementation and dissemination of EIs within the company. This Report aims to make a contribution in this sense.

According to the aforementioned objectives, the Report is organized as follows. Section 2 discusses the role of eco-innovation as a tool for pursuing the needs of sustainable development. Section 3 refers to Porter Hypothesis, a basic concept upstream of the drivers encouraging EIs, to which reference will be made several times during the Report. Section 4 describes the theoretical framework relating to the determinants discussed in the literature and the hypotheses to be tested. Sections 5 and 6 explain, respectively, the survey and the methodology adopted and the sample analysed. Section 7 reports the findings of the investigation. Section 8 includes final considerations, limitations and policy recommendations. Last, the copious list of references used in identifying the determinants relating to SMEs (Appendix 1), the other references (Appendix 2), a list of insights on the issue (Appendix 3), and the questionnaire (Appendix 4).

## 2. Sustainable development and eco-innovations

### 2. Sustainable development and eco-innovations

Over the past three to four decades, a unifying theme that has acquired central importance in all economic discussions is that relating to the goal of pursuing a sustainable development.

The need for a sustainable development, i.e. an economic development that does not jeopardize the possibility of future generations to reach a similar level of well-being of present generations (UNEP, 2011), emerged quickly in the face of the degree of pollution and degradation of the environmental context which, in a generalized way, is affecting practically the whole world. The loss of equilibrium of the natural system is also connected to these negative evidences, with undesirable implications in terms of environmental disasters, such as floods or avalanches. Multiple alarm bells on the risks of a path with no possibility of return have led most of the central authorities to intervene with a series of measures of address, guidance, or compliance directed to the main responsible for this situation; that is, the productive activities that must meet the needs of a rapidly growing world population. This occurred both at the level of individual states, the European Union and the United Nations, supporting the exponential increase in citizens' sensitivity towards environmental issues and awareness of environmental risks.

The policy makers of many world countries have thus endorsed rather pervasive actions to tackle territorial degradation inspired by the basic dictates of the so-called green economy; i.e. the ability to generate a well-being of better quality and more equally extended, protecting natural capital through a development model based on the reduction of resources consumed, the use of renewable energy sources (RES), the recycling of waste and the emissions' reduction (Pearce, 1992).<sup>1</sup> So, in accordance with the well-known dictates concerning the sustainable development, such as Corporate Social Responsibility, and Environmental, Social and Governance, the obligation of non-financial reporting for large companies has also recently been introduced at European level (Directive 2014/95/EU). It is related, among other things, to the use of RES, the emission of greenhouses gas, impact of their activities on health and safety (Mio et al., 2015; Venturelli et al., 2017; Sun and Carroll, 2019).

From these solicitations an unstoppable widespread process of improving the conditions of use of environmental and human resources, the latter also customers of companies, has emerged.<sup>2</sup> This has immediate implications for the governance of the company, when the organizational units have to re-determine most of the management and organizational methods with the adoption of eco-sustainable methods, technologies and production processes. A dynamic loop of virtuous paths of environmental protection

## 2. Sustainable development and eco-innovations

(go-green) but also of economic opportunities; with a plurality of potential benefits ranging from strengthening the image towards customers to the obtaining public incentives. In parallel, new markets arise for companies that are dedicated primarily to the production of environmental goods and services (core-green) for other companies.

So, if in the '90s researchers wondered whether adapting to the principles of sustainable development, or being able to meet the needs of present generations without compromising the similar ability of future generations, was compatible with the pursuit of traditional business economic conditions, currently, in line with the consolidated dictates of the Italian business school (Coronella et al., 2016; 2018), it is believed that this is not only possible, but essential for the survival and development needs of businesses, and the value generation (Corazza et al., 2017; Ferramosca and Verona, 2019). This is as firms' competitiveness and the health status of the surrounding communities are in some way directly correlated (Boesso et al., 2015). This activism and interest in sustainability first of all involves nations and companies aspiring to become market leaders, first mover or to position themselves in the top level of the market, as to satisfy the needs of sustainability is nowadays considered primarily a medium-long term investment, rather than a mere cost. However, this issue, more fully discussed in the next section, is not yet unambiguously defined.

As with all investments aimed at increasing future competitiveness, the engine of these changes lies in the constant implementation of innovations. Specifically, reference is made to innovations, already defined as green, environmental, responsible, sustainable (Berrone et al., 2013; He et al., 2018) or more simply eco-innovations; here meant as "the introduction of any new or relevantly improved product (good or service), process, organizational change or marketing solution that reduces the use of natural resources and decreases the release of harmful substances across the whole life-cycle" (EIO, 2012). If, from a business point of view, there are multiple stimuli towards the adoption of EIs that are linked to a plurality of elements; both positive (differentiate from competitors, increase customer satisfaction, benefit from an incentive ...), and negative (having to comply with a rule, avoid penalties, adapt to competition...), it is true that, like every investment, EIs impact on cost and revenue configurations, actual and expected. So, consequences on economic and financial dynamics, as well as on the medium-long term competitiveness are not easily predictable.

The company's growing attention to environmental protection pushes companies to adapt their production processes and methodologies to the new criteria made available by technological progress. In this view, the issues of environmental innovations (EIs) have become a key theme

## 2. Sustainable development and eco-innovations

within the thriving multidisciplinary scientific debate on the ability of companies to pursue the Sustainable Development Goals (SDGs) while improving their competitiveness. EIs are considered a key factor supporting the development of companies along the environmental and social dimensions. EIs allow companies to comply with environmental laws and the expectations of stakeholders in terms of environmental awareness; thus ensuring greater strategic relevance of its investment choices (Bos-Brouwers, 2010; Horbach et al., 2012; Duygulu et al., 2016).

Not surprisingly, depending on the economic, financial and competitive implications associated with the implementation of EIs, which affect both the operating conditions and the strategic choices of the company, the topic has attracted the interest of numerous scholars of economic and managerial disciplines. Initially limited to large corporations due to the significant environmental impact, attention has only recently been extended to smaller companies (Mazzanti and Zoboli, 2009; Schiederig et al., 2012; Klewitz et al., 2013).

Given that the decision-making processes and the conditions of competitiveness between large and small companies do not necessarily coincide, the need for knowledge regarding SMEs is more felt in countries, such as Italy, where the incidence of SMEs in the economic system is particularly high. To date, however, the approach of SMEs towards eco-innovations is still considered a poorly analysed issue (Triguero et al., 2013; Díaz-García et al., 2015; Tang et al., 2018; Xavier et al., 2017; de Jesus Pacheco et al., 2017); at least with respect to the aforementioned quantitative consistency that they hold as a whole, and the qualitative potential of some specific categories of SMEs (Storey and Greene, 2010; Audretsch et al., 2014). In this light, the Report aims to identify, within a specific population of Italian SMEs, those of an innovative nature, the level of diffusion of EIs and the drivers encouraging their adoption. The findings of the survey are, therefore, functional both to the information need of policy makers to define an action plan towards environmental sustainability, and to that of executives to commit themselves in this direction.

Currently, most theoretical approaches aspire to discover the antecedents of firms' decision to invest in EIs at different levels, i.e. the determinants (Zubeltzu-Jaka et al., 2018; Liao and Liu, 2020; Zarthia Sossa et al., 2020). As mentioned, these studies mainly focus on large companies operating in the manufacturing sectors due to their greater environmental impact, while the EI processes of small and SMEs that make up the vast majority of initiatives in many Western economic contexts are poorly studied. Furthermore, to the best of our knowledge, no survey considers the real propensity of small businesses belonging to cutting-edge sectors to innovate from an

## 2. Sustainable development and eco-innovations

environmental point of view, despite their strategic importance. Therefore, an increasing number of researchers over the past 15 years have aimed to identify the factors that encourage or hinder the adoption of EI. However, no single body of literature has provided a comprehensive framework for examining the explanatory variables of EIs (Jové-Llopis and Segarra-Blasco, 2017; Kiefer et al., 2018; Balasubramanian et al., 2020).

With this in mind, there are three knowledge gaps that this report helps fill in this stream of research. First, it sheds further light on the determinants affecting eco-investments within the heterogeneous and diverse landscape of SMEs. As is well known, the decision-making processes of small firms can differ from those of large firms. Specifically, while investment decisions in large firms usually derive from managers' meetings or from proposals from the planning and control function, the final decision in small firms is often attributed to a single manager / entrepreneur (Triguero et al., 2016; Yang et al., 2017). They may have insufficient knowledge, skills and environmental sensitivity or may not have a specific mindset to understand and appreciate the potential tangible but above all intangible benefits of EDs. In this circumstance, therefore, greater responsibilities must be assumed towards the political decision-makers. Secondly, since it is assumed that the sector directly affects the propensity for environmental innovation (De Marchi, 2012; Berrone et al., 2013; Mrkajic et al., 2019), broadening the survey to cutting-edge sectors, different outcomes and indications could emerge with respect to the manufacturing sector most frequently analyzed. For example, it has been shown that companies' responses to exogenous stimuli differ according to their level of innovation or eco-innovative intensity (Cainelli and Mazzanti, 2013; Cagno and Trianni, 2013). Again, researchers (e.g. Xia and Wang., 2021) have verified that the disclosure of environmental and technological information already shows a negative impact on financial performance in traditional manufacturing sectors, due to the narrow parameters to be followed for these producers. Third, most empirical investigations ignore the age parameter of firms, while some researchers (Berrone et al., 2013; del Río et al., 2017; Hazarika and Zhang, 2019) have found that this is correlated. negatively with the decision to innovate because younger companies tend to hire younger staff, who normally show a greater sensitivity towards environmental issues. An open approach to sustainability supports the understanding that the adoption of IE is primarily an investment rather than a mandatory cost to avoid possible sanctions (Marin et al., 2015; Tumelero et al., 2019).

## 3. The Porter hypothesis

### 3. The Porter hypothesis

A central and preparatory point for discussions relating to the determinants of sustainable innovations is the so-called Porter Hypothesis (Porter and van der Linde, 1995a; 1995b; Porter and Kramer, 2006). As widely known, in its original formulation, the theory argues that the introduction of well-designed regulations aimed at guiding corporate behaviour from the side of sustainability have a positive effect on corporate competitiveness, since they stimulate the introduction of innovations that guarantee better exploitation of resources production, and therefore an increase in productivity. The role of regulations is, not surprisingly, one of the most analysed determinants in the literature regarding the solicitations to adopt EIs.

In so doing, this theory stands in opposition to the so-called traditional approach according to which the need of companies to ensure compliance with environmental and sustainability parameters in general determines an increase in costs; therefore, a loss of competitiveness with respect to companies that do not bear these costs or, in any case, a decrease in profitability to the detriment of the shareholders. Management, therefore, may not be encouraged to pursue this development direction.

After 35 years from its original and intuitive formulation, Porter's thesis is still controversial, as scholars are still unable to affirm or deny its veracity with certainty. In many cases, moreover, the validity of the hypothesis has been verified only subject to the occurrence of contingent or particular situations. Given that already there is a debate about what the Porter Hypothesis really says, Porter's hypothesis has been declined in three versions based on three basic questions, as suggested by André (2015):

1. Can environmental regulation foster firm's innovation? If so, is this true in general or just for some kinds of regulation?
2. Can regulation-induced innovations generate some benefits for the firms that are subject to the regulation?
3. If those benefits exist, can they be strong enough to (partially or totally) offset the cost of complying with the regulation?

A first hypothesis, called weak, argues that the regulations determine a push towards innovation but without being able to discern whether the benefits will outweigh the costs or not. So, according to the weak version, the answer to questions 1 and 2 would be generally yes and the answer to question 3 would be generally not.

The second hypothesis, so-called strong, argues that the costs of compliance with environmental regulations are in any case offset by the advantages that the company benefits from in terms of greater competitiveness (Jaffe and Palmer, 1997). The strong version is the only one that provides a positive answer to the third question. The latter question also implicitly suggests a



### 3. The Porter hypothesis

positive answer to the second question. However, even Porter and van der Linde point out that this assumption is true not for every type of regulation. Hence, to support this strong version implies the positive answer to all three questions only for some types of regulations.

A third version named narrow exists. According to this version, only certain types of environmental regulation, but not all of them, stimulate innovation. Flexible environmental policy regimes, such as market-based instruments, give firms greater incentive to innovate than prescriptive regulations, such as performance-based or technology-based standards (Ambec et al., 2013). As Porter and van der Linde stressed, in order to encourage EIs, environmental regulations should be properly designed and, more precisely, they should be flexible and focus on outcomes rather than processes. By reminding the same words of the two Authors: "If environmental standards are to foster the innovation offsets that arise from new technologies, they should adhere to three principles: first, they must create the maximum opportunity for innovation, leaving the approach to innovation to industry, second, regulations should foster continuous improvement, rather than locking in any particular technology, and third, the regulatory process should leave as little room as possible for uncertainty at every stage" (1995a: 110). Consistent with this version, the answer to question 1 is yes only for some types of regulations, but not for all. The answer to the second question is positive but conditional on having regulations that meets the first requirements. The answer to the third question is, again, generally not. Anyway, Porter and van der Linde advise that, under some circumstances, question 3 may also have a positive answer. It is likely to be positive if the environmental regulations were properly designed (Rubashkina et al., 2015).

An additional uncertainty concerns the concept of higher competitiveness underlined by Porter and van der Linde. Indeed, some practitioners interpret that, after applying the regulations, companies will obtain lower costs, others researchers that firms will gain higher profits, and others again that businesses will reach wider market share.

In summary, despite the Porter Hypothesis has attracted and continues to attract the attention of a substantial number of scholars, it is difficult to address it in theoretical terms, as well as in empirical terms, to establish its truthfulness. Anyway, some aspects to be considered from a purely corporate perspective that affect other determinants of the push towards EIs subsist.

A first aspect refers precisely to the future competitiveness of the company when it is supported by a multiplicity of intangible advantages, not immediately perceptible and difficult to quantify. Among them, for example, customer loyalty, image improvement, increase of the company's

### 3. The Porter hypothesis

legitimacy to operate. It is obvious that the weight of these intangible advantages grows hand in hand with the sensitivity of the exogenous context (collectivity) or of the end markets, of the management as well as of the company's staff.

Regarding the collectivity, citizens are increasingly sensitive to the effects of pollution and, therefore, show a growing willingness to pay a higher price for environmentally friendly products and services, or to bear economic burdens that avoid further environmental degradation; both of their own context and of other less rich contexts. Consequently, people are increasingly able to appreciate the efforts of economic organizations in this direction (value appropriation) (Petroni et al., 2018).

With regard to the SME leader, namely the founder/CEO/management, it is clear that each executive has his own sensitivity towards sustainability issues that they might be tempted to bring back into the company's management methods at the expense of other priorities. The subjective characteristics (sex, age, level of education ...) or experience (personal or collective, work experience...) of the decision makers can affect the sensitivity of each manager/founder (Barrett et al., 2021). Where certain methods of approach towards sustainability are stratified over the years in company choices, they rise to the role of a real corporate culture which therefore tends to free itself from the predispositions of the manager who decides in the specific moment, to become a behaviour style, or an identifying and distinctive element of the company. Regarding the staff, it is the protagonist in several guises; as a consumer of more environmentally friendly products and services, directly interested in improving working conditions as well as a citizen sensitive to environmental degradation, but also as a stakeholder on the positive performance of the company. It is no coincidence that these four aforementioned interlocutors, the community, management, business culture and employees, are very analysed determinants in the specialist literature.

A second aspect refers to the positive externalities that investments in EIs in any case determine for the exogenous context. In this circumstance the regulations would be a way through which national or supranational administrations shift the burden of sustainability directly onto the economic units. On the other hand, the tax charges paid by companies traditionally are the main form of state financing. Therefore, in this perspective, there would be no penalization for those companies that are subject to the regulations when, clearly, these regulations apply to all companies in a given geographical area. The problem arises for companies that are not subject to the same regulations (for instance exporters located in other countries) that, therefore, could have lower costs (unfair competition). In

### 3. The Porter hypothesis

the face of this concrete possibility, public administrations could react by imposing compliance with certain standards also on all potential exporting companies. The latter, although benefiting from differentials in production costs tout court, in particular for products and services with an absolute low cost, would instead be penalized on high quality productions where the specified intangible factors, such as reputation, normally count a lot.

A third aspect relates to the fact that the regulations should be distinguished from forms of incentive tout court, of a financial type (subsidies, tax benefits and so on) and not (e.g. access to public contracts). The incentives, albeit in a more “polite” and proactive way, have the same objective as the regulations; that is, to direct business behaviours. As we will see in section 4, researchers investigating determinants usually consider the effect of regulations and incentives separately, although they believe the former to be more effective by virtue of the compulsory compliance effect. From an entrepreneurial point of view, however, the presence of incentives is more likely to ensure a positive return on the investments made, in line with Porter’s strong hypothesis.

Having said that, without going further on the subject, we can summarize this paragraph by confirming that the established intuition of Porter and van der Linde constitutes the corner stone of the studies and research on the determinants of EIs. The investigations of practitioners on the topic discussed in the next paragraphs, however, are limited to reiterating how the regulations impact on the choices of eco-innovating, or they point out that entrepreneurs often hope to obtain economic benefits, tangible or intangible, from the introduction of EIs, but they do not check whether the regulations (or incentives) have led to an increase in the competitiveness of the company itself.

In any case, if it is true that there are no certainties in this sense, there is no doubt that the action of policy makers remains crucial to guide, if not force, the behaviour of companies in line with the needs of sustainability and reproducibility of resources for the benefit of future generations. Policy makers not only have the task of stimulating entrepreneurial action, perhaps creating the conditions for a favourable business climate, but also the duty to ensure compliance with the conditions of free competition between companies, in order not to penalize the most proactive companies on the sustainability side. Policy makers are also responsible for carefully assessing the consequences of regulatory policies translated into the coherent set of measures and tools introduced for this purpose, with the ultimate goal of achieving sustainability goals without penalizing the competitiveness of the involved companies.

### 4. Determinants of eco-innovation in SMEs

#### 4. Determinants of eco-innovation in SMEs

##### 4.1 The difficulties of identification

The confidence researchers grant in EIs as a priority way to improve the competitiveness of companies has led to the publication of a high number of contributions analyzing drivers and barriers supporting/inhibiting eco-investments. So far, scholars admit that none of these contributions appear exhaustive in representing the complex dynamics that induce companies to invest in EIs (Triguero et al., 2015; Saez-Martínez et al., 2016; Kiefer et al., 2017; Martínez-Conesa et al., 2017). Nor, perhaps, will it be possible to achieve this goal, due to the difficulties of hardening in a defined way a concept that by its nature is multiform, changeable over time, and with expected behaviors difficult to predict (Sánchez-Medina et al., 2013; Díaz-García et al., 2015; Marin et al., 2015; de Jesus Pacheco et al., 2018). Determinants affecting EIs, i.e., may differ or vary in importance, depending on the circumstances and making their identification as well as the attribution of unambiguous relevance complex.

From this view, at least eleven questionable aspects emerge. They merit to be underlined in order to correctly frame and understand the outcomes of this and other researches on this issue.

- 1) The notion of EIs is often declined with different names, such as environmental, clean, green, lean or responsible innovation. Even if we consider these terms as synonymy in this Report, sometime researchers really refer to dissimilar concepts (Klewitz and Hansen, 2013; Martínez-Conesa et al., 2017; García-Granero et al., 2018). Clearly, this eventuality alters possible of comparison between the results of the various field investigations.
- 2) A same determinant is often labelled differently. Conversely, two identical labels can refer to concepts that are different (Bos-Brouwers, 2010; Darnall et al., 2010; Kiefer et al., 2017).
- 3) A similar determinant can be read either in positive terms, as a driver favoring EIs, or in negative terms, as a barrier hindering EIs when its shortage emerges (Shi et al., 2008; Zhu et al., 2012; Seth et al., 2018; Jun et al., 2019). We cannot be sure that reading the determinants positively or negatively leads to the same behavioral interpretations.
- 4) Even though scientific literature states that each determinant could have a different impact according to the type of EI it refers (Hansen et al., 2002; Dong et al 2014; Del Rio et al., 2017), the large majority of investigations does not distinguish between incremental or radical EIs, and among those of process, product or organizational. But scholars recognise these dissimilarities can exert a distinct influence (Horbach et al., 2012; Triguero et al., 2013; Kiefer et al., 2018).

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- 5) In line with what has just been expressed, the “weight” that each determinant (or barrier) shows cannot be considered a fixed parameter, but must be evaluated from time to time in relation to contextual or functional elements which, in turn, tend to change in the time and space (Horbach et al., 2012; Schiederig et al., 2012; Bossle et al., 2016). It is easy to imagine that a period of financial difficulty, the possibility of establishing a relationship with an important customer, the issue of a new standard or an incentive ... alter the priorities of companies and, consequently, the weight attributed to the determinant.
- 6) In addition to what has been said in the previous points, the discussion on the “weight” or importance of the characteristics of the determinants on the propensity to eco-innovate should be extended to all the determinants. For example, with regard to customers and suppliers, it is obvious that their weight would vary considerably depending on whether the company is inserted in a supply chain (or forced in some way to adapt to the requests of supply chain leaders), or that it is aimed at an outlet market or fragmented supply (Klewitz and Hansen, 2014; del Rio et al., 2017; García-Granero et al., 2018).
- 7) Scientific literature, besides having identified multiple drivers (see 4.2), has also verified that they have a tendency to overlap or influence each other, even in opposite directions (Del Brío and Junquera, 2003; Klewitz and Hansen, 2014; Seth et al., 2018; Keshminder and Del Rio, 2019). This evidence, in addition to hindering the identification of the determinants considered individually, makes the company reactions unique, that is, they cannot be generalized in intensity, with respect to similar solicitations (Mazzanti and Zoboli 2009; Carrillo-Hermosilla et al., 2009; Marin et al., 2015).
- 8) Up to now, investigations have examined sometimes only one determinant, or even just an aspect of a determinant, or several drivers at the same time. An emblematic example concerns resources and skills. Occasionally they are examined as a whole, other times researchers distinguish between tangible or intangible resources, or even between the specific type of competence; such as organisational, managerial, and so on (Halme and Korpela, 2014; Cuerva et al., 2014; Aboelmaged and Hashem, 2019). Consequently, it is difficult to make comparisons between the results, while the risk of possible reciprocal interrelationships between several determinants, that can mutually reinforce or weaken, emerges.
- 9) Rarely both exogenous solicitations coming from stakeholders, and endogenous solicitations related to the availability of adequate resources and expertise are jointly investigated by researchers (Pinget et al., 2015; De Jesus Pacheco et al., 2017; Aboelmaged, 2018). In doing so, the possibility of reciprocal interrelationships between the external environment and endogenous aspects is implicitly excluded.

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- 10) As a corollary to the previous point, the features of the external context, such as the perception of the business climate, the local culture, or the socio-economic trends and peculiarities, should be specified. They affect EIs intensity (Corrocher and Solito, 2017; Park et al., 2017), making difficult both to generalize the effect of EIs, and to compare outcomes coming from different areas. However, so far, little is known about the factors and contextual settings that promote EIs and maximize their effect on regional economic performance (Autio et al., 2014; Krupoderova and Portnov, 2020).
- 11) Determinants may originate from positive motivations (differentiating from competitors, improving customer satisfaction, benefiting from an incentive ...), or negative ones (having to comply with a rule, avoid penalties, adapt to competition...). Positive motivations are believed to show higher EIs intensity (Lee, 2009; Simpson et al., 2004; Hoogendoorn et al., 2015).

By virtue of these 11 assumptions (a further assumption, number 12, is reported into the next subsection), also by considering that this issue is relatively new, it is not surprising that most of the investigations conducted so far have cognitive limitations related, for example, to the availability of data, the type and number of variables considered, and even to the adopted concept of EI.

#### 4.2 The process of selection of scientific contributions

This Report explicitly aims to identify the determinants affecting the eco-investment choices of SMEs of innovative nature. To this aim, the starting point concerns many hundreds of articles on EIs that range radically from financial and economic aspects, to other technical and technological ones. So, to identify the determinants subsequently considered, the first step was to restrict the field of analysis only to papers explicitly focused to deal with drivers affecting EIs in SMEs. Investigations concerning start-ups, or large companies, or firms indiscriminately, including SMEs, were excluded; except those in which SMEs are compared to other size firms.

We decided to consider the whole category of SMEs without focusing only on innovative SMEs as, to the best of our knowledge, there are no surveys on this specific type of SME. From our literature review emerges that only 3 surveys have been conducted on high-tech SMEs. Anyway, we have to remind the concept of innovative enterprise includes by definition that of high-tech firms, but it does not coincide with it. Even so-called traditional low-tech firms can be of innovative type.

As already reminded, scholars (Horbah, 2008; Cainelli and Mazzanti, 2013; Triguero et al., 2013) demonstrated that determinants of EIs differ among sectors (assumption number 12). So, to avoid results conditioned by the

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field to which SMEs belong, a further limitation inserted in this analysis was to exclude detailed sectors or subsectors (for instance, sector drink and subsector wine), as well as those focused on specific matters, such as energy consumption or climate change. Consistently, even case studies were omitted.

In addition, attention was paid only over works of managerial nature, taking in account all and only articles published on Journals with blind review present on February 2021 in the two known and widespread databases Scopus and Web of Science.

Hence books, chapters of books, working papers, proceedings and so on were excluded. Moreover, only English-language papers were monitored. To individuate the database, several search strings with different keywords have been designed, integrating different synonymous for EI (green, clean, ecological, sustainable, responsible), SMEs (small and medium firms, small businesses) and drivers (determinants or barriers), linked with the boolean "OR" / "AND". In this way more than two hundred articles were initially found. Anyway, not always the terms "eco-innovations", "SMEs" and "drivers" with their synonymous, were concurrently in the titles of the selected articles. Hence, before deciding to include or exclude an article in the selected database, in addition to read the title of the articles, also abstract and key words were considered. Applying all these criteria, altogether over 130 articles were found. All these articles were subsequently examined individually to understand whether they actually met the mentioned parameters set concerning the exclusions of sectorial studies, type of SMEs, case studies and so on. At the end of this work, the articles that were found to be consistent were 86. The exhaustive list is reported into appendix 1 (Reference section). This list also includes 4 literature reviews about determinants of EIs in SMEs.

These 86 articles have been published on 35 journals (Figure 1). The very high number of journals interested in the theme of eco-innovation confirms that it has now become a transversal issue affecting many disciplines, not only economic and managerial.

The two most quoted Journal (Journal of Cleaner Production and Business Strategy and the Environment) cover 29% of the total articles. It is interesting to note that the Journals more interested in publications exhibit titles underlining environment, clean production, ethic and social responsibility. This peculiarity would seem to underline how the concept of innovation is effectively becoming subordinate to the priority need of respecting the social and ethical parameters linked to sustainability.

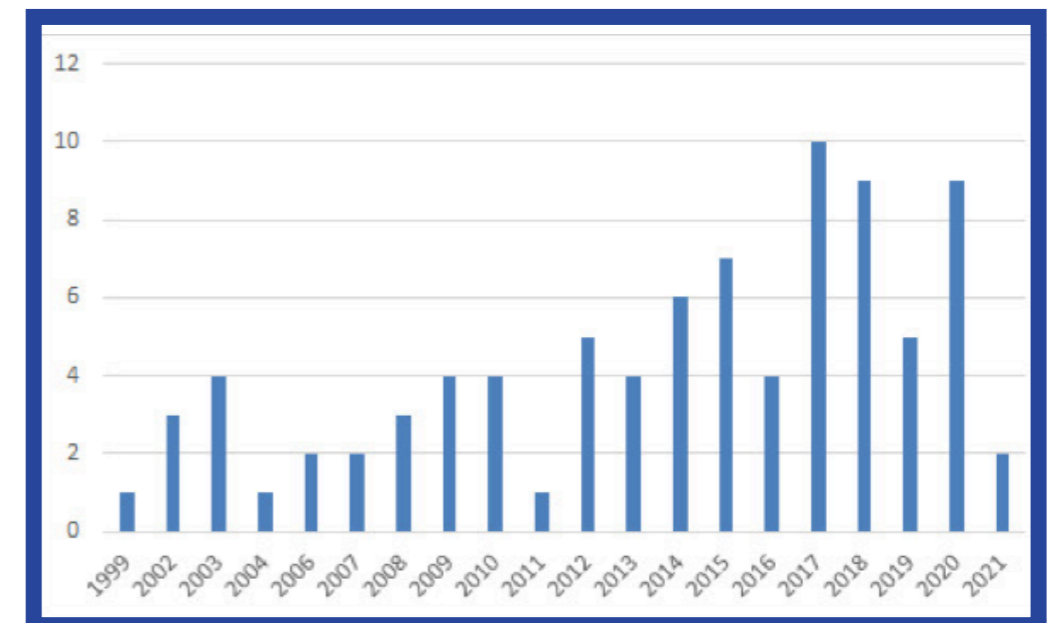
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Fig. 1 – Distribution of the 86 papers about eco-innovation by journal



Even if the first article on SMEs was edited in 1999, the majority of the contributions has been published in the last decade (Figure 2). Specifically, the years 2017 present the highest number of articles published. However, there is no a clearly growing trend, confirming that so far the scientific literature has not paid particular attention to the specific needs of SMEs.

Fig. 2 – Distribution of 86 papers about eco-innovation by year of publication



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### 4.3 Detecting the determinants

For each of the 86 selected articles, the drivers and the emerging outcomes were extracted. Then all the determinants dealt in the whole database were analysed and grouped into twenty 'categories'. We prefer to speak in terms of categories of determinants because, as explained, authors often named the same determinant with a different terminology; vice-versa, a similar label could refer to a concept somehow dissimilar. Furthermore, some authors analysed very broad determinant (e.g. corporate culture) and others very definite determinant (e.g. a type of competence or skill). Again, in many circumstances, some determinants were already grouped. A typical case is the so-called networking, which usually includes at least suppliers and customers (see *infra*).

Until now, many literature reviews (Schiederig et al., 2012; Dong and Shy, 2013; Xavier et al., 2017; Widyawati, 2019; Balasubramanian et al., 2020) or meta-analytic reviews (Hojnik and Ruzzier, 2013; Hizarci-Payne et al., 2020; Oduro et al., 2021) about the drivers of EIs have been published. By analysing these reviews, up to 79 determinants of the sustainable innovation system (Zartha Sossa et al., 2020) were detected. Some of them have been tested only recently.

Anyway, with reference to the warnings regarding this type of investigation reminded in subsection 4.1, the more the number of determinants increases, the more the probability that these drivers overlap or influence each other increases, or that they refer to hard-to-extract qualitative aspects, hence becoming unaffordable (Kiefer et al., 2018). The difficulty of considering more drivers jointly also rises due to practical and statistical difficulties (Halme and Korpela, 2014; del Río et al., 2017).

Regarding specifically SMEs, our database includes four literature reviews (Del Brío and Junquera, 2003; Klewitz and Hansen, 2014; Díaz-García et al., 2015; de Jesus Pacheco et al., 2018). They are very heterogeneous in objectives, method, number of articles considered, and results. The highest number of determinants reported in these reviews are 23 (de Jesus Pacheco et al., 2017) and 35 (Díaz-García et al., 2015).

The decision to channel all the drivers dealt by the author/s of the 86 selected articles in twenty "categories" mirrors the double necessity to be consistent with previous literature reviews, and to take in account the described warnings, reducing the risk to obtain inconclusive results when the number of evaluated determinants rises. On average, except for the four literature review, each article deals with 4 determinants, verifying if they affect investment decisions of SMEs. Anyway, in many articles just one driver is investigated.

When author/s found in their investigations to be relevant (qualitatively or

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statistically) one or more examined determinant, that is clearly and really affecting EIs, this or these drivers were inserted in one or more of the twenty identified categories.

The attribution of each determinant dealt by literature in the twenty categories tried to be as attentive as possible to the intentions of author/s, while the categories were labelled by using the name of the twenty most quoted determinants emerged from the analysis of all the determinants present within the database. However, we must point out that some determinants considered relevant by the author(s) were not considered when their denomination or concept was too far away and different from the twenty categories of determinants proposed.

Moreover, the same determinants sometimes emerged as relevant in some investigations, but not relevant in other investigations. Drivers did not find to be relevant by author/s, that is not affecting EIs or just slightly, were not inserted in the twenty categories. For instance, among determinants found not affecting EIs: Fernández-Viñé et al. (2010) and Cuerva et al. (2014) underlined the customers; Sánchez-Medina et al. (2011) the age, Linder (2016) and Aboelmaged (2018) the regulations; Aboelmaged and Hashem (2019) the firms' staff; Jun et al. (2019) the external partnership and cooperation; Jové-Llopis and Segarra-Blasco (2018) the economic performances, and so on.

Again, the same determinants sometimes deemed relevant in some surveys, that is encouraging EIs, in other surveys have been assessed as relevant in the negative sense of barriers. The drivers found to be barriers toward EIs, that is obstacles to eco-innovate, were inserted in the twenty categories since they are in every case "relevant". Many articles underline how some determinants can reveal themselves as barriers when there is a shortage of this aspect. For instance: Xie et al. (2010), Marin et al. (2015), Alvarez and Iske (2015) and Kiefer et al. (2018) underline the absence of adequate competencies; Cuerva et al. (2014) of the public support and financial constraints; Shi et al. (2008) and Thomas et al. (2021) the lack of economic incentive policies and opportune regulations; Del Brío and Junquera (2003), Zhu et al. (2012), and Pinget et al. (2015) the shortage of financial resources, and managers/staff' scarce environmental experience; Gadenne et al. (2009) and Sánchez-Medina et al. (2011) underline the lack of environmental awareness; Simpson et al. (2004) point out the absence of good economic performances; Gupta and Barua (2018) indicate the weak requests of customers not aware of the benefits of green products; van Hemel and Cramer (2002) suggest the lack of clear environmental benefit.

The heterogeneity of the determinants quoted in the examples reported in the last two paragraphs helps even more to understand how the results

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obtained by the researchers may differ according to the methodological criteria adopted, the sample analysed or its localisation. For this reason, in this Report we tried to adopt very precise and prudent operating logics. Having said that, Table 1 reports, alphabetically listed:

- I) the twenty considered categories,
- II) author/s' name who investigated the related driver, and
- III) the frequency with which these determinants were taken into account and found relevant by the 86 considered articles. This last point, reports only the number of times a determinant was deemed "relevant" by the authors of the 86 articles, regardless of the number of times the determinant has been overall investigated.

The categories are: *Competencies/skill/capabilities; Competitors; Community as whole, Culture* meant as firms' environmental awareness; *Customers, Economic performances; Environmental performances*, specific prior innovative *Experiences; Financial resource; Incentives and subsidies; Internationalisation; Investors, Management* features, such as gender of board, age, personal experiences and so on; *Personnel* (other staff); *Regulations*; presence of an internal *Research and Development* activity; *Size of the SMEs, Sector and localisation; Supplier*; external *Technological push*.

Table 1 – The determinants of eco-innovation for SMEs

N.	Category of determinants	References	
1	Competencies/capabilities/skills	Chen, 2008; Xie et al., 2010; Oxborrow, Brindley 2013; Triguero et al 2013; 2016; Klewitz, Hansen, 2014; Bocken et al., 2014; Halme, Korpela, 2014; Alvarez, Iske, 2015; Pinget et al., 2016; Diaz-Garcia et al., 2015; Marin et al., 2015; Saez-Martínez et al., 2016; Thanki et al., 2016; de Jesus Pacheco et al., 2017; Gupta, Barua, 2018; Kiefer et al., 2018; Aboelmaged, Hashem, 2019; Setiawan et al., 2019; Ceptureanu et al., 2020; Scuotto et al., 2020; Carfora et al., 2021 Valdez-Juárez, Castillo-Vergara, 2021	23
2	Competitors	Hansen et al., 2002; Zhu et al., 2012; Tang, Tang, 2012; Klewitz, Hansen, 2014; Wu, 2017; Ooi et al., 2020	6
3	Community as whole	Demirel, Danisman, 2009; Diaz-Garcia et al., 2015; Aboelmaged, 2018; Zhu et al., 2018	4
4	Culture (internal environmental awareness)	Del Brio, Junquera, 2003; Gadenne et al., 2009; Sánchez-Medina et al., 2011; Triguero et al 2013; Cagno, Trianni, 2013; Cuerva et al., 2014; Diaz-Garcia et al., 2015; de Jesus Pacheco et al., 2018; Kiefer et al., 2018; Seth et al., 2018; Jun et al., 2019; Andersson et al., 2020; Scandurra et al., 2021	13
5	Customers	van Hemel, Cramer, 2002; Côté et al., 2006; Hitchens et al., 2006; Mazzanti, Zoboli, 2009; Fernández-Viñé et al., 2010; Xie et al., 2010; Oxborrow, Brindley, 2013; Cuerva et al., 2014; Halme, Korpela, 2014; Klewitz, Hansen, 2014; Woo et al., 2014; Ardyan et al., 2017; Wu et al., 2017; Kiefer et al., 2017; 2018; Seth et al., 2018; Jun et al., 2019; Afshar Jahanshahi et al., 2020; Ooi et al., 2020; Thomas et al., 2021	20
6	Economic performances (factors affecting, such as cost-saving, competitive advantages...)	Simpson et al, 2004; Côté et al., 2006; Hitchens et al., 2006; Williamson et al., 2006; Halila, 2007; Masurel, 2007; Chen, 2008; Bos-Brouwers, 2010; Sánchez-Medina et al. 2013; Linder, 2016; Ardyan et al., 2017; Martínez-Conesa et al., 2017; Yang, 2017; Jové-Llopis, Segarra-Blasco, 2018; Zhang, Walton, 2018, Zhu et al., 2018; Colombelli et al., 2019; Wang, 2020	18
7	Environmental performances (factors affecting, such as lower pollution, resources...)	Biondi et al., 2002; van Hemel, Cramer, 2002; Lefebvre et al., 2003; Simpson et al., 2004; Williamson et al., 2006; Masurel, 2007; Chen, 2008; Sánchez-Medina et al. 2013; Woo et al., 2014; Linder, 2016; Martínez-Conesa et al., 2017; Seth et al., 2018; Geng et al., 2021	13
8	Experience (prior sustainable innovative initiatives)	Del Brio, Junquera, 2003; de Jesus Pacheco et al., 2018; Seth et al., 2018	3
9	Financial resources	Clement, Hansen, 2003; Del Brio, Junquera, 2003; Shi et al., 2008; Sánchez-Medina et al., 2011; Zhu et al., 2012; Cuerva et al., 2014; Pinget et al., 2016; Jové-Llopis, Segarra-Blasco, 2018, Pierre, Fernandez, 2018; Cecere et al, 2020	10
10	Incentives/subsidies	Clement, Hansen, 2003; Shi et al., 2008; Parker et al., 2009; Xie, 2010; Zhu et al., 2012; Cagno, Trianni, 2013; Hoogendoorn, et al., 2015; Triguero et al., 2015; Gupta, Barua, 2018; Jun et al., 2019	10
11	Internationalization (export)	Martín-Tapia et al., 2008; Keshminder, del Río, 2019	2
12	Investors	Demirel, Danisman, 2009; Halme, Korpela, 2014; Pinget et al., 2016	3
13	Management attributes (gender of board, awareness, and so on)	Del Brio, Junquera, 2003; Williamson et al., 2006; Lee, 2009; Cuerva et al., 2014; Yang, 2016; de Jesus Pacheco et al., 2017 Aboelmaged, 2018; Gupta, Barua, 2018; Chege, Wang, 2020; Mitchell et al., 2020; Singh et al., 2020	11
14	Personnel (staff soliciting management)	Masurel, 2007; Mazzanti, Zoboli, 2009; Bocken et al., 2014; Diaz-Garcia et al., 2015; Cecere, Mazzanti, 2017; Aboelmaged, 2018; Zhu et al., 2018; Aboelmaged, Hashem, 2019; Jun et al., 2019; Chege, Wang, 2020; Singh et al., 2020; Carfora et al., 2021; Thomas et al., 2021	13
15	Regulations	Gombault, Versteeg, 1999; Hansen et al., 2002; van Hemel, Cramer, 2002; Hitchens et al., 2006; Williamson et al., 2006; Shi et al., 2008; Gadenne et al., 2009; Parker et al., 2009; Fernández-Viñé et al., 2010; Xie et al., 2010; Zhu et al., 2012; Tang, Tang, 2012; Cagno, Trianni, 2013; Sánchez-Medina et al. 2013; Dong et al., 2014; Hoogendoorn, et al., 2015; Linder, 2016; Pinget et al., 2016; Saez-Martínez et al., 2016; de Jesus Pacheco et al., 2017; 2018; Aboelmaged, 2018; Pierre, Fernandez, 2018; Jun et al., 2019	24
16	R&D (presence of a business area to this activity)	Mazzanti, Zoboli, 2009; Cuerva et al., 2014; Halme, Korpela, 2014; Pinget et al., 2016; Corrocher, Solito, 2017; de Jesus Pacheco et al., 2018; Gupta, Barua, 2018, Geng et al., 2021	8
17	Size	Chen, 2008; Damall et al., 2010; Hoogendoorn, et al., 2015; Xie et al., 2010; Dong et al., 2014; Woo et al., 2014; Corrocher, Solito, 2017	7
18	Sector and localisation	van Hemel, Cramer, 2002; Lefebvre et al., 2003; Côté et al., 2006; Williamson et al., 2006; Cuerva et al., 2014; Triguero et al., 2015; Corrocher, Solito, 2017	7
19	Supplier	Mazzanti, Zoboli, 2009; Halme, Korpela, 2014; Klewitz, Hansen, 2014; Wu, 2017; Kiefer et al., 2018; Keshminder, Del Rio, 2019; Ooi et al., 2020; Thomas et al., 2021	8
20	Technological push (knowledge provided by local system)	Gombault, Versteeg, 1999; van Hemel, Cramer, 2002; Del Brio, Junquera, 2003; Mazzanti, Zoboli, 2009; Zhu et al., 2012; Buttol et al. 2012; Hansen, Klewitz, 2012; Klewitz et al., 2012; Cuerva et al., 2014; Triguero et al., 2013; 2015; 2016; Diaz-Garcia et al., 2015; Marin et al., 2015; Gupta, Barua, 2018; de Jesus Pacheco et al., 2018; Kanda et al., 2018; Kiefer et al., 2018; Jun et al., 2019; Pigozzo et al., 2020; Scuotto et al., 2020	21

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By the analysis of Table 1, we observe that just 3 contributions found as relevant, that is affecting the EIs, the “categories” (previous) experiences and serial investors. These two findings seem to disprove the hypothesis that the entrepreneur of small companies is usually a person with a background of experiences, often not positive, and who aspires to be supported by external investors (Berry and Junkus, 2010; Halme and Korpela, 2014). Being an internationalized company (to be exporters) was found relevant in only 2 cases. Probably this low value is linked to the fact that the SMEs have low internationalization level or that researchers tend to consider this aspect under the more generic heading of customers (e.g. Hojinik et al., 2018). Indeed, customers are a determinant found relevant in 20 cases. So, we suppose innovative SMEs are very sensitive to their expectations; especially when they have privileged customers with high bargaining power (B2B). It is also plausible that when clients are of the retail type (B2C), they tend to express the sensitivity of an entire territorial context.

In this regard, another category of driver explicitly considered is the community (that has been found relevant in 4 cases), here understood precisely as an expression of the sensitivity of the citizens of an area towards sustainable development. Generally, as the average income of the community increases, sensitivity towards environmental sustainability issues, respect for working conditions, and so on also grows. Even if sustainability is often seen as a luxury for the economically well-off countries, it cannot be excluded that elements of a cultural nature that have been established over the years may cause some less rich communities to be more sensitive to environmental issues than others economically stronger.

Only in 6 articles the role of competitors as possible partners or as stimulus to eco-innovate in order to differentiate the output were found relevant in 6 articles, while the propulsive effect of an own R&D function was underlined in 8 papers. This picture evidently reflects the reduced visibility of SMEs respect on the mentioned stakeholders. Furthermore, due to their dimension, SMEs usually do not possess a R&D function, even if this statement is not generalizable for this specific category of innovative SMEs. At the opposite, the most analyzed determinants concern regulations (frequency is 24), and the availability of endogenous competencies (23). Regulations refers to the system of normative and rules which lead and address the companies’ choices in terms of sustainable development. Scholars argue compulsory laws affect EIs intensity of SMEs much more than possible monetary or fiscal incentives and subsidies (relevant in 10 articles) (Díaz-García et al., 2015; Linder, 2016; Saez-Martínez et al., 2016). Researchers also underline the shortage of all the competencies necessary to implement innovations which typically affects SMEs.

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Of course many researchers paid attention to the upstream and downstream linkages. Establishing a partnership with the mentioned customers and suppliers (relevant 8 times) often is an optimal way to fill the aforementioned gaps of competencies, and even of tangible resources (Xie et al., 2010; Woo et al., 2014; Wu, 2017); included financial resources (Zhu et al., 2012; Cuerva et al., 2014; Pierre and Fernandez, 2018). The access to banking credit for SMEs, often undercapitalised, is believed crucial 10 times. Moreover, respect on other SMEs, financial needs of innovative SMEs are nowadays mitigated by the presence of the mentioned public supports or external serial investors.

About the supply side, suppliers can exert pressure on their client companies to adapt to EIs consistent with those they have already adopted or to implement their own creations (Yalabik and Fairchild, 2011; Guoyou et al., 2013). To be an SMEs, often, imply weaker relationships on this upward perspective. This eventuality could explain why the number of times in which this determinant was found to be relevant is lower when compared to the attention paid to clients.

High relevance is also devoted to technological push (21) linked to the knowledge made available by the support system of the context in which the company is located. We refer to the solicitations coming from local intermediaries, such as research centres, universities or chambers of commerce, which can become a strong driving force for small and fragile businesses; also helping them fill their endogenous resource gaps (Bjerregaard, 2009; Olsson et al., 2020). SMEs often look for the external support of these actors in order to tackle some of their challenges in eco-innovation; for this reason, these subjects are also called, as just mentioned, intermediaries (Klewitz et al., 2012; Kanda et al., 2018; Olsson et al., 2020). This result confirms the theories remarking the importance of a conducive environment for the development of small firms often lacking of all the intangible resources they need for a coherent qualitative and quantitative expansion. So, the presence of an external technological push is a mean to overpass a possible shortage of internal resources. We have to point out newly that, often, scholars jointly consider customers, suppliers and the technological push in terms of “networking matrix” (e.g. Mohannak, 2007; Mazzanti and Zoboli, 2009; Fernando et al., 2016).

Consistent with the literature on SMEs (Chen, 2008; Martinez-Conesa et al., 2017; Jové-Llopis, Segarra-Blasco, 2018), also the importance of the factors underlying the possible achievement of better economic and environmental performances is confirmed with a high frequency, respectively, of 18 and 13. To improve the environmental performances, that is a reduction in the consumption of natural and other tangible resources, harmful emissions or

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an improvement in working conditions, is a means to improve the company image, and consensus and legitimation. To invest in EIs is also believed to reduce costs, or improve productivity or competitiveness in general (Tang and Tang, 2012; Linder, 2016; Krupoderova and Portnov, 2020). Hence, the previously discussed Porter Hypothesis (section 3) seems confirmed; that is, the hope to improve the competitiveness of the firm thanks to the EIs is believed a strong stimulus to eco-innovate. Anyway, as already explained, existing literature, while often suggesting a positive relationship between EIs and firms' performance, is inconclusive.

Other determinants that researchers have considered and found relevant with average frequency concern:

- the culture (13), here meant as internal environmental awareness of the firm linked to its own image and traditions,
- the pressure coming from the internal staff (13), or
- from the view of the managers (11) towards the environment; sometimes together called industrial relations (Seth et al., 2018).

About the personnel, we refer to quadruple reminded role he has in terms of beneficiary of the improvement of working conditions, customers of the products and services made by the same firm, citizens of the local environment aspiring at a less polluted environment, stakeholder interested into the economic performances of the firm (e.g. Horbach and Jacob, 2017; Carfora et al., 2021). About the decision-making managers, we refer to those personal features (such as age, sex, individual experiences, subjective sensitiveness...) which makes them more attentive toward the investment in EIs.

Of course, also structural variables such as size, and localisation and sector have been investigated. Their frequency is for both 7; that is, their importance is not believed so crucial into the decision to invest in EIs, at least respect on the possibility to access to provider of competencies and technological support. In our sample these two variables are quite homogeneous; an aspect that will be discussed and deepened shortly.

#### 4.4 The interpretative model

In addition to what has been presented in the previous section, the analysis of the theoretical framework and of the results of the 86 articles in the database has allowed us to structure an interpretative model of the main determinants affecting the EIs choices.

The model is presented in Figure 3.

The model is based on four basic assumptions, named Stakeholders, Competitive advantage, Firms' culture, Public administrations, which enclose the main determinants underlying reasons for introducing EIs previously discussed; that is those judged the most relevant by the specialist literature

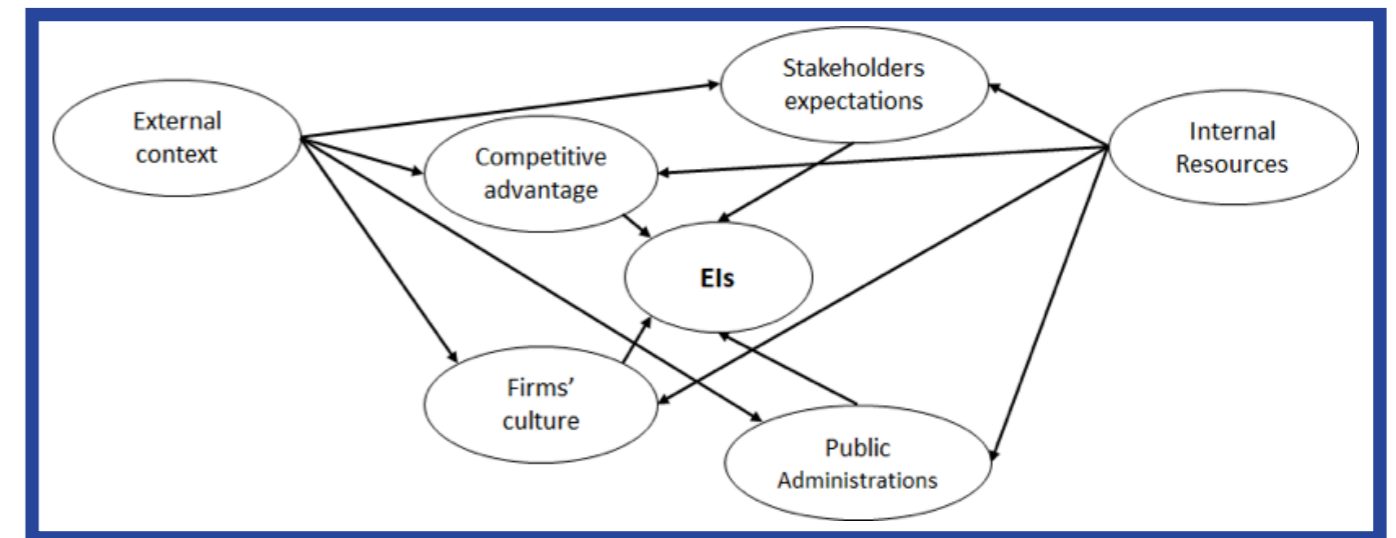
#### 4. Determinants of eco-innovation in SMEs

about the issue of drivers encouraging (or barriers hindering) EIs among SMEs. That is to say, the twenty preceding categories of determinants emerged by the literature review have been encompassed into four new classes, homogeneous by nature, covering a wide bow of reasons affecting the choices of EIs by SMEs.

Since, as just said, the determinants are substantially the reasons that explain the propensity to adopt EIs, we believe appropriate to label these four groups as key motivations. These four key motivations, in turn fuelled by the determinants, mirrors almost all the reasons that can rationally encourage SMEs to invest in EIs.

Anyway, both for reasons of consistency related to the type of driver, and to minimize the criticality linked to the risk of obtaining inconsistent results when simultaneously considering too many drivers, eleven drivers were excluded by this further grouping; Experience, Internationalisation and Community due to their low relevance. We have also to specify that, in the proposed interpretative model, to reach better environmental performances is not a driver soliciting EIs, but the final expected outcome of implementing EIs. Lastly, competencies/skills, financial resources and technological push were considered among the exogenous variables (see infra).

Fig. 3 – The conceptual model



In addition, we do not to consider the Size, Sector and Localisation. These structural variables have been measured to influence the predisposition to EIs by many scholars (Berrone et al., 2013; De Marchi, 2012; del Rio et al., 2017; Cristo-Andrade and Franco, 2019). For example, as underlined in the previous sections, it is believed that the smallest companies may not yet be adequately structured to approach the issues related to environmental sustainability in a systematic way (Cai and Zhou, 2014; Hojnik and Ruzzier



## 4. Determinants of eco-innovation in SMEs

2016; Cai and Li, 2018). These two variables were, however, exploited for further deepening of the interpretative models.

Moreover, even if the presence of an internal R&D function within SMEs can certainly help the company in the process of adopting EIs, we preferred not to insert this driver in the four groups of motivations as this function normally does not exist in other SMEs, conditioning next comparisons (Seo et al., 2017). Lastly, being the investigated sample mainly composed by micro-firms, we preferred not to consider R&D as this function normally does not distinctly exist in these very small units while management's attributes tend to coincide with firm's culture.

### 4.4.1 The key motivations

1) The first key motivation concerns to satisfy the stakeholders expectations in terms of sustainable development. Hence, this motivation is fuelled by drivers such as supplier, customer, financial intermediaries, community, and other possible stakeholders here not considered.

The first category refers to the influence of pressure groups linked to the competitive positioning of the company. On the demand side (market-pull factor), strong solicitations come from the market, being they related to other client companies (B2B) or final consumers (B2C) (Horbach et al., 2012; Hojnik and Ruzzier, 2016), where the latter are considered the most attentive to the needs of the green economy (Doran and Ryan, 2012; Yalabik and Fairchild, 2011). Disregarding the expectations of consumers feeds a high risk of exit from the firm's portfolio. In low-income countries per capita, this push is expected to be weaker as consumers' environmental awareness is mitigated by the reduced ability to pay higher prices for environmentally friendly products and services (del Rio et al., 2017; Hyatt and Berente, 2017). Likewise, on the supply side, as the degree of integration and cooperation with other firms rises, the probability of adopting EIs pushed by suppliers increases (Wu, 2017; Triguero et al., 2013; Tumelero et al., 2019). International openness is also significantly and positively associated with EIs (Hojnik et al., 2018; Abubakar et al., 2019); but in our database this determinant has emerged little considered by the literature. Reason for which, as just reminded, it was omitted in order not to further complicate the subsequent statistical analysis.

To create an image of a green institution, ethical in a broad sense, even financial intermediaries and investors show a greater propensity to finance environmentally friendly investments with increasing frequency (Johnson et al., 2012; Halila and Rundquist, 2011). In general, the entire community belonging to a specific area can develop a sensitiveness or attention toward the sustainable development embodying within its behaviour and

## 4. Determinants of eco-innovation in SMEs

expectations; in doing so influencing firms' adoption of EIs (de Jesus Pacheco et al., 2017; Marin et al., 2015).

2) The second basilar motivation is aimed to pursue immediate or future economic benefits respect on competitors slower in adopting EIs. The fact that many researchers have found the driver of economic performance relevant feeds the idea that SMEs seriously believe in this eventuality. Therefore, solicitations coming from determinants such as economic performance and competitors converge in this basilar motivation to reach, thanks to the EIs, competitive advantages (Ferreira et al., 2020; Andersén, 2021).

This aspect has been widely discussed in section 3 about the Porter hypothesis. At a purely cost-based level, it is presumed that the adoption of EIs might involve high sacrifices of wealth not compensated by similar immediate benefits. For example, investments in innovations that reduce emissions or increase safety in the workplace determine additional costs, both for investment and for day-to-day management which, impacting the cost of production, at least initially penalize adopting companies compared to non-adopting equivalents. It is, therefore, possible that the socially desirable outcome of less pollution associated with company operations will prove incompatible with the goal of maximizing profit (Horbach, 2008). However, better environmental performance and eco-innovation strategies can be a source of competitive advantage, translating into indirect economic benefits of future enhancement that pertain to other dimensions of business development (social, environmental and competitive).

In summary, there is no certainty about a possible trade-off between the pursuit of sustainable development and profitability (Doran and Ryan, 2012; del Rio et al., 2017). The economic result connected to EIs is somewhat uncertain, as it depends on unpredictable reactions from the various industrial players. A greater push towards EIs is plausible when companies aspiring to be the leader of a market segment, or want to act as a first mover in the adoption of innovations (Ahmed and Sheperd, 2010). Similarly, we can imagine that the greater the level of competition in the markets in which the company operates, the more likely it is that it feels the need to differentiate itself from competitors by adopting EIs.

3) The third basilar motivation concerns the firms' culture. The corporate culture reflects both the solicitations coming from the company staff and the predisposition and the sensitivity towards EIs expressed by the managers with decision-making power. According to previous literature reviews, it is highly possible that employees of the company stimulates the adoption of EIs (Pereira and Vence, 2012; Paraschiv et al., 2012). Anyway, as already pointed out, often corporate culture toward sustainability can be the result

## 4. Determinants of eco-innovation in SMEs

of a long process of sedimentation of behaviours and attitudes over the time, and to which human resources must adapt, regardless of their role in the company. Not by chance, there are many cases of companies, usually large, that make sustainability a distinctive and characteristic element towards the outside; for instance, with a tight pursuing of the CSR or ESG principles.

4) The fourth basilar motivation concerns the compliance with the rules provided by Public administrations at various level (national, European, international). Usually, these rules are manifested through two major guidelines which are: mandatory rules usually called regulations which impose firms to adapt to the rules (push-effect); monetary and fiscal incentives, which encourage firms to adopt EIs and other virtuous behaviours (pull-effect). This fourth key motivations encloses fundamentally these two determinants, often jointly examined by researchers.

Their rationale underlying regulations and incentives is that each innovation brings positive externalities at the territorial level thanks to fertilization and the imitative effect. In the case of EIs, environmental diseconomies are also reduced, but they are usually not valued by the market (eg pollution by emissions) (Rennings, 2000). Faced with this, public bodies have multiple tools to address the action of EIs (policy-driven eco-innovations) to favour the reduction of negative environmental externalities related to company activity.

In general, policies based on the pull-effect have a greater impact on EIs than those based on push-effect; that is to say that public regulatory policies are more effective than grants (Mazzanti and Zoboli, 2009; Hojnik and Ruzzier, 2016; He et al., 2018). Often also addressed to citizens, these rules often inaugurate new markets or strengthen existing ones (e.g. the obligation to separate waste collection or the incentives for the scrapping of old cars).

### 4.4.2 The moderators – exogenous variables

The presence of motivations can be considered as a necessary condition but not enough to assure investments in EIs. If motivations represent subjective aspects interpreted by the firms, other objective elements come into play, conditioning the behaviour of the SMEs. In this view we refer at least at two widespread and largely debated elements represented by the availability of adequate company resources, tangible (such as financial resources) and intangible (competences and skills), and by the external business climate. The availability of resources, and the solicitations coming from the whole external context represent two exogenous and more objective context variables that influence the subjective motivations to eco-innovate. Of course, these two wide exogenous context variables can both increase, and

## 4. Determinants of eco-innovation in SMEs

decrease the influence of original subjective motivations to eco innovate.

I) The first exogenous context variable concerns SMEs' resources. EIs are very heterogeneous and can range from the mere replacement of an old machinery with a new less polluting one, up to requiring significant changes in production processes.

So, for SMEs, the availability of the endogenous technological, organizational and managerial skills to implement EIs, as well as satisfactory financial resources, is less obvious than for large companies (Mazzanti and Zoboli, 2009; Wagner and Llerena, 2011; Kesidou and Demirel, 2012); slowing down the paths of adoption of EIs.

The difficulty of assessing the presence of such tangible and intangible resources tends to underestimate their weight in eco-innovation surveys; although, in some cases their weight has been proved to be particularly relevant, or decisive (Horbach, 2008; Pereira and Vence, 2012; del Rio et al., 2016).

II) The second exogenous variable concerns the external context. It includes the technological push discussed above and in general the propulsive push exerted by the whole business climate.

Since knowledge dissemination bodies, such as universities, research laboratories, chambers of commerce... are increasingly aimed at studying and deepening the issues of sustainability, it follows that in their usual relationship with companies they will tend to encourage EIs (Cainelli et al., 2012; Triguero et al., 2013).

The knowledge provided by these external sources of knowledge is judged more relevant for EIs than for other types of innovations (Horbach, 2019; Tumelero et al., 2019). As reminded in the assumption reported in sections 4.1, investigations normally do not consider this aspect, which could be crucial for SMEs engaged in innovative activities, with higher probability to be profitable, but also riskier (Autio et al., 2014).

### 4.4.3 The hypotheses

As told, each key motivation matches the availability of resources and by the external context, and just then the real push toward EIs arises. For instance, a firm having a great solicitation to differentiate its output or productive model by the competitors according to a sustainable development line will exhibit a high motivation to eco-innovate.

But if this firm suffers of a shortage of financial resources to invest, his ambition could be discouraged or even null. Vice-versa, if wide availability of funds to borrow is present in an area, firms could be further encouraged to invest. So, these two exogenous context variables were also introduced in the interpretative model (Figure 3).

#### 4. Determinants of eco-innovation in SMEs

Consistently with this setting composed of determinants, key motivations and two exogenous variables, we formulate the following hypotheses to test

- HP1a Internal resources affect the power of the motivations coming from stakeholders
- HP1b External context affects the power of motivations coming from stakeholders
- HP1c The motivations coming from stakeholders affect Els
- HP2a Internal resources affect the power of the motivations inherent the search of competitive advantage
- HP2b External context affects the power of motivations inherent the search of competitive advantage
- HP2c The motivations inherent the search of competitive advantage affect Els
- HP3a Internal resources affect the power of the motivations concerning firms' culture
- HP3b External context affects the power of motivations concerning firms' culture
- HP3c The motivations concerning firms' culture affect Els
- HP4a Internal resources affect the power of the motivations coming from Public administrations
- HP4b External context affect the power of motivations coming from Public administrations
- HP4c The motivations coming from Public administrations affects Els



#### 5. The Survey

##### 5. The survey

In order to achieve the aim of the Report, we surveyed a population of innovative SMEs registered in a specific section of the Register of the Ministry of Economic Development called "Innovative SMEs". Policy makers believe that innovative SMEs are the second evolutionary stage of innovative start-ups; or more mature companies, ready to face a phase of consolidated growth with a high potential for employment absorption and transition of the production system towards economic activities with foreseeable future development. In this perspective, as has been mentioned several times to underline the importance of these enterprises, innovative SMEs represent a crucial group of enterprises that favor the improvement of the country's competitive capacity.

##### 5.1 The innovative SMEs

With the aim of strengthening the competitiveness of the national productive structure and, in particular, of fostering a capillary diffusion of technological innovations in all sectors, Law Decree No. 3 of 24 January 2015 (also known as "Investment Compact"), converted by Law No. 33 of 24 March 2015, assigned a large part of the resources already provided for the benefit of innovative start-ups, to a wider range of enterprises: innovative SMEs, i.e. all Small and Medium Enterprises operating in the field of technological innovation, regardless of the date of incorporation and the formulation of the corporate purpose. The measures in question are open to Small and Medium Enterprises within the meaning of the Community framework (Recommendation 2003/361/EC), i.e. companies that employ fewer than 250 people and whose annual turnover does not exceed EUR 50 million or whose balance sheet total does not exceed EUR 43 million, and which meet the following requirements:

- they are established as corporations, including cooperatives;
- they are resident in Italy within the meaning of Article 73 of the Consolidated Income Tax Act, approved by Presidential Decree No. 917 of 22 December 1986, as subsequently amended, or in one of the Member States of the European Union or of the States party to the agreement on the European Economic Area, provided that they have a production plant or branch in Italy;
- they have certification of their latest financial statements and any consolidated financial statements prepared by an auditor or auditing firm registered in the register of auditors (newly incorporated companies are therefore excluded);
- their shares are not quoted on a regulated market;
- they are not registered in the special section of the Companies' Register

## 5. The Survey

dedicated to innovative start-ups and certified incubators;

the innovative content of the company is identified by the possession of at least two of the following three criteria:

volume of expenditure on research, development and innovation amounting to at least 3% of the greater of cost and total value of the output of the innovative SME.

at least 1/5 of the total workforce (employees or collaborators in any capacity) must be in possession of a doctoral degree or be pursuing a doctoral degree at an Italian or foreign university, or be in possession of a university degree and have carried out, for at least three years, certified research activities at public or private research institutes, in Italy or abroad, or, in a proportion of at least 1/3 of the total workforce, personnel in possession of a master's degree.

Ownership, also as depositary or licensee, of at least one industrial patent.

Innovative SMEs are entitled to various facilities, from the date of their registration in the special section and for a maximum of 5 years from their date of establishment. The Ministry of Economic Development offers assistances such as credit loans, monetary and fiscal incentives, and the possibility of raising capital through equity crowdfunding. By virtue of these expected benefits, the number of SMEs registering is growing rapidly.



## 5. The Survey

### 5.2. The sample

The choice of sample units based on probabilistic sampling requires that the population list be exhaustive. At 30 April 2019, 1,035 companies were registered in the Italian register of innovative SMEs. One of the main limits in the use of administrative data is due to the so-called "list errors" (e.g. Zhang, 2012; Wallgren and Wallgren, 2014) and others non-sampling errors that can introduce bias in the estimates. To avoid the presence of non-sampling errors, we must have an exhaustive and updated list that includes all active SMEs. For these reasons, all SMEs included in the register were initially contacted. Companies that could not find a website, email or phone number ( $n = 51$ ) were dropped from the list. The Italian productive system is characterized by the presence of a strong heterogeneity.

The Northern regions have a greater entrepreneurial vocation and represent the driving force of the national economic system. To control for the spatial variability in the regional distribution of firms, a stratified sampling was used, using the region (NUTS2 level) in which the SME has its registered office as stratification variable. In this way, the innovative SMEs enrolled in the registry has been divided into homogeneous subgroups. Then, the sample units were randomly selected in proportion to the size of each subgroup, reducing the sampling error. To fix the minimum sample size we consider the variability of some structural characteristics (production, capital and employees). It was set at 200 units (about 20% of the population) and includes SMEs operating in the trade, manufacturing and service sectors. Moreover, to limit the effect of total non-response we increase the minimum sample size. It was therefore set at 225 units (~ 22% of the population).

In line with the theoretical framework and similar surveys (e.g. Sanchez-Medina et al., 2011; Cai and Li, 2018), the questionnaire aimed at identifying the driving forces that stimulate EIs presents four main areas: endogenous skills, economic and environmental performances, public administration, and other stakeholders. In a preliminary step, the questionnaire was proposed and discussed by a team of six experienced researchers and business leaders who provided suggestions for improving clarity and validity. Furthermore, the questionnaire was pre-tested in five innovative SMEs. All SMEs extracted from the list by simple random sampling were asked to answer to the questionnaire (web-based) consisting of 52 questions on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) ( Appendix 4). An email was sent to the sample units presenting the survey and its objectives, as well as the concept of EI. That e-mail contained the direct link to the questionnaire and a request that the questionnaire be completed by the most informed person on the matter under consideration. In addition, to overcome the problem of common method variance, (1) we

## 5. The Survey

assured respondents (owners or managers) that we would protect their identities and (2) minimize apprehension for evaluation using a web-based questionnaire. As suggested by Tehseen et al., (2017), these procedures can minimize common method bias. The survey was conducted in June 2019. At the end of the survey period (June 30), despite reminders, three companies did not provide feedback. Some of the SMEs included in the sample expressed their reluctance to participate in the EI survey. They were promptly replaced by other companies with similar characteristics. The final sample size was then 222, satisfying the minimum sample size. Table 2 shows the main characteristics of the sample.

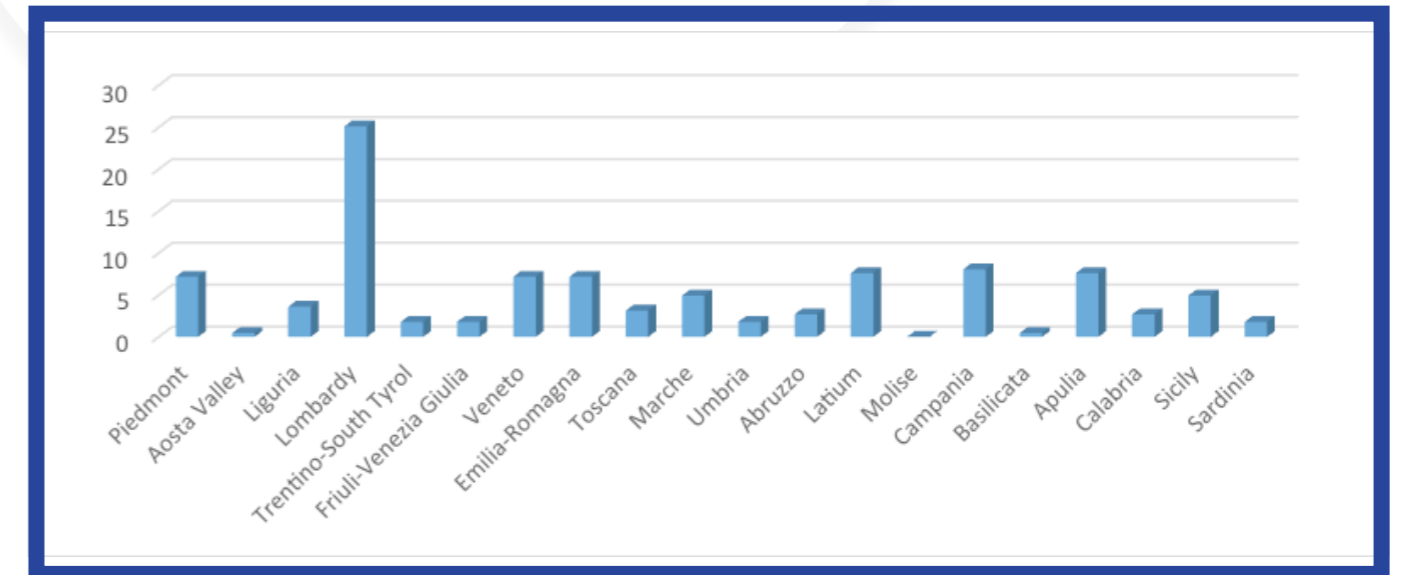
Table 2. Sample features (n=222)

Sector	Frequency (ni)	Percentage (%)
Trade	13	5.9
Manufacturing	52	23.4
Service	157	70.7
<b>Total</b>	<b>222</b>	<b>100.0</b>
<b>Turnover (thousands €)</b>		
0-100	27	12.2
101-500	68	30.6
501-1,000	39	17.6
1,001-2,000	30	13.5
2,000-5,000	32	14.4
5,001-10,000	12	5.4
10,001-50,000	14	6.3
<b>Total</b>	<b>222</b>	<b>100.0</b>
<b>Employees</b>		
0-4	72	32.4
05-09	48	21.6
10-19	51	23.0
20-49	34	15.3
50-249	15	6.8
>250	2	0.9
<b>Total</b>	<b>222</b>	<b>100.0</b>
<b>Capital</b>		
0-5,000	2	0.9
5,000-10,000	3	1.4
10,000-50,000	32	14.4
50,000-100,000	85	38.3
100,000-250,000	33	14.9
250,000-500,000	25	11.3
500,000-1,000,000	14	6.3
1,000,000-2,500,000	8	3.6
2,500,000-5,000,000	11	5.0
>5,000,000	9	4.1
<b>Total</b>	<b>222</b>	<b>100.0</b>
<b>Localisation</b>		
North		
Center		
South	117	
39		17.6
66		29.7
<b>Total</b>	<b>222</b>	<b>100.00</b>

## 5. The Survey

A large proportion of SMEs were active in the service sector (about 71%), followed by manufacturing (about 23%) and trade (about 6%). They were mainly small firms (about 75% having less than 20 employees) or micro-firms up to 9 employees, with low capitalization (55% less than €100,000) and turnover (about 60% with no more than €1,000,000). Moreover, most of them (52,7%) were located in the regions of Northern Italy. The localization at regional level is showed in Figure 4.

Figure 4. Distribution of sampled enterprises by region



To test the presence of a relationship between the business characteristics described in the previous tables and the firms' regional distribution, we employ a test based on  $\chi^2$  statistics, which confirm that the structural characteristics of the innovative SMEs are independent of the territorial breakdown: Employees  $\chi^2=14.963$ ; Turnover  $\chi^2=14.469$ ; Capital  $\chi^2= 20.092$ ; Sector  $\chi^2=2.497$ ).

Further descriptive tables based on the intersection of the data of Tables 3-5 are reported below. They will be useful for comments and interpretations in the following sections.

Table 3 – SMEs by number of employees and territorial breakdown

	0-9	10-49	50-249	>250	Total
North	56	48	12	1	117
% row	47.9	41.0	10.3	0.9	100.0
%column	46.7	56.5	80.0	50.00	52.7
Centre	18	19	1	1	39
% row	46.2	48.7	2.6	2.6	100.0
%column	15.0	22.4	6.7	50.0	17.6
South	46	18	2	0.0	66
% row	69.7	27.3	3.0	0.0	100.0
% column	38.3	21.2	13.3	0.0	29.7
Total	120	85	15	2	222
% row	54.1	38.3	6.8	0.9	100.0
% column	100.0	100.0	100.0	100.0	100.0

Table 4 – SMEs by activity sector and territorial breakdown

% row	4.3	22.2	73.5	100.0
%column	38.5	50.0	54.8	52.7
Centre	4	6	29	39
% row	10.3	15.4	74.4	100.0
%column	30.8	11.5	18.5	17.6
South	4	20	42	66
% row	6.1	30.3	63.6	100.0
%column	30.8	38.5	26.8	29.7
Total	13	52	157	222
% row	5.9	23.4	70.7	100.0
%column	100.0	100.0	100.0	100.0

Table 5 – SMEs by capital group (thousands) and territorial breakdown

	0-100	100-1,000	>1,000	Total
North	60	38	19	117
% row	51.3	32.5	16.2	100.0
%column	49.2	52.8	67.9	52.7
Centre	20	15	4	39
% row	51.3	38.5	10.3	100.0
%column	16.4	20.8	14.3	17.6
South	42	19	5	66
% row	63.6	28.8	7.6	100.0
%column	34.4	26.4	17.9	29.7
Total	122	72	28	222
% row	55.0	32.4	12.6	100.0
%column	100.0	100.0	100.0	100.0

### 5.3. Economic performance

In order to better understand the business dynamics, an analysis was also carried out on the main economic and financial indicators of the SMEs belonging to the sample obtained along the three years 2016-2018, distinguishing them according to two structural variables, which have been also considered subsequently: location and size. As previously explained, these two parameters are believed by the literature to be influential on the choices of EIs. In this case, as showed in the previous table, they allow an almost equal subdivision of the entire sample. The financial indicators taken into account are: net income and Ebitda, and the following ratios: ROI, ROE, ROS, ROA, debt ratio.

About the localization, SMEs of Northern Italy show an average value of profit

that is clearly higher than those of the Center-South, even if the Edibta is aligned (Table 6). On the other hand, it is surprising that for SMEs of Northern Italy the analysed ratios are lower on average, in the case of ROS, ROA, ROE, or aligned (debt rate and ROI) to the values of the SMEs placed in the Center-South. The consequent impression is that Northern SMEs, on average larger in size than those of the Center-South, currently have a lower return on their investments, that should be bigger in dimension and maybe in ambitions. These observations are however resumed later to explain the results of the sample survey.

Table 6 – Economic and financial performances split up for size years 2016-2018

Indicator	North	Centre-South	Italy
Net income (thousands euros)			
Mean	52.33	33.62	43.78
Standard deviation	481.51	376.01	435.62
Relative standard deviation (RSD)	9.20	11.18	9.95
EBITDA (thousands euros)			
Mean	283.38	289.06	285.99
Standard deviation	687.35	753.37	716.75
Relative standard deviation (RSD)	2.43	2.61	2.51
ROS			
Mean	1.71	5.08	3.29
Standard deviation	13.69	11.91	12.97
Relative standard deviation (RSD)	8.01	2.34	3.94
ROA			
Mean	-0.71	3.01	1.00
Standard deviation	22.40	17.07	20.17
Relative standard deviation (RSD)	31.34	5.67	20.21
ROE			
Mean	1.02	7.55	4.07
Standard deviation	34.28	26.15	30.85
Relative standard deviation (RSD)	33.61	3.46	7.57
Debt ratio			
Mean	4.12	4.35	4.23
Standard deviation	9.17	3.62	7.17
Relative standard deviation (RSD)	2.23	0.83	1.70
ROI			
Mean	5.06	6.02	5.53
Standard deviation	11.75	11.61	11.65
Relative standard deviation (RSD)	2.32	1.93	2.11

About the size, a clear difference in performance emerges between micro-enterprises with up to 0 employees and larger SMEs (Table 7). In particular, in the first case the average value of the net profit is even negative; while the ratios show performance values that are even more than half lower than those of the larger companies. Even the debt ratio is lower; it means these firms could have more difficulties to obtain loans.

By considering the structural characteristics of this type of company, these

## 5. The Survey

findings must be read in a temporal key. That is to say that innovative companies are, by definition, usually companies with a high growth rate. Therefore, it is presumed that this part of the sample basically contains the younger SMEs that are, in fact, set out on a development path. On the other hand, the age of all companies enclosed in the register of innovative SMEs is very low; reason why this variable was not considered as discriminated against with respect to economic and financial performance.

This assumption is important for the subsequent interpretation of the results of the questionnaire to which the companies have been subjected, and helps to make people understand the importance of variables such as the allocation of resources or the support offered by the external context in order to support their qualitative development and quantitative growth. We have also to underline that the incidence of micro-firms up to 9 employees is higher in the Center-South (65% of the total) than in the North (49%), as reported in Table 2.

Table 7 – Economic and financial performances split up for size years 2017-2019

Indicator	< 10 employees	≥10 employees
Net income		
Mean	-31.93	140.56
Standard deviation	159.45	620.83
Relative standard deviation (RSD)	4.99	4.42
Debt ratio		
Mean	3.40	5.29
Standard deviation	6.08	8.27
Relative standard deviation (RSD)	1.79	1.56
ROS		
Mean	2.08	4.71
Standard deviation	14.33	11.06
Relative standard deviation (RSD)	6.87	2.35
ROA		
Mean	-2.57	5.60
Standard deviation	23.37	13.90
Relative standard deviation (RSD)	9.09	2.48
ROE		
Mean	1.47	7.33
Standard deviation	29.40	32.44
Relative standard deviation (RSD)	20.00	4.43
EBITDA		
Mean	32.06	613.98
Standard deviation	111.19	987.62
Relative standard deviation (RSD)	3.47	1.61
ROI		
Mean	3.88	7.11
Standard deviation	12.70	10.39
Relative standard deviation (RSD)	3.27	1.46

## 6. Method

### 6. Method

To estimate the relationship between the four motivations and the investments in EIs, a structural model based on Partial Least Squares (PLS-SEM) was proposed. The PLS-SEM method is a prediction-oriented approach to structural equation modelling. It is a nonparametric statistical tool that can be used to assess a wide range of hypotheses. It evaluates the cause-and-effect linkages between a group of latent (i.e., unobserved) constructs, each of which is measured by one or more manifest variables.

Multidimensional notions that are thought to be the product of an underlying unobservable latent feature are referred to as latent variables. They are determined as a mixture of measurable factors that operate as markers of the underlying structures and cannot be measured directly (Khine, 2013). PLS-SEM focuses on latent constructs, which can simultaneously be dependent in some equations, and independent in some others. The use of this class of models is increasing because scientists are focused on improving the measurement of unobservable concepts and understanding the relationships and potential biases between different pieces of observable information and the measurement procedures that link this information to theoretical concepts.

In a nutshell, its statistical properties make PLS-SEM particularly useful for exploratory research settings that are “simultaneously data-rich and theory-primitive” (Wold, 1985, p. 589). It also allows researchers to model, simultaneously estimate and test complex theories with empirical data (Hair et al., 2014).

In Figure 3 the structural equation model plot is presented. It represents the underlying theory, previously explained, with the variables that are not directly measured, usually know as latent variables (LVs), which are commonly represented in structural equation model framework as ovals.

EI as well as its determinants are multidimensional concepts defined by a large set of indicators measured during the survey, or manifest variables (MVs). These indicators were grouped into the latent constructs (LV). We further assume that a change in MV reflects a change in the latent construct. In other words, we estimate a reflective PLS-SEM model. Following Coltman et al. (2008), many reasons are behind this choice; among them: i) the nature of the construct (stakeholders exist, in an absolute sense, independently of the measures); ii) the direction of causality (change in the construct causes a change in the indicators); and iii) characteristics of indicators (change in the LV must precede variation in the indicator(s)).

The analysis of this class of model are firstly based on the assessment of the two main stages of the equation system (Hair et al., 2017; Henseler et al., 2009):

- the measurement model (or outer model);
- the structural model (or inner model).

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However, before proceeding to assess the quality of the estimated model, we check for the presence of common method bias. In fact, surveys often provide the information used to measure both independent and dependent variables of an analysis. However, in these cases the estimated effect of one variable on the other risks being biased due to the common method variance; i.e. the shared systematic variance between the variables, which is introduced into the measures by the measurement method rather than by the theoretical constructs that the measures represent (eg, Richardson et al., 2009; Podsakoff et al., 2012). In the case of bias in the estimated relationship between two variables, the common method can be thought of as a confounding (or third) variable that influences both of the substantive variables in a systematic way. This may either inflate or deflate the observed relationship between the substantive variables of interest. As previously reported, to limit the risk of common method bias, we follow the procedure suggested by Tehseen et al. (2017). Moreover, we further test for the common method bias, using the single-factor Harman test (see, eg, Jakobsen and Jensen, 2015). Harman test is based on the total variance explained by the items detected during the survey, obtained through an exploratory unrotated factor analysis. The idea is that in presence of common method bias, the first factor explains more than 50% of the covariance between the items and the LV. In our case, the first factor explains about 38.75% of the total variability, excluding the presence of common method bias. In a nutshell, the analysis of the relationships among the four motivations and the EIs was first based on the assessment of the reliability and validity of the nexus between the MVs and the LVs to which they are associated, known as the measurement model. Moreover, given that PLS-SEM is nonparametric, the estimated coefficients test-statistics were obtained using a bootstrap procedure. SmartPLS 3.0 (Ringle et al., 2015) was used for the analysis. The proposed model highlights several levels. The first level identifies the multidimensional aspects not directly observable related to some of the items surveyed. These aspects, called motivational drivers, help to define the second level of the proposed model, which identifies the motivations, as a synthesis of the previous latent variables, and which impact on eco-innovation. As previously reported, exogenous contextual variables also act on motivations. The variables identified in the first level do not enter directly into the system of hypotheses to be tested, which is mainly focused on the link between the exogenous context variables and motivations and among these and eco-innovation in SMEs.

### 6.1. The measurement model

The measurement model represents the theory and specifies how the items define the theoretical aspects considered relevant. Also known as path analysis, the measurement model, summarizes the relationships between exogenous and endogenous variables.

## 6. Method

According to Hair et al. (2017) and Henseler et al. (2009), there are four criteria to be used to assess the validity and reliability of the measurement model:


- individual item reliability;
- internal consistency reliability;
- convergent validity.

Validity and reliability statistics are reported in Table 8. Results provide a clear evidence that measurement model satisfied both the criterion of internal consistency reliability and convergent validity.

### 6.1.1 Individual Item Reliability

The factor loading obtained aer useful to assess the individual item reliability. The minimum suitable loadings have to be greater than 0.4 (Hair et al., 2017; Hulland, 1999) and to the preferred level of 0.7 (Bagozzi and Yi, 1988) are acceptable. Any item below the established threshold value must be eliminated. In this report, threshold was fixed at 0.5, in line with the empirical literature specifically related to EI (e.g., Mazzanti and Zoboli, 2009; Thomas et al., 2021). Model was iteratively estimated. First, we estimated a model in which all items were partitioned into the LVs was estimated. Then, some of the indicators presented loadings smaller than the threshold level, were dropped (A4) and a new model estimation was performed. We repeated these steps until all the loadings were greater than 0.5. At the end of the iterative procedure, we observed that all of the items now considered in the measurement model presented loadings greater than 0.5 (A1-A6, R1 were progressively dropped). Therefore, items show a sufficiently strong relationship with their own LVs.

### 6.1.2 Internal Consistency Reliability

Internal consistency reliability, or the degree to which all MVs on a certain scale measuring the similar variable, is usually assessed with Cronbach's alpha and Composite Reliability. The use of Cronbach's alpha was recently criticized as it assumes that all indicators are equally reliable and have equal loading on the latent construct neglecting the individual items reliability. Therefore, Composite Reliability is regarded as the more appropriate technique to measure internal consistency reliability (Hair et al., 2017). However, we prefer to jointly consider Cronbach's alpha and Composite Reliability. Both measures fall in the range of acceptability. Thus, all the LVs at least met the acceptable reliability's threshold of 0.60. Only the value of Cronbach's alpha for the external contest is slightly lower than the acceptability threshold. However, some scholars have suggested that even lower figures of alpha estimates could be accepted (e.g. Spiliotopoulou, 2009; Bonett and Wright, 2015; Punzo et al., 2019). In this way, we can confirm the internal consistency of items. 



## 6. Method

### 6.1.3 Convergent Validity

This type of measurement criteria refers to the extent to which a set of items can measure the same latent variable in agreement (Henseler et al., 2009). Following the suggestions by Valerie (2012) and Hair et al. (2014), to assess convergent validity we consider the AVE threshold of 0.50. It means that a latent variable has to be able to explain half or more of the indicators' variability. For the purpose of the current study, the values of AVE for all constructs were between 0.657 and 0.922 (see Table 8.). Hence, the findings of AVE test of the study have exceeded the advised cut-off value of 0.50, indicating a good convergent validity.



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Table 8. Factor Loadings, Reliability and validity statistics.

Latent and Manifest Indicators	Factor Loadings	Cronbach's Alpha	Composite Reliability	Average Variance Explained (AVE)
FIRMS' CULTURE		0.837	0.925	0.860
b1	0.926			
b2	0.929			
AWARENESS		0.622	0.841	0.726
b3	0.857			
p4	0.847			
NORMS		0.840	0.902	0.755
c	0.894			
d	0.894			
s5	0.815			
INCENTIVES		0.915	0.959	0.922
e1	0.957			
e2	0.963			
PUBLIC ADMINISTRATION		0.722	0.849	0.657
e3	0.887			
e4	0.890			
s6	0.626			
STAKEHOLDERS		0.654	0.852	0.742
b4	0.894			
s4	0.842			
COMPETITIVE ADVANTAGES		0.775	0.899	0.816
q8	0.917			
s2	0.890			
CUSTOMERS		0.855	0.912	0.776
f	0.871			
g	0.922			
q9	0.848			
RESOURCES		0.928	0.954	0.874
r2	0.956			
r3	0.956			
r4	0.891			
SUPPLIERS		0.812	0.889	0.727
q4	0.795			
h	0.866			
i	0.893			
BANKS		0.794	0.903	0.824
l	0.870			
m	0.944			
PERSONNEL		0.820	0.892	0.734
p1	0.884			
p2	0.848			
p3	0.838			
EXTERNAL CONTEXT		0.598	0.833	0.713
n	0.830			
o	0.859			
EI		0.909	0.936	0.786
q1	0.910			
q10	0.825			
q2	0.912			
q3	0.898			
COMPETITORS		0.691	0.866	0.763
q5	0.887			
s3	0.861			
ECONOMIC PERFORMANCE		0.839	0.904	0.761
q6	0.909			
q7	0.930			
s1	0.768			

## 6. Method

### 6.2 Structural model

Assessed the quality of the measurement model, we have to evaluate the quality of the structural model by examining:

- the full collinearity,
- the determination coefficients (R2 and Adjusted R2) of the endogenous latent constructs,
- the effect size (f2),
- the path coefficients.

#### 6.2.1. Full collinearity

To test the presence of collinearity, the approach proposed by Kock and Lynn (2012) with the full collinearity test was used. This approach follows a comprehensive procedure that evaluates both vertical and lateral collinearity (Table 9). There are no rules of thumb in the literature on the threshold value of the Variance Inflation Factor (VIF) (eg, O'Brien, 2007).

Hair et al. (1995) suggest that the maximum acceptable level of VIF is 10, Becker et al. (2015) argue that value above 5 are acceptable, while Kock (2015) suggests that VIF values should be close to 3 and lower. In the estimated model, almost all the LVs have a VIF below 3. Some of LVs (competitors, customer and economic performance), instead, present a VIF higher than 3 but lower than 5. Following the criterion suggested by the literature we can exclude the presence of collinearity.

Table 9 – Full collinearity test

Latent Constructs	EI	Competitive advantages	Firms' Culture	Public Administration	Stakeholders
Competitive advantages	2.486				
Awareness			2.056		
Banks					1.705
Competitors		3.898			
External context		1.448	1.333	1.539	1.970
Firms' Culture	1.949				
Customers					3.296
Incentives				1.314	
Norms				1.401	
Public Administration	1.323				
Economic performance		3.680			
Personnel			2.357		
Resources		1.962	1.750	1.502	1.636
Stakeholders	2.774				
Suppliers					2.941

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### 6.2.2 The determination coefficients and the the effect sizes

Another criterion to assess the quality of the structural part of the model is based on the determination coefficients (R2 and Adjusted R2) of the endogenous LVs. In PLS-SEM, R2 can be interpreted similar to any multiple regression analysis indicating the amount of variance in the endogenous LVs explained by its independent variables and can be classified into three levels: low if  $R^2 < 0.20$ , moderate if  $0.20 < R^2 < 0.50$ , and high if  $R^2 > 0.50$  (eg, Chin, 1998).

Table 10, Determination coefficients and effect sizes

Endogenous Latent variables	R-square	Adjusted R-square	f <sup>2</sup>
EI	0.629	0.617	
Competitive advantages	0.842	0.840	0.234
Firms' Culture	0.505	0.496	0.063
Public Administration	0.612	0.605	0.003
Stakeholders	0.555	0.545	0.050

In the estimated model, the adjusted R2 are between 0.496 and 0.840 (Table 10), indicating a high relationship between the motivations considered and the outcome variable.

The change in the value of determination coefficients when a certain exogenous being omitted from the model is known as effect size (f2). It also offers a measure of practical significance in terms of the magnitude of the effect, independently of sample size. Following the guidelines proposed by Cohen's (1988),  $f^2 \geq 0.02$ ,  $f^2 \geq 0.15$ , and  $f^2 \geq 0.35$  represent small, medium, and large effect sizes, respectively.

It is interesting to observe that effect size is just above the lowest threshold indicated by Cohen (1988) only for Public Administration. Competitive Advantages has the biggest (medium) effect size in the model, followed by Culture and Stakeholders, both with small effect sizes.

#### 6.2.3 Significance of the estimates

The preliminary analysis on the quality of the estimated model (reliability and validity of the measurement model; adjusted R2 and effect sized (f2) of the structural model), confirm that the model is correctly specified. Therefore, it can adequately explain the hypothesized relationship among the motivations and the EI in SMEs.

Since PLS is a nonparametric method, significance levels for the parameter estimates are not suitable. Instead, resampling procedures such as bootstrapping is used to obtain information about the variability of the parameter estimates. To test the significance of the estimated coefficients (path

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coefficient) related to the research hypotheses, a bootstrapping technique employing 6,000 sample replications was used. Table 11 reports the estimated path coefficients, the standard errors, the p-values.

Table 11 – Hypotheses, path coefficients, standard deviation, t-statistics, p-value.

	Path coefficient	Standard deviation	t statistics	p-value
<i>Motivations and motivational drivers</i>				
Competitive advantages → EI	0.465	0.064	7.276	0
Econ perf → Competitive advantages	0.505	0.065	7.726	0
Competitors → Competitive advantages	0.408	0.065	6.27	0
Public Administration → EI	-0.04	0.045	0.873	0.383
Incentives → Public Administration	0.573	0.08	7.147	0
Norms → Public Administration	0.195	0.05	3.906	0
Firms' culture → EI	0.213	0.062	3.434	0.001
Awareness → Firms' culture	0.284	0.085	3.343	0.001
Personnel → Firms' culture	0.368	0.084	4.391	0
Stakeholders → EI	0.227	0.077	2.949	0.003
Suppliers → Stakeholders	0.19	0.096	1.992	0.047
Customers → Stakeholders	0.304	0.087	3.487	0.001
Banks → Stakeholders	0.043	0.066	0.649	0.516
<i>Exogeneous Variables</i>				
External context → Competitive advantages	-0.01	0.036	0.268	0.789
External context → Culture	0.047	0.07	0.666	0.505
External context → Public Administration	0.173	0.052	3.319	0.001
External context → Stakeholders	-0.044	0.067	0.665	0.506
Resources → Competitive advantages	0.066	0.041	1.603	0.109
Resources → Firms' culture	0.126	0.068	1.85	0.065
Resources → Public Administration	0.05	0.049	1.037	0.3
Resources → Stakeholders	0.361	0.056	6.434	0

Focusing on motivational drivers, i.e. the LVs that define the motivations, we observe that almost all are significant. Only Banks present a not significant relationship with the underlying motivation (stakeholders).

By the analysis of the motivations, instead, emerge that Stakeholders, Firm's culture and Competitive Advantages present a significant relationship with eco-innovation, confirming the hypotheses that motivations act positively in companies' choices to invest in sustainable innovations.

On the other hand, and consistently with the literature (e.g. Thomas et al., 2021), the Public Administration does not influence the outcome variable.

Unexpectedly, almost all the exogenous context-related variables do not present a significant relationship with motivations. Only the links between the resource on stakeholders and the external context and public administration are significant.

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### 7. Findings

By the analysis of Table 11 emerge that not all motivations affect innovative SMEs in their decisions to invest in EIs. Anyway, statistical evidence confirms the basic coherence of the model when, as expected, three of the four key reasons refer to the eco-innovation choices (HP1c, HP2c, HP3c). Instead, public administration (HP4c) is not significant; but this is not a surprise, rather a confirmation.

Indeed, this last outcome is consistent with very recent similar surveys on the same territorial reality (Carfora et al., 2021; Thomas et al., 2021), when public administrations results even to have a negative effect on the eco-innovation choices of companies. That is to say that the action of public administrations seems to hinder the eco-innovative paths of businesses. This observation is linked to a series of interventions proposed by policy makers but unrelated to the actual needs of companies or their operational logic, or not accompanied by bureaucratic procedures or the availability of resources consistent with what was promised. As a result, businesses risk being sidelined by uncertainties such as the timing of grants; while investment programs require certainties. As repeated several times, the proposition of ad hoc rules with respect to the requests of the beneficiaries is a fundamental point in the validity of the Porter's Hypothesis. In Italy, on the other hand, the operations of public administrations, particularly in many southern and central areas, have never been considered, at least in recent decades, as a strength in support of the competitive capacity of Italian companies; if anything, the opposite. All this is truer for SMEs, notoriously more fragile and conditioned by contextual situations.

Furthermore, confirming what has just been said, again for the first 3 key motivation (HP1b, HP2b, HP3b), the results show that the external context is not considered influential by SMEs. This means that these companies, in order to satisfy the requests of stakeholders, to seek forms of competitive advantage to be asserted towards competitors, or to support their values or sensitivity towards environmental sustainability, do not rely on the system of intermediaries present locally, nor on the system of interlocutors that constitutes the economic system as a whole.<sup>3</sup> SMEs have to rely only on their own skills or resources. Consequently, the interviewees do not believe they are living in a context with a business climate appropriate to their needs.

The fact that the external context is significant only in the case of the fourth key motivation relating to Public Administrations (HP4b) further strengthens this assumption. From the side of the benefits granted or the adjustment to the regulations, the SMEs probably believe they have to rely on the actors of the external context. This support could be evident, for example, into preparing business plans, investment plans and project initiatives; all the more so since the disbursements are often linked to partnerships of various types with institutional

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actors. That is to say, the SMEs would seem passive waiting for stimuli from the outside; unable to propose themselves independently. In line with what has been said above, however, at the moment these external actors do not have, on the whole, the ability to concretely support companies.

The significance of HP4b can also be read from the opposite point of view, always with a negative meaning. National public administrations are not able to devote to the economic units directly but seek the intervention of other territorial actors to whom they can delegate supervisory and control tasks. The latter, however, are not, on the whole, up to the task; further penalizing the eco-innovation choices of companies. Conversely, since efficiency usually recalls for efficiency, it appears plausible that more efficient public administrations would be able to issue rules more suited to the needs of SMEs (eg, Fadic et al., 2019). This would not only make the presence of any intermediaries superfluous, but it would also guarantee a greater predisposition of companies to adapt to these rules, because they are considered correct but also consistent with corporate interests.

Overall, therefore, a clear distrust of public administrations emerges both in direct and indirect terms: public administrations seem not able to satisfy the need of innovative SMEs through suitable regulations and benefit, neither they are enough able to act as coordinators and organizers of a support system for the development of SMEs. These are two serious gaps precisely for the smaller economic units with a high innovative content. The established theses relating to the establishment of territorial ecosystems to support firms with a high potential and probability of development assume an effective and active role of public administrations (Isenberg, 2011; Autio et al., 2014; O'Connor et al., 2018).<sup>4</sup> Compared to these theses, that see Public Administrations as directors and coordinators of development processes, in Italy the public administrations seem to have freed themselves from these tasks. Their action is limited to a bureaucratic activity, such as the granting of monetary incentives or fiscal benefits, which does not respond to the actual needs of SMEs. But tax relief for SMEs is not necessarily the best response to SMEs requests; for instance, as the hypothesis they suffer severe financing constraints is not overwhelming (Manzo, 2011).

Regarding the influence of internal resources, they are significant in two cases. HP1a (resources that influence the key motivation called stakeholders), is in line with expectations. Meeting the requests of stakeholders from the side of corporate sustainability requires an effective possibility of resources to be dedicated to the purpose. Conversely, the ambitions of firms risk to be frustrated,

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with obvious consequences of legitimacy and image. An aspect that increases the responsibilities of public administrations.

The non-significance of HP2a, the internal resources that influence competitive advantages, underlines an overall positive attitude. Consistent with what has already emerged in the analysis of the key factors, the high response confidence in EDs as a means of differentiating oneself from the competition seems to be the primary motivation for the drive towards EIs. A goal that SMEs believe they must pursue regardless of the resources' availability.

Instead, the significance of HP3a, the internal resources that influence the key motivation firms' culture, could suggest that social and environmental issues are a "luxury" that can only be accessed by companies that already have adequate resources or that demonstrate valid economic performance. If confirmed, this result would be the opposite of what is desirable.

Finally, the non-significance of HP4a (the internal resources that refer to the key motivation Public administrations) indicates that adapting to the precepts of the regulations or to benefit from the incentives provided does not presuppose a prior availability of tangible or intangible resources. That is, there are no economic or knowledge barriers to accessing benefits or implementing regulations. Definitely a positive element that dilutes the previous judgments. In summary, the picture that emerges is that of SMEs which, by their intrinsic nature, are aware of the importance of IEs as a tool both to meet the expectations of their stakeholders and to differentiate themselves from the competition. Their objectives in the direction of sustainable development, however, would seem limited by the capacity of public administrations, as well as the external economic context in general, to meet the needs of SMEs. A very important constraint when it comes to innovative SMEs; as such, it needs to be addressed by policy makers.

### 7.1. A deepening: the effect of structural variables

In order not to further complicate the model, at the risk of making the results unreliable, previously we told we decided not to consider the structural variables directly in the interpretative model proposed, but only subsequently. In this section, we consider the effect of the variables localization and size; while we cannot also consider the variable sector since the SMEs in the analysed sample are 94.1% active in the service sector, compared to 5.9% in the manufacturing sector.<sup>5</sup>

The first distinction we have considered relates to companies located in Northern Italy (53%) compared to those located in Central and Southern Italy (47%). As widely known, Northern Italy as a whole is considered an area that boasts an overall better business climate than that of the Central and South. Furthermore, the higher level of GDP per capita of the population, the greater

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incidence of economic activities, the better infrastructural, the greater presence of financial intermediaries, the greater inclusion in international commercial circuits and so on, give the North the most favourable characteristics for corporate location; especially larger companies (e.g. Calignano and Quarta, 2015). Comparing the significance of the assumptions with respect to the data relating to the entire sample, three differences emerge. HP2a Internal resources compared to the key motivation competitive advantages is significant in the North; while in Central and Southern Italy the HP4a Internal resources compared to Public administrations, as well as HP4b External context on Public administrations are, respectively, significant and insignificant.

With regard to HP2a, the fact that in the North, an area notoriously closer to being a business climate than the rest of Italy, this hypothesis is verified suggests that the SMEs located in this area seek clear elements of differentiation that require the availability of consistent financial resources and skills.

The fact that HP4a is confirmed only in the Central-Southern areas underlines that, in line with what has been said in the previous sections, the possibility that any existing benefits or regulations are not fully compliant with the characteristics of the SMEs located in these areas, or that the lower availability of resources of these companies compared to the equivalent in the North, may have an effect on their behaviour. For instance, as pointed out later, they tend to apply cheaper EIs. This assumption is consistent with what is already known in the economic literature about the lower average level of material equipment and skills of Southern companies compared to the equivalent Northern ones. Therefore, in order to adapt to the regulations or benefit from any incentives, the SMEs of the Central and Southern Italy need to resort to external support. HP4b, that is motivations coming from the Public Administrations are not affected by the external context in the Centre-South, attests once more how the external context is, unfortunately, completely irrelevant on the choices of innovative SMEs in terms of eco-innovations. That is to say, it is not considered to positively support firms. The SMEs of the Centre-South are now used to act without the supports of the external context, and to rely fundamentally on themselves. This indication, however, cannot be judged favourably. As these are largely micro-enterprises, this means that these SMEs, presumably, will have to limit their ambitions and investments.<sup>6</sup>

The second analysed variable is, as mentioned, the size. In this regard, we preferred to use the number of employees rather than turnover or capital, both for consistency with the definition of small and medium-sized enterprises adopted, and because the sample is divided almost in half between micro-enterprises, SMEs up to 9 employees (54 %), and SMEs with a number of employees between 10 and 250 (46%).

In this case we have four differences compared to the entire sample that affect

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only the larger SMEs (those placed mainly in the North). A first interesting aspect is to note that HP1c (stakeholders affecting EIs) is not significant for these SMEs. Probably the greater size of the firms determines a certain independence from the requests of the stakeholders in terms of environmental sustainability; as if the company already had its own identity. This, of course, does not mean that the company is not interested in pursuing sustainability; far from it, perhaps it is already very ahead on this path that it does not need attestations from external interlocutors. A confirmation of this hypothesis is linked to the non-significance of HP3a (internal resources affecting firms' culture). Having one's own distinctive image in terms of sustainability is a characteristic and non-negotiable aspect, much less influenced by the lack of resources; a strategic priority to be pursued. HP2a (internal resources affecting competitive advantage) also offers a contribution in this direction, as the largest SMEs deem it necessary to have resources to invest in EIs to give rise to differentiation from competitors. This need is evidently less felt by micro-enterprises that often live in market niches not in direct competition; with foreign competitors in particular. The HP4b, External context affecting Public administrations, is also confirmed only for larger SMEs. An explanation probably linked to the fact that while micro-enterprises may be somehow less constrained by regulations, and perhaps even less subject to public subsidies and benefits; while larger and more visible SMEs obtain advantage (or disadvantage) from being in systematic networking with interlocutors and intermediaries in the external context.

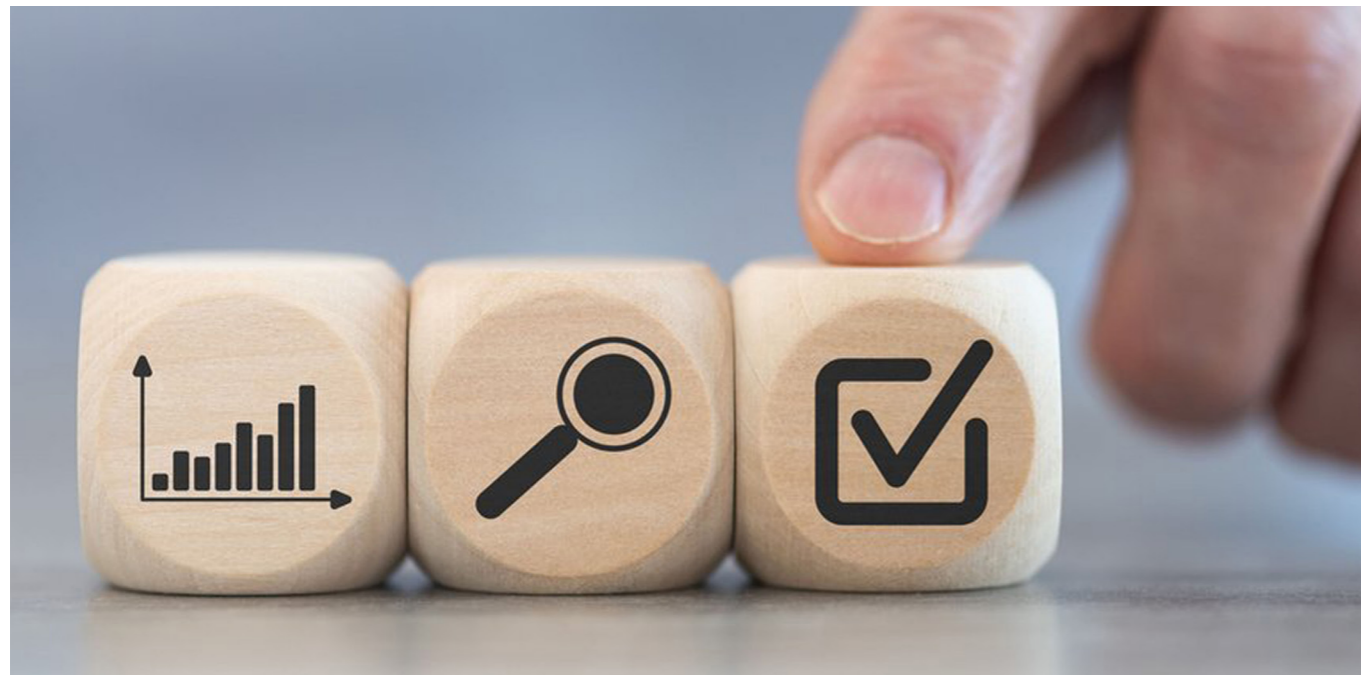
Table 12 – Hypotheses tested by subgroups of enterprises

Hypotheses	Confirmed/not confirmed				
	Overall sample (n=222)	North (n=117)	Centre-South (n=105)	Small (<10 employees) (n=120)	Medium (10 and over) (n=102)
HP1a Resources → Stakeholders	Confirmed	Confirmed	Confirmed	Confirmed	Confirmed
HP1b External context → Stakeholders	Not confirmed	Not confirmed	Not confirmed	Not confirmed	Not confirmed
HP1c Stakeholders → EIs	Confirmed	Confirmed	Confirmed	Confirmed	Not confirmed
HP2a Resources → Competitive advantage	Not confirmed	Confirmed	Not confirmed	Not confirmed	Confirmed
HP2b External context → Competitive advantage	Not confirmed	Not confirmed	Not confirmed	Not confirmed	Not confirmed
HP2c Competitive advantage → EIs	Confirmed	Confirmed	Confirmed	Confirmed	Confirmed
HP3a Resources → Firms' culture	Confirmed	Not confirmed	Not confirmed	Confirmed	Not confirmed
HP3b External context → Firms' culture	Not confirmed	Not confirmed	Not confirmed	Not confirmed	Not confirmed
HP3c Firms' culture → EIs	Confirmed	Confirmed	Confirmed	Confirmed	Confirmed
HP4a Resources → Public administrations	Not confirmed	Not confirmed	Confirmed	Not confirmed	Not confirmed
HP4b External context → Public administrations	Confirmed	Confirmed	Not confirmed	Confirmed	Not confirmed
HP4c Public administrations → EIs	Not confirmed	Not confirmed	Not confirmed	Not confirmed	Not confirmed

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At the end of this section we can state that the strength of the key motivations towards EIs is only marginally influenced by the two external context variables. In particular, their influence is almost negligible for micro-enterprises located in the Centre-South, but more evident for the more structured SMEs located in a more dynamic environment of North. This statement, also by referring to the discussed economic and financial performances, reflects two important basic assumptions: 1) a fundamentally negative view of the exogenous context and of the action of public administrations, that is which does not support the search for the competitive levers of innovative SMEs helping their development and growth; 2) the low relevance of internal resources of innovative SMEs for their sustainable development projects.

A corollary of these two assumptions is that the EIs endorsed by SMEs are not, on average, those positioned on the knowledge frontier. These innovations, in fact, require both substantial investments and very high skills, and the support of the so-called intermediaries of the external context. A second assumption is linked to the fact that the needs of innovative micro-enterprises are quite different from those of larger SMEs; for instance, SMEs have modest economic and financial performances which urge for external support to continue the investments programs. A third observation concerns the enterprises of the Centre-South, which seem to operate in a marginalized way, in market niches, rather than in an open and competitive way; but this aspect could be related to their small average size (Table 2). Fourthly, as cross-instrumental policy mix has a stronger positive effect on process eco-innovations than the impact of general innovation policy instruments alone, both in the short and long term (Greco et al. 2020), a synergic interrelationship among general innovation policies and environmental policies is requested.



## 8. Conclusions

### 8. Conclusions

#### 8.1 Discussion

The issue of eco-innovations (EIs) is one of the main topics in almost all economic discussions among scholars, practitioners and policy makers. The explanation is linked to the fact that the EIs represent the junction point of different needs that come from various interlocutors at multiple levels.

On the institutional side, the need to promote an economic growth compatible with sustainability's principles and to safeguard the natural resources has been evident for several years. On companies' side, in the face of the constant incentive to innovate determined by the increasing intensity of competition at an international level and according to the established assumptions of Schumpeter's thesis, it is now well shared among scholars that firms' growth processes must be compatible with the needs of sustainable development. Currently, these needs normally find expression in well-defined standards, such as Corporate Social Responsibility, or Environmental, Social and Governance, and / or the drafting of specific social reports.

One way to reconcile the highlighted requirements is to adopt and implement innovations defined from time to time as clean, environmental, green, responsible... in a word eco-innovations.

From the perspective of the institutional interlocutors, EIs can guarantee a fundamental contribution to the pursuit of the 17 Sustainable Development Goals (SDGs) Agenda by the United Nations, which aim to promote and develop actions crucial for the humanity and the planet over the next 15 years. The desired introduction of new products or production methods can help reduce the levels of pollution and waste associated with production activities. Consequently, institutional authorities at various levels are constantly proposing increasingly stringent regulations (or incentives) to which companies must conform their behaviour. Not surprisingly, about the 37% of the funds provided by PNRR, formally announced by the EU, will be used to promote the green deal and sustainability projects.

Seminal contributions by Michael Porter have pointed out since '90s that this trend does not necessarily imply an increase in costs respect to companies that for some reason do not have to comply with regulations. The increased awareness of consumers towards sustainability issues, in fact, makes the products of these companies more desired; albeit with a higher cost. Even if the question about the validity of this hypothesis has not yet found a univocal answer, it remains essential to understand the reasons, usually called drivers or determinants (vice-versa barriers), that can encourage companies to adopt EIs to which, as just mentioned, the creation of positive externalities for the external environment is associated.

Anyway, although EIs have received much academic interest in recent years, our 

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understanding of why some organizations adopt these innovations and others do not is still underdeveloped. With this in mind, this study examined a sample of 222 young so-called innovative SMEs registered in a special register created only in 2015 and managed by the Italian Ministry of Economic Development which, currently, includes about 1,000 companies but is speedily increasing. Although these SMEs tend to show a low environmental footprint, at least compared to large manufacturing companies operating in traditional sectors, these companies are of considerable importance for the future growth capacities of the economic context in which they are located. That is both for the intrinsic potential for quantitative development with net employment absorption, and for the ability to disseminate knowledge and favouring the transition of an economic context towards cutting-edge economic activities. So far, no survey has examined this particular type of company, which is however mainly composed by young firms active in the service sector. In general, the issue of the adoption of EIs in SMEs is still only marginally analysed; although these economic units also constitute 99% of the companies present in the economic systems of many European countries.

With this in mind, the research activity of this report was primarily aimed at carrying out a review of the literature for identifying the determinants/barriers that researchers have found to be most significant in eco-innovation choices. On this basis, an interpretative model was built which also tried to take into account both the availability of adequate economic and financial resources necessary to support the eco-innovation objectives, and the role played by the external context; an aspect, the latter, usually neglected in investigations of this type even if scholars agree to underline its importance and influence.

The picture that emerged from this survey has positive and negative sides. The generalized perception of the importance of such EIs for future competitiveness appears positive on the part of the SMEs examined. They exhibit a high level of awareness. Less positive is the contribution of the external context, which is an irrelevant, if not negative, variable for the EIs choices of companies. A belief that has significant consequences when the specialized literature has undoubtedly shown the importance of having an ecosystem suitable for the proliferation of these innovative high-potential SMEs; but at the same time, also extremely fragile.

This fragility, higher for micro-firms, clearly emerges from the results; first of all because the relative majority of these companies are modest in size, therefore very exposed to economic events and with greater difficulty in procuring all the resources they need to carry out their development projects.

Another negative aspect is the impression that many of these innovative SMEs, where the term innovative is not synonymous but incorporates the concept of high-tech, are focused on low-knowledge or non-borderline innovations.

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In other terms, they could be centred chiefly on incremental rather radical innovations, but radical innovations are those that provide the biggest boost to the firm's competitive edge in terms of technology, market position, and customer value in general (Sainio et al., 2012). Anyway, this is a speculation that, even if supported by a general survey proposed by Istat (2020), should be deepened with further specific investigations. In this case it should be understood whether this depends on the external context not sufficiently adequate.

In this specific regard, it also emerged that the role of institutions or public administrations cannot be limited to the passive introduction of regulations or the possible proposition of incentives. In line with the Porter hypothesis, all these forms of intervention, in order to be successful, must be dimensioned according to the actual characteristics and needs of the enterprises. But these requests are not the same for each type of firms, even for the only SMEs of innovative nature, being influenced by multiple objective parameters, such as sector, location, size, economic trend and subjective perceptions, such as motivations, ambitions, awareness. These differences amplify the responsibilities of the policy makers. They have also the duty to directly create a suitable business climate within the external context.

Nor does it seem sufficient, on the part of public administrations, to delegate the tasks of guidance and support to what are called local innovation intermediaries (universities, research centres, chambers of commerce...). Especially when, as happens in Italy, they are not sufficient resources and tools have been allocated to those subjects.

On the other hand, although the results confirm that the local availability of scientific and technological knowledge offered by these intermediaries is a crucial determinant in support of EIs, it risks being insufficient to promote effective behaviours when environmental awareness is lacking at the local and entrepreneurial level.

In other words, with respect to economic systems increasingly dedicated to innovative segments of the service sectors, at present policies do not yet seem sufficiently adequate or ready to support eco-investments by SMEs. The need for a double effort is therefore evident.

The growing intensity of competition from East Asian countries makes it essential to accelerate the transition of traditional businesses that are less able to withstand the international competitive environment towards industrial activities with foreseeable future development and ample potential for qualitative and quantitative expansion. It is a complex path, certainly not easy to pursue. In this perspective, the prevalent presence of SMEs in many Western contexts makes it inevitable to look with renewed attention to the needs of this large and heterogeneous category of enterprises.

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### 8.2 Limitations

Like all sample empirical surveys, this investigation also has got limitations. Some of them are common to those that characterize the majority of other studies on the determinants that urge the SMEs to eco-innovate. In section 4.1 a list of twelve assumptions concerning typical limits of these type of surveys has been proposed. For instance, investigations usually consider only 2-3 variables each time. If this practice reduces the risks of reciprocal influences of determinants, it also represents a limit to an overall understanding of the firms' behaviour. Until now, does not exist research papers simultaneously investigate all the variables suggested by scientific literature, due to their high number. To face this problem, we tried to sum up a consistent group of determinants in four group of key motivations.

Similarly, analogous variables can be considered at the same time as positive drivers or barriers; in addition, their weight and importance vary according to the situation (economic trend, objectives or development phase of the firms, and so on).

Moreover, similar to previous empirical surveys, this report considered EIs as a homogeneous concept. In other words, we do not distinguish among the different types of EIs (e.g., radical/incremental, organizational, technological, and managerial), even though the literature states that key factors could have a different impact according to the type of EI. However, to minimize this limitation, in the letter accompanying the questionnaire, we report the definition of EI to respondent entrepreneurs, and asked whether they approached it systematically by planning/ adopting specific investments.

As mentioned, the results were also interpreted in the light of the characteristics of the sample and their economic and financial data. In this last case, it should be specified that there are multiple gaps in the database made available by the Ministry of Economic Development.

Last but not least, the result of this study focused on the Italian context, cannot be generalised to other countries. The specific Italian business climate or the comparison with other types of firms can lead to different results. As largely described, these innovative SMEs show different features to the majority of other national firms. Specifically, being innovation oriented, the investigated SMEs are presumably more open to change. Accordingly, their willingness to adopt EIs is stronger than in other types of SMEs.

Future deepening of this survey or comparisons with other similar investigations could clarify some of these doubts.

### 8.3 Practical and managerial implications

The statements so far expressed suggest that many of the basic objectives linked to the diffusion of EIs have to be pursued first and foremost with active measures

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by policy makers. The lack of this actions leads to see public administrations as disconnected from the real needs of companies, and the external context as irrelevant to the needs of innovative SMEs, despite their strategic potential. The obvious consequence could be limiting investments and their riskiness. If these interpretations were confirmed by other specific surveys, then it would be necessary for public administrations to radically change the approach towards territorial development policies. However, already in the light of what has emerged up to now in this report, it is possible to suggest some directions for intervention.

The first direction is to increase the effectiveness of actions in favour of SMEs by extending the structures and regulations explicitly directed to spread innovativeness among innovative small businesses, given their strategic importance for the future development of the context in question. The objective also implies encouraging the adoption of EIs through cultural channels that aim to raise awareness of the importance of EIs as a strategic lever of corporate competitiveness. Stimulating relations with universities, research centres and other public agencies is certainly a valid way to achieve this goal. But in this case, it is also a question of further investing in these intermediaries and, however, this path cannot be the unique. Scholars underline the necessity to create a proper ecosystem. To have a register just providing economic subsidies is a not sufficient condition; maybe neither the most important. For a country as Italy, whose economic system is penalised by the so-called crystallization of economic activities, the potential of innovative firms is too important to be understated or neglected.

A second path is to encourage collaborations and networking capabilities between SMEs and larger companies. The small average size of the selected innovative SMEs belonging to the surveyed dataset makes real industrial partners indispensable, as innovations often requires substantial investments in material resources and knowledge that are not always within the reach of small enterprises. Furthermore, having preferential channels of collaboration offers psychological security, opens up to supply chains, procurements channels or new final markets, and encourages the transfer of know-how.

The third related direction concerns the types of measures proposed, which should be well targeted to specific purposes focused on the type of company and the EIs to be introduced. In line with this objective, it may be advisable to move from financing generic fixed asset investments, to investing in research and development.

A fourth direction concerns the proposal of financial measures aimed at overcoming typical qualitative or quantitative credit rationing of innovative SMEs wishing to invest in EIs. They often suffer of rationing as they usually lack collateral compatible with the access to loans from traditional financial



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intermediaries. So, new specialised investors, such as business angels and serial investors should be encouraged to collaborate with these innovative SMEs. The fifth direction concerns a parallel aim that is the consolidation of a system of institutional investors and consultants who support SMEs by sharing the risks associated with the implementation of border line innovations without immediate commercial lapels. The mentioned intermediaries, at least in Italy, cannot make up for this lack. So, the ecosystem to build needs of support action offered by organizations that mainly offer both non-repayable contributions, and real services to innovative SMEs, which are often still in the development phase, in the form of consultancy, mentoring, participation in international initiatives projects and so on.

Clearly, entrepreneurs also have to play their duties. That is to say, they cannot limit themselves to accepting the available benefits coming from the external environment, but must assume the risks associated with the implementation of innovative techniques and technologies that contain a differential of knowledge and skills compared to other firms. Entrepreneurial innovative activity within upper potentialities requires the ability and willingness to take higher risks. Hence, on the part of entrepreneurs, especially those who manage young businesses, there must be responsiveness not only of the potential underlying the EIs, but also of the need to commit themselves personally with their own capital, without expecting only external supports. In parallel, since in this type of innovative activity there is a need for a high level of specialization, it is a task of the entrepreneurial staff to find external executives with the right skills to involve in the working team, and to whom to delegate responsibilities and roles. A delegation activity that is often a source of potential conflicts, or that the founders do not want to endorse fearing to lose the control of the company. In any case, only by acting in synergy with public bodies, together with the pursuit of the same objective, private entrepreneurs will presumably be able to achieve the desired objectives. Further investigation into these topics and validation of the results of this study are, therefore, needed.

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### Appendix 1 - Literature review: 86 selected articles

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A. In order to access at innovations, how is important for your company?
1. internal R&D activity
2. the relationship with universities / research centers
3. partnership with other companies
4. the use of specialized consultancy
5. the purchase of patents/licenses
6. participation in workshops/exhibitions
B. Your firm:
1. • has a documented plan or rules for eco-innovation and ecological management
2. • considers environmental audit as a management standard.
3. • encourages staff to work towards energy saving and emission reduction
4. • advertises to stakeholders its commitment to eco-sustainability
C. Have your products / services to meet the requirements of national and international environmental regulations?
D. Have your productive processes to meet the requirements of national and international environmental regulations?
E. In your opinion, local Public Administration offers:
1. adequate fiscal benefits for the eco-innovations of your interest
2. adequate monetary incentives for the eco-innovations of your interest
3. a more streamlined bureaucratic procedure for accessing the expected benefits
4. a regulatory framework that supports the adoption of eco-innovations
F. Do your customers pay attention to environmental and sustainability issues?
G. Is your firm encouraged to pursue eco-innovations from customer requests?
H. Do your suppliers pay attention to environmental and sustainability issues?
I. Is your firm encouraged to pursue eco-innovations from suppliers' proposals?
L. Are banks and financial intermediaries more likely to finance eco-compatible investments?
M. Are venture capitalists and business angels more likely to finance companies pursuing eco-compatible investments?
N. Do the other actors in the local economic context (eg competitors) call for the adoption of eco-innovations?
O. Does the presence of research centers and universities favor the adoption of eco-innovations?
P. Is environmental sustainability a very felt problem in your company?
1. our employees propose environmental sustainability actions
2. there are professional figures (eg energy managers) who are dedicated to environmental sustainability issues
3. we plan to hire professionals dedicated to environmental sustainability issues
Q. Investments in eco-innovation have made possible to:
1. reduce energy and raw material consumption
2. reduce the cost of energy and other raw materials
3. reduce the pollution connected with the company activity
4. increase the number of employees
5. increase sales
6. increase the use of productive capacity
7. improve economic results and profitability
8. gain a competitive advantage over competitors
9. retain customers
10. improve the working environment of employees
R. How much you think are appropriate to the eco-innovations you intend to adopt the current:
1. technological skills of the company
2. organizational skills of the company
3. managerial skills of the company
4. material and financial resources of the company
S. In the immediate future, does your firm plan to invest in eco-innovations in order to?
1. reduce the cost of energy and other raw materials
2. increase economic and financial performance
3. improve the image or differentiate from competitors
4. reduce the environmental impact
5. contribute to respecting European targets
6. receive incentives
T. Has your company requested any incentives for investments in eco-innovation?
1. requested and received
2. requested but not received
3. did not request
4. I am not aware of it

## Notes

<sup>1</sup> In this regard, it is sufficient to recall that, since 2013, the EU Environmental Technologies Action Plan has invested over € 12 billion for eco-innovation projects falling within the 6th and 7th Framework Programs and other EU funding programs.

<sup>2</sup> The Istat's continuous Business Census now makes it possible to fully measure the issue of sustainability in companies and to integrate it into an extremely rich and comprehensive information framework. A survey on over 280,000 companies with over 3 employees verified that: 68.9% declare that they are engaged in actions aimed at improving the working well-being of their staff; 66.6% carry out actions to reduce the environmental impact of their activities (with a higher percentage among manufacturer firms); 64.8% have taken steps to improve the level of safety within their company or in the area in which they operate. In addition, 31.3% support or implement collective interest initiatives external to the company; a similar number of companies support or implement initiatives for the benefit of the productive fabric of the territory in which it operates (Istat, 2020).

<sup>3</sup> According to Istat (2020), improving the reputation of customers and suppliers is the main reason for reducing the environmental impact (32.1% of companies).

<sup>4</sup> An innovation ecosystem is the evolving set of actors, activities, and artifacts, and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors (Granstrand and Holgersson, 2020).

<sup>5</sup> The variable age was not considered, both because it did not emerge from the selected database and because, in any case, it is very homogeneous for all the companies in the selected sample. this, clearly, does not exclude the possibility that age may be a discriminating variable, as stated in other surveys not focused on SMEs.

<sup>6</sup> The results are, on the whole, consistent with what emerges in the aforementioned Istat survey (2020). For sustainability objectives, the companies in the Centre-South basically opted for free internal activities using company staff (14.2%) while those in the North are more oriented towards economic financing of projects / initiatives (11.9%). The choice is, however, linked to the size of the company; 42.8% of large companies with over 500 employees chose financing for sustainable initiatives.



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