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IS START-UPS' INTERNATIONALIZATION DRIVEN BY INNOVATION?

A STUDY ON THE EFFECTS OF INNOVATION DIMENSIONS ON THE
INTERNATIONALIZATION PROPENSITY OF ITALIAN YOUNG
INNOVATIVE COMPANIES

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Abstract

The process of internationalization of young highly-innovative firms has aroused a strong interest in the scientific community studying International Business. One aspect that has received less interest is the analysis of the enterprises' propensity to internationalize. This type of analysis aims to highlight the factors that facilitate the expansion beyond the domestic boundaries of a company's business.

Starting from a traditional literature in the context of the internationalization studies, it is underlined that many extant findings are still valid in defining the direction that young innovative companies should follow to effectively expand their business activities abroad. Innovation is found to be the focal point of interest for the context of reference, especially in consideration of the Open Innovation paradigm developed in the last two decades.

With the use of a Probit regression model, built from a database containing information about 1661 young and innovative Italian firms, some relevant insights are defined. Firstly, the *'innovation input'* dimension is strongly linked in a positive way to the internationalization decision for the reference companies. A similar but less incisive relationship also applies to the *'innovation output'* dimension, where it is confirmed that investments in *product innovation* facilitate the choice of internationalization more effectively than investments in *process innovation*. Finally, the *participation in R&D networks* is found to have no particular influence on the decision to operate in international markets, while the use of an *'Outside-In'* innovation approach – maintaining collaborations with R&D suppliers while holding the innovations inside the firm – appears to have a positive influence on this decision. This last finding underlines the relevance of the *direction of knowledge exchanges* dimension when studying the internationalization propensity of young knowledge-intensive firms.

Compendio

Il processo di internazionalizzazione di imprese giovani ad alto contenuto innovativo ha suscitato un forte interesse nella comunità scientifica che studia International Business. Un aspetto strettamente collegato a questi studi ma che ha ricevuto meno interesse è l'analisi della propensione alla internazionalizzazione delle imprese. Questo tipo di analisi permette di evidenziare quali siano i fattori che facilitano l'espansione oltre i confini domestici delle attività operative di un'azienda, rappresentando dunque gli elementi primi che abilitano l'intero processo di internazionalizzazione.

Partendo da una letteratura di riferimento tradizionale nel contesto dello studio di internazionalizzazione, si sottolinea come molti ritrovamenti di tali autori sono tutt'ora validi nel definire la direzione che le giovani imprese innovative dovrebbero seguire per espandere efficacemente la propria attività commerciale all'estero. In questo modo, si vuole mettere in luce la sussistenza di un continuum fra la realtà rappresentata da questa recente ascesa di piccole e giovani imprese che operano in attività ad alto contenuto conoscitivo e i risultati della ricerca più tradizionale in riferimento a quei fattori che permettono alle imprese di costruire un'attività di successo nei mercati internazionali. Il collante di tutto questo è rappresentato dall'*innovazione*. Analizzando più approfonditamente il concetto, si espone la grande rilevanza che ha l'innovazione in questo costrutto, specialmente in riferimento al filone di Open Innovation sviluppatosi nelle ultime due decadi.

Viene successivamente presentato il modello econometrico costruito per lo studio delle relazioni ricercate, permettendo l'analisi statistica delle ipotesi formulate tramite una regressione di tipo Probit. Il database di riferimento comprende dati raccolti su 1661 imprese italiane che rispettano le direttive espresse nel decreto '*Start-up Act*' all'anno 2016.

I risultati del modello confermano tre delle quattro ipotesi formulate e in seguito ad un'analisi critica di questi sono evidenziati dei ritrovamenti rilevanti per il contesto di riferimento. In primis, la dimensione di '*innovation input*' è fortemente legata in modo positivo alla decisione di internazionalizzare l'attività commerciale delle imprese di riferimento. Una relazione simile, ma meno incisiva, vale anche per la dimensione di '*innovation output*', dove viene confermato che investimenti in '*innovazione di prodotto*'

facilitano più efficacemente la scelta di internazionalizzazione rispetto ad investimenti in *‘innovazione di processo’*. In ultimo, la *‘partecipazione in network di R&S’* risulta non avere particolare influenza sulla decisione di operare su mercati internazionali, mentre l’utilizzo di un approccio *‘Outside-In’* allo sviluppo di innovazione risulta influire positivamente a questa decisione, oltretutto in modo più consistente rispetto all’utilizzo di un approccio *‘Inside-Out’*. Questo ultimo ritrovamento sottolinea implicitamente l’importanza di fondo che ha lo studio della dimensione di *‘direzione degli scambi di conoscenza’* fra imprese innovative in riferimento alla loro relativa propensione ad internazionalizzare.

Infine, i limiti contestuali di questo studio contribuiscono a delineare la direzione per ricerche future in questo ambito, nonché per approfondimenti di natura economico-politica che hanno il potenziale di definire azioni efficaci per la creazione di incentivi specifici per lo sviluppo di imprese capaci di competere nei mercati internazionali nel settore di riferimento.

Executive Summary

Young and innovative firms are seen populating the international markets since the very first stages of their growth. Thanks to particular characteristics of their structure – such as flexibility, short time-to-market and disruptive business models among the many – and to the globalization trends that are affecting major markets in the world, these small players have the power to firmly impose themselves over large and established value chains. This study investigates the propensity to internationalize in relation to the innovation measures undertaken by the firms. This is an aspect that is still underdeveloped in the research field of reference but that yields a very idiosyncratic meaning, as it unveils what are those *ex-ante* factors that facilitate the internationalization process. In this specific research, the aim is to highlight what components of innovation hold this characteristic.

By analysing the traditional literature related to *internationalization* studies, in *Chapter 2*, it is highlighted how insights stemming from past research are still very related to the reality of innovative start-ups. *Liabilities of newness, foreignness* and *size* represent the main entry barriers on international markets, other than serious obstacles for the survival of knowledge-intensive young firms. Building a *sustainable competitive advantage* is mandatory for the success of the firm, especially when competing with international players. Developing *dynamic capabilities* is the key to overcome many threatening forces, as it enables the firm to adapt its operations to the context of the business, while incrementally developing proprietary competences to be one step ahead of competitors. *Innovation* is found to be a strategic factor to consistently produce uniqueness and firm specific advantages, which ultimately enable the effective internationalization of a company. In consideration of the resource constraints related to the firms of reference, *absorptive capacity* acquires a crucial role for quickly bringing innovative products to diverse markets.

In *Chapter 3*, the analysis focuses on shaping innovation, which results to be a very complex and intricated task: the more it gets detailed in a specific context of reference, the more the related measurement becomes inconsistent. Focusing on a single innovation dimension would necessarily leave outside many other aspects inherent to innovation itself. To avoid this result, the analysis is split into two main sections: firstly, the

traditional innovation framework is described, with a focus on the *innovation input* and *innovation output* dimensions; then, the more recent open innovation framework is presented in contrast, focusing on the importance of *R&D Networks* and presenting the *Outside-In* and *Inside-Out* approaches to open innovation. The analysis of theoretical works related to these topics are used to shape the four hypotheses of this research. The aim is to understand what of the following dimensions of innovation act as facilitators for the international propensity of the sampled firms.

- **H1:** *YICs with high R&D spending have a higher propensity to internationalize than YICs with low R&D spending*
- **H2:** *YICs undertaking product innovation have a higher propensity to internationalize than YICs undertaking process innovation*
- **H3-A:** *YICs participating to research networks have a higher propensity to internationalize than YICs not involved in such networks.*
- **H3-B:** *YICs that establish an Outside-In Innovation approach have a higher propensity to internationalize than YICs that establish an Inside-Out Innovation approach.*

In *Chapter 4*, the analytical model used to test the hypotheses is described. The relevance of the database used is highlighted by introducing micro-data related to R&D spending in the Italian small-sized enterprises context. Furthermore, a normative context is provided, as the dataset had been commissioned to ISTAT (the Italian National Institute of Statistics) by the MISE (Italian Economic Development Ministry) as a means to keep track of the socio-economic developments related to the '*Start-up Act*', a previous policy aimed at incentivizing start-ups creation. The dataset collects information about 2'275 unique companies that satisfy those requirements to be classified as Young Innovative Companies (YICs). The sample used for the analysis is formed by 1'661 firms, out of the initial 2'275, due to missing data. In the rest of the chapter it is provided a thorough description of the variables generated for the model, together with related descriptive statistics. Finally, the statistical regression – a Probit model – is presented.

In *Chapter 5*, the results of the econometric model are presented.

- H1 is verified, implying that R&D spending is positively and significantly related to the propensity to internationalize;
- H2 is verified, implying that YICs investing in product innovation tend to internationalize their business more frequently and more consistently than YICs that invested in process innovation;
- H3-A is not verified, implying that participating in knowledge networks is not strictly related to the internationalization decision;
- H3-B is verified, implying that YICs using the ‘Outside-In’ innovation approach are more likely to internationalize their business compared to YICs using the ‘Inside-Out’ innovation approach.

These results provide some interesting insights. First, it is found that innovation input and innovation output are positively related to the international propensity of young and innovative firms, confirming that results of extant literature on related topics are valid also in the context of study. Secondly, the direction of knowledge exchanges is found to be relevant for the internationalization decision of young and innovative firms, as the participation in knowledge networks per se is not significant in this relation while firms that adopted an ‘Outside-In’ approach to develop innovation are more consistently related to it. This last finding contributes to fill a research gap that can help researchers and policymakers define more comprehensively the enabling factors of the internationalization process.

Chapter 6 provides some conclusive remarks while highlighting the limitations of this study, that can be starting points for future research to expand the actual state of the art and corroborate the underlined results.

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1 INTRODUCTION

In the last decades, the world has witnessed the fast and wide imposition in the international markets of new business ventures, that all share very similar traits, such as: flexibility, knowledge-intensive resources, disruptive-approach, lean structure, innovation-driven, quick time-to-market and customer-orientation. Most of the time, these enterprises are addressed to as high-tech start-ups, or innovative start-ups, but more in general they represent the newest trend for business creation in the SMEs (Small- and Medium-sized Enterprises) sector. The fact that many of these firms are established as a response to very specific market imperfections or needs – e.g. cutting the intermediaries, providing value-adding services – implies that these ventures represent a real threat even on the international landscape. In fact, previously it took many years for a firm to efficiently operate on the international markets due to all the considerations related to the Uppsala Model (Johanson and Vahlne, 1990), where firms gradually approach the foreign markets by incrementally developing experience related to their domestic operations, and then using that expertise to slowly expand their market to culturally similar foreign countries. Contrarily, nowadays the disruptive potential of young and innovative firms, in relation to the scalability of their business model, enables an incredibly quick internationalization process – firms with these characteristics are *born global* (Knight and Cavusgil, 2004).

Private equity funds, business angels, venture capitalists, crowd-funding and all the many forms of financial investors that are available today on the market are undoubtedly the most important engine for the fast growth of these firms. On one side, they represent the most democratic opportunity for the quick success of new-born businesses, and this has fostered start-ups creation. On the other side, not so many firms are able to receive such investments, and even less can survive the initial years and build a sustainable business, and this has fostered hyper-competition in the sector. Then, these young and innovative firms can only be successful as long as they are one step ahead of the market, while maintaining marketability as a core value. In this context, innovation becomes the true enabling factor for the success of the firms, where financial backing becomes one of the most important means to reach that goal. What still has not been thoroughly studied by past research is the impact that innovation has on the internationalization propensity

of such firms.

The aim of this study is to unveil what role innovation has in the internationalization propensity of young and innovative small firms. This analysis uses a database that collected information of a large number of Italian start-ups, in relation to a policy developed in Italy to incentivize the start-up creation – mainly represented by the ‘*Startup Act*’. This research is also strongly related to the open innovation paradigm (Chesbrough, 2003), as collaborations and networking are fundamental to the effective development of innovation. Open innovation approaches are found to be beneficial both at the firm-level and at the individual-level by extant literature, but the lack of an appropriate metric system to effectively and consistently measure the diverse shapes that innovation can assume remains the biggest hindrance for truly comparable findings.

This research provides relevant qualitative insights on the effects that innovation has on the internationalization decision of the sampled firms, that can be used both by future researchers, to prove the validity of our findings in different contexts, and by policymakers, to have an improved understanding of what fosters internationalization in relation to this relatively recent business reality.

The structure of the study is briefly presented here, to help the reader acquaint with the contents and navigate through it.

In *Chapter 2*, some of the most traditional research fields related to the internationalization context are presented with the aim of providing a structural continuum with past research. At the same time, this helps us highlighting that those factors that contribute to the effective internationalization of young and innovative firms remain strictly related to the said literature. The INV, IE, RBV, DCP and ACAP insights proposed all supply different reasoning related to the use, creation and exchange of resources and knowledge with the aim of increasing a firm’s competitiveness and solidity. Applying these concepts to our context results in the common understanding that innovation not only is necessary to the internationalization of innovative small firms, but it is the most relevant leverage that can enable the success of these firms.

Then in *Chapter 3*., the effort shifts towards the analysis of innovation itself. A comprehensive classification of innovation would require a dedicated study – if not an encyclopaedia – therefore we focus on some morphological components related to the

internationalization literature. The analysis provides a more thorough exploration of past research, which is used to formulate four distinct hypotheses. These are employed to structure the goal of our research and aim at investigating the impact that three main dimensions of innovation have in the internationalization decision of young innovative start-ups. Namely, these three dimensions are: innovation input (H1), innovation output (H2) and innovation direction (H3-A vs H3-B) – more correctly the direction of the knowledge exchange related to innovation.

Thereafter, *Chapter 4.* presents the model of this study. Starting from the juridical context – referring to the ‘Start-up Act’ – we provide all the information related to the creation of the database used to perform the econometric analysis. After describing the structure of the sample of reference, we present the variables of interest and the econometric model developed to test the hypotheses.

Chapter 5. portrays the results of the econometric model. Firstly, the statistical data is presented and analysed to assess the veracity of the hypotheses, then a critical dissertation is performed with the goal of providing insightful findings that stem from this research.

Finally, *Chapter 6.* provides some conclusive remarks while the limitations of the study are highlighted.

2 LITERATURE REVIEW

This chapter is deemed to provide the required contribution of authors from the different semantic fields related to our study, in order to both showcase the state of the art in relation to the topics of interest, for a clearer and stronger dissertation, and to unveil the controversy in the results of many researches, to best structure our hypotheses on the case. This dispute – i.e. contrasting or non-aligned results in recent literature concerning the catalysts of internationalization in entrepreneurial environment – could still not be solved at a holistic level, since findings are related to the point of view taken in the specific cases and contingencies are more relevant than ever when studying a polymorphous entity such as entrepreneurship. Reviewing focal points regarding IB (international business), RBV (resource-based view), Resource Dependency and Transaction Cost theories will give us the tools necessary to study our case – international scope of Italian YICs and its contingencies – and test the hypotheses with the aim of contributing to the topical research, but also understanding those factors that actually impact the market vectoring of Italian innovative start-ups in order to provide practical insights to policymakers.

2.1 CONTEXTUALIZATION

Before understanding what makes firms actively compete in multiple foreign markets, one must first comprehend the fundamental distinctions between ventures and markets. With the help of Coase's (1995) pivotal work, we can say that the firm is a structure of economic activities effectively displacing market organization, built in a way that cannot be applied to open markets all the same. This happens mainly because the use of market-like incentives could result in the depletion of cooperative arrangements at the firm-level (Teece et al., 1997) and also because of the economic benefits linked to the Transaction Cost theory (Riordan and Williamson; 1985) that arise from the integration of such organizational activities. Aside from more conceptualized reasons, it is quite straightforward to note that it would be too complicated to calibrate the contribution of the singles resources to the joint marketable output.

In contrast to Arrow's (1969) framework, we believe that managers do not try to inject external markets inside the firms, as there are inherent limits and cons in modelling

firms – or even sectors – as the inner side of markets. Actually, the most distinctive feat of firms is their nonmarket-like organization of relations among agents: learning curves, cooperation efficiency and knowledge transfer are intangible aspects that can distinguish one firm from another but can hardly be valued with market rationales (Teece et al., 1997). Both these intangible forms of resources and the more easily valuable ones are crucial in determining the competences/capabilities package of the individual firm. Competition is what legitimates markets¹, and even though firms can be competing on a broad number of different aspects – price, time to market, innovativeness, ... – what actually gives them competitive advantage in the end is the effective use of their competences/capabilities. These cannot be readily assembled through the market pricing system (Teece, 1982, 1986; Zander and Kogut, 1995) but on the contrary are the result of strategic and contextualized managerial decisions. The same set of resources could bring advantages in different dimensions, depending on the sector or geography for example, and at the same time the use of a certain strategy to exploit such resources could generate drastic improvements or dramatic failures in relation to the structuring of the firm or the culture instilled in the employees.

Fama (1980) tried to explain how markets can regulate the exchange of competences/capabilities by defining firms as a '*nexus of contracts*', but this endeavour clearly contrasts with the Transaction Cost theory, as the clear and lawful spelling of rights, responsibilities and payoffs is inevitably creating market failures. At the same time, the '*nexus of contracts*' implies a series of biunivocal relationships restricted in terms of potentiality and coordinated by a regulator (Teece et al., 1997). This is not in line with our study, as our firm is better described as a multilateral organization orchestrated by different behaviours from more decentralized sources, but with a strong dependency from the managing team.

Summarizing, the pivotal concept here is that the competences/capabilities of firms cannot be easily reproduced by the integration of different subsets of similar business units in the market². This also implies that entrepreneurial activity cannot immediately

¹ If conditions subsist for a non-monopoly market.

² As Teece et al. (1994) noted on the subject, the conglomerate option aims to edge risks and therefore cannot provide similar – or any – efficiencies in terms of competences. Shareholders cannot obtain for themselves what managers created over time simply by holding a diversified portfolio of stocks.

replicate competitors' competitive advantage by a simple duplication of the parts, but on the contrary competition is based upon constant strategies of imitation and limitation of competition, without a clear outline of an objective best practice (Teece et al., 1997). Again, from a balance sheet point of view we cannot highlight what value to attribute to the distinctive components of the competence/capability of a firm. This, on the other hand, stresses the intrinsic nature of competitive advantage, so that the only way for competitors to acquire what is distinctive in a firm is to buy the whole firm itself.

The competitive advantage of a firm need not to be considered in market values, but in terms of internal organization, interconnections of resources and management of processes and productive activities. What really differentiates one firm from its competitors is actually how its customers perceive it: markets are requiring always more, both in terms of performance and offering, so firms must constantly upgrade their value proposition and deliver it through the '*innovative development of business models*' (Chesbrough and Rosenbloom, 2002; Chesbrough, 2004). The ability to conceive and deliver innovation to the market is what differentiate the effective use of firms' competences/capabilities to shape strong and sustainable competitive advantage (Johnson et al., 2008). This is what enables certain firms to successfully penetrate in different foreign markets and still be able to address local needs adequately while bearing with the complex interactions of swift and localized changes happening across the international market environment (Evans and Wurster, 1999).

The figure of the entrepreneur – and many related entrepreneur-specific factors delineated by past literacy – gains a pivotal role in the study of what propels young and small – but not necessarily – firms to exceed the domain of their contextual domestic market to seize profits in less familiar conditions. The risk-propensity and versatility that necessarily shape the entrepreneur are probably among the most important factors to consider in this internationalizing process of firms. The lack of information about foreign markets pushes managers to *seek-and-pick* knowledge base, validate the viability of opportunities and the ability to effectively position in the local market before committing their (scarce) resources to it (Liesch and Knight, 1999; Venkataraman, 1997). In doing so, relationships with local agents become crucial as they enhance the efficiency of this process and facilitate the insertion of the firm in a social/business network with a stronger associated social/business presence (Madsen and Servais, 1997).

The bottom line is that to grasp what is distinctive about competences/capabilities at firm-level – that ultimately leads to a sustainable competitive advantage and fosters internationalization strategies – one has to consider an extensive set of business dimensions. As Teece et al. (1997: 526) underline in their pivotal work on strategic management:

“Slavish adherence to one paradigm to the neglect of all others is likely to generate strategic blind-spots. The tools themselves then generate strategic vulnerability.”

This research develops a theoretical framework built both on IB literature regarding mainly the internationalization of young and small firms and on the dynamic capability theory originated from the RBV related strategic management studies. Sustainable competitive advantage – deriving from firms’ specific competences/capabilities – gains the role of common denominator in uncovering how these fields are intertwined. Among firms’ competitive advantages, many authors underlined the prevailing role of innovation as an effective avenue for creating uniqueness and venture beyond the firms’ resource constraints (Aharoni, 1993; Wakelin, 1998). In *Chapter 3.*, innovation is declined into some of its many acceptations with the aim to confront and answer research questions concerning the implications of two complementary frameworks (i.e. Traditional/Closed Innovation Paradigm vs. Open Innovation Paradigm) in regard of the internationalization process of YICs in Italy.

2.2 INTERNATIONAL NEW VENTURES

Small firms, especially in the Mediterranean region, represent a large source of GDP (gross domestic product) for European countries and make an important contribution on job creation, local economic development and national exports (Zucchella and Siano, 2014). Many of these firms leave their domestic boundaries and start setting up foreign sales operations with the goal of reducing production costs (i.e. offshoring of assembly activities), gaining access to limited resources (i.e. green/brown-field operations) or more generally expanding their own market share and reducing their dependency from the domestic environment. Differently from the more established players that enter new markets through FDIs (foreign direct investments), small firms most commonly reach foreign markets using export activities because of their resource constraints (Love and

Roper, 2015). At the same time, due to the recent trends in the business environment – such as enhanced market complexity, international competition and globalization among others (D’Aveni and Gunther, 1994) – managers have to directly face international players even in their own domestic market, especially when talking about manufacturing and high-tech sectors (D’Angelo, 2010). Therefore, there are both internal and external pressures that drive rapid internationalization nowadays, and this phenomenon is enabled by the flexibility and responsiveness that characterizes small firms (Miesenbock, 1988). Thanks to a variety of tools, the internationally-focused firms are able to enter foreign markets in few years and survive despite the many difficulties (Autio et al., 2000; McDougall and Oviatt, 2000), so it is important to comprehend what enables this process.

2.2.1 THE INTERNATIONAL CONTEXT

This early trial for survival can, on the other hand, create the premises of an early international growth, if managers seize the proper opportunity with the correct strategy. Global competition requires these small firms to quickly develop capabilities and competences to enable the creation of unique firm-specific advantages. Past research on international performance of Italian SMEs (Cerrato, 1999; D’Angelo, 2010; Giovannetti et al., 2011; Nassimbeni, 2001) highlighted that one effective avenue to produce firm-specific advantages is innovation, which becomes compulsory when considering high-tech industry. In this frame of reference, the nature of competitors is inherently global if we consider that most established businesses in the sector are part of much larger networks and value chains – from research centres to VCs (venture capitalists) relations, from more value adding activities developed in OECD countries to assembly activities located in countries with the lowest cost of labour. Shrewd managers would promptly conceive their business as international by nature and should quickly develop a strategic vision to exploit the opportunities it brings (Oviatt and McDougall, 2005) rather than building a defensive strategy. These firms often perceive the awaiting internationalization process as:

- a) a multidimensional process concerning inward and outward movement of resources and assets across the boundaries of different countries through a variety of coordination means (Dunning, 1988; Oviatt and McDougall, 1994; Onetti and Zucchella, 2008);

- b) a relational process, necessarily built on both commercial and social relationships with agents from different geographies (Yli-Renko et al. 2002);
- c) a knowledge-augmenting process, due to numerous benefits originating from the access to new knowledge – mostly achievable through the participation in foreign clusters or more formalized networks – that can reduce the overall risks of the firm (Kuemmerle, 2002; Onetti et al., 2012).

From a more theoretic perspective, the seminal work of Oviatt and McDougall (1994) generated worldwide attention to the phenomenon of successful early internationalization of small firms, considering that commonly internationalization strategies were undertaken by MNEs (multi-national enterprises) at the time. In their study, Oviatt and McDougall (1994: 49) provided a first definition for INVs (international new ventures):

“a business organization that, from inception, seeks to derive significant competitive advantage from the use of resources and the sale of outputs in multiple countries”.

The recognition of INVs as a developing reality and, most of all, the potential impact they could generate on the world economy spurred worldwide interest to uncover the nature of those factors that can power effective early internationalization and allow firms to create and protect such competitive advantages through the configuration of streamlined processes and the participation in value chain with a strong position. One would immediately think of ‘age at internationalization’ as a critical factor in this setting, but there actually is a debate on its importance. Zahra (2005) finds it to be positively related to successful expansion, export performance and survival on international markets, but at the same time he highlights the limits of such measure. The age of a firm often does not represent its newness to the market, in fact since the 90s many new ventures are just a spin-off of bigger companies or even the restructuring of existing enterprises. These firms can undoubtedly enjoy booting benefits thanks to the resources and finances – comprising their networks, well-recognized brand and established structures – of the holding group (Zahra, 2005). Regardless, there are ‘inherent learning advantages of newness’ (Autio et al., 2000) related to the lack of those inertial forces that make established companies stumble when venturing into new routes. Thanks to the highly

organic structure and to the direct interest of owners the assimilation and acceptance processes of the new knowledge required by the broader context happen much quicker and flawlessly. INVs can draw important and quasi-instant benefits thanks to their ability to learn quickly and adapt their operations consequently without incurring in significant costs (Oviatt and McDougall, 1994).

Another thoughtful insight stemming from Oviatt and McDougall's (1994) work is the difference between resources and resourcefulness. Considering that RBV³ was one of the most convincing literatures at the time – and still has incredible importance in many aspects of businesses – in relation to the shaping of firm-specific advantages, managers were convinced that resource ownership was necessary to internationalize a firm's operations (Stevenson and Gumpert, 1985). What actually enables the internationalization process, though, is the actions that managers come up with in order to create and develop value far beyond their resource limitations (Oviatt and McDougall, 1994). This is definitely how competition works among high-tech INVs: it is the ability to capitalize on the ownership of few core resources while being capable of collecting the rest from the right agents. Resourcefulness is the capability to dynamically have at arm's length all the resource needed – trying to avoid surpluses – without actually owning them. This is even more complex for SMEs venturing in unknown landscapes. We have talked about the advantages of venturing into foreign markets, but we have not stressed enough how complicated is to successfully do so. Nowadays, it may seem easy enough to spot opportunities overseas, locate potential interesting partners and structure an exporting activity. Even though access to international markets is more facilitated today than thirty years ago, this also implies that competition is far fiercer. At the same time, this sentiment of globalization may lead superficial managers to underestimate the role that culture, nationality and tradition have in shaping different opportunities in different regions. A comprehensive understanding of a local market might require years of first-hand experience and respectful study of national cultures, depending on how contrasting is the foreign context from the domestic one. In international business, to measure this dimension the concept of *psychic distance* has been introduced and describes the perceived differences between the selected foreign region and the domestic country, using

³ We will briefly present it, but for a more thorough analysis see Barney (1991), Penrose (1959), Rumelt (1984) and Peteraf (1993).

social, cultural and administrative characteristics as units of measure instead of physical distance (O'Grady and Lane, 1996). Theory suggests that firms willing to expand their boundaries should focus on the psychically close countries first and one way of reducing this distance is to set up relationships with local agents or participate in existing networks to increase the ability to adapt and innovate accordingly (Onetti et al., 2012). Another factor that helps in this endeavour is the presence of managers who have had previous international experience in other companies Oviatt and McDougall (1994). Some of the potential gains in having such backgrounds highlighted by recent literature are the ability of gaining access to existing international networks, efficiently configuring international value chains, the management of strategical trade-offs and the confidence in approaching strategic partners (Shrader et al., 2000; Reuber and Fischer, 1997). These are key activities that managers of high-tech SMEs have to orchestrate if they want to pursue success, yet the disruptive power of many diverse '*unicorns*'⁴ proves by itself that small firms are able to interpret innovation and internationalization efficiently and rather quickly despite the liabilities they encounter.

2.2.2 THE LIABILITIES

Despite being more versatile in nature and quicker to respond to external changes, INVs face some important difficulties when trying to compete with bigger and established firms. With the entrance in foreign markets, small firms commit their limited resource base to seize opportunities surrounded by risks, uncertainty (Knight and Cavusgil, 2004) and a multitude of expenses. International strategies in the high-tech business require innovativeness, proactiveness and risk propensity, which, respectively, are related to upfront investments, search, learning and retaliation costs, and a financial slack to respond to potential failures (Kreiser et al., 2013; Bell, 1995; Shrader et al., 2000). These hindrances are mainly related to three types of liability that are common to the vast majority of INVs.

- The first is referred to as '*liability of size*' (Bruderl and Schusserl, 1990), since many INVs are small they lack managerial and financial resources compared to

⁴ A *unicorn* is a privately held start-up company valued at over \$1 billion. The term was coined in 2013 by venture capitalist Aileen Lee, choosing the mythical animal to represent the statistical rarity of such successful ventures.

established competitors. The absence of a slack increases the riskiness of their international operations: managers are aware that if the strategy undertaken reveals to be a failure there could not be another chance to do it right, so the resource shortage limits their propensity to make drastic moves.

- Second, there is the '*liability of foreignness*' (Zaheer, 1995), which arises from the fact that INVs want to serve distant markets and have to overcome entry barriers, cultural differences and update their infrastructure and logistic systems. Adaptation to different cultures may be more feasible for INVs in respect to established firms, but at the same time these competitors can offer a much wider range of products/services since they have been longer in the business.
- Lastly, there is the more tautological one as it is referred to as '*liability of newness*' (Freeman et al., 1983), which underlines the limits that young firms encounter due to their bounded relations and inexperience. The credibility and the potential of INVs are often understated and their ability to gain access to important resources is hindered. Entering a new market is easier for established firms as they can leverage on their wide networks and well-known brand.

Any of these liabilities alone raises alarms in young firms, but the combination of these significantly heighten the overall stake for INVs, making it a matter of survival (Zahra, 2005). To offset these handicaps INVs must focus on the creation and exploitation of sustainable competitive advantages to obtain a more powerful position on foreign markets (Zucchella and Siano, 2014), although the vast presence of SMEs on international markets can attest that they can overcome both resource constraints and the liabilities described on its own, according to Zahra and George (2002).

2.2.3 THE ROLE OF PARTNERSHIPS

As we already mentioned, in order to develop competitive advantages firms competing in the high-tech industry must commit to innovativeness (D'Angelo, 2010). Due to the *liability of size* and *newness*, INVs find it difficult to invest conspicuous sums of money in R&D (research and development) activities to stay on pace with established competition. But even if financial resources were not a problem, the innovation required to adapt and meet local customers' demands in very diverse contexts implies the planning

of complex yet efficient R&D programs, even more so if we consider the high-tech market where patents and IP (intellectual property) rights shield a wide range of tech base (Chesbrough and Crowther, 2006). In general, when serving diverse geographies, SMEs have to take into account many variables and often there is an overload of information that only a very effective resource management and precise product development allow successful outcomes (Calantone et al, 2006). In IB (international business) literature, this situation is described as ‘*the decreasing marginal returns of international R&D activities*’ when firms aim to reach diverse local markets (Lu and Beamish, 2004). Hence, the capacity of learning acquires a crucial role in the internationalization process. Zahra (2005) describes two different routines in this direction: ‘*exploratory learning*’ relates to the knowledge that a firm needs to incorporate from the context; ‘*exploitative learning*’ refers to the application of proprietary knowledge in different circumstances. We will provide a more detailed framework in *Chapter 3.*, but this helps us understand the role of external actors in the internationalization process of a young firm. In fact, there have been quite some studies on the matter recently – especially since Chesbrough (2003) first introduced the framework of Open Innovation⁵ – and most of the findings highlight that SMEs are creating and maintaining always more relations over the years mainly for market-related benefits (van de Vrande et al., 2009). D’Angelo (2010) analyses Italian SMEs and finds that the ones operating in the high-tech sector are more inclined to create partnerships with research centres than their manufacturer counterparts. Export intermediaries and distribution partners cover an important role as they facilitate the learning process of SMEs by channelling innovation from end customers to exporters (Zucchella and Siano, 2014). International networking could be one of the fastest avenues that INVs have in order to neutralize negative liabilities (Erramilli and Souza, 1993) and, if correctly intertwined, could as well propel innovation into better management (Zucchella and Siano, 2014).

2.3 INTERNATIONAL ENTREPRENEURSHIP

This reasoning so far has brought some thoughtful insights that we can use to extend Casson’s (1982) debate about the recurrence of entrepreneurial characteristics in the study

⁵ With no doubts, Chesbrough is the most important advocate in the related stream of literature, but it has been Teece et al. (1994) to first introduce the topic even if with different implications.

of firms' internationalization. Despite there are many differences in the findings of studies concerning this field due to diverse ex-ante assumptions and dependencies related to geographic/social contextualization, what results clarify is that INVs' competitive advantages lie in the founders/managers' abilities to spot and exploit opportunities outside the radar of traditional businesses (Zahra, 2005). Entrepreneurship in itself is about discovery, seizing opportunities and cognition of the limits, all of which drive knowledge-creation and decision-making capabilities towards potential competitive advantage (Barney, 1991). Having recognized these issues, McDougall and Oviatt (2000: 903) provided a definition comprehensive of both INVs and some more established firms that make use of an '*international entrepreneurship*' approach when expanding their boundaries:

“International entrepreneurship is a combination of innovative, proactive, and risk-seeking behavior that crosses national borders and is intended to create value in organizations. [...] Firm size and age are not defining characteristics here. [...] Further, international entrepreneurial behavior may occur at the individual, group, or organizational levels”.

The focus shifts from early internationalization towards the entrepreneurial qualities at firm-level, mainly because findings related to age at internationalization did not provide sufficient explanatory power. On the other hand, the decisive factor that powers competitive advantage in small firms operating in different markets seems to be the entrepreneurial behaviour (Zahra, 2005). Entrepreneurial mindset has to be studied with a heuristic-based logic (Alvarez and Busenitz, 2001) to uncover how managers should behave to make profits out of uncertainty and complexity. This entrepreneurial decision making should aim to develop forward-looking abilities, to foster a heightened perception for new opportunities, an increased and earlier slope in the learning-curve of the firm and mainly to develop unorthodox and creative ways to initiate innovation (Gavetti and Levinthal, 2000). Entrepreneurial cognition facilitates the creation of competitive advantages through the ability of detecting new and unconventional opportunities and efficiently bootstrapping the firm in the initial stages. In this perspective, knowledge acquisition, financial means, specialized assets and organizational capabilities represent drivers that remain in the background, especially considering that small firms lack them. International thinking, risk-propensity, past experience and networking are

entrepreneurial characteristics that revealed to be more relevant to explain early international expansion (Kuemmerle, 2002; Zucchella et al., 2007).

Traditionally in the first development of IB literature, internationalization had been considered an alternative growth path to innovation, the latter corresponding to a small and incremental expansion of the business while the former corresponding to a more drastic and instantaneous one (Ansoff, 1957; Vernon, 1966; Johanson and Vahlne, 1990). Nowadays though, innovation and internationalization are rather simultaneous, interrelated and necessary for sustainable growth especially in relation to young tech-based firms. Knowledge exploitation and exploration are the keys to reach inter-organizational networks and develop ties with agents across different regions in order to solidly back international activity. For all the above, it is now clear that innovation, internationalization and entrepreneurial behaviour are deeply related in the high-tech industry.

2.4 RESOURCE-BASED THEORY AND INTERNATIONAL COMPETITIVE ADVANTAGES

One of the most widespread models known by scholars to describe the internationalization process of a firm is definitely the Change-State framework (*Figure 1.*) – mainly referred to as the Uppsala Model – developed by Johanson and Vahlne (1990). The model describes the path that domestic firms follow from having a purely domestic market to enabling widespread international activities. Starting from the analysis of a case study of firms located in Uppsala, a small city near Stockholm, the authors were able to describe the stage theory behind the gradual internationalization process used by many SMEs. In this dynamic model, the output of one block becomes the input of the other, thereafter generating an ongoing cyclic following of events (*Figure 1.*). The state aspects are market commitment – mainly in terms of resources dedicated to international operations – and internal knowledge about those markets. The change aspects are commitment decisions – usually new resources are pledged with small and steady increments – and performance of current activities. The process usually follows these steps:

1. The firm has no commitment in international operations and focuses its knowledge about the domestic market to expand its business;

2. Opportunities arise as the firm feels confident to start exporting to few clients beyond the domestic borders. Most of the time, the first export countries are geographically close and culturally similar – i.e have a low psychic distance;
3. The firm enters the ‘Change’ phase, by committing resources to the exporting activities and slightly shifting the strategic direction towards exports;
4. A new ‘State’ phase develops, where the firm establishes the freshly acquired exporting activities by incrementally developing knowledge about the new markets and improving the export operation;
5. Once the firm is efficiently operating in its enlarged business, new opportunities to expand its international activities are evaluated. This step usually takes into account imposing the firm position in the previous export countries – even through green-field or brown-field operations – and/or expanding the export activities to other countries – always in consideration of the psychic distance.

This cycle continues as the firm alternates the incremental expansion of its international operations to the establishment of such increment. This is a slow process that enables SMEs to evolve from purely domestic companies to multinational enterprises. The authors recognize four main different stages that a firm passes through in relation to this process, each one related to an increased involvement in international activities: no regular exports, export via third party enablers, establishment of overseas sales subsidiary and, finally, establishment of overseas production plants.

The basic assumption behind this model is that the gradual increase of resources committed to perform foreign activities implicitly develops internal knowledge, which in turn can translate into competitive advantages and help the firm grow its overseas operations (Andersen, 1993).

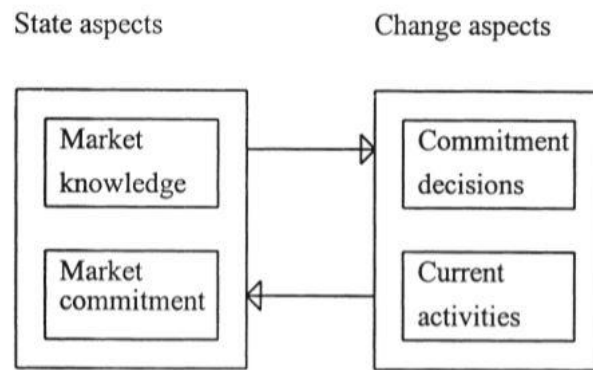


Figure 1. The Internationalization Process of the Firm (Source: Johanson & Vahlne, 1990)

The Uppsala Model clearly stems from the RBV, as it states that the growth of the firm is bounded to the resources committed in its activities and only by capitalizing on these resources and on the new knowledge available a firm can establish a competitive advantage. To understand the substance of competitive advantages one has to confront a business and its competitors in terms of the multidimensional points of superiority and deficiency (Day and Nedungadi, 1994). Penrose (1959) is the first to structure competitive advantage and strategic management in a RBV, stating that it is the mix of proprietary resources of a firm and not the management scope that constraints the choice of the markets it may enter. In this view, resource limitation in small and young firms are a subset or combination of: lack of raw materials and workforce, lack of financial solidity – which implies that the firm cannot sustainably invest in more than few opportunities – and lack of managerial experience. RBV literacy has developed in many routes since then and among the most insightful frameworks there are the ones introduced by Barney (1991) and Peteraf (1993). Fundamentally, they expanded the concept of resources and tried to explain competitive advantage through the relations that competitors have – or, better, do not have – with a broad set of different proprietary resources, with the aim of highlighting that what powers firm specific advantages is what a firm have and can make use of in ways that competitors cannot.

More in detail, Barney (1991) is most famous for the VRIN framework, where resources are classified according to their nature and the level of uniqueness they represent. To be a source of sustainable competitive advantage a resource must check all the following parameters:

- *Valuable* – When it is a source of greater value, by allowing a firm to exploit opportunities and/or protect from external threats. The net sum in terms of benefits vs relative costs must be higher than similar resources in competing firms.
- *Rare* – When it is difficult to find the same resource on the market or if its endowment is scarce relative to the demand for its use. This is where rent – in a Ricardian fashion – is generated.
- *Inimitable* – When competitors find it difficult to copy or emulate with similar results. There are four main ‘*isolating mechanisms*’ (Rumelt, 1987) that enable this: uniqueness of the resource, path dependency (when resources are valuable only in relation to context or past processes), causal ambiguity (when competition cannot detect what enables value for the resource) and economic deterrence (economies of scales or need of mass production to give value to the resource)
- *Non-substitutable* – When there are no other similar resources that can provide the same advantage. If competitors can substitute this resources at a reasonable cost to generate similar outputs then it is not a source of advantage anymore.

These criteria state that only firms with a strong hold of scarce resources that have no substitutes can develop sustainable competitive advantages only if this process cannot be imitated by competitors, hence the best practices of established firms – easily copied by fast growing competitors – do not represent a competitive advantage but are the manifestation of their presence.

Peteraf (1993) depicts a framework explaining competitive advantage centred around the concept of Ricardian rents⁶ and how these can generate a positive net sum. Sustainable competitive advantage is, in fact, presented as the ability of a firm to sustain above normal returns in the long run, and this is enabled by four categorical cornerstones (*Figure 2*).

⁶ Ricardo (1809 ca.) defined the rent of a production factor as a portion of the producer's surplus stemming from the optimal characteristics of the factor and/or its efficient exploitation. In a way, it can be seen as the differential gain that a firm can generate from the same resource that competitors use, implying that it can bring different outcomes.

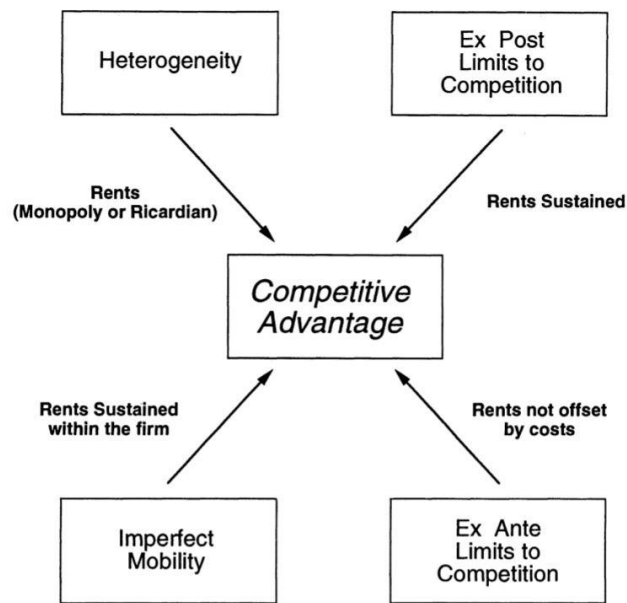


Figure 2. The Cornerstones of Competitive Advantage (Source: Peteraf, 1993)

- The first and most important one is defined ‘*heterogeneity*’ and represents the basic assumption of the RBV by itself. It is hypothesized that competences, capabilities and resources are heterogeneous factors of production across firms, which implies that firms bundled with differing capabilities can compete on the marketplace and cover at least their costs. Those firms that are endowed only with marginal resources can only expect to break-even, while those endowed with superior resources can expect to gain rents. Alvarez and Busenitz (2001) suggest that this view, in the real world, is best represented by entrepreneurs in open competition across markets, as their characteristic behaviour – namely cognition, discovery and exploitation of opportunities – naturally leads to heterogeneous outputs.
- The second condition is defined as ‘*ex-post limits to competition*’ and represents all those actions required to preserve heterogeneity, in order to earn rents – regardless of their nature – for long periods. A firm must develop the forces needed to limit competitors consume these rents. Here, Peteraf (1993) basically refers to the ‘*inimitability*’ and the ‘*non-substitutability*’ conditions proposed by Barney (1991), and so all the consideration already made about the ‘*isolating mechanisms*’ (Rumelt, 1987) persist. It is interesting to highlight that those

resources that are more likely to enable competitive advantages are non-tradable, socially augmented and with a strong tacit/intangible dimension. They are the result of prior discovery, investments, learning and relationships activities – ‘*path dependent*’ in a word – and are a representation of organizational skills and proprietary knowledge.

- The third component is referred to as ‘*imperfect factor mobility*’ and refers to those resources that are tradable but bring a lower value to competitors. This happens when resources are used for contextualized and specific needs, so that the managers had to incur in what may be regarded as non-recoverable costs, which provide stronger ties between the factor and the firm. It also implies that any Ricardian rent stemming from it cannot be entirely countervailed by the asset’s opportunity cost – here referring to the asset’s value for its second highest-valuing potential user. In this reference, resources need not be non-imitable or rare to bring rents, as the factor productivity is attributable only to a firm context. These two characteristics – that firms maintain ownership of imperfectly mobile resources, the rents of which will be shared within the firm – are keys to sustain competitive advantages.
- Lastly, we have the ‘*ex-ante limits to competition*’, meaning that firms wanting to establish a predominant position in reference to a resource subset must first make sure that there can be limits to competition in that resource market. A competitive advantage can be sustainable only if there are no higher costs of implementation than the level of returns (Barney, 1986). The earning of positive rents is possible only when the net sum of a firm’s operation ex-post value and the ex-ante value of the resources invested is higher than zero – which is allowed by the imperfections in the strategic factor markets. Profits, in a way, are determined by the uncertainty of the resource-base.

Summarizing, a firm has to fulfil four conditions to sustain above-marginal returns: resource ‘heterogeneity’ enables rents earning, ‘ex-post limits to competition’ prevents competition to erode these rents, ‘imperfect factor mobility’ ensures that the resources stay with the firm and rents are shared, and ‘ex-ante limits to competition’ prevent the costs to offset the returns.

Both these two frameworks help us uncover interesting insight in relation to small and young high-tech firms facing the internationalization process. First of all, it is important to stress how superiority of resources is a function of the ways they are employed and of the managing skills to coordinate them flawlessly into the organization. At firm level, these models can guide managers to spot and select those resources that could enable sustainable competitive advantage. Innovation is undoubtedly pertinent to this endeavour, since it does comply with all the conditions of both frameworks (Barney, 1991; Peteraf, 1993). Considering that we are referring to young and small firms in the high-tech industry, managers will probably not have the resources necessary to invest in many diverse innovative projects and they will have to choose what to develop internally, what to let go and what to outsource. The RBV states that only those technologies that are inherently immobile – in the sense that co-development would reduce its value due to the revealing of proprietary core knowledge – should be performed internally. On the contrary, if a technology is inherently perfectly mobile, then there is no benefit in not outsourcing it. Innovations that require resources not possessed by the firm have to be meticulously analysed: if there are strong relationships with the owners of the cospecialized resources, then the innovation can be jointly developed; otherwise, partners could be incentivized by the market value of such innovation and reduce the potential rents of the investment. Other factors managers should take into account are related to the grade of inimitability – if the innovation is just a complex assembly of more available technology IP protection cannot protect the firm for long – and the benefits related to the first-mover advantage – they might consider to develop complementary innovations foreseeing a new market need.

What is overwhelming is the repercussion of competitors' advantages causal ambiguity on the firm. Despite resources are the basis of competitive advantage, in the high-tech context there are strongly time-dependent, standard-dependent or socially complex factors to consider for non-common knowledge (Liu and Liang, 2015). Often, firms owning the required resources are not able to further generate innovation because they lack all the necessary information/knowledge. To exploit this type of situations, managers can either decide to find the complementary knowledge required and foster new innovations to expand the markets thanks to the new technology, or license those specialized resources – given that they are protected by IP – and generate new rents. Small

firms could benefit much more from the first option considering that participating in innovative networks would possibly facilitate its internationalization process.

The main problem of RBV theory, though, remains in its fundamentally static approach: firms can benefit a lot from using its contents to achieve a sustainable competitive advantage, but once changes happen managers are not able to promptly react using this approach.

2.5 DYNAMIC CAPABILITIES PERSPECTIVE AND MANAGERIAL IMPLICATIONS

Now, to answer the question of how to actively sustain the competitive advantages in response of rapidly changing business environments, we present the DCP (dynamic capabilities perspective). This perspective stems directly from the Strategic Management literature and from RBV itself, trying to provide a framework to efficiently manage and change a firm's operational capabilities in response to radical discontinuous change, while maintaining minimum capability standards and remaining competitive in the market (Helfat et al., 2009). Competitive survival is not granted in a Schumpeterian⁷ world, where competitors continuously clash for market shares through price wars, performance rivalry and the 'creative destruction' of new technologies (Teece et al., 2016). Strategic Management literature had tried to unveil the sources of value creation in different ways: the dominant paradigm until the 90s has been the '*competitive forces approach*'⁸ developed by Porter (1989), where the focus was on entry deterrence and the defence of the firm's strategic position; then, Shapiro (1989) introduced the '*strategic conflict approach*'⁹, where the interaction among competitors is studied through the use of game-theories to enable expectations about the future; RBV focuses on the exploitation of firm-specific resources. Each one of those models tries to find the seeds of successful and sustainable firm growth, without offering a sufficiently comprehensive consideration of the constantly changing settings.

⁷ Schumpeter (1883 – 1950) had been one of the most influential economists of the 20th century, and popularized the term "creative destruction", which is still very crucial to understand modern competition, especially in the innovation driven context of high-tech industry.

⁸ Porter's most notorious 5-forces framework: a firm should implement strategic moves in order to defend itself from direct competitors, suppliers' potential downward integration, customers' potential upward integration, secondary competition and potential new entrants.

⁹ In sequential move games, each player looks ahead and anticipates his rival's future responses in order to reason back and make decision for the next future, i.e. look forward & reason backward.

The DCP, on the other hand, recognizes these sources of entrepreneurial rents without trying to explain them, instead focuses on the development of those managerial skills that allow the firm to dynamically react and adapt to innovative changes in the market. Managers need to evolve a combination of organizational, functional and technological skills while efficiently coordinating IP protection, process/product innovation, knowledge transfer across networks and productivity (Teece et al., 2016). Hence, DCP should be used to uncover and understand novel sources of competitive advantage in a more integrated way. The first widely accepted definition of dynamic capabilities is provided by Teece et al. (1997: 512) and refers to:

“the firm’s ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments”,

which implies that the competences and capabilities are, in their essence, embedded into some kind of organizational activity. These are, in turn, moulded by the resources a firm possesses – mainly how these are specialized in respect of the market – and by the history/tradition of the firm itself – considering to what degree its structure can be evolved to follow market trends. Thus, a combination of these factors represents a firm’s dynamic capabilities and shapes the competitive advantage it could gain.

The ‘*managerial and organizational activities*’ we refer to are what might be called its distinctive routines, but in a broader view this includes the whole historic pattern of current best practices and the extent of the learning capabilities of the firm. Then, there is the ‘*current strategic position*’ to consider, which comprises current IP protection systems, specialized assets, power and relationship status in the value chain and the relative endowments of technology-base. Moreover, there are the ‘*paths*’, namely those potential strategic alternatives that the firm can undertake in relation to the rents generation enabled by strong path dependencies. The basic concept of this theory is that a firm has to capitalize on its ability to efficiently combine these three factors in order to achieve higher rewarding positions.

The most straightforward framework to guide through this process is the “*Sense-Seize-Transform*” model (*Figure 3.*) (Teece, 2018). These are the three necessary dynamic capabilities required to effectively face new and unexpected challenges: the structure and culture of the firm should enable employees to quickly *sense and shape*

external threats/opportunities, enabling the establishment of new assets; the integration and exploitation of these new technologies/knowledge should not be hindered by internal operations in order to allow the company to *seize such opportunities*; the maintenance or the entitling of a high strategic position should be realized through the enhancement, the combination or the *transformation of business's organizational processes* thanks to the new resources incorporated. The effective implementation of these stages is a clear evidence of a firm's '*corporate agility*', i.e. the 'bundle' of dynamic capabilities that powers sustainable competitive advantage.

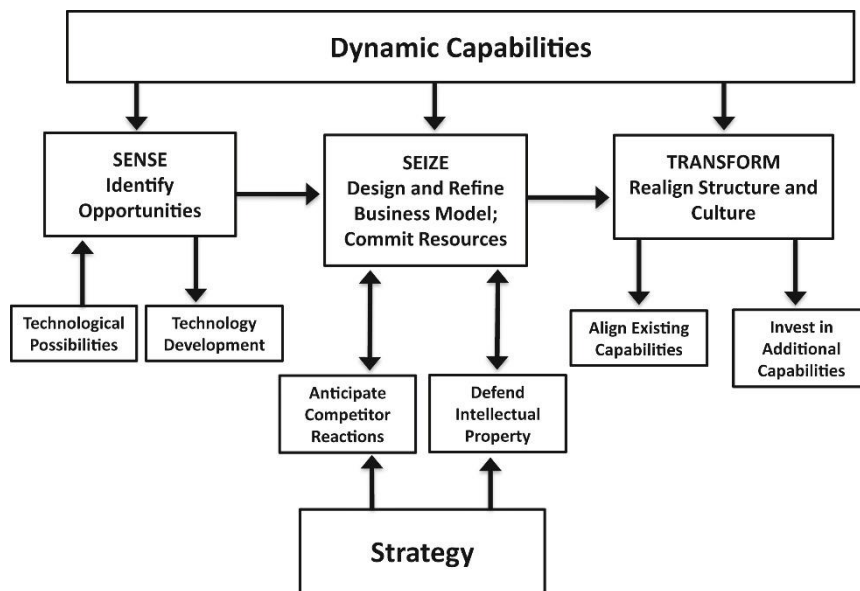


Figure 3. Dynamic Capabilities Perspective Framework (Source: Teece, 2018)

The nature of this 'bundle' necessarily varies in relation to the context considered: what is a dynamic capability for an international distributor may not represent any value for a small specialized manufacturer. Returning to our case study, what can be considered highly valuable in a DCP for small and young high-tech firms? First and foremost, *learning*. It requires a multi-layered and complex coordination activity, as it involves a multitude of different interaction routines from the common codes of communication at individual level to the highly formalized knowledge exchange procedures among firms. Especially in this setting, learning cannot be fostered only internally, as collaborations and partnerships may help firms to spot dysfunctional practices and prevent strategic

failures, other than providing new resources. *Co-specialization* is often inherent in this industry: it means that assets/resources accrue their value if combined with certain other assets/resources. The ownership of resources that are synergetic gives a firm increased competitive advantage – it is quite clear if we compared it to another firm that only owns one co-specialized resource and needs to acquire the others to exploit its potential. Lastly, *asset orchestration*¹⁰ is crucial. Firms' capabilities are often co-specialized and path-dependant in the high-tech business, making their coordination and exploitation particularly difficult. Innovative SMEs trying to effectively enter foreign markets should be able to reconfigure their supply chain to engage new international agents, adapt and develop their product/service offering and protect their IP (Teece, 2007). A good management generates value from the combination of a firm's parts, provided that it can differentiate organizational capabilities from dynamic capabilities. Only dynamic capabilities can define the paths of evolution and adaption of a firm (Zahra and George, 2002).

2.6 ABSORPTIVE CAPACITY

Until now, we have comprehended that in order to be competitive on international markets small firms have to develop strong and sustainable competitive advantages. These arise from those resources that hold the characteristics described above by the RBV (Barney, 1991; Peteraf, 1993). Then, to ensure the sustainability of such advantages, firms have to possess a set of capabilities that can be used to reactively stabilize in a dynamic environment. These dynamic capabilities are strongly related to the same critical resources just depicted and are represented by a combination of knowledge, technologies and mediators (Matusik and Hill, 1998). Thereafter, innovation can be considered to be among the most critical success factors that small and young high-tech firms have to establish a strong strategic position in international markets. It does check all the boxes of both RBV and DCP – innovative capability in this regard. But in order to sustain its competitive position a firm has to be aware of outer changes, so what is still missing is the capability of enabling strategic flexibility (Barney, 1991). That is the *absorptive*

¹⁰ "Asset orchestration involves identifying the critical assets and investing in them and then developing a governance system along with a means for their effective use identified. The second part of asset orchestration involves the coordination of co-specialized assets and their use in productive ways." (Hitt, 2016: 2).

capacity (ACAP) of the firm.

There have been a wide range of different definition for ACAP, each one highlighting a peculiar aspect of it. This also means that ACAP is quite a flexible concept in itself and has been studied across different fields of literature. *Table 1.* summarizes some insightful definitions:

DEFINITION	AUTHOR
ACAP is the firm's ability to value, assimilate, and apply new knowledge	Cohen and Levinthal (1990)
ACAP requires a broad set of skills needed to deal with the tacit component of transferred knowledge and the need to modify this imported knowledge	Mowery and Oxley (1995)
ACAP requires learning capability and develops problem-solving skills; learning capability is the capacity to assimilate knowledge - for imitation - and problem-solving skills to create new knowledge - for innovation	Kim (1998)
We define ACAP as a set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability	Zahra and George (2002)

Table 1. Extant Literature Definition of ACAP

Especially in the high-tech context, many firms may possess very similar resources and capabilities, but only a few profits from them. The reason is that some firms have developed the right innovation at the right time (Cockburn et al., 2000): these firms have a stronger and reliable ACAP. We can view ACAP as a dynamic capability that depends mainly from the firm's routines and organizational processes related to knowledge creation, transferring and stocking. As a combination of knowledge-based capabilities that can ensure reactivity in dynamic market conditions, ACAP can be considered a source of sustainable competitive advantage (Zahra and George, 2002).

Recent researches on the matter revealed interesting findings. Zahra and George (2002) and D'Angelo (2010) find that in SMEs there is a strong relationship between ACAP and innovative output, even if the measurement of such factor is still complex. Raff (2000) states that firms' strategic flexibility is a success factor as it enables the exploitation of emerging opportunities, which, in turn, provide a much higher return for

those firm that are able to enforce a first mover advantage (Ferrier et al., 1999). Firms with strong ACAP are more likely to continuously update their knowledge-base and hence protect themselves from the inertia problem caused by competence-traps (Zahra and George, 2002). Though, the lack of strategic and specialized resources may hinder ACAP, thus preventing the incorporation of the knowledge required to enter foreign markets through innovation processes (Neirotti and Paolucci, 2015).

In short, SMEs that try to succeed in the high-tech business necessarily face international competition in their early development. Effectively penetrating foreign markets might provide high returns, but a solid and sustainable competitive advantage is required in this endeavour. Innovation is compulsory as it represents one of the most important resources in this industry, holding the potentiality of disrupting entire markets or even creating new ones in no time. Though, in order to put innovative products on multiple foreign markets these firms have to face challenges related to innovative knowledge absorption, collaboration and negotiation with local distribution partners on foreign markets, and information overload in the portfolio management of their R&D programs. ACAP gains then a crucial role as the mediator of learning capabilities and the ability to seize opportunities – inherently firm-specific and path-dependent. All these dynamic capabilities represent the success factors of this business, as they support firms in managing the complexity of such challenges, while enabling the efficient combination of all the firm's resources. What still is to understand is the role of partners and networks in facilitating this process. Innovation would certainly benefit from widespread collaborations, but competitive advantage might easily be diluted in the network of relations in this way. What is, then, the ideal equilibrium?

3 HYPOTESIS FORMULATION

The theories and frameworks presented above must be interpreted in their own interdimensional way to be integrated into a systemic managerial approach that can be effectively applied to young tech-based firms. The holistic nature of their growth process across foreign countries implies that innovative effort, internationalization and entrepreneurial behaviour are deeply inter-related dimensions (Onetti et al., 2012). As already mentioned, innovation represents one of the strongest sources of competitive advantage, and the ownership of innovative and technological resources has been proved to enhance export performance (Schoonhoven et al., 1990; Teece et al., 1997), also in relation to the internationalization processes of Italian SMEs (Cerrato, 1999; D'Angelo, 2010; Giovannetti et al., 2011). Moreover, Knight and Cavusgil (2004) find that those firms that are inherently innovative – i.e. innovation is among their core competences – seem to be more prone to internationalize their business, as it was already anticipated by Miller and Friesen (1984) and Steensma et al. (2000). Interesting insights come from researches using Italian SMEs as samples, where those innovations not strictly associated to R&D activities manifested positive and significant relations to export intensity (Sterlacchini, 1999, 2001; Nassimbeni, 2001). Analogously but with different settings, Rodriguez and Rodriguez (2005) state that innovative outputs, technology endowments and IP protection positively affect both export intensity and decision.

Being innovative implies that a firm utilizes creative ways to serve the market, has a tendency to promote the development of new ideas (Lumpkin and Dess, 1996) and establishes relationships with different agents to foster knowledge absorption. Consequently, the introduction of innovative products into international markets is facilitated by innovation strategies (Sekliuckiene et al., 2016). Besides, innovation facilitates the development of new products, processes, technologies and services that make it easier to answer the needs of foreign country markets (Cassiman and Golovko, 2011). Small firms' organic growth now depends on the joint effect of both innovative effort and international propensity (Onetti et al., 2012), but innovations close the gaps towards new markets and provide access to broader and diverse sources of knowledge, thus the internationalization process itself nurtures innovativeness, and vice versa (Andersen and Kheam, 1998; Zucchella and Siano, 2014). When considering the knowledge intensive, small and young firms environment, the learning process that stays

at the essence of internationalization (Johanson and Vahlne, 2009) becomes necessarily contingent on the participation in networks and collaborations (Casillas and Moreno-Menéndez, 2014) – with implications related to the bargaining power of the collaborators. Due to the aforementioned *liabilities of foreignness, size and newness*, the lack of comprehensive knowledge and human resources imply that direct contact with foreign suppliers and customers is an important success factor for the effective internationalization (Johanson and Vahlne, 2009). Openness to external collaborations is then a potential source of competitive advantage (Sekliuckiene et al., 2016), and when coupled with strong ACAP it may easily provide successful innovations. On the other hand, firms usually tend to collaborate only if they are gaining more than they are losing – in terms of net knowledge exchanged – and only under strict contracts they are willing to exchange strategic knowledge. Thus, there is an inherent controversy behind the use of partnerships, as every player aims to gain at least more than their competitors.

The main obstacle in innovation related studies is the measurement itself of a firm's innovative effort, since a plethora of different indicators has been used already without actually being able to represent innovation as a whole (D'Angelo, 2010). Consequently, the effect and intensity on firms' innovativeness of collaborations are often very difficult to track, most of the relationships being informal and occasional, hence most researches investigate these relations with more qualitative methods (Zucchella and Siano, 2014). The goal of this study is to contribute to the expansion of the academic research in regard to the relationship between innovation and internationalization in highly innovative young firms. This research uses '*international propensity*' as the dependent variable, considering that this facet of internationalization is still underdeveloped in the field and could yield remarkable outcomes. Moreover, innovation had been approached from multiple angles in order to cover three different aspects strictly related to it. Through the structuring and analysis of an econometric model built on a database of Italian innovative small firms, testing it against the hypotheses and providing thoughtful comments, we aim to respond to the following research question:

What are those components of innovation that drive internationalization among high-tech young firms?

Is the direction of the knowledge flows exchanged with external entities relevant for the internationalization of high-tech young firms?

Before presenting the model we built to answer these, a thorough understanding of innovation and some of its main sources is necessary. In the following chapters, we will decline and present the most structural components of innovation, utilizing literacy's definitions and insights to guide ourselves in the formulation of the hypotheses pertinent to our mission. We will distinguish traditional sources of innovation from more recent ways to foster it as a primal partition. The former are broadly represented by those activities related to an internal development – input- or output-wise – of innovation, while the latter consists in those joint activities – formal and informal – with external agents that contribute – directly or indirectly – to an increased innovative capacity of the firm.

3.1 DECLINING INNOVATION

When referring to innovation and its building blocks one can easily provide a ridiculously long list of indicators, without actually be able to clearly define its multidimensional perspective. Distinguishing innovation inputs from outputs or internal sources from external may not be so harsh, but there are many ways to approach these contingencies (D'Angelo, 2010), so we will use the most cited references of the literature. Innovativeness at its core is the firm's ability to question itself and challenge its own structure to improve and be able to sustain the competitive advantage pursued. Then, competitive advantage can be propelled by the strong planning and control of change – in a holistic sense (Goksoy et al., 2013). At the same time though, innovation cannot be represented just by the ability to change, as technology and knowledge endowments are crucial, especially in the young high-tech firms' context (Dai et al., 2014). The Oslo Manual (OECD, 2005) provides a definition widely accepted at country level of innovation, as:

“the implementation of a new or significantly improved product (good or service), process or business function such as marketing methods and organization changes or external relations”.

This formulation highlights the intrinsic Schumpeterian acceptance of the entrepreneurial endeavour, while encompassing the fact that it is the enterprise sector to primarily implement innovations in its various forms (European Commission, 2002). Goel and Jones III (2016) find that the explorative and exploitative activities of entrepreneurs are the key drivers that enable the growth and renewal of family businesses

in OECD countries. The definition above also accounts the relevance of external collaborations, paving the way towards the OI (open innovation) paradigm that has been a very prolific field of interest for many scholars (Chesbrough 2003, 2004, 2006; Lorenzoni and Lipparini, 1999; Onetti and Zucchella, 2008; Onetti et al. 2012; Veugelers and Cassiman 2005, van de Vrande et al., 2009, and many more).

Even though context is quite stringent in this regard, smaller firms steadily became more and more relevant in the innovation landscape of the OECD. Chesbrough (2003) provided statistics of the contribution of small enterprises on the overall R&D spending in the US¹¹ to introduce the argument that innovation is becoming more fragmented, implying the necessity for firms to open up to collaborations. Previous studies demonstrated that larger firms are still the leaders in innovation if we consider R&D spending as indicator, but recently the trend has been to outsource innovation to smaller firms and independent research labs (Audretsch, 2002). The main reason is that the bigger the firm the higher the organizational inertia that slows the business down when trying to apply newer routines (Anderson and Tushman, 1990; Scherer, 1991), due to bureaucratic constraints and a strong cultural influence (Link and Bozeman, 1991). On the other hand, small and young firms are way more flexible and can adapt more easily to market changes, moreover they can only benefit from the collaboration with established businesses – since they suffer resource constraints (Christensen and Rosenbloom, 1995; Scherer, 1991). In general, large firms have a very different approach to innovation in comparison to smaller ones. Their larger size implies a large resource base and a more diversified portfolio, which translates into a very broad set of innovation projects to be simultaneously financed, using standard risk hedging methods. Contrarily, small firms can only focus on few – if not single – innovative projects, and if the investment does not provide the estimated returns it may even result in bankruptcy. The stakes are very high, even more if we consider that commonly small firms – again, contrarily to larger enterprises – do not have the resources/experience to structure their projects in detailed sub-activities, and this can even offset the participation of highly-specialized personnel (Singh and Kota, 2017). As an example, we briefly outline the P&G case studied by Davey and Sanders (2012). What has been found to power P&G's competitive advantage

¹¹ Small firms (up to 49 employees) accounted for the 4.3 % of overall US R&D spending in 1981, while in 2005 the same indicator grew up to 24.6 % (National Science Foundation, 2006).

were the strategic innovations in different key areas of the business – namely advertising, market research, brand management, distribution, product innovation and high-tech – and the fact that the enterprise has invested in these projects since inception. The authors also validated the importance of ‘*planned innovation*’ – the ability of a firm to predict the right innovative projects and readily engage them – and ‘*serial innovation*’ – the capacity to bring effectively to the market more successful innovations, without focusing on the capitalization of the first success – in sustaining the leadership of the market. These are avenues that are much more likely to be applied by firms of larger size (Hamel, 2006; Ireland and Webb, 2007).

SMEs that are able to grow organically usually apply more formal structures also in the innovation process, by recruiting professionals, introducing figures dedicated to the management and control of these projects, implementing ground rules to speed up the procedures and enabling more formal collaborations (Greiner, 1972). Once a critical mass is reached, firms start to implement external partnerships, innovative formalized practices and IP protection systems. This is way, when we consider that SMEs are increasingly investing in collaborative innovation, it is the medium enterprises more than small ones that are the strong representatives (van de Vrande et al., 2009). On the other hand, the lack of financial resources and the small margin for failure that characterize smaller firms inherently channel them towards networks to make use of the missing resources they need. In relation to the high-tech business, where product life-cycle is always briefer and the tech required to develop a product is very fragmented, the ability to gain access to and benefit from external collaborations has acquired high relevance also for smaller firms (van de Vrande et al., 2009). An alternative way to accelerate this process and lower the risk associated is to outsource the R&D component of the innovation and focus on the exploitation phase, but this is generally more costly and not time-efficient for those innovations that may provide sources of competitive advantage, aside from the fact that this would only be short-lived because it is the supplier to have the ownership of the resources (Veugelers and Cassiman 1999).

The vast majority of past research utilized R&D investments as the primal indicator of a firm’s innovative effort, mainly due to the easiness and adaptability of the measurement itself. But this indicator only represents one component of internal innovation input and even though it is still an important factor for considerations

regarding innovation, it is not the only one (Parisi et al., 2006). In our analysis, we will also present internal output indicators, as well as external indicators, in order to offer a simple yet comprehensive view of the multidimensional components of innovation.

3.2 TRADITIONAL INNOVATION FRAMEWORK

Stemming from the fact that innovation is highly contextualized (Garud et al., 2015), we will now present some extant literature insights in this regard, then we will use the findings presented to guide us through the formulation of the first two hypotheses.

3.2.1 INNOVATION INPUT - R&D EXPENDITURE

Considering that SMEs must invest in R&D in order to develop those core competences and sustainable advantages that competitors cannot have access to (van de Vrande et al., 2009), we provide a broad range of literature findings that relates innovation inputs to internationalization in very different contexts, underlying how results strongly depend on the contingencies.

Zhao and Li (1997) find that Chinese firms that invested more than the average in R&D activities had faster export growth. Ito and Pucik (1993), on the contrary, do not find any significant relation between internal innovation inputs and export sales for Japanese firms, when divided in sub-samples by size. Similar results are provided by Willmore (1992) that tested the effects of innovation inputs on exports for Brazilian MNEs. Harris and Li (2009) state that internal innovation inputs, especially R&D expenditure, are significant explanatory variables for the internationalization of SMEs in the UK, even if they do not affect export intensity. Though, Roper and Love (2002) state that internal innovation inputs do significantly influence exports in relation to a large sample of English and German manufacturing large firms. Hasan and Raturi (2003) studying manufacturing firms in India find that R&D indicators can forecast the entry modes of these firms into international markets. Kalafsky and MacPherson (2001) suggest that innovative input activities are strongly related to export intensity, in consideration of the medium-high tech machinery sector in the US. Ozelik and Taymar (2004) validate the existence of positive relations between R&D and export intensity of Turkish SMEs. Lefebvre et al. (1998) do not find supporting evidence for the same hypothesis in relation to Canadian small firms. Hirsch and Bijaoui (1985), on the other hand, find that internal

innovation inputs strongly affect the export growth path of Israeli small firms.

As far as Italian firms are concerned, Sterlacchini's (1999) study on non-R&D intensive small firms proves that innovative inputs do affect export performance, even though internal inputs are not significantly related to it. Similarly, Nassimbeni (2001) finds that small manufacturing firms' international presence is not directly affected by R&D, but technology and innovative inputs in general are positively related. D'Angelo (2010) only finds partial evidence to support the positive relationship between internal innovation inputs and export intensity in high-tech SMEs. Even if R&D direct expenditures are not significantly related to export growth, the number of R&D employees has a significant and positive impact.

All of these diversified studies show that innovation inputs and internationalization can be measured through different indicators, though many of these, especially those in relation to small firms, often specified the importance of expanding the use of internal innovation inputs as the main indicators for innovativeness. External sources of innovation can be even more crucial for the development of new technology in the high-tech sector if we consider that R&D should inherently enhance the ACAP of a business. This view has been largely emphasized by recent literature¹² and validates the hypothesis that R&D increases the export performance by enabling larger and quicker knowledge transfer at country level, especially when firms are internationalized (Griffith et al., 2004). Parisi et al. (2006) find that this interaction exists also at firm level, as their analysis on Italian firms shows that R&D is related to the absorption of external innovations and can in turn foster new investments.

In brief, R&D spending represents only a component of the internal innovation inputs that a firm can make use of to develop new innovations. Literature provides contrasting evidence of its role in affecting internationalization components, though many studies related to SMEs find that innovative inputs do have an important role in defining export growth and intensity. Moreover, R&D expenditures implicitly measures also the increase of ACAP in a firm, which is a capability that is necessary to develop sustainable competitive advantage in young and innovative firms operating in the high-tech sector.

¹² Among the many contributions, Rosenberg (1982), Cohen and Levinthal (1990), Romer (1990), Grossman and Helpman (1991), Segestrom (1991), Neary and Leahy (1999), and Griffith et al. (2004) shaped the concept of induced absorptive capacity in relation to R&D activity.

Then, if we consider that in Italy firms are on average less endowed with technology and financial resources than comparable foreign firms, R&D gains even more importance in the high-tech industry because young firms aiming to penetrate international markets need to develop proprietary innovations to compete with foreign players.

Thereafter, we hypothesize that

H1: *YICs with high R&D spending have a higher propensity to internationalize than YICs with low R&D spending.*

3.2.2 INNOVATION OUTPUT – PRODUCT VS PROCESS INNOVATION

As a consequence of the fact that R&D has been widely used in literature as the sole indicator of innovation, the measurement of internal output innovation have not been adequately studied, with very few researching the relation that exists between these indicators and the internationalization process. Although, this is very much needed, since R&D only reflects a partial facet of the innovative capability of firms, and moreover the findings – as we already mentioned – are often controversial, depending on the contingencies. Previous researches on innovation outputs, on the other hand, find that they have a consistent and significant relationship with export indicators, both for SMEs and large firms (Rodriguez and Rodriguez, 2005; Basile, 2001; Sterlacchini, 2001; Roper and Love, 2002; Tavassoli, 2018). Basile's (2001) analysis on the micro-evidence of a sample of Italian manufacturing SMEs highlights that innovation output can predict export decision and subsequently positively affects the export intensity of the firm. The core idea is that innovation output provides an improved capacity to the firm to effectively penetrate foreign markets and sustain international competition. In this view, innovation inputs acquire a different role, as they become the enabler of innovation outputs through improved learning and knowledge base (Griffith et al., 2004) and ACAP and the exploitative capabilities convert these augmented resources into new products and/or practices (Kogut and Zander, 1996). In particular, R&D expenditures are strongly and directly correlated with the introduction of product innovation, but not necessarily imply process innovation (Parisi et al., 2006).

Innovation outputs can be split into many different categories, but the most used in research are aggregated measures that describe either product innovation or process innovation. These two activities are more difficult to effectively measure than R&D, and

often their long actualization process might make them irrelevant for spot researches. Parisi et al. (2006) prove that these two innovation outputs are statistically distinct, in the sense that one does not imply the other when analyzing the descriptive micro-data. Basically, through product innovation, firms are able to develop the Schumpeterian growth characterized by the creative destruction concept, meaning that differentiated or disruptive products are able to create the competitive advantage necessary to successfully enter into competitive foreign markets (Tavassoli, 2018). A similar relation has been found by D'Angelo (2010) studying an Italian sample: product innovation is significantly and positively related to export intensity, as it enables product differentiation which is crucial in technology-based industries. Sekliuckiene et al. (2016) find that product innovation has a positive and significant influence on the intensity of knowledge intensive SMEs' export in Lithuania. Contrarily, the role of process innovation is more arguable, since there have been different findings about its relation to internationalization. D'Angelo (2010) states that the relevance of process innovation in affecting export intensity is not sufficiently supported, but the income coming from the innovative activities can predict export intensity. Parisi's et al. (2006) research on Italian SMEs shows that process innovation is more common than product innovation, but at the same time more occasional. Process innovation takes longer to develop but once the firm adapts to the new routines the need for further changes shifts to the long-term, so its relation to international market penetration must be studied on longer timeframes. Though, Basile (2001) finds that higher process innovation increases the firm's competitiveness abroad, by reducing production costs and time to market, but this is true especially in consideration of established manufacturing firms.

As a matter of facts, most of the studies concerning innovation outputs are conducted at firm level, which means that the external aspects of innovation output are not considered, even though they provide a strong contribution to innovative capability at network- and country-level (Enkel et al., 2009). Instead, the majority of the work presented above has been develop by opposing the effect of product innovation to process innovation (generally described by dummy variables) in relation to export intensity/decision of a firm. Summarizing, product innovation consistently resulted to have a significant and positive effect on exports – both intensity and propensity – thanks to the differentiation effect that enables international competitive advantage, despite the

different contingencies. Evidence on process innovation are yet inconclusive and the positive results are mostly related to the large manufacturing firms' context. Considering that our focus is on small and young firms operating in a knowledge intensive market, we believe that process innovations at this early stage of a firm life-cycle should be studied with time series data in order to provide significant results. Moreover, in this sector the ability to quickly offer new versions of high-tech products/services is definitely more important to sustain a strong competitive advantage.

Therefore, we hypothesize that:

H2: *YICs undertaking product innovation have a higher propensity to internationalize than YICs undertaking process innovation.*

3.3 OPEN INNOVATION FRAMEWORK

Owing to the fact that in the high-tech sector the wide presence of VCs (venture capitalists), the high mobility of employees, the product life-cycle is much shorter and the knowledge is dispersed across many different agents, firms cannot solely rely on their internal innovative capacity anymore, but rather they need to seek alternative avenues to innovate more efficiently and consistently (van de Vrande et al., 2009). To effectively reduce the increase of marginal costs related to innovation and speed the processing up, businesses have to look beyond R&D investments and start absorbing information from the surrounding ecosystem (Chesbrough, 2003). The creation and establishment of collaborations with external agents provide access to new knowledge, enabling small firms to focus on their core competences to maintain competitive advantage (Onetti et al., 2012). The expertise in few fields associated to the knowledge of different functional activities has been demonstrated to bring quicker international expansion (Cavusgil and Zou, 1994; Kogut and Zander, 1993).

This may explain why, since the late 90s, a number of MNEs started to adopt an '*OI model*', where both internal and external resources are employed concurrently to foster innovation (Chesbrough, 2003). If confronted to the '*closed model*' – which refers to the traditional way of focusing on internal R&D, underlining the lack of recurring interactions with the external environment – the open model refers to a much broader set of activities that contribute to the innovation of a firm (van de Vrande et al., 2009).

Partnerships and collaborations become the primal sources of innovation (Amara and Landry, 2005) and help the firm to integrate the missing knowledge to offer complete products (Sobrero, 2000), thus networking activities have a prominent importance in driving innovation (Veugelers and Cassiman, 2005). Firms should expand their links to diversified agents and create intense relationships with strategic networks, therefore enabling the creation of an open system of innovators aiming at increasing the benefits in terms of knowledge generation and transfer (Chesbrough et al., 2006; Lorenzoni and Lipparini, 1999; Nooteboom, 2000). The effective establishment of such a system will benefit the firm by reduces the difficulties of the traditional innovation processes, related to shorter time to market, knowledge gaps, technology cohesion and financial constrains of the firms among the others (Kuppers and Pyka, 2002).

Though, OI is not the simple outsourcing of R&D activities (Chesbrough and Crowther, 2006). OI has been first introduced as a new paradigm to better manage innovation by Chesbrough (2003: 6), who firstly defined it as:

“the antithesis of the traditional vertical integration model where internal R&D activities lead to internally developed products that are then distributed by the firm. [...] [OI is] the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively”.

Insightfully, this definition states that firms can gain much more innovative productivity and find new ways to commercialize tacit knowledge if they start collaborating with external actors instead of limiting innovation to their inner innovative capability. In the closed innovation model, firms rely only on the internal R&D performance in a consistent and linear process (Marques, 2014), while OI is dynamic and complex, it integrates very different organizations that have different background, cultures and goals, with the common goal of accruing the knowledge base of the network. At the same time the resources owned by a firm – even the idle ones – inherently develop new pathways of exploitation thanks to a sort of multidimensional complementarity (Sekliuckiene et al., 2016). An OI approach gives the firm the ability to attract external knowledge more efficiently and more quickly, other than enabling better network creation and participation abilities (*Figure 4.*). Through the establishment of international

collaborations, knowledge intensive firms can acquire higher flexibility, missing specific knowledge and improved credibility on foreign markets, all of which implies that OI facilitates international expansion and reduces the negative factors related to it (Ejler et al., 2012; Bianchi et al., 2010). Nevertheless, networking does not represent entirely the implementation of OI in a system, as factors/HR mobility, the VC endowment of the region, the level of scientific research in the area and strength of the IP protection structure have all an important effect on the possibility to use OI in a strategic way (Chesbrough et al., 2014). The following are the 8 main improvements made by the OI paradigm depicted by Chesbrough et al. (2006), that highlight the major flaws and lacunas inherent in the traditional (closed) model:

1. *Equal importance given to **external knowledge**, in comparison to internal knowledge*
2. *The centrality of the **business model** in converting R&D into commercial value*
3. *Type I and Type II **measurement errors** (in relation to the business model) in evaluating R&D projects*
4. *The **purposive outbound flows of knowledge** and technology*
5. *The abundant **underlying knowledge landscape***
6. *The proactive and nuanced role of **IP management***
7. *The rise of **innovation intermediaries***
8. *New **metrics** for assessing innovation capability and performance*

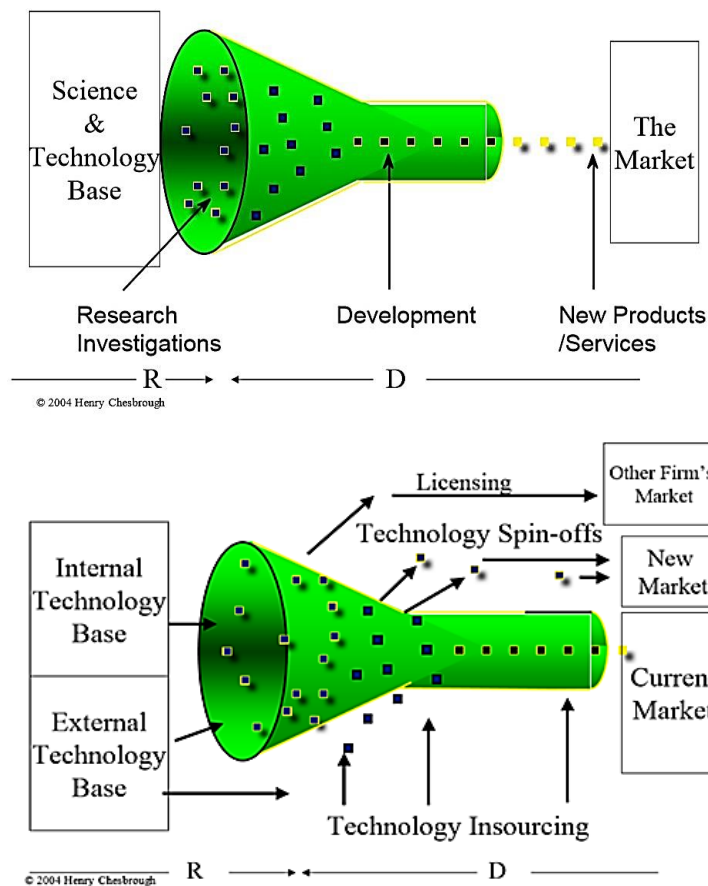


Figure 4. Confronting the Closed Innovation Paradigm – above – and the Open Innovation Paradigm – below (Source: Chesbrough, 2004)

According to Vanhaverbeke et al. (2012) OI has received large attention in recent academic research and can affect differently small-, medium- or large-sized firms, though it has been studied mainly in the context of in-depth case analysis of high-tech MNEs and large manufacturing companies (e.g. Chesbrough, 2003, 2004; Kirschbaum, 2005). Research in the context of SMEs is underdeveloped, but Parida et al. (2012) assert that smaller firms can achieve more advantages from the OI than larger and already internationalized enterprises, because small businesses have lower bureaucracy levels, more risk propensity and they are quicker to adapt and react to environmental shocks. At the same time, OI literature does not pay much interest regarding the links between the international dimensions and the use of this approach in the many cases analysed, revealing a research gap to fill (Chesbrough et al., 2014). The acquisition of foreign market knowledge is enabled through the use of international networks with the aim of reducing the liabilities (*size, foreignness* and *newness*) associated to the entrance in new

markets, and to gain access to unique resources (Amal and Filho, 2010). This network of relationships becomes a key resource to effectively maintain competitiveness in foreign markets, especially for knowledge intensive firms, as it allows them to channel knowledge flows in the direction most needed in the occasion, to spot opportunities and exploit them much faster (Ejler et al., 2012; Casillas and Moreno-Menéndez, 2014).

Enkel et al. (2009) have distinguished three distinct modes to categorize OI in relation to the internationalization problem, that are differentiated by the direction of the flow of knowledge between the internal organization and the external environment.

- ***Outside-In Innovation*** is the first mode, and its main characteristic is to internalize external knowledge through relationships with selected international partners, with the goal of reducing the time-to-market or establishing joint research programs with a transnational nature.
- ***Inside-Out Innovation*** is the second mode, it is grounded on the ability to externalize internal knowledge through formal (mainly licensing) or informal paths with the aim of opening new marketable channels for proprietary resources.
- ***Coupled Open Innovation*** is the third mode, it integrates both the outward and the inward directions by creating reciprocal information movement. Strong partnerships, alliances, joint ventures are examples of how this mode can take place in real markets: the objective is to co-create products/services with higher value added through the integration of firm specific advantages, core activities and value chains.

Hence, the analysis of the mode of interaction can be relevant to assess a firm's knowledge endowment and needs, even if generally smaller firms will be much more interested in implementing the first mode, in order to accrue their ability to effectively serve international markets. Resources constraint is with no doubt their greatest hindrance, but thanks to the purposeful flows of innovative activities they can ensure to exploit every last bit of resource. At the same time though, the increasing number of activities that result from the adoption of the OI model generates some new challenges (Sekliuckiene et al., 2016). The interest from VCs can at first look very promising, but if the founders do not comply with their requests could end up losing any tie with the company, and pivoting towards new directions is often necessary. The outbound flow of

knowledge could backfire into the loss of core competences, if the firm does not develop appropriate protective measures for their intellectual capital. For this reason, the *inside-out mode* has been fairly associated with strong appropriability (West, 2006; Christensen, 2006), as only large companies with a relevant stock of patents could benefit from the out-licensing activity. Smaller firms, though, have started adopting the strategy of partially reveal their technologies, in this way they are more inclined to attract the interest of potential partners and acquire reputation on the market (Henkel, 2006). These firms, in particular the knowledge intensive ones, are willing to share some of their technology – primarily when these have *path-dependency* or *causal ambiguity* characteristics – as pledge to participate in a reciprocal collaboration with third parties, even though in the sector reciprocity is neither given nor foreseeable (Henkel, 2006). Teece (2007) highlighted the problem that new entrants that try to get in the market through innovations are bounded to either integrate vertically or to abstain from commercializing the innovative product, as appropriability cannot be ensured by IP patenting. Consequently, firms that want to develop strong appropriability at firm-level must extend their strategic relationships to competitors, in order to enable a sustainable net transfer of knowledge. For this reason, ACAP and R&D become crucial when established firms have many links with a diverse set of agents, so that they can absorb more knowledge than they leak.

Summarizing, the OI approach has shifted the foundation of competition in the knowledge intensive sectors, implying that firms have now to collaborate with their competitors if they want to remain competitive, but at the same time they must be able to strategically select what to exchange in order to dynamically develop a strategic advantage, exploiting their a priori technology and absorbing external knowledge.

The following paragraphs develop more in detail the OI paradigm, with the aim of investigating whether it is just the presence of research networks – in the more general sense – that encourages the firms' decision of going international, or if this phenomenon can be better explained by the establishment of a particular approach to OI. Academic research is underdeveloped concerning the study of the relation between the direction of the knowledge flows among firms and the firms' propensity to internationalize. In fact, researchers studying similar topics had focused mainly on comparing the type of knowledge exchanged or just whether firms exchange resources with others or not. To fill this research gap, we are going to develop two parallel hypotheses in the next

paragraphs. Firstly, we will elaborate on the argument that research networks benefit the international potential of firms, with no considerations on how the knowledge flows among the firms in the network. Secondly, we will deepen the analysis about the first two modes of approaching OI presented above when referring to Enkel et al. (2009).

3.3.1 OPEN INNOVATION - KNOWLEDGE NETWORKS

There has been a large interest recently in the research field on the specific effects that external relationships and networks have on firms. Cooperation and research partnerships have been found to reduce the overall risks of joint R&D projects and share the costs related to the innovation (Veugelers and Cassiman, 2005). Relationships involving the exchange of knowledge can interest very different agents – e.g. other firms, public institutions, research labs and non-profit organizations – but the common goal is to find alternative ways – other than buying – to acquire missing and complementary resources (Nassimbeni 2001, Cohen and Levinthal, 1990). Collaborations represent the most important source of technical and reputational resources for international firms, and high-tech ones, in particular, gain the position of intermediaries between technological and scientific researchers and established firms (Stuart et al., 2007). Lu and Beamish (2001) find that smaller firms can greatly benefit from alliances and relationships with international players and improve their international position thanks to the uncertainty reduction and resource absorption, enabling high-tech companies to expand early outside domestic boundaries (Keeble et al., 1998). In this sector, the networking capability has become imperative, as Saint-Paul (2003: 3) clearly states with this simple example:

“In an industry with, say, ten firms similar in output and investment in R&D, each member of a nine-firm technology cartel [i.e. network] can expect to obtain immediate access to nine times the number of innovations that the remaining enterprise can anticipate on the average”.

If competitors start to develop collaborative agreements, then each other firm who does not participate will be left behind. Koschatzky (2001) emphasizes this concept and demonstrates that firms that do not exchange knowledge lose their ability to form further collaborations and in the long run will see their knowledge-base drop. Relationships, if coupled with a strong ACAP, become the first engine of innovativeness, since in knowledge intensive sectors networks and collaborations are the main drivers of

innovation (Veugelers and Cassiman, 1999). Most of the time, smaller firms in the context may acquire knowledge from non-formalized relationships or other informal sources to support their international growth, due to their liabilities and scarce credibility on the market (Bonte and Keilback, 1995). Amal and Filho (2010) state that international networks acquire great importance when entering foreign markets because they enhance the firms' ability to spot threats and opportunities thanks to the externalization of the liabilities of foreignness and size and the management of strategic relationships. Then, the collaboration with research centres and/or universities can quickly enable the development of new products to meet specific needs in the market (Teece, 2007).

Some empirical findings validate the existence of strong relations between networks of research and early internationalization of the firm. Sekliuckiene's et al. (2016) study on the internationalization of Lithuanian high-tech SMEs highlights the fact that most of the internationalized firms under analysis have established relationships with local partners in the export countries. Johanson and Vahlne (1990) find that in different context related to SMEs a common factor that drives early internationalization is the pre-existence of networks and relationships related to the management team, which facilitates the overcoming of the liability of newness and the lack of reputation on the market.

Thereafter, we hypothesize that:

H3-A: *YICs participating to research networks have a higher propensity to internationalize than YICs not involved in such networks.*

3.3.2 OPEN INNOVATION - UNIDIRECTIONAL COLLABORATIONS

Following the classification made by Enkel et al. (2009) based on the direction of the flows of knowledge, many studies has associated the purposive outflows to an increased capacity of benefitting from internal innovative effort, while the purposive inflows are associated to the ability to develop internal innovation more quickly. Purposive outflows of knowledge – also called technology exploitation in literature – refers to the innovative activities used to leverage the internal technological capability outside the boundaries of the company, through new ways and means available thanks to the more open market (Chesbrough and Crowther, 2006). Purposive inflows of knowledge – also called technology exploration in literature – relates to those innovative activities aimed at acquiring knowledge and know-how from sources external to the firm,

in order to enhance the internal development of innovation (Chesbrough et al., 2006). To avoid unnecessary confusion, we will keep referring to these innovative approaches using Enkel et al. (2009) interpretation: namely, Inside-out and Outside-in Innovation¹³ respectively.

3.3.2.1 *Outside-in Networks*

Small firms operating in knowledge intensive markets often try to reduce their disadvantages related to knowledge gaps, resource constraints, high risks and high variable costs by enlarging the social and commercial networks they operate in (Hoffman and Schlosser, 2001). This usually is reflected by Outside-in Innovation activities, which consists in internalizing external knowledge to enrich the internal competitive capabilities of the company, that brings to an increased innovative effort (Laursen and Salter, 2006). Van de Vrande et al. (2009) explored this phenomenon while studying a broad sample of Dutch SMEs and were able to describe the primal methodologies used in this frame of reference:

- *Customer Involvement* – firms can benefit from the proactiveness and creativity of their customers by enabling an adequate market research activity (Von Hippel, 2005);
- *External Networking* – allows the company to rapidly fill in specific technology gaps, without investing large amount of resources;
- *External Participation* – relates to the external contributions that may permit small firms to recover abandoned or idle projects. Equity investments often enable a further expansion of the firm's network (Van de Vrande et al., 2009);
- *R&D Outsourcing* – young and small companies cannot conduct internally all the R&D activities needed to achieve a certain technology base and must capitalize on external deals (Gassmann, 2006);
- *Inward Licensing of IP* – the acquisition of external IP, through licensing contracts, is often the most convenient method to legally exploit updated technologies (Chesbrough et al., 2006).

¹³ Coupled Open Innovation will not be treated, as our sample cannot highlight such occurrences. Though, it would be a very interesting variable to study in the context.

This networking experience proves that there is no need of owning the whole knowledge package to create innovation internally, meaning that the locus of tech/knowledge base may be different from the locus of innovation (Onetti et al., 2012), something that is not possible in the Traditional [Closed] Paradigm. The main goal when establishing this kind of networks is to reduce the direct commitment of resources needed to develop radical innovations by incorporating those new technologies and processes from the outside context. In relation to SMEs this often requires the firms to relate with those actors that operate at the frontier of technology and scientific development, such as universities and research labs (Kafouros et al., 2015)

3.3.2.2 *Inside-out Networks*

When discussing the Inside-out Innovation approach – that is when companies secure revenue streams through the commercialization of patented IP, the externalization of internal knowledge/technology or the rents stemming from proprietary innovations (Enkel et al., 2009) – the regime of appropriability is particularly important in determining if the firm can sustain a competitive advantage through these innovative activities. The regime of appropriability describes the ability of firms to protect the advantages generated by their own products or processes in relation to the contingencies of the industry: low levels of appropriability reflect high knowledge spillovers and strong imitation from competitors, high levels reflect that knowledge replication is costly and patents structure is legally strong. In consideration of the high-tech sector, appropriability tends to be medium-low, as the patenting system incorporates only the very founding components and the specific assembly of these into final products, making it possible to replicate products in a wide variety of ways (Zahra and George, 2002).

In this context, firms tend to invest more in ACAP rather than structured R&D projects, following the ideology that the presence of knowledge spillovers on the market could provide faster and broader innovation to those firms that are able to internalize and exploit the missing information. On the other hand, long term R&D plans have the inherent risk of imitability: either the firm is able to strongly capitalize on the innovative output and commercialize it securely, or the resources invested in the project could very likely offset the benefits in such a competitive market (Cohen and Levinthal, 1990). Replication costs are much higher when there is radical innovation, as the competitors' knowledge base and the technological imitation is not sufficient to offer products with

equal performances at reasonable price (Zahra and George, 2002). This is why large firms tend to invest in multiple disruptive projects not necessarily related to their core business, with the aim of unlocking the patenting/leasing potential of few strong innovations. These companies exploit the opportunities of the OI paradigm by capitalizing the networks and relationships they have to negotiate out-licensing deals and generate revenues faster than they could through internal development. Koruna (2004) studied the diverse methods applied by the firms to shift the 'locus' of exploitation outside the company and the most beneficial are: setting the industry standards; infringements indemnity; capitalizing on learning effect; technology and IP outward licensing; mutual licensing agreements.

In brief, it is reasonable that large multinationals often have active inside-out strategies on which they generate substantial revenues in relation to the costs of the out-licensing process. Corporate venturing has increased in importance recently as an efficient method to generate internal innovations through the investment and acquisition of smaller activities already developing projects with high ROI potential (Vanhaverbeke et al., 2008). On the other hand, small firms do not have the resources necessarily to capitalize on this OI approach, especially in the high-tech sector where the product lifecycle are particularly short and the innovative process continuous.

Finally, we hypothesize that:

H3-B: *YICs that establish an Outside-In Innovation approach have a higher propensity to internationalize than YICs that establish an Inside-Out Innovation approach.*

4 EMPIRICAL ANALYSIS

In this chapter, we will provide an in-depth description of how the econometric model had been structured, starting from the presentation of the data sampled and then listing all the variables that are used in this study. To underline the relevance of the sample of this research, we now briefly depict how weak the Italian SMEs context is in terms of R&D spending when compared to similar European countries.

Descriptive micro-data highlights that Italian businesses have always struggled to stay in line with other OECD countries when considering R&D spending at country-level. Aggregate statistics provided yearly by OECD shows that Italian business spending in R&D accounted for only 0.7 % of the value added in the 1995-99 timeframe, while the EU average of the same statistics was 1.5 % and 1.8 % for OECD countries (OECD, 2001). This is quite alarming, considering that Italy is the 4th European country by nominal GDP, and R&D spending should represent a large portion of firms' investments. In the preceding three positions, the enterprises with more than 500 employees account for 78.9 % in France, 74.8 % in UK and 81.4 % in Germany of total formal R&D business spending, compared to the 53.2 % in Italy (European Commission, 2018). The main reason related to this large difference is that the business structure of Italian economy is very peculiar, with an overwhelming 95.1 % of all firms being micro enterprises that employ 45.9 % of all workforce, against the average of 93.1 % in the EU employing on average 29.4 % - refer to *Table 2*. for a more detailed outline. Moreover, due to major prevalence of manufacturing, traditional or family small-sized businesses in the country (Nicoletti, 2002), the firms are way below the average of comparable foreign firms in technology endowment (Malaman, 1997). It is possible, though, that due to the lack of easy access to financial resources and the low governmental commitment in facilitating the R&D spending, small firms have been able to develop innovations through more informal or "tacit" activities, that cannot be represented by the R&D spending figures (Parisi et al., 2006; Zucchella and Siano, 2014). This might be the main reason why R&D spending is so much lower in Italian small firms if confronted to comparable systems (Foresti, 2005).

Class size	Number of enterprises			Number of persons employed			Value added		
	Italy		EU-28	Italy		EU-28	Italy		EU-28
	Number	Share	Share	Number	Share	Share	Billion €	Share	Share
Micro	3 565 046	95.1 %	93.1 %	6 661 193	45.9 %	29.4 %	201.2	28.6 %	20.7 %
Small	162 598	4.3 %	5.8 %	2 921 184	20.1 %	20.0 %	144.9	20.6 %	17.8 %
Medium-sized	18 465	0.5 %	0.9 %	1 808 802	12.5 %	17.0 %	125.3	17.8 %	18.3 %
SMEs	3 746 109	99.9 %	99.8 %	11 391 179	78.5 %	66.4 %	471.5	67.1 %	56.8 %
Large	3 221	0.1 %	0.2 %	3 125 454	21.5 %	33.6 %	231.7	32.9 %	43.2 %
Total	3 749 330	100.0 %	100.0 %	14 516 633	100.0 %	100.0 %	703.1	100.0 %	100.0 %

Table 2. Distribution of Italian firms, by firm size (ISTAT, 2017)

4.1 THE DATASET

In 2012, the Italian Government has been engaged in the creation of a modern, sustainable and all-encompassing legislation intended to facilitate and encourage the establishment of new enterprises with high technological content. Such endeavour has culminated in the Law 179/2012 on “Further urgent measures for Italy’s economic growth”, also known as “Decreto Crescita 2.0”, soon after converted into Law 221/2012, better known as “Start-up Act”. The specific economic objective of this new policy is to promote sustainable growth, technological development and, more specifically, to create interest and push investments for the development of a new business culture inclined towards innovation, through the renovated favourable conditions related. Moreover, this policy aims to enhance social mobility, foster new employment – Italian youth unemployment has steadily registered percentages over the 30%, making it the third worst case in Europe for the last decade (Eurostat, 2018) – reinforce the collaborative environment between universities and firms and increase Italian palatability for foreign investments.

The decree also introduced the concept of Young Innovative Companies (YICs) as the entities that are the subject of these new measures, specifying the prerequisites that these new firms must meet in order to benefit from the incentives built on a comprehensive base, such as administrative simplification, labour market facilitation, tax benefits, bankruptcy law. One of the specific objectives of this law has been to stimulate the creation of start-ups at national level, trying to keep up with the more advanced OECD

countries that found an incredible economic engine in these new innovative micro firms (Ritchie and Swisher, 2018). In order to be classified as a YIC, a firm has to meet a series of requirements:

- a) it must not be the result of a spinoff, merger, split-up or selling-off of a company, corporate branch or M&A process;
- b) the enterprise needs to be newly incorporated or have been operational for less than 5 years¹⁴;
- c) the company headquarters must be in Italy or it can be located in a country belonging to the European Economic Area (EEA); in the latter case the company must have at least one production or sales branch in Italy;
- d) it cannot be listed on any Stock Exchange Market;
- e) the annual revenues of the firm cannot be higher than €5 million;
- f) no dividends can be distributed by the enterprise;
- g) the company must have as exclusive or prevalent company object – as stated in the deeds of incorporation – the production, development and/or commercialization of innovative goods/services with high technological value.

In addition, the start-up has to fulfil at least one of the following requirements to be considered '*Innovative*':

- the company must allocate at least the 15% of the highest between turnover and annual costs to Research and Development (R&D) activities;
- a significant number of employees must be qualified with academic certifications: more specifically, at least one third (33%) of employees must be entitled with a research degree or a Ph.D.; or, alternatively, at least two thirds (66%) of the employees must have achieved a Master's degree;
- the company must be the owner, depositary, author or licensee of a registered patent, software or IP right.

¹⁴ To note that the law was conceived as retroactive: firms born before 2012 and that met all the listed prerequisites could anyway be qualified as YICs.

The Italian Economic Development Ministry (“Ministero Italiano dello Sviluppo Economico” – MISE) had been appointed to keep track of the evolution of this particular economic sector to assess the policy effectiveness. A National Committee had been established and had been delegated to design a survey, with the goal of covering many diverse aspects of interest regarding the start-up world and its context. After being drafted and accepted by the Ministry, the questionnaire had been managed by the Italian National Institute of Statistics (ISTAT), which started delivering it to all registered companies that met the YICs standard in April 2016. The survey¹⁵ is structured through four different sections, regarding different thematic, namely:

- *Section I*, further sub-divided in IA and IB, covers all the aspects concerning human capital and organizational structure of the firms, distinguishing the operative partners and employees from the rest of the engaged personnel that contributed in more contingent occasions;
- *Section II* covers the financial background and actual financing situation of the companies, with particular attention to highlighting the potential interaction of financial facilitators (i.e. accelerators, incubators, VCs);
- *Section III* broadly covers the different innovative pathways that start-ups can potentially go through, with a separate focus on the use of IP protection strategies. For obvious reasons, this is the section where most of the variables used for our study are generated;
- *Section IV* asks the respondents questions regarding different parts of the ‘*Start-up Act*’, with the aim of assessing what is the level of knowledge, understanding and satisfaction for the ‘consumers’ of the Decree.

ISTAT sent the survey to all the registered companies that could be recognized as YICs in 2016, corresponding to 6,262 different organizations by the end of that year. For this firms – i.e. the population of our analysis – ISTAT already pre-compiled the dimensions of firm’s age, sector of reference, legal status and geographic location with the data registered when the companies first established. There has been a very high response rate – equal to 36.3% – highlighting a positive and encouraging behavior in the

¹⁵ The complete survey can be downloaded online at the URL:
https://d3alc7xa4w7z55.cloudfront.net/upload/images/04_2016/160401164353.pdf

start-up community. With the 2,275 responses received, ISTAT have then created two large datasets due to the nature of the survey: one is reflecting the survey at the individual-level, the other at the firm-level. Considering the scope of this study, the database we used to run the econometric analysis was the one representing the firm side of the survey, while the one at individual-level had been utilized mainly to explore and compute control variables.

4.2 THE SAMPLE

Thereafter, our starting point was represented by two different datasets, each comprised by data related to the responses of 2,275 individual firms. The one at firm-level was organized by firm, with all the data gathered linked to the individual firms in a biunivocal manner. Here, each firm was indexed with the corresponding social security number (*'codice fiscale'* in the database), followed by the registered denomination of the business, a series of baseline descriptive statistics calculated from the relative declared data and the responses to the survey received. The other part of the dataset – i.e. the one collecting the data at individual-level – had been indexed by a key-ID number, that univocally corresponds to a firm. In this section, though, the data presented had more than one entry for each key-ID, reflecting the fact that there could be more than one respondent per firm. In order to integrate these databases, we had to rework the data – by separating the answers in an ordered way¹⁶ and by calculating the mean values for each multiple entry variable to uniquely represent all the individuals for each firm – and map the biunivocal relation between key-ID and the social security number.

Once the two subparts were comparable in terms of dimensions, we merged them to have a comprehensive representation of the responses. The data related to many firms was partially missing, so we had to clear all the firms with incomplete data – in relation to the variables of interest – from the dataset. The final number of distinct firms with complete data was 1,661 out of the initial 2,275, representing a loss of 26.99 % from the overall population.

¹⁶ Often, the answers to a question were coded in a set of '1' and '0' to reflect whether the respondent ticked the ordered alternative or not – e.g. 0110 corresponds to the selection of alternatives b) and c).

4.2.1 DESCRIPTIVE STATISTICS

In the previous chapters, we often specifically referred to – depending on the context – high-tech SMEs, technology intensive small firms, knowledge intensive industry and young and innovative start-ups in order to better analyse the empirical and academic context of our study. Now, we will briefly present some descriptive statistics that can provide the reader the needed data to ascertain that the sample we used is actually represented by a wide group of young and small firms operating in sectors where knowledge and technology are really important resources. Obviously, the following considerations are merely parameters that can be used to verify the fact that the policy in consideration (*'Start-up Act'*) specifically aimed to reach very young and small businesses.

- **Value of production:**

The production value is a determining proxy to assess the size of a business, especially in consideration of young firms operating in technology intensive sectors, where turnover or profit indexes can easily mislead due to the high costs linked to the initial stages. As *Figure 5*. below clearly depicts, only less than 10% of the sampled firms produce more than 500,000 € worth of output. These figures emphasize the fact that the enterprises studied are still at very early stages of the firm life cycle, and especially the large majority (60.6%) being at the very first interactions with the market.

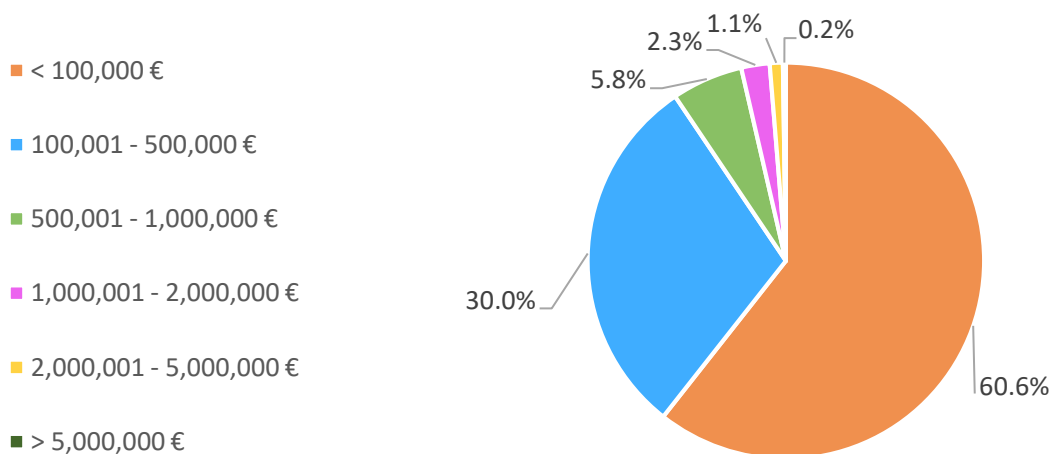


Figure 5. Descriptive statistics: classification of the value of production

- **Size of the firm:**

Generally, size at firm-level is measured through the number of people uniquely employed by an enterprise. The OECD Glossary (2005: 17) provides a structured definition in the context, stating that:

“small and medium-sized enterprises (SMEs) are non-subsidiary, independent firms which employ fewer than a given number of employees. This number varies across countries. The most frequent upper limit designating an SME is 250 employees, as in the European Union. However, some countries set the limit at 200 employees, while the United States considers SMEs to include firms with fewer than 500 employees. Small firms are generally those with fewer than 50 employees, while micro-enterprises have at most 10, or in some cases 5, workers.”

Following this definition and looking at *Figure 6.* below, we can affirm that all our sample is represented by SMEs – except one single outliers with 327 employees but being so distant from the mean – 4.4 employees per firm – we can consider it as an exception. Specifically, almost the entire sample is represented by small firms (99.7%) and the vast majority can be described as micro, with 95.2% of the firms having at most 10 employees. These results are in line with the goal of the Decree that wanted to reach and incentivize the creation of start-ups, which generally are formed by a very restricted number of employees, especially in relation to their first stages. What is interesting to highlight is that the number of occurrences seems to be exponentially inversely related to the firm’s size. Though, such analysis is out of scope now, but we will further develop the dimension in *Paragraph 4.3.3 (Control Variables).*

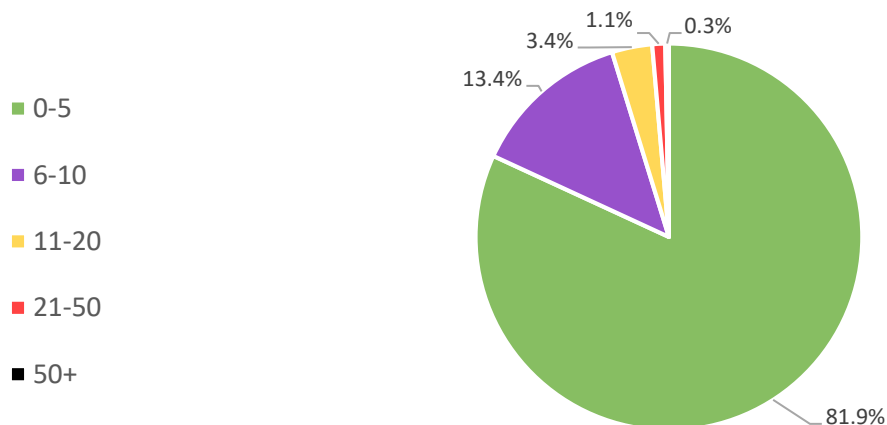


Figure 6. Descriptive statistics: classification of the number of employees

- **Nominal capital:**

Another useful indicator of the firm size is the related nominal capital, which represents the maximum amount of share capital that the company is authorized by its constitutional documents to issue to shareholders. In the start-up context, EPS (earning per share) and the ownership of the relative majority of the shares have a very strong role in defining the growth potential and the direction of the firm in the near future. At the pre-seed stage the start-up founders have to register the company and invest an initial sum in it, representing the starting amount of equity of the firm. For obvious reasons, the smaller this amount is the younger/smaller the enterprise is. *Figure 7.* below provides an overview of the sample in this regard. Notably, it is interesting to highlight the presence of firms with share capital equal to 1€, which at the time of the survey represented a freshly introduced juridical resolution (introduced by the Decree 1/2012, then actualized by the Law 27/2012), aimed at reducing the financial constraints related to the creation of start-up companies and stimulating the entrepreneurial behavior associated to successfully deliver innovation. The vast majority (85.5%) of the sample is formed by firms with less than 50,000 € of nominal capital, which, again, represents the smallness and newness of the companies studied. Less than the 1% of the firms exceeds the 1 Million € ceiling, which, in turn, underlines the effectiveness of the policy to reach only those companies that actually have limited financial resources.

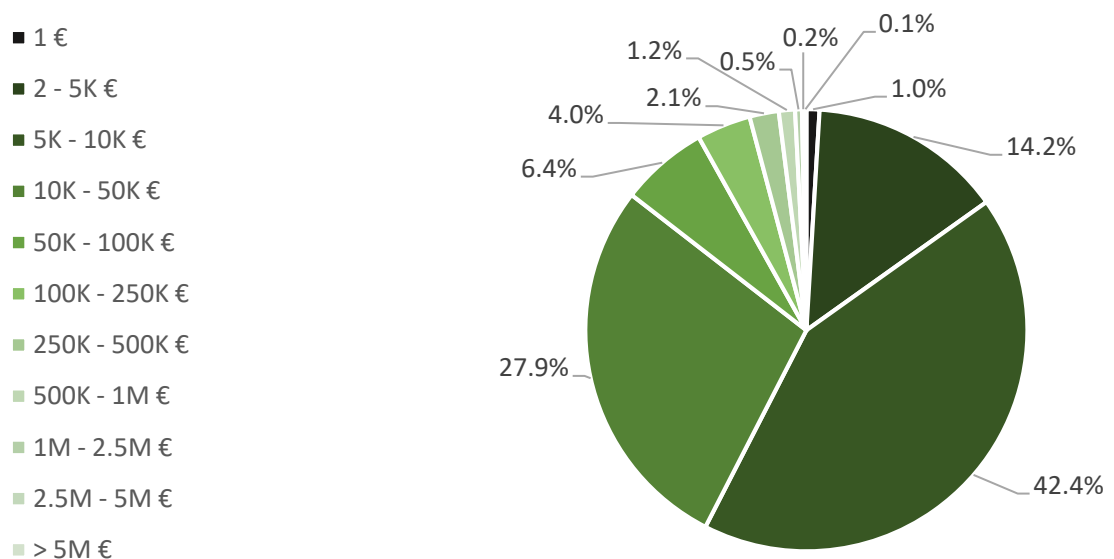


Figure 7. Descriptive statistics: classification of the nominal capital

- **Entrepreneurial team:**

From the demographic perspective, it is interesting to study the composition of the firms' entrepreneurial team. The globalization, the internet connectivity, the internationalization, the digitalization and the broad serviceability are overwhelming trends that are multiplying the market possibility everywhere. These trends together with an aimed policymaking should extremely facilitate the creation of new businesses. Considering the European environment, the Italian case is a little behind in the representation and defence of the rights of the minorities in the workplace – i.e. female, foreign and young workers primarily – and the '*Start-up Act*' also aimed at improving the administrative and juridical bureaucracy associated to business creation in order to increase the participation of these minorities.

As we can see from *Figure 8.* below, minorities are still real, especially in respect of the foreignness aspect, where only the 2% of the firms sampled was under the control of an entrepreneurial team mainly composed by foreigners (i.e. not Italian citizens). This might be a problem as the knowledge of different cultures and the experience of working abroad could strongly benefit new companies in terms of marketability.

Gender equality has become a very important matter in OECD countries lately and still has not been resolved, especially in Italy. We only have the data regarding the entrepreneurial team composition, which shows a strong predominance of firms (87%) controlled by teams formed by male absolute majority. It could be even more interesting studying more thoroughly the matter in order to emphasize how many problems are yet to be solved in the field.

Lastly, we consider the situation of young – maximum 27 years of age – workers, which is the minority more related to this study. The Decree mentioned above tried to improve the conditions of young people entering the work environment, aiming at reducing the number of Italians that start working abroad looking for higher wages and better opportunities. The graph shows that the policy did not strongly changed the Italian situation, as almost 82% of the firms sampled are still controlled by teams with few – or none – young people. What is encouraging is the relatively high percentage (7%) of firms controlled by a team formed

exclusively by young workers, shaping the reality of a developing working force that will gain its relevance in the next future.

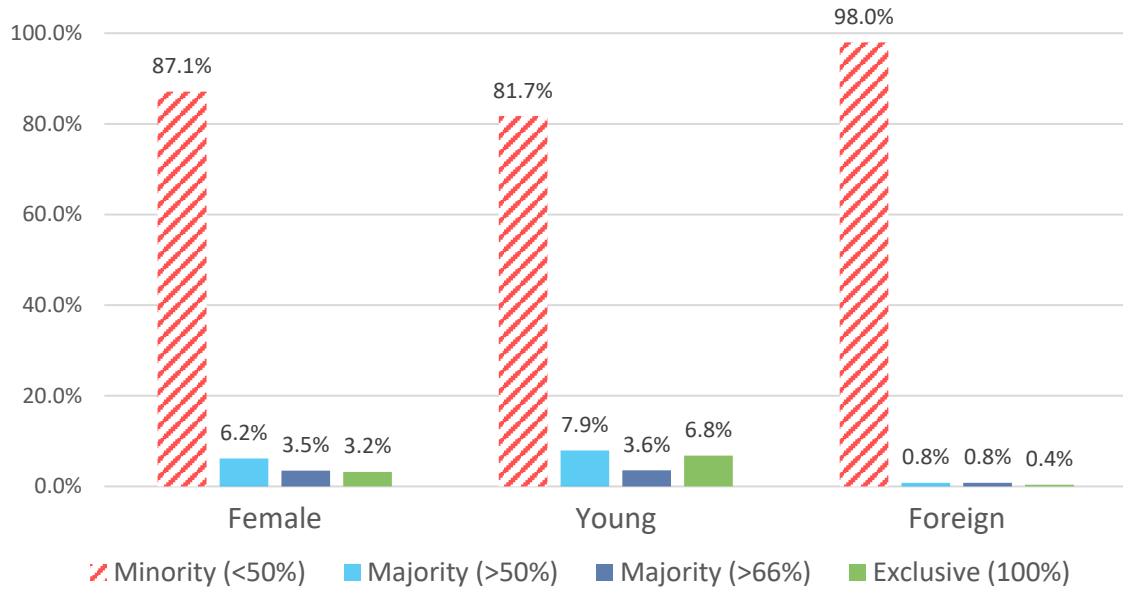


Figure 8. Descriptive statistics: Composition of the entrepreneurial team

- **Innovativeness:**

There are multiple ways to assess if a company operates in a high-tech sector, based on different indicators such as the Ateco codes guideline – which is the national classification of all the sectors and sub-sectors present in Italy – or economic ratios like the R&D spending over total revenues, R&D spending over total costs or even the number of R&D employees over total employees. Considering that in the situation under study practically all the firms are in their first years of existence, it seems that the sectorial classification might be too stringent as often young and small firms tend to rework on the scope of the company for a couple times before succeeding. At the same time, revenues and overall employees are fast growing numbers in a developing business, so we decided to focus on the most pressing matter for newborn firms, which is the cost management. As it is highlighted below in *Figure 9.*, the percentage of firms

sampled that respects the policy requirements¹⁷ in terms of costs is predominant (87.7%) but what really impresses is that 37.7% of the sample dedicates more than half of the yearly expenses to R&D activities. This underlines the importance that technology and knowledge have among the firms studied. At the same time, this data give credit to the newness and smallness factors of the firms, as established Italian companies in the high-tech world with fully operational productive cycles struggle to surpass the 20% limit¹⁸. Moreover, it is to consider that in such early phases of the company the cost structure is relatively subjective and the costs allocation may be intentionally focused on the R&D department to fully benefit from the ‘*Start-up Act*’.

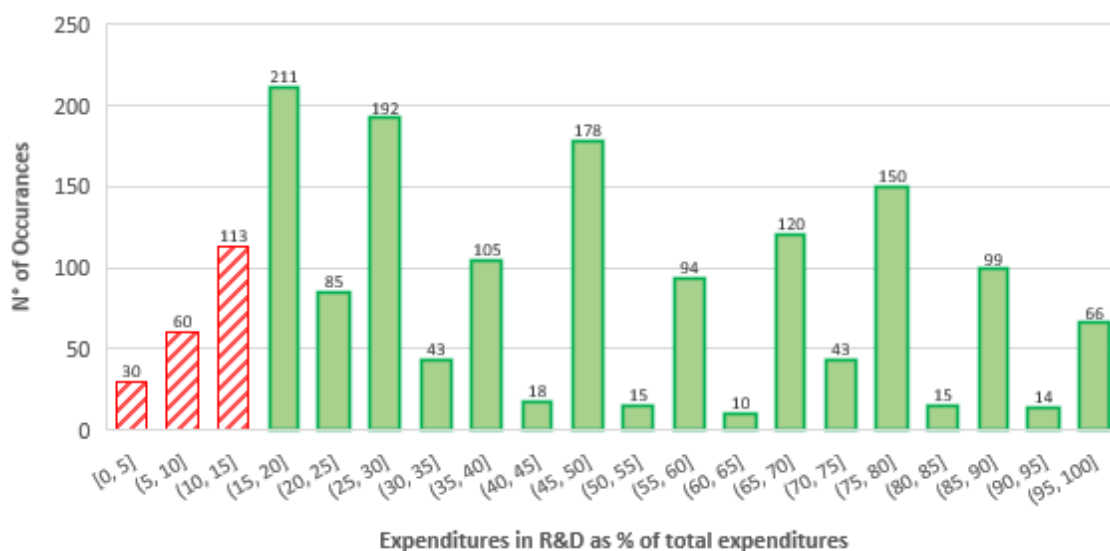


Figure 9. Descriptive statistics: innovativeness by cost structure

4.3 THE VARIABLES

In this section we are going to present and describe the different variables, dividing them into three main categories: dependent variables, independent variables and control

¹⁷ As already mentioned, the policy applies only to those firms that can be considered innovative – namely, those firms that spend at least 15% of overall expenses in R&D related activities, or at least 15% of overall production value is represented by innovation.

¹⁸ Leonardo (helicopters constructor) reaches 13.9%, Brembo (world leader in braking systems) reaches 16.7% and Chiesi Farmaceutici (pharmacological products) reaches 22.4%. These firms are taken as a small benchmark as they represent 3 of the top 15 Italian investors in R&D. Figures are calculated referring to the relative financial statements of FY2017.

variables. In the following list, there are some variables that try to reflect a certain innovative effort, even though it is a quite difficult job. Measuring innovation is a complex operation and there are no commonly agreed-upon methods or measures that exhaustively represent all the manifestation of innovation. Moreover, the measures used in the definition of our model are strictly related to the nature of the dataset, as many variables are merely qualitative indicators of the occurrence of specific contingencies, due to the lack of exhaustive quantitative data.

4.3.1 DEPENDENT VARIABLE

The dependent variable represents the core of an econometric model, as it must enable the precise observation of how the investigated aspects are affected by other factors and where the most important contribution come from. As already stated before, the goal of this study is to find whether or not innovation in its various shapes can facilitate the internationalization decision. Therefore, we decided to set as the dependent variable of our model the “*International Propensity*”, that is a measurement of the firms’ willingness to sell in countries outside Italy. The aim has been to find a variable that could correctly measure if a firm had been actively pursuing an internationalization strategy, and then study its changes in relation to the different explanatory variables. The “*International Propensity*” variable had been constructed starting from question 3.9 of the survey, which is reported here translated:

3.9 – Describe what are the key markets of your company: (you can provide multiple answers)

- a) Italian retail market (B2C Domestic)
- b) Foreign retail markets (B2C Foreign)
- c) Italian firms (B2B Domestic)
- d) Foreign firms (B2B Foreign)
- e) Italian Public Administration (B2G Domestic)
- f) Foreign Public Administrations (B2G Foreign)

Considering the nature of this question, the variable created will be dichotomous¹⁹: its value will be ‘1’ (i.e. “true”) whenever at least one among answers b), d) or f) are present in the response, if not – only answers a), c) and/or e) – the variable will be set to ‘0’ (i.e. “false”). Consequently, the variable will return a “true” value for every firm that selected at least one of the Foreign markets (B2B, B2C and/or B2G), independently from the fact that the firm has selected or not one of the Domestic markets (B2B, B2C and/or B2G) at the same time. This implies that hybrid strategies – in the sense that both Foreign and Domestic markets are targeted – are considered equal to the pure internationalization strategies. The main reason is operational, as at first we tried to use an ordered dependent variable²⁰ that could discriminate between ‘hybrid’ and ‘pure’ internationalization strategies, but considering that only 4.6% of the sample resulted as ‘pure international’, the associated econometric model resulted to be biased due to the disproportionate sample.

In the sample used for the analysis, the “*International Propensity*” variable showed a significant majority of positive results, as shown in *Figure 10*. below. Even if strictly contextualized, this is a representation of the fact that the ‘*Start-up Act*’ fostered the development of new firms focused on exploiting those new opportunities that the digitalization has uncovered at global level. These figures might also be considered as an encouraging index of the resourcefulness of the Italian YICs, as the ability to target different foreign countries requires large resource commitment and particularly well-developed activity management – a part from a solid and feasible value proposition – but at the same time international markets unfold new and profitable opportunities for knowledge intensive firms (Dai et al., 2014).

¹⁹ Dichotomous variables are categorical nominal variables which can assume only two possible values, that represent two distinctive categories, usually “*true*” and “*false*”.

²⁰ A variable with values whose order is significant, but on which no meaningful arithmetic-like operations can be performed.

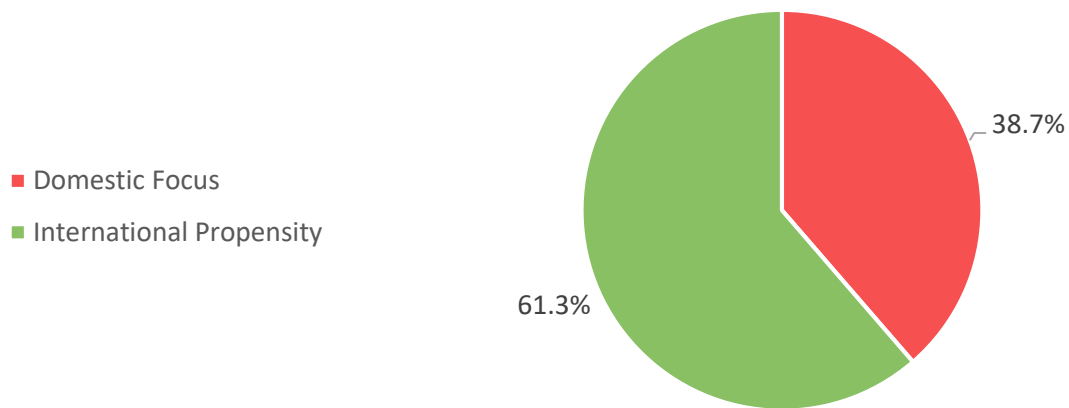


Figure 10. Descriptive statistics of the dependent variable

As already discussed, the internationalization process is strictly related to the strategic acquisition of knowledge. Sapienza et al. (2005) highlight the need of understanding the many contingencies related to a specific country – e.g. customer needs, product standards, industry norms and the way of doing business of local competition – before taking the ‘entry’ decision. In this endeavour, highly innovative firms are facilitated in the recognition of foreign market peculiarities (Li and Atuahene-Gima, 2001) and can therefore actively pursuing an effective internationalization strategy since very early phases of the company development.

4.3.2 EXPLANATORY VARIABLES

In this paragraph, we are going to present those variables of interest used to explain the solidity of the econometric model and, in particular, to study their effect on the behaviour of the dependent variable with the aim of testing the hypotheses presented before. In order to maintain a structural coherence, the description of each variable will contain the variable code, variable name, a brief definition, an explanation of the variable construction and descriptive statistics related to it.

R&D Expenditure

This is a quantitative variable that represents the resource commitment of the firm in R&D related activities. The values that the variable assumes define the expenditures for such activities as a percentage of the overall expenses of the company, therefore ‘R&D

Expenditure’ value ranges from ‘0’ to ‘100’ making it a discrete numerical variable. The variable had been constructed with question 3.5 of the survey, that is reported here translated:

3.5 – Indicate the percentage of total expenditures allocated for R&D related activities:

___.00 %

The results are displayed in absolute values in *Figure 11.* above and in a more qualitative way in *Figure 8.* below. As already stated, it is interesting to see the strong dedication that the majority of the sampled firms has in investing in R&D activities. The average value of ‘*R&D Expenditure*’ in the sampled firms equals to 47.1%, which is an incredibly high figure. In fact, the graph suggests that half of the firms invested less than 40% of their overall resources, while the other half invested more than 40%. Though, the values comprised between 80% and 100% may seem exaggerated, but there are two factors to consider: first, the start-ups usually burn out of financing pretty fast in their first stages to come up with strong MVP (minimum viable product), but still we are not talking about million dollars; second, the veracity of the data we have is totally entrusted to the respondents, as we have no detailed information about any of the firms. Therefore, some respondents may have overestimated their commitment to R&D activities, but in such small firms there is no clear and formal distinction between R&D and non-R&D sometimes.

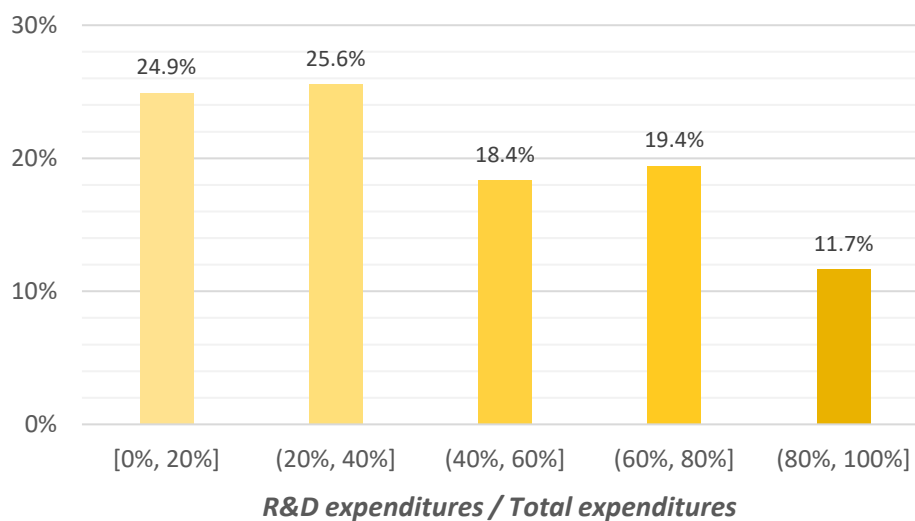


Figure 11. Descriptive statistics of the ‘R&D Expenditure’ variable

Process Innovation

This is a qualitative variable that determines whether the firm has been investing in the development of process innovation or not. It is a dichotomous variable that assumes the value '1' when the condition is met – meaning that the firm has invested in process innovation – and the value '0' otherwise. The variable is constructed from question 3.1 of the survey, that is reported here translated:

3.1 – The innovation you are developing refers to: (you can provide multiple answers)

- a) A new good/service for the related market (Product Innovation)
- b) A new process or production system (Process Innovation)
- c) A new organizational system (Managerial Innovation)
- d) A new way to advertise and sell goods/services (Marketing Innovation)
- e) Other

'*Process Innovation*' assumes value '1' if the respondent ticked alternative b). The results are displayed in *Figure 12*. below. As it is clearly presented in the graph, almost 2/3 of the entire sample is not developing any process innovation, while only 1/3 of the firms that respond positively is actually creating uniquely innovation regarding processes, the remaining 2/3 are also simultaneously developing product innovation. These figures – also in consideration of the following variable description – highlight the fact that start-ups at early stages tend to focus more on the product side when innovating and in general process innovation is not so popular in this reference group, probably because the benefits stemming from this type of innovation usually are more related to larger firm size and broader set of operations.

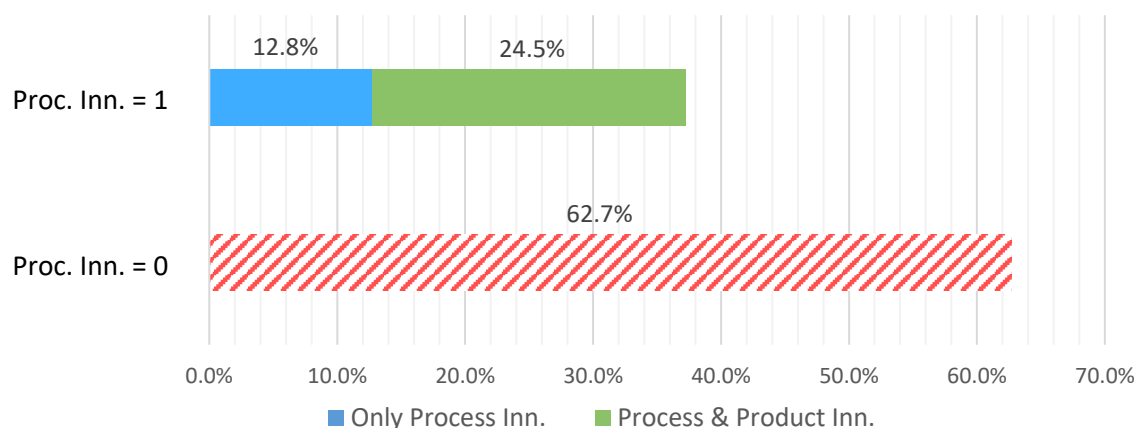


Figure 12. Descriptive statistics regarding the 'Process Innovation' variable

Product Innovation

This is a qualitative variable specular to the previous one but investigating whether the firm has been investing in the development of product innovation or not. It is a dichotomous variable that assumes the value '1' when the condition is met – meaning that the firm has invested in product innovation – and the value '0' otherwise. The variable is constructed from same question 3.1 of the survey, that is reported here translated:

3.1 – The innovation you are developing refers to: (you can provide multiple answers)

- a) A new good/service for the related market (Product Innovation)
- b) A new process or production system (Process Innovation)
- c) A new organizational system (Managerial Innovation)
- d) A new way to advertise and sell goods/services (Marketing Innovation)
- e) Other

'Product Innovation' assumes value '1' if the respondent ticked alternative a). The results are displayed in *Figure 13*. below. Looking at the graph, there are clear differences with the 'Process Innovation' statistics. First of all, almost 80% of the sampled firms introduced product innovations, which is a huge number if compared to the 37% that invested in process innovation. Contrarily to the previous case, those who invested

uniquely in product innovation are more than twice as much of those that invested in both types of innovation. This implies that the majority of YICs focuses on product development to create value and expand their initial operations. In the early stages of the firm life cycle, the product/service offering is much more relevant than the efficiency in delivering it, as the goal is to acquire a stable positioning in the market and, once the customer base is adequately large, strategic actions on the efficiency side should be implemented.

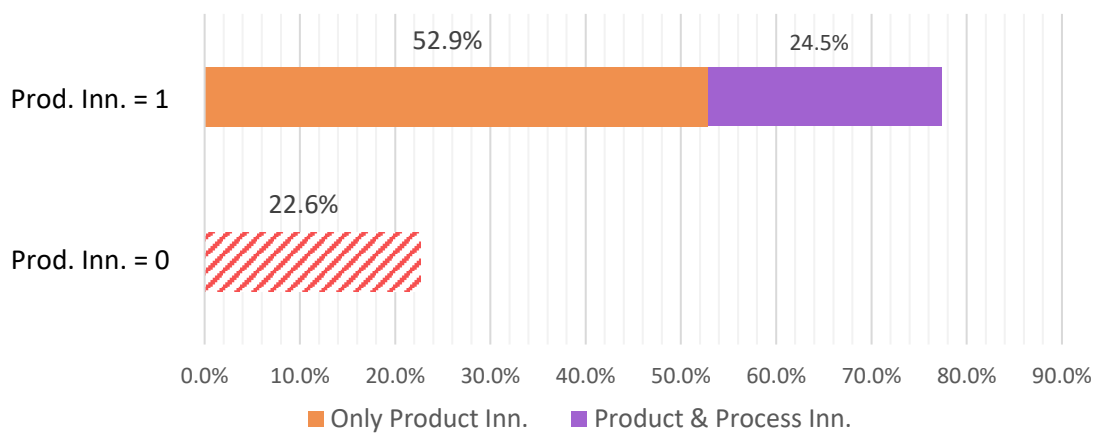


Figure 13. Descriptive statistics regarding 'Product Innovation' variable

R&D Network Participation

This is a qualitative variable that describes whether the firm participates or not in networks aimed at exchanging R&D related knowledge. It is a dichotomous variable that assumes the value '1' when the condition is met – meaning that the firm is participating in R&D networks – and the value '0' otherwise. The variable is constructed from three different questions of the survey (2.17, 3.6, 3.7), each one defining a distinct R&D relation with external parties. The questions are reported here translated, each one preceded by the name of the indicator they represent:

R&D Formal Agreements:

2.17 – Has the start-up ever implemented formal cooperation agreements

with other actors (universities, companies)? If yes, what kind? (you can provide multiple answers)

- a) Technology based agreements (R&D related)
- b) Production/commercial agreements

R&D Suppliers:

3.6 – Indicate how you developed R&D: (you can provide multiple answers)

- a) Intra muros
- b) Extra muros

R&D Clients:

3.7 – Indicate the recipient(s) of the R&D activities (only for the Intra muros quota) (you can provide multiple answers)

Prod. Inn. = 0 intra muros own enterprise – to improve the products/services (or processes)

- b) Other companies in the same sector
- c) Other enterprises in other sectors
- d) Governmental institutions

‘*R&D Network Participation*’ assumes value ‘1’ if the respondent ticked alternative a) for question 2.17, or alternative b) for question 3.6, or alternative b), c) or d) for question 3.7 or a combination of these.

Results are displayed in *Figure 14*. below. Looking at the statistics, a first important trend to highlight is that 75% of the sampled firms are actively engaged in at least one kind of R&D network. This is a huge number if we consider that the majority of the companies in the dataset are relatively new, so this is a positive sign in relation to the fact that in knowledge intensive industries networking has become one of the most used means to acquire missing knowledge. On the other hand, this figure might also implicitly tell that competition is much fiercer now than ever before. YICs can hardly forecast the strategy and direction of their peers, as often they depend on the objectives set by the larger organizations with whom they collaborate – and usually not revealed to protect competitive advantage. Now, taking a look at the composition of the positive results, we can see that only 55% of the sampled firms that responded positively only interacts with

external actors with a single method. Almost 8% of the positive results are represented by firms that have both Suppliers and Clients in R&D related activities and have stipulated Formal Agreements for the collaborations. The remaining 37% is formed by those firms that either have Clients/Suppliers for R&D related activities backed by Formal Agreements to secure the collaboration, or on the contrary do not have any Formal Agreement but participate in R&D networks with both Suppliers and Clients actors. Here it seems that in order to collaborate with R&D Suppliers YICs are required²¹ to formalize the contract with Formal Agreements more often than when collaborating with R&D Clients. In general, we can say that YICs are strongly committed in networking activities regarding R&D activities, and almost half of those firms that participate in such networks do so in a multilateral way.

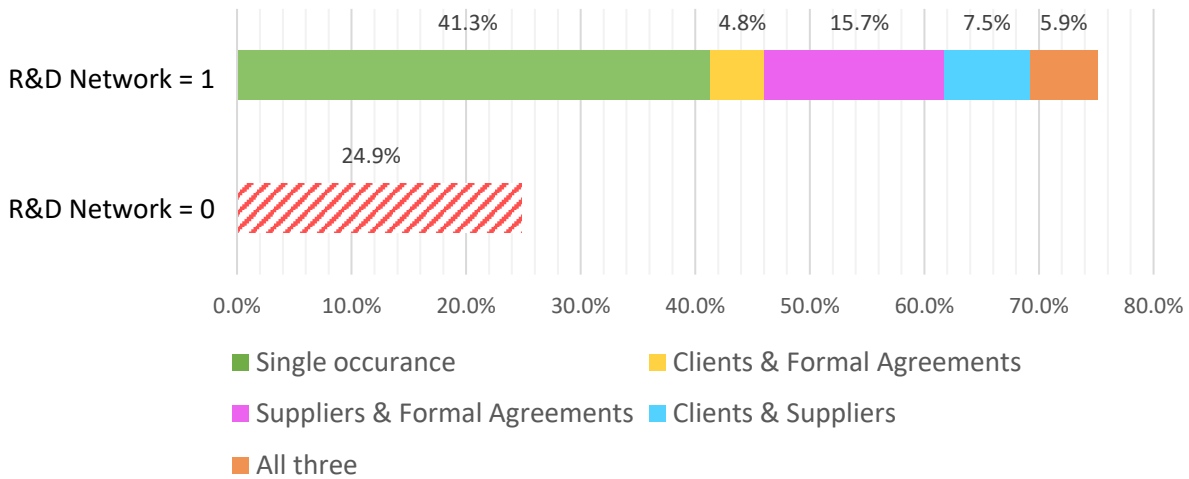


Figure 14. Descriptive statistics regarding the 'R&D Network Participation' variable

Another interesting statistic can be seen in *Figure 15.* below. In the graph it is represented the number of positive occurrences associated to each sub-variable ('R&D Suppliers'; 'R&D Clients'; 'R&D Formal Agreements'). What is interesting here is that it seems that YICs are more interested in collaborations with Suppliers rather than with Clients, as positive occurrences for 'R&D Suppliers' count for twice as much as those for 'R&D Clients'. This can be considered to be in line with the 'Product Innovation'

²¹ We are taking as an assumption the fact that YICs should try to minimize the number of Formal Agreements in order to alleviate pressure from their operations, but also because legal entities are required for the stipulation of such contracts and that is costly

statistics, in fact it makes sense that if YICs are more inclined to focus on marketable products/services then they also require more knowledge input to facilitate their own R&D process, while collaborations with R&D Clients might turn out to be profitable only once the innovations are verified to be relevant on the market and secured through IP protection.

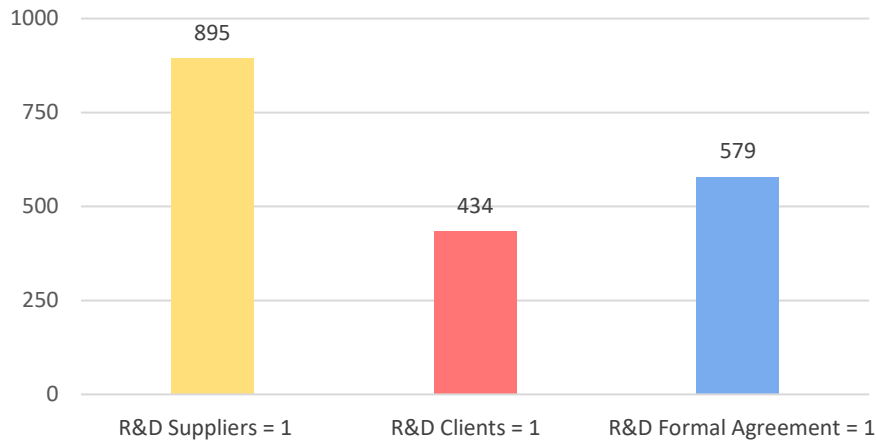


Figure 15. Descriptive statistics regarding the 'R&D Network Participation' sub-variables

Outside-in Innovation Approach

This is a qualitative variable investigating whether the firm is engaged or not in collaborations with research Suppliers while it is not collaborating with any R&D client. It is a dichotomous variable that assumes the value '1' when the condition is met – meaning that the firm is actively making use of the Outside-In innovation approach – and the value '0' otherwise. The variable is constructed from questions 3.6 and 3.7 of the survey, that are reported here translated:

R&D Suppliers:

3.6 – Indicate how you developed R&D: (you can provide multiple answers)

- a) Intra muros
- b) Extra muros

R&D Clients:

3.7 – Indicate the recipient(s) of the R&D activities (only for the Intra muros quota) (you can provide multiple answers)

- a) Your own enterprise – to improve the products/services (or processes)
- b) Other companies in the same sector
- c) Other enterprises in other sectors
- d) Governmental institutions

‘*Outside-In Innovation Approach*’ assumes value ‘1’ if the respondent ticked only alternative b) for question 3.6, or only alternative a) for question 3.7 in case they responded a) and b) to question 3.6. In consideration of the high innovation context, it is interesting to highlight whether the knowledge exchange flow is exclusively inward – therefore there are no collaborations with R&D Clients – because it means that the firms sampled are exploiting such collaborations only to develop their own innovative strategy. Moreover, this variable aims at investigating if the presence of such structured collaborations is of relevance in relation to YICs. We have further studied this dimension by differentiating the type of entity that represents the origin of the knowledge flow. Question 3.8 of the survey provided us with the required information for this endeavour:

Typology of Originator

3.8 – Indicate the provider of the R&D activities (you can provide multiple answers)

- a) Other companies in the same sector
- b) Other companies in other sectors
- c) Public and private universities
- d) Public/private research centres and laboratories

Answers relative to alternative a) and b) highlight that the originators of the knowledge flow are other Private Firms, while alternatives c) and d) highlight research institutions as the originator, in our case these institutions are represented by Universities and Research Labs. Different implications can be deferred in relation to the typology of the originator. If the sampled firms have Private Firms as their research Suppliers, this means that they can benefit from a wider set of knowledge and resources to acquire, and often these are already marketable solutions. Though, the collaborations with Private Firms also implies a more strategical approach since the research partners are often incumbents in the market of reference of the YIC. On the other hand, knowledge inflows originated from Universities and Research Labs are usually richer in terms of innovative

potential and enable the development of products/services that are not marketized yet – at least not in a large scale.

Results are displayed in *Figure 16*. below. In the graph we can see the overall level of adoption of the Outside-In innovation approach, with a highlight on positive results concerning the type of originator of such collaborations. The descriptive statistics of the variable unveil that 40.5% of our sample is actively engaged in Outside-In innovation, which is a strong result also if compared to the results of the ‘*R&D Network Participation*’ variable – see above. Furthermore, the figures suggest that Universities and Research Labs account for almost 1/3 of the positive occurrences of the Outside-In variable. This is a positive result, considering that this type of collaborations is often just a niche if compared to all kinds of R&D out-sourcing collaborations.

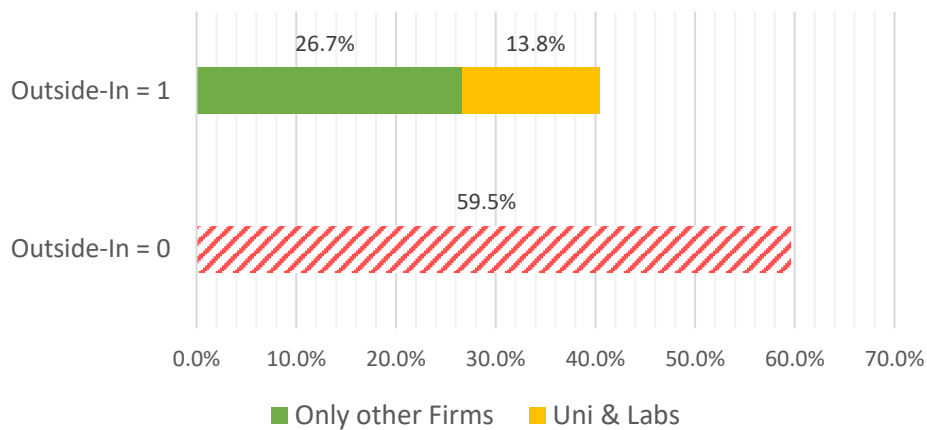


Figure 16. Descriptive statistics regarding the ‘*Outside-In Innovation Approach*’ variable

Inside-Out Innovation Approach

This is a qualitative variable that describes whether the firm is engaged or not in collaborations with R&D Clients while not having any Supplier for its R&D activities. It is a dichotomous variable that assumes the value ‘1’ when the condition is met – meaning that the firm is actively making use of the Inside-Out innovation approach – and the value ‘0’ otherwise. The variable is constructed from questions 3.6 and 3.7 of the survey, that are reported here translated:

R&D Clients:

3.6 – Indicate how you developed R&D: (you can provide multiple answers)

- a) Intra muros
- b) Extra muros

3.7 – Indicate the recipient(s) of the R&D activities (only for the Intra muros quota) (you can provide multiple answers)

- a) Your own enterprise – to improve the products/services (or processes)
- b) Other companies in the same sector
- c) Other enterprises in other sectors
- d) Governmental institutions

‘Inside-Out Innovation Approach’ assumes value ‘1’ if the respondent ticked only alternative a) for question 3.7 and either alternative b), c) or d) for question 3.7 (or a combination of these). First, we take a look at the results for the sub-variable R&D Clients, constructed with question 3.7. Results are displayed in *Figure 17.* below. As already stated above, in the YICs context it seems that firms are not so inclined to exploit their knowledge and sell it to potential R&D Clients. In fact, only 26% of the sampled firms are engaged in collaboration with R&D Clients and in this regard it seems that collaborations with Public Institutions is not facilitated, as the total number of positive occurrences for alternative d) sums up to only 113 out of 434 in total. On the other hand, it also seems that YICs are not scared of competition, as they do not avoid providing knowledge to other companies in their same sector – positive occurrences to alternative b) account to 209 out of 434.

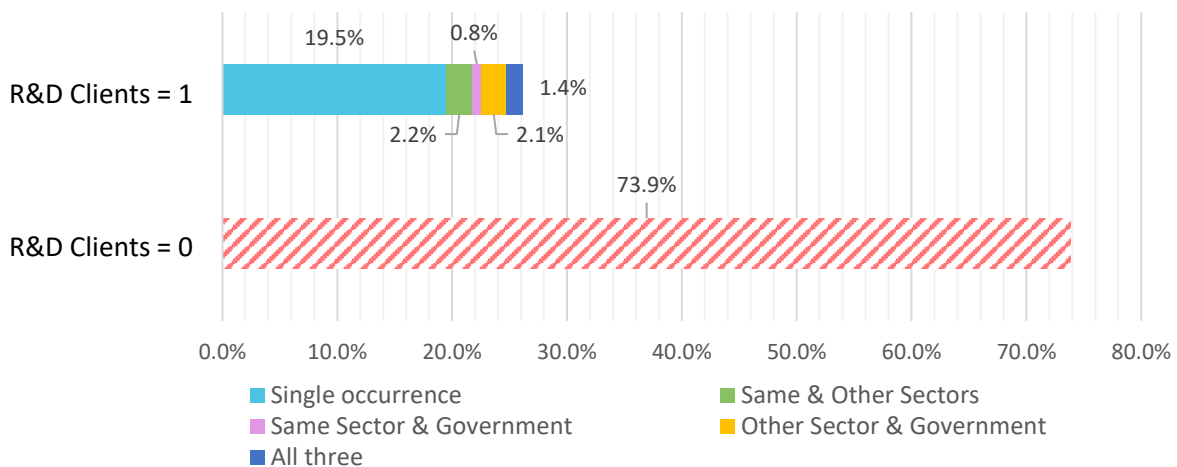


Figure 17. Descriptive statistics regarding sub-variable ‘R&D Clients’

Out of the 434 positive occurrences related to R&D sub-variable, we eliminated those in which the respondent also answered in a way that triggered sub-variable R&D Suppliers – already presented above. By doing this, we have been able to highlight only those firms of the sample that respect the assumptions of the Inside-Out innovation approach. *Figure 18.* below showcases the loss in positive results in each category of R&D Clients. Interestingly, it seems that they all lost around 50% of the original value, meaning that there are no implications related to the type of client in this regard.

'Inside-Out Innovation Approach' assumes value '1' 210 times, meaning that 52% (234 out of 434) of the firms that have engaged collaborations with R&D Clients are also in collaboration with R&D Suppliers, so they are not exploiting their own proprietary knowledge to generate revenues. *Figure 19.* below displays the final results in respect to the *'Inside-Out Innovation Approach'* variable. If compared to the results of the *'Outside-In Innovation Approach'* variable (see *Figure 16.*) it is very clear that the Inside-Out innovation approach is much less used by YICs than the Outside-In approach – 13% against 40% respectively.

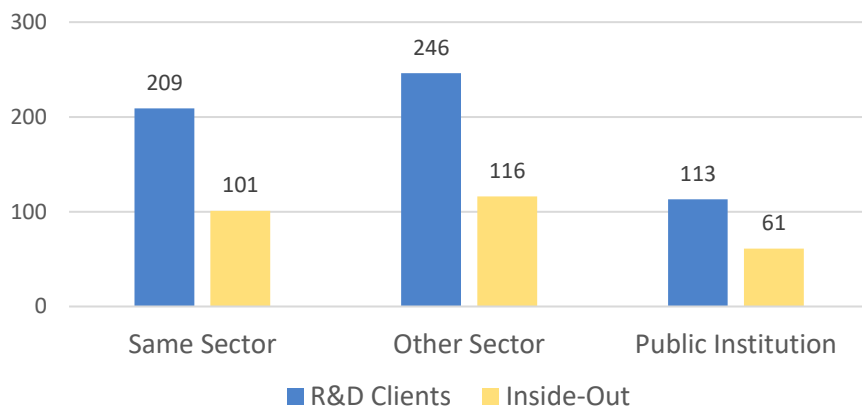


Figure 19. Descriptive statistics: comparison of positive responses between 'R&D Clients' and 'Inside-Out Innovation Approach'

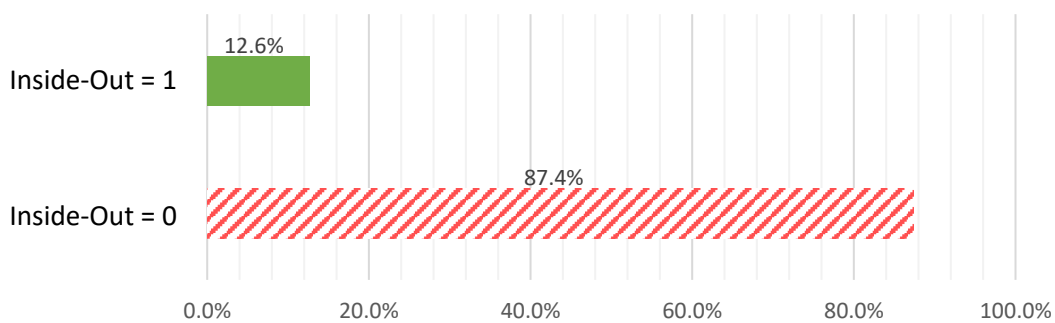


Figure 18. Descriptive statistics regarding the 'Inside-Out Innovation Approach' variable

4.3.3 CONTROL VARIABLES

In this paragraph, we are going to present those variables of interest used to provide a solid structure to the econometric model in order to take into consideration those contingencies that are somehow related to the study, but that are of no interest in regard of the final goal of our analysis. In order to maintain a structural coherence, the description of each variable will contain the variable code, variable name, a brief definition, an explanation of the variable construction and descriptive statistics related to it.

Financial Network Participation

This is a qualitative variable that describes whether the firm participates or not in financial networks, more specifically we want to check if the firm has any private financial investor (either formal or informal) as the owner of any shares or as a formal investing agent. It is a dichotomous variable that assumes the value ‘1’ when the condition is met – meaning that the firm has participations of external financial related operators – and the value ‘0’ otherwise. The variable is constructed from five different questions of the survey (2.4, 2.5, 2.6, 2.7, 2.15), each one defining a specific case of relationships with Financial Agents. The questions are reported here translated, preceded by the name of the indicator they represent:

Participation of External Private Financial Agents in the Shareholding Structure

2.4 – Composition at the foundation of the shareholding structure (indicate the share of the share capital held as a %):

a) <u>Venture capital fund (VC)</u>	___.00 %
b) Enterprise	___.00 %
c) University or research centre	___.00 %
d) <u>Bank or other financial intermediaries</u>	___.00 %
e) <u>Business Angel (BA)</u>	___.00 %
f) Family members	___.00 %
g) Other individuals	___.00 %
Total	___.00 %

2.5 – Current composition of the shareholding structure (indicate the percentage of share capital held in %):

a) <u>Venture Capital fund (VC)</u>	____.00 %
b) Enterprise	____.00 %
c) University or research centre	____.00 %
d) <u>Bank or other financial intermediaries</u>	____.00 %
e) <u>Business Angel (BA)</u>	____.00 %
f) Family members	____.00 %
g) Other individuals	____.00 %
Total	____.00 %

Participation of External Private Financial Agents as formal investors

2.6 – Financial sources that contributed to the establishment of the start-up (indicate % of total sources of funding):

a) Own resources	____.00 %
b) Donations from ‘Family, friends and fools’	____.00 %
c) National public funding	____.00 %
d) Regional/local public funding	____.00 %
e) <u>Private equity investment (VCs, BAs, other)</u>	____.00 %
f) Bank loan	____.00 %
Total	____.00 %

2.7 – Current sources of financing (indicate % of total sources of financing):

a) Own resources	____.00 %
b) Donations from ‘Family, friends and fools’	____.00 %
c) National public funding	____.00 %
d) Regional/local public funding	____.00 %
e) <u>Private equity investment (VCs, BAs, other)</u>	____.00 %
f) Bank loan	____.00 %
Total	____.00 %

Participation in a certified incubator program

2.15 – Is the start-up currently located or has it previously been located within a certified incubator?

1. Currently located
2. Localized in the past
3. Not currently located but located in the past
4. Not located, neither now nor in the past

‘*Financial Network Participation*’ assumes value ‘1’ if the respondent valorised – i.e. inserted a valid number, between ‘1’ and ‘100’: either alternative a), d) or e), or a combination of these, for questions 2.4 and 2.5; alternative e) for questions 2.6 and 2.7; either alternative a), b) or c), or a combination of these, for question 2.15.

Results are displayed in *Figure 20.* and *Figure 21.* below. Even if the study of the importance of some financial relationships and the ability for a firm to find reliable sources of financing is out of scope in our analysis, there have been many studies that did find strong correlations between the firm’s relationships with established Financial Agents and its ability to enter more easily in foreign markets²². Considering the purpose of this study, the variable serves merely as a controller with the aim of reducing the bias of the model, but also to increase the accuracy of the affected explanatory variables so that their relationships with the dependant variable can be considered more exclusive. As we can see from the graphs, the vast majority of YICs chose not to undertake relationships with External Private Financial Agents²³, but being the motives unknown we can only speculate on the reasons. The most probable scenario is that External Private Financial Agents were not sufficiently present at country-level at the time the Decree was approved, but even more worrying is how uneven the dispersion of them was (See *Table 3.* below). Moreover, in *Figure 21.* we can see that the number of firms that participated in

²² This is not the place to uncover the literature background, but for the interested reader the followings are some interesting reads on the matter: Carpenter et al. (2003), Cowling (2003), Fenn et al. (1997), George et al. (2005), Wong et al. (2009).

²³ Namely Business Angels, Venture Capitalists, Institutional Investors and Incubators in this particular context, as they potentially represent a viable way to enter Financial Networks and, differently from Public Institutions, FFF, Research Labs and standard Banking activities, exploit the advantages related to it and propel the business into preferred avenues. Professional Investors, for example, can often function as gateways to enlarge the network of the investee.

Incubation Programs is much larger than the number of firms that have relationships of the Shareholders or Investors type, which implies that there might have been some structural problems inherent the Financing Supply Chain at the time, as YICs seem to struggle to expand their Financial Network after an initial Incubation. On the other hand, if we compare these results to the descriptive statistics of the ‘*R&D Network Participation*’ variable, it is very clear that YICs tend to focus much more resources on getting inside networks regarding knowledge exchange (75.1%) rather than establishing formal financial networks (31.5%).

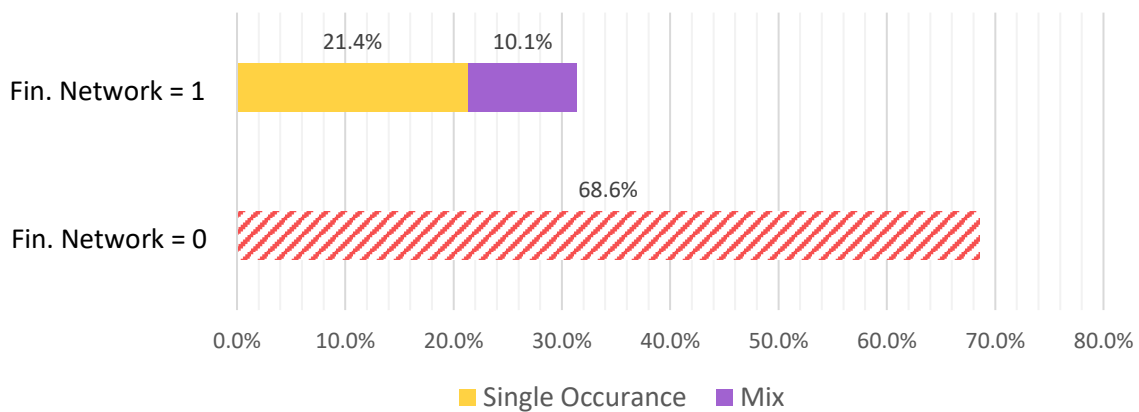


Figure 20. Descriptive statistics regarding the ‘Financial Network Participation’ variable

Region	Nord Italia	Centro Italia	Sud Italia	Isole
<i>fin_net</i> = 1	269	146	72	35

Table 3. Financial Network presence in the sample divided by Regions

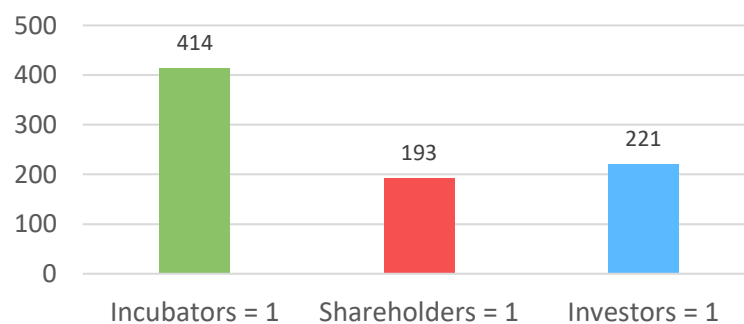


Figure 21. Descriptive statistics: Financial background divided by typology

Type of Legal Entity

This is a categorical ordinal variable that keeps track of the differences at the administrative level among the firms sampled. The variable is numerically ordered – from ‘0’ to ‘7’ – so that the correct classification of the whole sample into clusters is achievable, each corresponding to one of the possible legal entities registered by ISTAT during the creation of the Dataset. In this sense, there is no information regarding this variable that could be collected from the survey. The possible legal entities are reported here in Italian, as there is not an equal juridical structure that could allow a meaningful translation:

1. ***SOCIETÀ A RESPONSABILITÀ LIMITATA***
2. ***SOCIETÀ A RESPONSABILITÀ LIMITATA A CAPITALE RIDOTTO***
3. ***SOCIETÀ A RESPONSABILITÀ LIMITATA CON UNICO SOCIO***
4. ***SOCIETÀ A RESPONSABILITÀ LIMITATA SEMPLIFICATA***
5. ***SOCIETÀ CONSORTILE A RESPONSABILITÀ LIMITATA***
6. ***SOCIETÀ COOPERATIVA***
7. ***SOCIETÀ COSTITUITA IN BASE A LEGGI DI ALTRO STATO***
8. ***SOCIETÀ PER AZIONI***

The alternatives are ordered in consideration of the number associated to each different value by the statistical software, as results are originally displayed with numerical relation by the statistical software. Further considerations will be provided in *Chapter 5. “Analysis of Results”* when necessary. The reason why this is a control variable stems by the fact that different legal entities have different tax regimes, incentives, regulations and administrative obligations – among the many limitations and consequences related – so that the registration of a firm as a specific legal entity is motivated by a series of considerations related to the future direction of the business. The analysis of which legal entity seems to facilitate most internationalization strategies is out of scope but it could provide very interesting insights, with strong implications from the policymakers’ point of view. Descriptive statistics of the variable are described by *Figure 22. below*. As it is very clear, the sample is almost fully represented (93.4%) by just two

categories out of the eight registered, and these are ‘*Società a Responsabilità Limitata*’ and ‘*Società a Responsabilità Limitata Semplificata*’, which are two very similar representation of legal entity, both of them really widely used in Italy by entrepreneurs to register small size firms (European Commission, 2018).

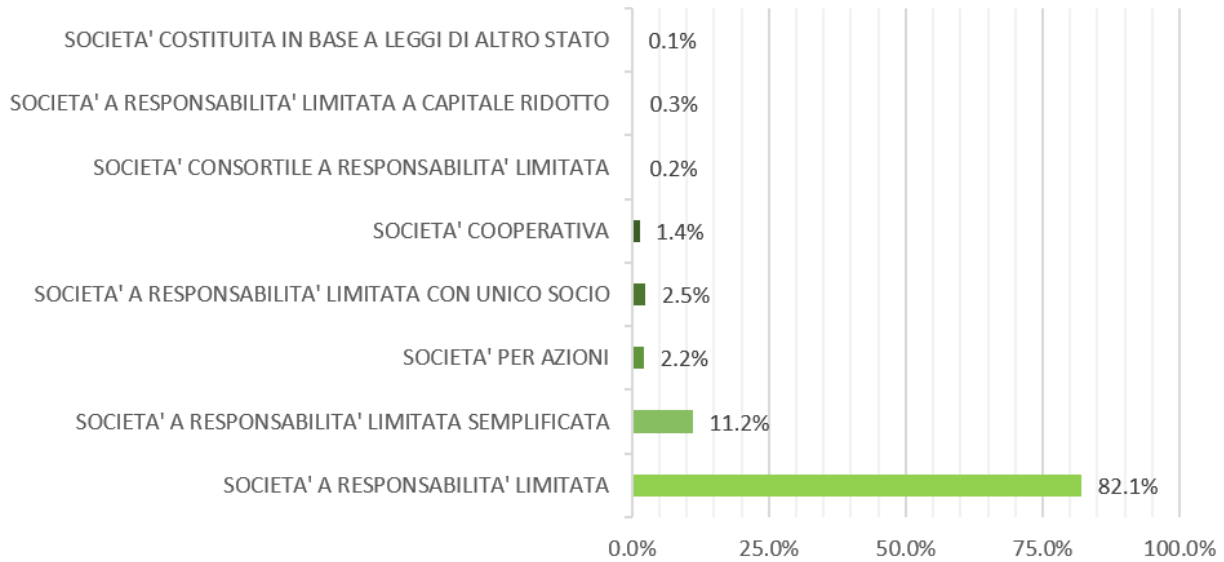


Figure 22. Descriptive statistics regarding the ‘Legal Entity’ variable

Firm Size

This is a quantitative variable that details the size of the firms sampled. Differently from the previous description of this dimension – see *Paragraph 4.2.1 Descriptive Statistics* – and from other control variables, we are not using a categorical ordered approach here. The variable acquires the number of employees as value and therefore its potential valorisation belongs to the numerical interval represented by the subset of positive whole numbers – i.e. $\forall x \in (0, +\infty) \mid x \in N$ or $\forall x \in N \mid x > 0$. By considering the quantitative dimension rather than classifying the sample into size subsets, the variable increases its accuracy in determining the impact of the number of employees in relation to the dependent variable and provides us with an easier mathematical understanding of the regression results. Moreover, the quantitative approach gives us the capability to better delineate the size structure of our sample and, in case, highlight the outlying data. Results are displayed in *Figure 23*. below. In this case, we decided to

present the variable through a Pareto Chart²⁴ so that anomalies could be more easily visualized, also in comparison with *Figure 6*. where we already showed that the number of occurrences is inversely related to the size of the firms sampled. As it can easily be inferred by the graph, there are no statistical outliers in the sample regarding the ‘size’ dimension, in fact in the x axis the values are seen growing from the minimum to the maximum from the left-hand side to the right-hand side with very few exceptions – but never with a substantial difference from the previous value. In order to make the graph more readable we decided that value ‘33’ represented our overflow limit, so that all values higher than that are represented by a single bar. This has been made necessary since there were only 9 firms in the sample that exceeded that number of employees, 4 of them registered values comprised between 50 and 100; only one outlier is identified in the sample as its registered ‘size’ value is ‘327’, with ‘4.4’ being the average of the sample. Some Pareto considerations are necessary to underline the structure of the sample: almost 50% of the sample is represented by firms with 2 or 3 employees; the 80% of the cumulative is reached at the fifth value, meaning that only the 14.3% (5 out of 35 categories) is representative of the whole sample, furthermore these most important five categories comprise only the firms with 1 to 5 employees; firms with more than 10 employees – threshold commonly accepted to identify micro firms – (all of which are at the right in the graph of all of those with 10 employees at maximum) represent only the 5.5% of the sample (64 occurrences out 1661). These results should help the reader to definitely position YICs into the high-tech small firms environment.

²⁴ It is a type of chart that combines a histogram and a cumulative linear graph. The individual values of the interval are represented in descending order by bars, while the cumulative line represents the aggregate of the values. The left vertical axis is the frequency of occurrence of the individual values; the right vertical axis is the cumulative percentage of the total number of occurrences. Because of the ordering of the values, the cumulative line is a concave function by construction. The chart is named after the ‘Pareto principle’ – also commonly referred to as the ‘80/20 rule’ – that states that in most circumstances the 80% of the effects may be associated to just 20% of the causes. Therefore, the aim of the Pareto chart is to highlight what are the most significant factors that have the strongest impact on the dependent variable of use, and, on the contrary, what are those factors that have almost no impact whatsoever.

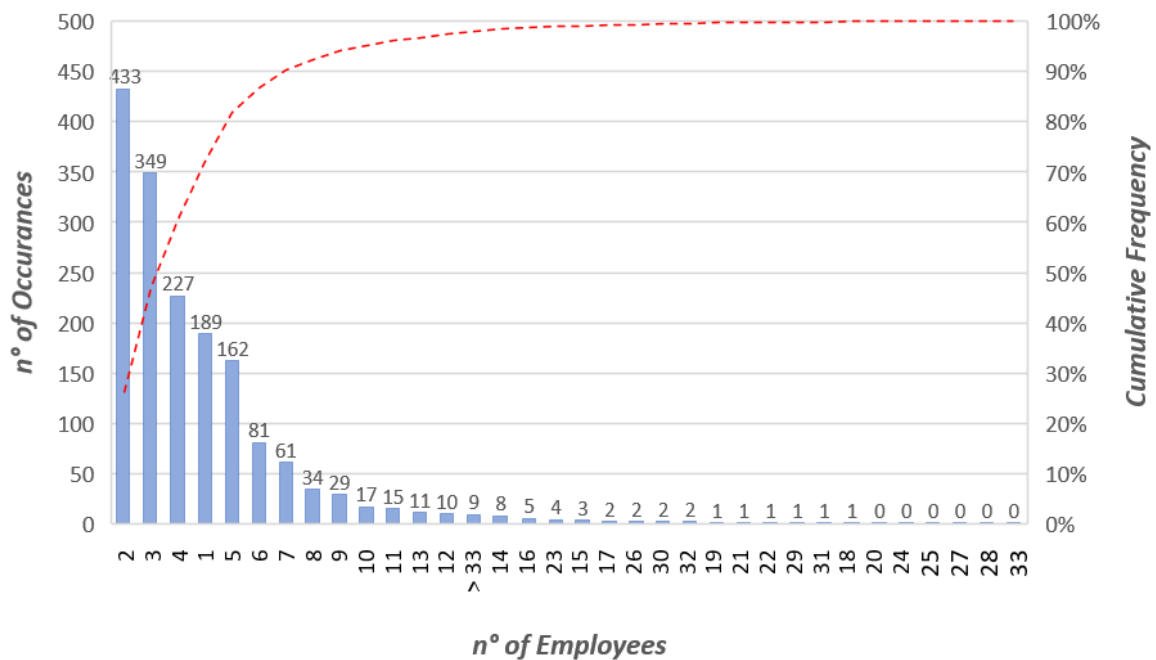


Figure 23. Pareto Chart representing the 'Firm Size' distribution in the sample

Firm Age

This is a quantitative variable that details the years of experience of the firms sampled. The variable acquires the number of operating years since its establishment as value, therefore its potential valorisation belongs to the numerical interval represented by the subset of positive whole numbers – i.e. $\forall x \in [0, +\infty) \mid x \in N$ or $\forall x \in N \mid x \geq 0$. The value is set by subtracting the year of registration (made available by ISTAT in the making of the dataset) from 2016, which is the year of data aggregation. In consideration of the context, one of the goals of the Decree had been to reduce the 'liability of newness' problem. In fact, one very relevant dimension that have a strong impact on both efficiency and effectiveness inside a company is the experience it developed through the years. Best practices, process streamlining and employees' learning curves are all improvements that are enabled by a do-check-fix-repeat process that happens automatically on a daily basis in the companies. Though, this is related to incremental improvements, not drastic, meaning that the results are visible only if we compare relatively distant periods. For this reason, the use of such a control variable becomes necessary, so that firms with more experience on the market are differentiated from those that are freshly born. Results are

displayed by *Figure 24.* below. As we can see from the graph, the vast majority of the firms (73%) have been on the market for a range of ‘1’ to ‘3’ years, while the maximum value registered for this variable is ‘6’, which is relatively low in relation to the firm’s lifecycle. These descriptive statistics underline how young the firms studied effectively are, providing a solid backing to the YICs name itself.

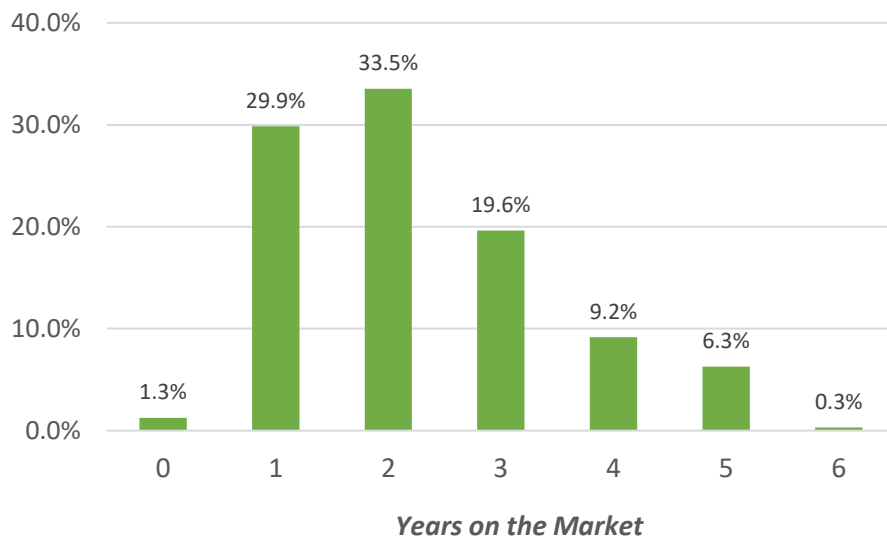


Figure 24. Descriptive statistics representing the ‘Firm Age’ variable

Average Age of the Entrepreneurial Team

This is a quantitative variable that details the entrepreneurial team average age of the firms sampled. The variable acquires the mean of all the ages related to the single firm as value, therefore its potential valorisation belongs to the numerical interval represented by the subset of positive whole numbers – i.e. $\forall x \in (0, +\infty) \mid x \in N$ or $\forall x \in N \mid x > 0$. The value is set adding up all the entrepreneurial team members’ ages and then dividing it by the number of people that form the entrepreneurial team. The Decree strongly worked in the direction of reducing the difficulties related to business creation in the high innovation context, so that even younger people could be incentivized to participate into the development of new and innovative companies, bringing their fresh academic background, strong motivation, creativity and willingness to succeed. Though, usually the more experienced a manager is the more facilitated he is in the establishment of a new enterprise, therefore a control variable might help validate the model by eliminating possible impacts related to the age dimension. Results are displayed in *Figure 25.* below.

The graph clearly resembles a Gaussian distribution, with a longer but thinner tail on the right side and a thicker and shorter one on the left side. This means that firms with low average age of the entrepreneurial team – in relation to the sample – are more common than firms with high averages in our sample, and more in detail the distribution is concentrated on the left side. Indeed, the mean value of the distribution is '42.5' with '21.5' and '75.6' being respectively the minimum and the maximum of the distribution, which means that half of the sample stays in the first 38.7% of the average age distribution – firms with average age of the entrepreneurial team members comprised between '21.5' and '42.5' – while the remaining half is distributed across the remaining 61.3% - firms with average age of the entrepreneurial team members comprised between '42.6' and '75.6'. To contextualize, a study on the age distribution of Italian ruling class performed by Boeri et al. (2010) states that the average age of Italians with managerial roles is around 47 years, and in our sample this dimension is relatively lower.

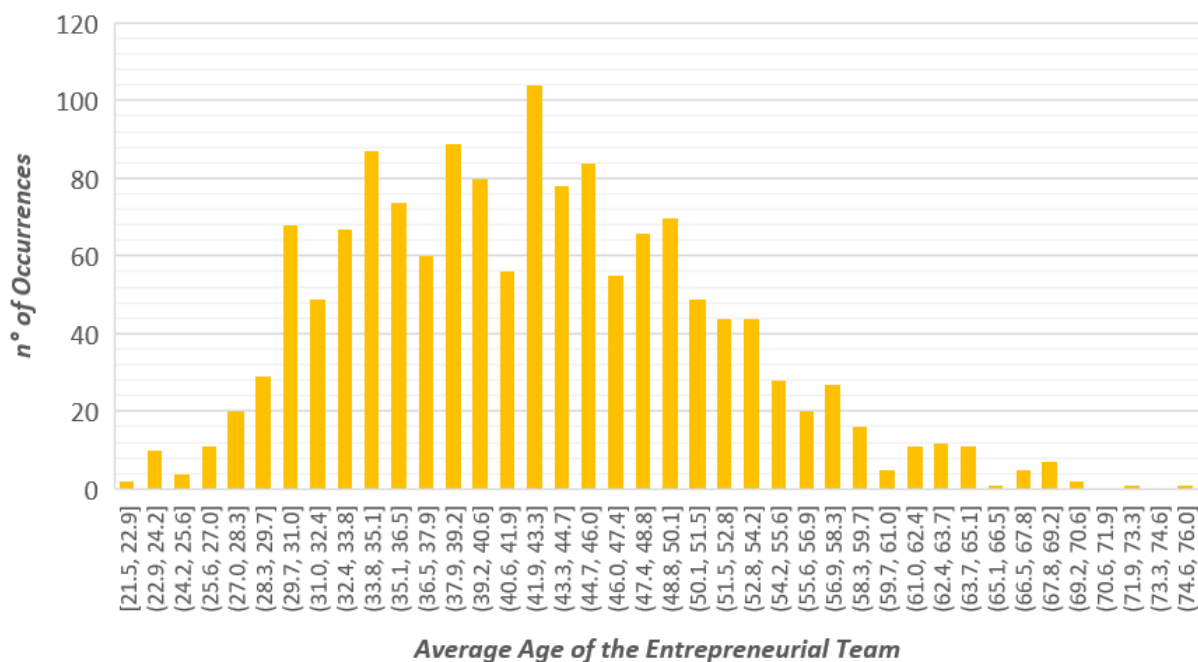


Figure 25. Descriptive statistics representing the 'Average Age of the Entrepreneurial Team' variable

International Background of the Entrepreneurial team

This is a quantitative variable that details the percentage of the entrepreneurial team members with past international experience. The variable assumes the percentage of the members with past international experience out of all the entrepreneurial team members as value, therefore its valorisation belongs to the numerical comprised between '0' and '1' – i.e. $\forall x \in [0, 1] | x \in Q$ or $\forall x \in Q | 0 \leq x \leq 1$. Therefore, the value is set by adding up all the members with past international experience and then dividing this number by the size of the entrepreneurial team. People that experienced working or studying in a foreign country often have a different approach to business creation, aiming at international markets – or specific foreign countries – since the very beginning. Moreover, they are facilitated in doing so because they have more knowledge and practical and personal experience related to specific markets, which people that never lived abroad do not have. In this sense, this variable tries to control whether those firms that are guided by a team with strong international backgrounds are more likely to enter foreign markets than those that have no international experience. This variable should then take in consideration the effect of a potential reduction in the '*liability of foreignness*' related to past personal experience in foreign countries. Results are displayed in *Figure 26*. below. As the graph suggests, our sample is mainly divided in two very distinctive groups: one represented by those firm with almost null international experience (29.4%); the other represented by those firms that have a strong international knowledge (47.3%). Interestingly, this may highlight an interesting social relation for what concerns the start-ups creation: it seems that the entrepreneurial team members are very likely to share a similar background in terms of internationalization activity. This could definitely be analysed more in detail, but remains out-of-scope for this study. However, the descriptive statistics for this variable underline an interesting characteristic of our sample: almost half of the firms analysed has an entrepreneurial team where each single member has a past international experience of some kind.

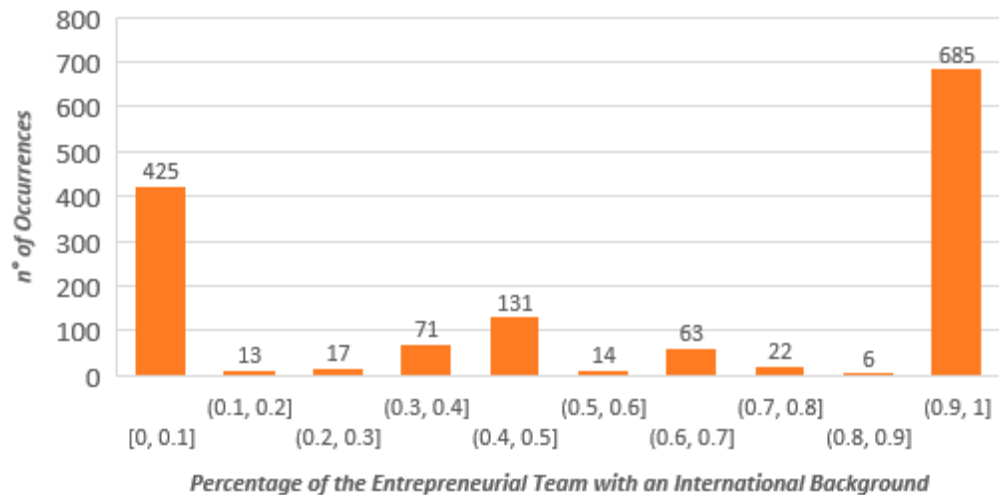


Figure 26. Descriptive statistics representing the 'International Background of the Entrepreneurial Team' variable

Headquarters Region

This is a categorical ordinal variable that keeps track of the differences at the geographical level for the firms sampled. The variable is numerically ordered – from '1' to '4' – so that the correct classification of the whole sample into clusters is achievable, each corresponding to one of the four macro-regions chosen to best represent the Italian differences. The variable has been constructed starting from the Province belonging of the firms, available in the dataset regarding the registration data provided by ISTAT. We decided to group all the Provinces into the following macro-regions:

- ***NORTHERN ITALY***
- ***CENTRAL ITALY***
- ***SUD ITALY***
- ***ISLANDS***

The detailed list of Province-Macro Region association is presented in *Appendix A*. The belonging to a specific industrial district or region can definitely increase the pace of evolution for those new businesses that are able to make use of particular networks and infrastructure available only locally. Italy has very different business environment throughout its territory, that are related to strong cultural and geographical contingencies.

As for many other countries, the development of a business in the proximity of most developed cities is facilitated in many ways mainly thanks to improved infrastructures, wide availability of resources and easiness of expanding the network; at the same time there is a fiercer and larger competition to take into account. On the other hand, nowadays firms can be established even in remote locations but they can still be able to reach customers pretty far away, especially in the high-tech service environment. This control variable should aim at taking into account this kind of influence related to the geographic belonging of the firm. Results are displayed by *Figure 27*. below. As it is made clear by the graph, the majority of the firms sampled have been registered in the North of Italy, which is not a surprise considering that the 48.6% of all entrepreneurial firms are established in what we defined as Northern Italy (ISTAT, 2017). Interestingly though, the descriptive statistics show what may considered a halving pattern, meaning that passing from North to Centre, from Centre to South and from South to Islands we have always around half the firms of the previous category.

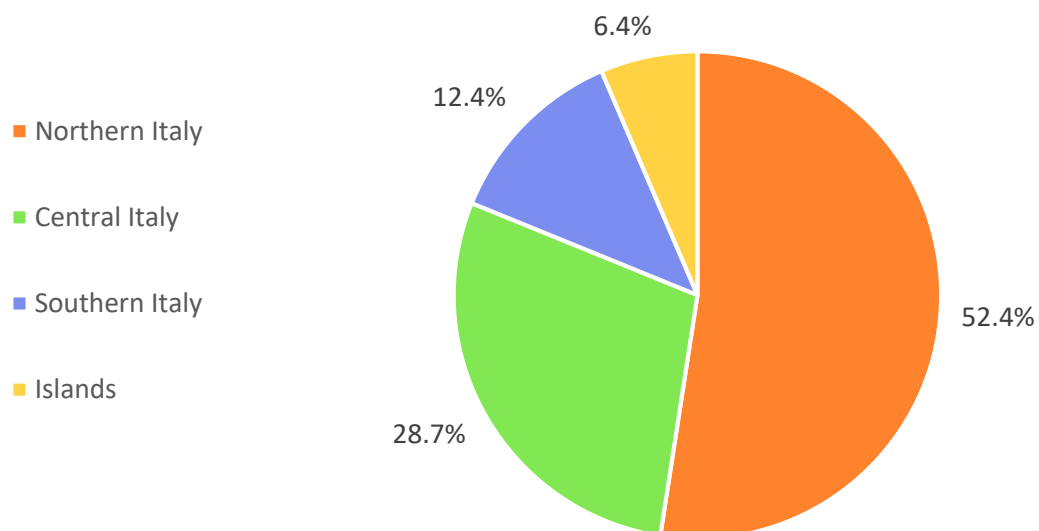


Figure 27. Descriptive statistics related to the 'Headquarters Region' variable

Firm Sector

This is a categorical ordinal variable that keeps track of the differences at the sectorial level in the sample. The variable is numerically ordered – from ‘0’ to ‘4’ – so that the correct classification of the whole sample into clusters is achievable, each corresponding to one of the five macro-sectors defined by ISTAT in the dataset. All the possible values are listed here, translated:

- ***SERVICES***
- ***INDUSTRY / CRAFTMANSHIP***
- ***COMMERCE***
- ***AGRICULTURE / FISHING***
- ***TOURISM***

This is a control variable aimed at accounting for the effects related to the sectorial belonging of the firms in the sample. A sector, even at such a high level as it is defined in our analysis, implies many diverse contingencies for the related firms. As previously stated, the sample is formed by firms that invested/produced a relative large value in/of innovation, though much larger than the actual standard for SMEs. In this sense, we are already taking into account only the high innovation industry, and this variable can help us classify and better understand how the sample is furtherly structured. Results are displayed in *Figure 28*. below. The graph is pretty self-explanatory: the vast majority of the sample (76.3%) is formed by firms operating in the Service sector, as one could easily anticipate; the Industry and Craftmanship sector covers almost the entire remaining share of the sample, as the Tourism and Agriculture/Fishing sectors together only contribute to less than 1% of the entire sample; what is actually excessively under-developed if compared to the real share in the Italian economical structure²⁵ is the Commerce sector, but evidently it is related to sectorial hindrances that limit the n° of successful innovating ventures or more generally to entry barriers associated to the market saturation.

²⁵ In 2016 the GDP related to Commerce sector in Italy accounted for the 21.1% of the total GDP, with a +0.8% increase in respect of 2014 data (ISTAT, 2019).

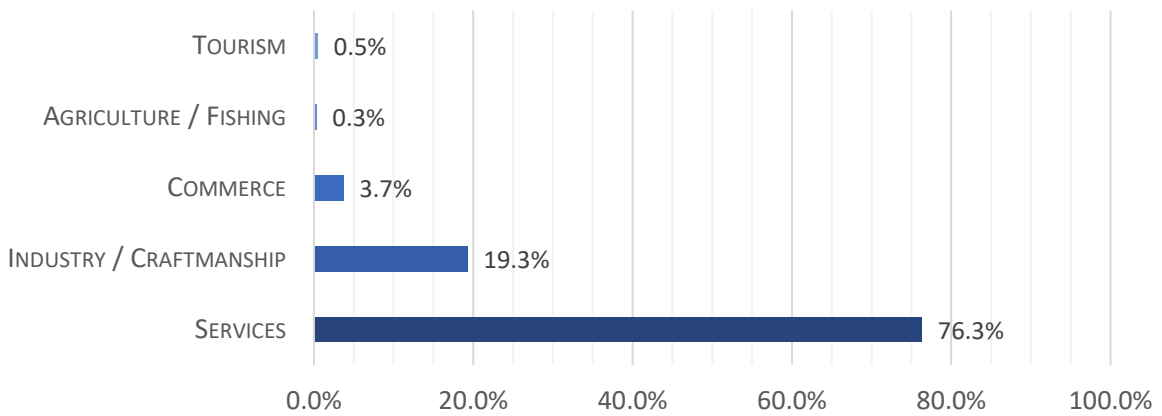


Figure 28. Descriptive statistics related to the 'Firm Sector' variable

4.4 ECONOMETRIC METHODOLOGY

Considering that the dependent variable considered in this study is a dichotomous variable, we had to select one binary classification model able to effectively work with the kind of data presented before in the chapter. We chose to use the Probit model as it provides very dependable results, in fact it is one of the most commonly used models by researchers when studying binary dependent variables. The word "Probit" is a portmanteau word, composed by "**Probability** + **Unit**" (Bliss, 1934). In statistics, the Probit model is a non-linear univariate regression that has the purpose to estimate the probability that a particular observation will acquire the specific value related to one of two different categories. This model is defined by the following equation:

$$\Pr(Y = 1 | X) = \Phi(X^T \beta)$$

Where Y is the dependent variable, X represents a vector of regressors, Φ is the Cumulative Distribution Function of the standard normal distribution and β indicate the parameters most often estimated through a Standard Maximum Likelihood procedure.

It is also possible to motivate the Probit model as a latent variable model. Suppose there exists an auxiliary dependent variable (Y^*) represented by the equation:

$$Y^* = X^T \beta + \varepsilon$$

where $\varepsilon \sim N(0, 1)$. Then the dependent variable of reference (Y) can be viewed as an indicator for whether this latent variable is positive:

$$Y = \begin{cases} 1, & Y^* > 0 \\ 0, & \text{otherwise} \end{cases}$$

During the next Chapter “*Analysis of Results*”, we will also make use of marginal effects related to the variables’ partial derivatives. Other than being helpful from an analytic point of view, the presentation of such results will also benefit the reader with more qualitative results. In fact, this further analysis provides how much the variation of the specific variable impacts the probability of success in the dependent variable as a result.

It is dutiful to specify that the analyses performed have a standard error robust to misspecifications.

4.4.1 ECONOMETRIC MODEL DESCRIPTION

The goal of this study is to estimate what is the probability that the observations – described in the model by the explanatory and control variables – are clustered into the two categories that describe the state of the dependent variable “*International Propensity*”. For clarity, we present here the equation constructed to test our hypotheses:

International Propensity_i

$$= \beta_0 + \beta_j \text{Explanatory Variables}_{ij} + \beta_k \text{Control Variables}_{ik} + \varepsilon_i$$

Where β_0 represents the intercept term; β_j are the regression coefficients related to the j Explanatory Variables; β_k are the regression coefficients related to the k Control Variables.

ε is the vector of the error terms, capturing all the other factors that impact the dependent variable other than the regressors.

The model depicted here aims at testing all the hypotheses of this study. More specifically, the regression variables relate to the specific hypothesis following the schema presented in *Table 4*. below.

HYPOTHESIS	EXPLANATORY VARIABLES	CONTROL VARIABLES
H1	R&D Expenditure	Financial Network Participation
H2	Process Innovation Product Innovation	Legal Entity Firm Size Firm Age
H3-A	R&D Network Participation	Average Age of the Entrepreneurial Team International Background of the Entrepreneurial Team
H3-B	Outside-In Innovation Approach Inside-Out Innovation Approach	Headquarters Region Firm Sector

Table 4. Schematic representation of the Model

All the hypotheses are tested with this single model in order to eliminate as much bias as possible. If different models had been employed to test the hypotheses, the results for the explanatory variables of interest would have comprised also some effects that could be attributed to other explanatory variables not present in the specific model. Instead, with the approach used, all the variables are tested together with the aim of providing the most comprehensive and all-embracing results. The presence of such a high number of control variables follows this same logic, trying to achieve the most truthful and reliable analysis as possible.

5 ANALYSIS OF RESULTS

In consideration of the model presented before, the results are now going to be shown. The econometric model has been built on a statistical software package (*Stata 14*) and the regression has been run through it. The focus of the following paragraphs will be to expose the raw data generated by the regression and briefly discuss it. A more critical and comprehensive analysis of the results is presented at the end of this chapter.

As the statistical analysis is concerned, first a general overview of the descriptive statistics of the entire model will be presented, followed by a brief analysis of the results related to the control variables with the aim of providing a robust contextualization. Secondly, the results of explanatory variables will be analysed more thoroughly divided in relation to the structure of the hypotheses of this research.

5.1 COMPREHENSIVE VIEW

Referring to *Table 6. and Table 7.* – respectively displaying the regression results and the statistical outcome of the model – it can be said that the model is quite strong from a statistical standpoint. The correlation terms between the variables of the econometric model are limited²⁶ and therefore the model is relatively solid in relation to this measure. Even if the pseudo- R^2 has a relatively low value (8.47%), this does not necessarily mean that the regressors used do not explain the dependent variable satisfyingly enough, as Probit regressions do not have an equivalent to the R^2 that is found in OLS regressions and pseudo- R^2 are more complex to interpret. By looking at the numbers, the probability of getting a LR test statistic as extreme as, or more so, than the observed statistic under the null hypothesis is represented by the $\text{Pr} > \chi^2$ value. The null hypothesis of the test is that all of the regression coefficients are simultaneously equal to zero. In other words, the small *p-value* from the LR test (0.00%) would lead us to conclude that at least one of the regression coefficients in the model is not equal to zero.

In consideration of the categorical variables there are some clarification to make, as the understanding of the raw results might not be that immediate. The different values that these variables can assume are interpreted by the statistical software as many variants of a single variable. One of the possible values is taken as reference to test the others, so

²⁶ For the complete correlation table, refer to *Appendix B*.

the results for this kind of variable are actually differential results in relation to the benchmark, which is not displayed in the tables of results. The ‘*omitted*’ values are generated by the statistical software when certain valorisations of the variable are univocally related to only one category of the dependant variable, therefore perfectly predicting ‘*success*’ or ‘*failure*’, or when values of categorical variables have a high correlation value. Running this regression, a total of 12 observations were dropped in order to maintain high statistical meaning.

One Control Variable is particularly relevant from a statistical point of view and that is ‘*International Background of the Entrepreneurial Team*’:

- *p-value* = 0.00 %;
- *Coefficient* = + 0.428045;
- *Standard Error*: ± 0.0812365.

This is the most important regressor in terms of statistical results and it means that those firms lead by a team with strong international experience are much more likely to go international than those firms with few international experiences in their leading teams. Interestingly enough, referring to the marginal effects side of the table, a unitary increase in this control variable causes an increase of + 14.85% (± 2.7%) in the predicted success of the dependent variable, all other things equal.

On the contrary, other control variables are much less relevant. In fact, ‘*Average Age of the Entrepreneurial Team*’ and, unexpectedly, ‘*Financial Network Participation*’ have a very high *p-value* – respectively of 89.8% and 92.1% – which implies that they cannot be considered to influence the dependent variable at all, in relation to our sample. Discussing the value of the coefficients and the related predictive margins is therefore purposeless.

‘*Firm Age*’ and ‘*Firm Size*’ have a limited effect on the dependent variable, as their *p-value* is around 30%, which is still acceptable but highlights that there is not a strong impact between the variables and the dependent variable. Though, the coefficients – respectively - 0.0288058 (± .029842) and + 0.0036815 (± 0.0036116) – seem to confirm some considerations explicated in the description of such variables. In fact, a unitary increase (+1 in total employees) in ‘*Firm Size*’ transforms into a positive increase of the

predicted success of the dependent variable, even if minimal (+ 0.127% ± 0.125%). Unlike wise, a unitary increase (+1 year since establishment) in ‘*Firm Age*’ transforms into a negative increase of the predicted success of the dependent variable, even if low (- 1.00% ± 1.03%).

5.2 TESTING THE HYPOTHESES

In relation to the scheme presented in the previous Chapter to synthesize our model – see *Table 4*. – the results for the Explanatory Variables are going to be presented in this Paragraph. In order to offer a more direct understanding of our findings, some graphs are going to be presented in the following analysis with the goal of providing qualitative and additional material, making use of some additional material. Consequently, each graph labelled as ‘*Additional Evidence*’ is associated to an ad-hoc model, constructed exactly as the one depicted above but with the introduction of the interaction term between ‘*R&D Expenditure*’ and the Explanatory Variable of reference²⁷. Nevertheless, the statistical quantities provided in such graphs should not be directly reconducted to the model presented above, as the interaction between variables had to be implemented in order to draw graphs with descriptive meaning, but such additional evidence should be interpreted as qualitative considerations to clarify the study in object.

5.2.1 H1 RESULTS

The only Explanatory Variable related to the first hypothesis is ‘*R&D Expenditure*’, which is strongly related to the Dependent Variable, as it can be easily seen from the results obtained with the Probit regression (*Table 6*):

- *p-value* = 0.00 %;
- *Coefficient* = + 0.0075321;
- *Standard Error*: ± 0.0013116.

²⁷ Not to be repetitive and redundant, it has been decided not to describe the models in the detail, as the explanation provided should be sufficient for the interested reader to recreate such models. As a framework, we added the interaction term of R&D Expenditure and the relative Explanatory Variable to the model. Consequently, a post-estimation statistic model has been run to find the relative predictive marginal effects. The results obtained were then plotted using R&D Expenditure as the x axis, with the goal of highlighting the differences in the sample related to the manifestation or not of the binary Explanatory Variables.

This is one of the strongest regressors of our model from a statistical point of view, as it has a positive coefficient and a null *p-value*. By looking at the marginal effects, a unitary increase of ‘*R&D Expenditure*’ (+1% of R&D Expenditure over Total Expenses) transforms into a positive increase of ‘*International Propensity*’ of 0.26% ($\pm 0.04\%$). This is an interesting result, since it says that the more a firm invests in R&D – relative to the overall investments – the more the firm is likely to enter foreign markets. These findings are in line with many researches on the topic and prove that R&D Expenditures are positively related to the firm’s entrance in foreign market, also in the context of YICs. H1 is therefore verified.

In *Figure 29*. below, it can be seen a graphical representation of the predictive marginal effects of ‘*R&D Expenditure*’ on the Dependent Variable. Interestingly, the slope of the line is quite high, implying that the variable has an important effect on the Dependent Variable. As a matter of fact, the increase in ‘*R&D Expenditure*’ from 0 to 100 generates an increase in the predicted success of ‘*International Propensity*’ of about 26% (with a 95% CI).

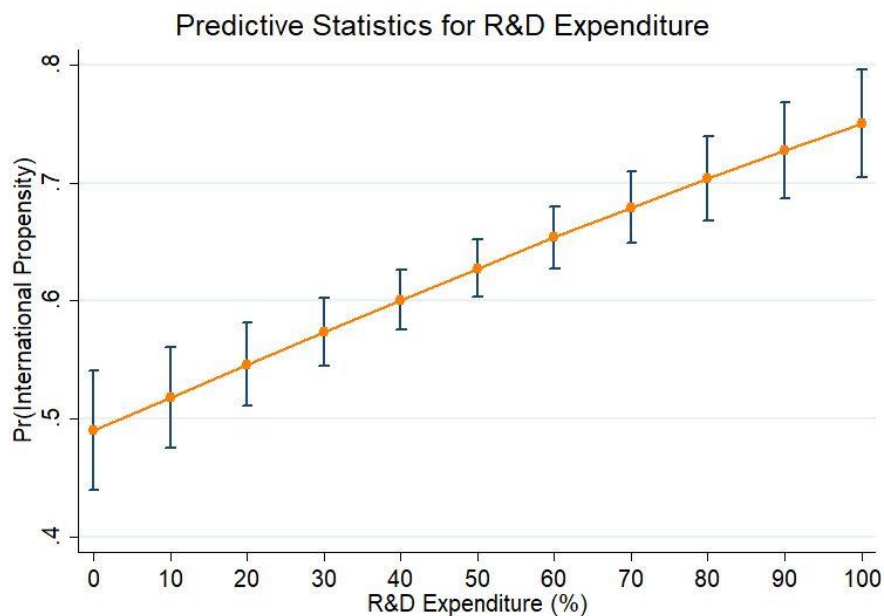


Figure 29. Graphic representation of the predictive marginal effects: focus on R&D Expenditure

5.2.2 H2 RESULTS

The two Explanatory Variables that determine the second hypothesis have a very different relation with the Dependent Variable. Confronting the results displayed in *Table 6*. for Process Innovation and Product Innovation:

Process Innovation

- *p-value* = 23.47 %;
- *Coefficient* = + 0.0889004;
- *Standard Error*: ± 0.0748259.

Product Innovation

- *p-value* = 0.00 %;
- *Coefficient* = + 0.3073745;
- *Standard Error*: ± 0.0867278.

Even if they both have a positive coefficient, Product Innovation has a much lower *p-value* than Process Innovation, and a much lower incidence of the standard error (28% vs 84% respectively). In consideration of these results, it can be said that ‘*Process Innovation*’ affects ‘*International Propensity*’ in a much less consistent and impactful way than ‘*Product Innovation*’ does. Looking at the marginal effects, a unitary increase of ‘*Process Innovation*’ (from ‘0’ to ‘1’)²⁸ generates a positive increase in ‘*International Propensity*’ of 3.09% (± 2.59%), while a unitary increase of ‘*Product Innovation*’ transforms into a positive increase of ‘*International Propensity*’ of 10.67% (± 2.97%). This implies that firms undergoing Product Innovation are up to 13.64% more likely to enter foreign markets than firms that do not invest in Product Innovation (with a 95% CI). In case of ‘*Process Innovation*’, there is a maximum increase of 5.68% in the predicted success of the Dependent Variable (with a 95% CI), but the *p-value* related is much higher (23.43%), meaning that the impact of this variable is not statistically consistent as the one registered for ‘*Product Innovation*’ (*p-value* = 0%). All of this considered, H2 is verified as it can be said that YICs investing in Product Innovation have a higher propensity to internationalize their business, if compared to YICs that invest in Process Innovation. These findings are in line with extant literature covering similar topics but in different contexts.

Additional evidence: refer to *Figure 30*. and *Figure 31*.. Differences can be easily found, firstly in consideration of the slope of the coloured line, which in the ‘*Process*

²⁸ For binary variables, the marginal effects are calculated as the differential results stemming from the switching on and off the variable itself.

Innovation’ case is visibly flatter both in relation of the black line and the ‘*Product Innovation*’ line. This implies that the benefits – in terms of ‘*International Propensity*’ – resulted from a firm investing in Process Innovation decrease the more that firm invests into R&D; the contrary can be said for Product Innovation. Moreover, in the graph describing the impact of Process Innovation both the red and black line are seen to be always comprised inside each other confidence interval region; for Product Innovation that is true only for values of ‘*R&D Expenditure*’ lower than 40%. Though, the most interesting insight stemming from these graphs is that firms that invest 100% of their budget in R&D and undergo Process Innovation have the same propensity to expand abroad, while those that undergo Product Innovation are almost 20% more likely to venture in foreign countries.

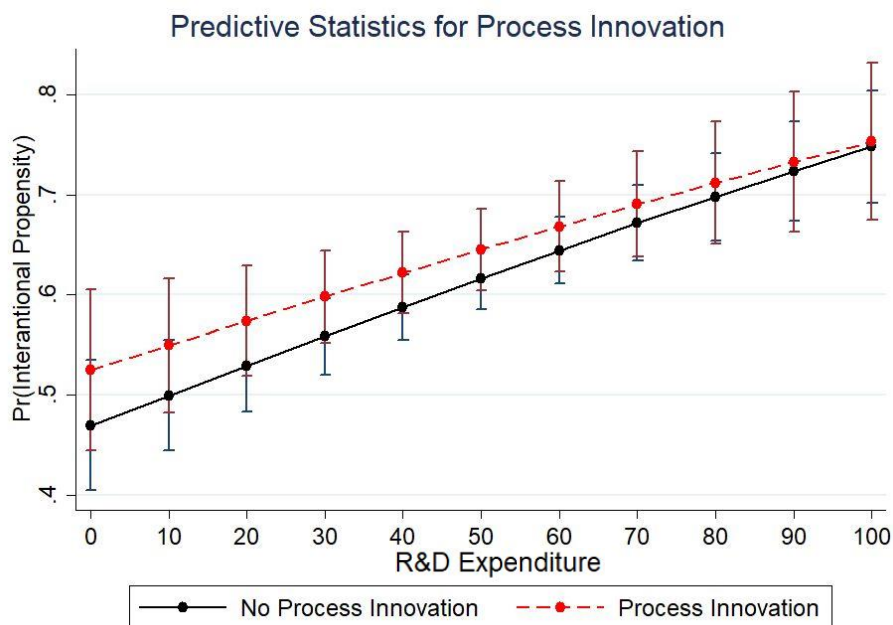


Figure 30. Additional Evidence: graphic representation of the predictive marginal effects for Process Innovation

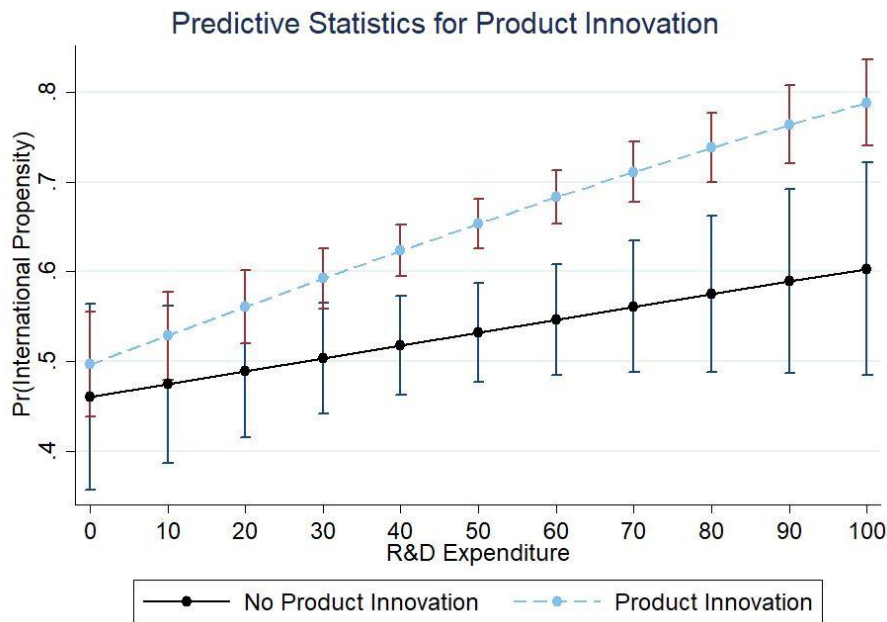


Figure 31. Additional Evidence: graphic representation of the predictive marginal effects for Product Innovation

5.2.3 H3-A RESULTS

The only Explanatory Variable that is used to test the third hypothesis exerts a moderate impact on the Dependent Variable. The statistical results coming from the Probit Regression (Table 6.) underline an unclear effect on the firm’s propensity to internationalize:

R&D Network Participation

- *p-value* = 53.49%;
- *Coefficient* = + 0.0642982;
- *Standard Error*: ± 0.1035416.

The first red flag is the very high *p-value*, meaning that there is little evidence about the impact of this Explanatory Variable on the Dependent Variable within our sample. As a consequence, the incidence of the standard error on the coefficient is very high (161%) as a further flag for high uncertainty. Moreover, the coefficient results to span in a range comprised between – 0.03924 and + 0.16784 (with a 95% CI), meaning that this variable could have either a positive or a negative influence over ‘*International Propensity*’, further demonstrating the lack of consistency. Then, it can be said that ‘*R&D Network*

Participation” do not consistently impact the Dependent Variable. By looking at the marginal effects, a unitary increase in this binary Explanatory Variable (from value ‘0’ to ‘1’) generates a positive increase in the firm’s propensity to internationalize of + 2.23% ($\pm 3.59\%$), meaning that the predictive success of the Dependent Variable associated to firms that established R&D Networks can increase in a range from -1.36% to 5.82%, but the p-value associated is so high (53.42%) that it cannot be considered as a reliable finding. Therefore, H3-A cannot be verified with our sample, so YICs with established R&D Networks seem not to be more or less internationalized than YICs that do not participate in such networks.

Additional evidence: refer to Figure 32.. In the graph, the red line defines the predictive marginal effects of firms with positive values related to ‘*R&D Network Participation*’ on the Dependent Variable, while the black line is associated to firms with ‘null’ values for the Explanatory Variable. Just looking at the lines, there seems to be a positive impact related to firms with established R&D Networks, but when considering the respective areas – defining the possible adjustment range associated to a CI of 95% – it is clear that the problem is that the red area is always comprised within the grey area. This means that the participation in R&D Networks is potentially non discriminating in relation to ‘*International Propensity*’, giving more reasons to understand why H3-A has been rejected.

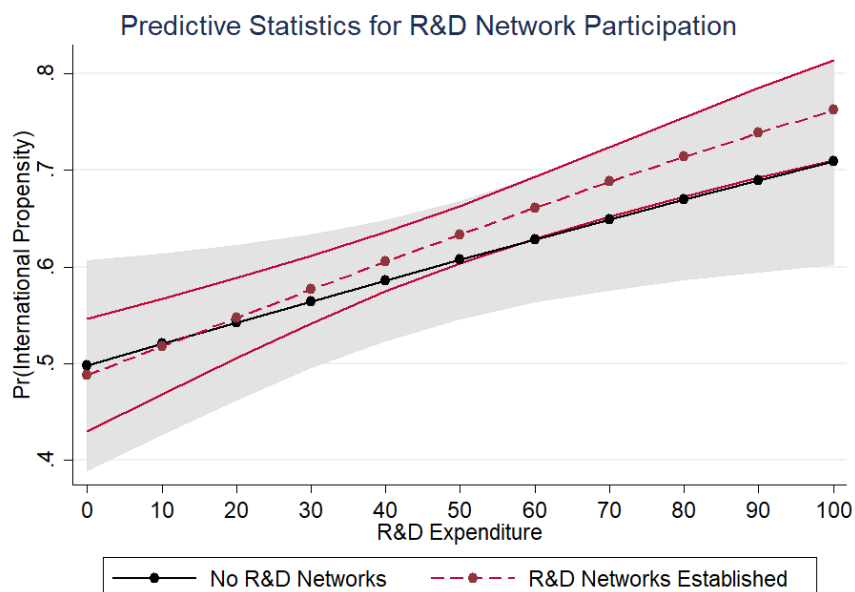


Figure 32. Additional Evidence: graphic representation of the predictive marginal effects for R&D Network Participation

5.2.4 H3-B RESULTS

The two Explanatory Variables that determine the second hypothesis have a similar relation with the Dependent Variable, but with different levels of certainty. Summarizing the results displayed in *Table 6*. for ‘*Inside-Out Innovation Approach*’ and ‘*Outside-In Innovation Approach*’:

Inside-Out

- *p-value* = 55.01 %;
- *Coefficient* = + 0.071972;
- *Standard Error*: ± 0.1204374.

Outside-In

- *p-value* = 19.77%;
- *Coefficient* = + 0.118808;
- *Standard Error*: ± 0.0923259.

Even if they both have similar coefficients and std. errors, the high difference in *p-values* can help us understand better their impact on the Dependent Variable. Although both *p-values* can be considered high for significant statistical relevance, this is an explorative study with plenty of dummy variables, so the *p-value* strictness can be loosened a little. We are comparing variables one with more than double the *p-value* of the other, so we are allowed to state that the impact of ‘*Inside-Out*’ is much less solid than the one of ‘*Outside-In*’. As a consequence, the incidence of the standard error is much higher for ‘*Inside-Out*’ than for ‘*Outside-In*’ (167% vs 78%). Another dissimilarity is related to the fact that ‘*Inside-Out*’ could possibly have a negative impact – the minimum value is – 0.04865 with a 95% CI – on the Dependent Variable, while ‘*Outside-In*’ remains always positive (at a 95% CI). In consideration of the marginal effects, a unitary increase in ‘*Inside-Out*’ (from value ‘0’ to ‘1’) transforms into a positive increase in ‘*International Propensity*’ of + 2.50% (± 4.18%), while a unitary increase in ‘*Outside-In*’ (from value ‘0’ to ‘1’) generates a positive increase of + 4.12% (± 3.20%). Potentially, the maximum predictive effects of these variables on the success of the Dependent Variable are very similar – 6.68% vs 7.32% respectively – but what makes a difference is the associated *p-value* – 54.99% vs 19.72% respectively. The results obtained for ‘*Inside-Out*’ are then much less solid than those for ‘*Outside-In*’ in relation to our sample. Therefore, in the light of these findings, H3-B is verified as it can be stated that YICs that have established an Outside-In innovation approach are more likely to expand their business in foreign countries if compared to YICs that have established an Inside-Out

innovation approach.

Additional evidence: refer to *Figure 33.* and *Figure 34.* The two graphs present similar behaviours for the two Explanatory Variables in study, but the main difference can be spotted by looking at the confidence interval region of the coloured lines. Indeed, in the graph presenting the impact of ‘*Outside-In Innovation*’ both the blue and the black line – representing the mean predictive margins of success – are excluded from each other confidence interval region, starting from values of ‘*R&D Expenditure*’ higher than 50%. Contrarily, considering the graph of ‘*Inside-Out Innovation*’, the confidence interval region of the green line is quite large and the green and black lines – representing the mean predictive margins of success – are very close, making it difficult to provide solid insights regarding the impact that the Inside-Out approach has on YICs’ propensity to internationalize. Interestingly, YICs that adopt an Outside-In approach in their innovation process seem to increase their likelihood to internationalize the more they actually invest in their R&D activities, if compared to YICs that do not use such approach.

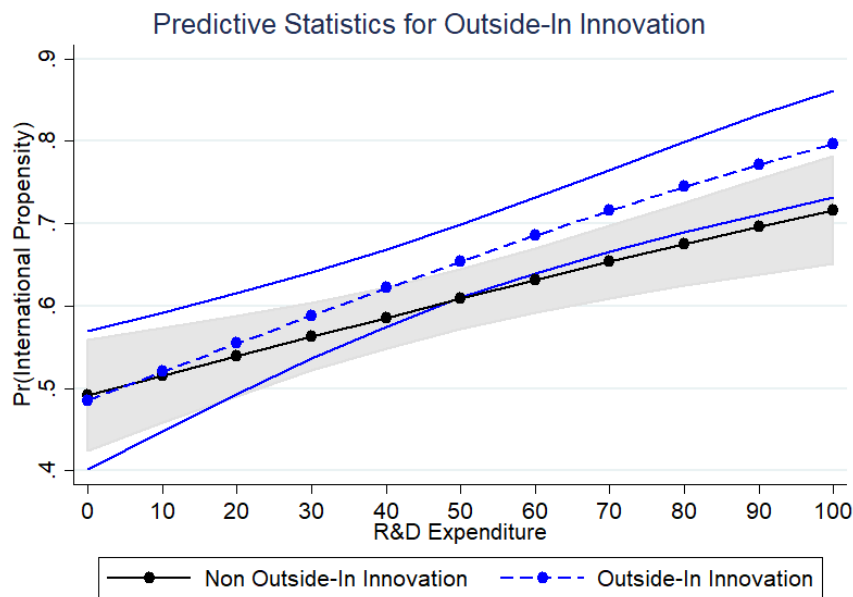


Figure 33. Additional Evidence: graphic representation of the predictive marginal effects for the Outside-In innovation approach

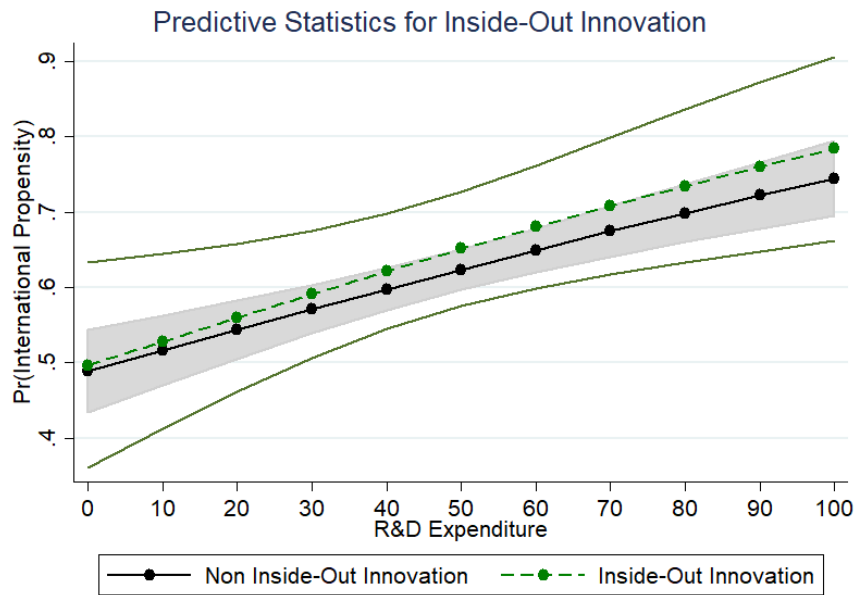


Figure 34. Additional Evidence: graphic representation of the predictive marginal effects for the Inside-Out innovation approach

Below, Table 5. summarizes the above analysis on the hypotheses' veracity:

Hypothesis	Statement	Finding
H1	<i>YICs with high R&D spending have a higher propensity to internationalize than YICs with low R&D spending</i>	CONFIRMED
H2	<i>YICs undertaking product innovation have a higher propensity to internationalize than YICs undertaking process innovation</i>	CONFIRMED
H3-A	<i>YICs participating to research networks have a higher propensity to internationalize than YICs not involved in such networks</i>	NOT CONFIRMED
H3-B	<i>YICs that establish an Outside-In Innovation approach have a higher propensity to internationalize than YICs that establish an Inside-Out Innovation approach</i>	CONFIRMED

Table 5. Schematic representation of the findings of this study, in relation to the hypotheses

Variable Name	<i>PROBIT MODEL</i>				<i>MARGINAL EFFECTS</i>			
	<i>Coefficient</i>	<i>Std Err</i>	<i>z</i>	<i>Pr> z </i>	<i>Coefficient</i>	<i>Std Err</i>	<i>z</i>	<i>Pr> z </i>
<i>R&D Expenditure</i>	.0075321	.0013116	5.74	0.000	.0026139	.00044	5.94	0.000
<i>Process Innovation</i>	.0889004	.0748259	1.19	0.235	.0308519	.0259388	1.19	0.234
<i>Product Innovation</i>	.3073745	.0867278	3.54	0.000	.1066709	.0296874	3.59	0.000
<i>R&D Network Participation</i>	.0642982	.1035416	0.62	0.535	.022314	.03592	0.62	0.534
<i>Inside-Out Innovation Approach</i>	.071972	.1204374	0.60	0.550	.0249771	.0417739	0.60	0.550
<i>Outside-In Innovation Approach</i>	.118808	.0923259	1.29	0.198	.041231	.0319913	1.29	0.197
<i>Financial Network Participation</i>	-.0074768	.0753625	-0.10	0.921	-.0025947	.0261543	-0.10	0.921
<i>Legal Entity: 2*</i>	0	(omitted)			0	(omitted)		
<i>Legal Entity: 3*</i>	.051492	.2256573	0.23	0.820	.0178697	.0783113	0.23	0.819
<i>Legal Entity: 4*</i>	-.0166092	.1155187	-0.14	0.886	-.005764	.040089	-0.14	0.886
<i>Legal Entity: 5*</i>	-.4122836	.7206226	-0.57	0.567	-.1430785	.2500134	-0.57	0.567
<i>Legal Entity: 6*</i>	-.6999765	.284977	-2.46	0.014	-.2429191	.0983495	-2.47	0.014
<i>Legal Entity: 7*</i>	0	(omitted)			0	(omitted)		
<i>Legal Entity: 8*</i>	-.0855924	.2643578	-0.32	0.746	-.0297039	.0917423	-0.32	0.746
<i>Firm Size</i>	.0036815	.0036116	1.02	0.308	.0012776	.0012533	1.02	0.308
<i>Firm Age</i>	-.0288058	.029842	-0.97	0.334	-.0099967	.0103478	-0.97	0.334
<i>Average Age of the Entrepreneurial Team</i>	-.0005166	.0040366	-0.13	0.898	-.0001793	.0014008	-0.13	0.898
<i>International Background of the Entrepreneurial Team</i>	.428045	.0812365	5.27	0.000	.1485483	.027374	5.43	0.000
<i>Region: Islands</i>	-.224576	.1568583	-1.43	0.152	-.0779366	.0543009	-1.44	0.151
<i>Region: Northern</i>	-.1515809	.0827315	-1.83	0.067	-.0526045	.0285622	-1.84	0.066

Variable Name	<i>PROBIT MODEL</i>				<i>MARGINAL EFFECTS</i>			
	<i>Coefficient</i>	<i>Std Err</i>	<i>z</i>	<i>Pr> z </i>	<i>Coefficient</i>	<i>Std Err</i>	<i>z</i>	<i>Pr> z </i>
<i>Region: Southern</i>	-.1787843	.1174072	-1.52	0.128	-.0620451	.0405969	-1.53	0.126
<i>Sector: Commerce</i>	-.4563952	.7021311	-0.65	0.516	-.1583869	.2433853	-0.65	0.515
<i>Sector: Industry</i>	-.2829105	.6847256	-0.41	0.679	-.098181	.2374615	-0.41	0.679
<i>Sector: Services</i>	-.9884714	.6788867	-1.46	0.145	-.3430381	.2346772	-1.46	0.144
<i>Sector: Tourism</i>	0	(omitted)			0	(omitted)		

* For the correlated variable names, refer to the “Legal Entity” variable description in *Chapter 4. Empirical Analysis*

Table 6. Results of the Econometric Regression and Post-Estimation Predictions

<i>PROBIT REGRESSION</i>	
N° of Observations	1649
Wald $\chi^2(22)$	148.18
Pr > χ^2	0.0000
Pseudo-R^2	0.0847
Log pseudo-likelihood	-878.2883

Table 7. Statistics representing the Probit regression

5.3 DISCUSSION

Innovation and internationalization are two spheres that have been largely studied by extant literature, with many researches focused on unveiling the existing relationship between the two. Most of them take into account export intensity – or other export related indexes – as a proxy of the internationalization of the company, while for innovation many different approaches have been tried, as it is an extremely heterogeneous factor. Moreover, the Open Innovation paradigm is a recent field of research that has seen a huge increase in interest in the past decade, but rarely it has been associated to the internationalization behaviour of the firms. The internationalization strategy is usually applied by established firms with a relatively viable offer for the international market, therefore innovation is not seen as the primal engine in such contexts. Companies usually have large costs associated to the effective entrance in new markets, as there is the need to redesign the resource base in accordance to the local needs, to see reduced margins due to increased competition and to establish new collaborations and entities in order to respect the local regulatory scenario. In such an environment, firms are overwhelmed with costly activities and cannot dedicate resources to wide innovation programs, not until the cashflow stabilizes. In the start-up context, however, innovation is often what directly enables the internationalization of the firm, as the usual strategy is to find disrupting business models and then select the market to enter, which is dependent to the financial investors preferences, institutional structure, incumbents bargaining power and so much more.

Therefore, this study aims to fill a gap in the extant literature, by analysing the impact that innovation – declined in different facets – has on the propensity to internationalize of knowledge intensive small firms and start-ups. Moreover, a large part of this research inherently provides descriptive information in regard of the use of Open Innovation in the start-up reality. In *Chapter 4. “Empirical Analysis”*, we already depicted the descriptive statistics of our model and sample, now some considerations are necessary. Relying on our database of 1661 Italian young and innovative companies, we conclude that knowledge intensive small firms and start-ups are extensively practicing Open Innovation, as more than 75% of the firms analysed have established collaborations or partnerships with external agents to foster knowledge acquisition and exchange. Open

Innovation is therefore widely present in such an environment and seems to be structural for its business life, considering that sharing costs through many small firms inside a network is usually both more efficient and effective than producing the same level of knowledge without collaborations. Coincidentally, there is to consider that knowledge intensive small firms and start-ups have an increasingly important role in the innovation landscape. In consideration of their lack of resources and the liabilities related, these companies are much more inclined in collaborating with external organizations, if compared to larger and established firms. On the other hand, there are some backlashes to consider: the unrestrained knowledge sharing would reduce the individual competitive advantage of the firms, therefore the amount and quality of the exchanged knowledge should be assessed with a strategical orientation; offering a comprehensive product/service should be out-of-scope for such small firms, as the high need for external participation related to all the different activities necessary in such endeavour would likely erode the profits substantially. Especially in the high-tech industry, small players hardly have the resources and competences to develop an all-embracing product. Therefore, firms at the very first stages should focus on providing targeted and tailored features and services in order to enter the market with a strong impact on the product/service value chain.

Open Innovation had been first developed in consideration of large MNEs, as initially the paradigm had been constructed in contrast to the Traditional (Closed) Innovation framework, which was widely applied by large enterprises. The size, formality and structural organization of such companies facilitated the drawing of the OI paradigm from a theoretical point of view, which then had been verified by empirical researches. Instead, when the focus shifts on very small and young firms, many difficulties arise, mainly in relation to the measurability problem. Surely, this is one of the reasons why research in this context is still underdeveloped: the extremely heterogeneous nature of innovation makes the measurement misleading per se, as often the measure itself is based on the combination of some prevailing drivers, where the isolation of the innovative components from the others is rarely feasible. Moreover, in such small and unstructured organizations there is no clear definition of innovative activities nor formal research logs to use as reliable data. At the same time, when studying the start-up world, there is a wide variety of different realities to encompass, considering that such young and small

companies are inherently non-homogeneous as each one of them has the goal to bring something different to their market of reference. All of this considered, the qualitative output of this kind of analysis is much more valuable than the mere quantitative results related to a specific econometric model, that should be taken as a stepping stone to provide meaningful insights and considerations. In this view, this study aims at highlighting that innovation is very relevant for small sized firms operating in knowledge intensive sectors, and most importantly that it has interesting relations with the internationalization propensity of such firms.

Indeed, the results of the econometric model presented in this research show positive and significant impacts between innovation and international propensity. In a highly open setting such as the start-up world, firms aim at building feasible and sustainable competitive advantage from the interaction of their own technological endowment and capabilities with external sources of knowledge and resources. The challenge is to determine what dimensions of innovation are actually the most effective to quickly build competitive advantages and lower the barriers to entry foreign countries.

Traditionally, R&D has been considered pivotal in relation to both innovation and the development of a sustainable competitive advantage. The main reason of such popularity is actually related to its measurability, since many quantitative data associated to it can be easily recovered, especially for large organizations. On the other hand, R&D is also a reliable indicator of innovation input, even more so when considering the high-tech context. The level of investment in such activities – internal and external – strictly defines the innovative capability that a firm can achieve, both in terms of creation and acquisition. In relation to young and innovative small firms, R&D can hardly be schematically defined and quantitatively measured, so R&D indicators should be taken as broad summaries of all the wide variety of activities that a firm can undertake with the goal of increasing their knowledge base and absorptive capacity. Therefore, a firm with low levels of innovation input can hardly transform into a firm with strong innovative presence on the market, which is a fundamental element to develop strong competitive advantages in the knowledge intensive environment. Without such advantages the internationalization process becomes definitely more problematic, as the firms of reference for our study do not have the necessary scale to enter new markets via price wars with incumbents.

Another widely studied topic in the innovation literature is the innovation output, even if the academic research is still not satisfying for what concerns the mediations effects on internationalization. Considering that this is a more complex variable to measure, empirical research has focused on the manufacturing sector, where outputs could be differentiated more easily in consideration of their innovative embeddedness. There are many different possible indicators for innovation output, but internationalization studies have mainly researched product, process and, more recently, marketing innovation. Since more than 95% of our sample is composed by micro-firms (less than 10 employees), the marketing side of innovation has been neglected, as advertising is a very demanding activity in terms of expenses, but it could be a very interesting topic for future studies. The variables we focused on are process and product innovation, both of which have been widely explored by researchers. They both have strong implications with the internationalization problem, in fact the correct implementation of these variables can easily generate competitive advantages and therefore create the conditions to enter foreign markets and still maintain positive cashflows. From a structural point of view, product innovation mainly differs from process innovation in terms of the investment related, the impact on the firm's operations and the marketability of the knowledge developed. Process innovation usually requires more funds, more time and is aimed at increasing the firm's efficiency in the long term. Product innovation aims at quickly bringing value to the market through new products/features, but a strategy focused on this approach requires many iterations in the long term.

Collaborating can greatly increase the innovative potential of small firms. Chesbrough and Crowther (2006) define technological exploration and technological exploitation as the two complementary routes that a firm can walk to create added value from external collaborations. The former represents all the activities related to knowledge acquisition, while the latter represents all the ways that a firm can profit from proprietary knowledge. Maximum value is created by the correct interpolation of these two dimensions, but there is not a combination that works for all the firms as many contingencies are present. Therefore, the introduction of unidirectional knowledge flows seems to have a pivotal role from the theoretical point of view, but empirical evidence are scarce in this context as most of the time the openness to innovate with external

organizations has been studied only in relation to the presence of external collaborators, omitting the 'direction' dimension.

Then, from a holistic point of view, this study has been structured to test the relevance of three main dimensions of innovation – namely, innovative input (H1), innovative output (H2) and the knowledge flow direction (H3-A vs H3-B) – on the propensity of young and innovative small firms to enter foreign countries. Given that the correlation results do not show highly correlated variables, the findings should be interpreted as reliable. The first objective has been to verify whether innovation input and output are positively related to international propensity also in consideration of the business segment of reference, since these findings have already been highlighted by some researchers (Sterlacchini, 1999; Nassimbeni, 2001; D'Angelo, 2010; Harris and Li, 2009; Basile, 2001; Kogut and Zander, 1996; Parisi et al., 2006). Given all the considerations made about the differences between the various business realities, this first part alone should bring value to the contextual research. Then the analysis shifts towards a more recent field of innovation studies, which is still underdeveloped in relation to internationalization. Hence, the aim is to provide empirical findings for what concerns the effect of Open Innovation towards the propensity to internationalize, taking the Italian YICs as a reference group for knowledge intensive young and small firms. This second part is of a far more explorative nature and tries to fill a gap in the extant literature. Nevertheless, the Open Innovation model is not something a firm decides to use for a specific end, instead it is a structural approach that is enabled at the system level: firms can effectively make use of Open Innovation only if knowledge, resources and competences can be efficiently shared and exchanged by a relevant number of players. As a matter of fact, this is the direction that many businesses have already undertaken, including the one subject to this study. Contrarily to van de Vrande's et al. (2009) findings, our research highlights that Open Innovation practices are widely engaged also by micro-sized firms, even if larger firms still have more resources and knowledge-base to apply more effectively such approach in a broader range. Now, this critical discussion shifts towards the results of the econometric model presented above, aiming at unveiling enriching insights.

Starting from H1, the results clearly indicate a strong and positive relationships of R&D expenditure towards the propensity to internationalize of our sample. Literature

background on the topic is not homogeneous, as innovation input can be measured with a multitude of different indicators – in our case, it is represented by the relative size of the investment in R&D activities out of the overall firm’s expenditures – and sectorial and regional contingencies do have a strong impact on the results. In this study, ‘*R&D Expenditure*’ comprises both internal and external activities related to the fostering of new knowledge and capabilities necessary to the development of strong firm’s advantages. Rosenberg (1982), Cohen and Levinthal (1990) and Griffith et al. (2004) – among the others – studied the inherent association between high innovation input and the enhanced absorptive capacity that follows. In this view, R&D expenditure – as a proxy of innovation input – assumes a crucial role in the ability of a firm to internationalize, as it both enables the development of competitive advantages and increases the absorptive capacity of the firm. Consequently, this allows firms with high R&D expenditure to acquire missing knowledge and impose themselves firmly in the product value chain more quickly and easily than firms that invested little resources in R&D activities. Especially in regard of young and innovate small companies, the ability to quickly adapt to different environments becomes a success factor, and it is enabled by particular dynamic capabilities, developed through continuous specialization fostered by the combination of internal and external innovations. These dynamic capabilities, then, are strictly related to the volume of resources invested in R&D activities, and in turn open up new avenues for such investments. Summarizing, ‘*R&D Expenditure*’ is one of the many indicators used to measure innovation input and, implicitly, can be consider a proxy of a firm’s absorptive capacity, particularly in reference of knowledge intensive young and small firms. Moreover, given that the Italian average R&D expenditure of small firms is significantly lower than the average of the EU countries, this measure acquires even more importance when analysing internationalization, because many international competitors that are already present in foreign countries are also stronger in the technology endowment – on average. Constant and incremental investments in R&D expenditure are found to be a very effective approach that high-tech small firms can use to quickly increase their likelihood to structurally internationalize their business.

For what concerns H2, the results of the analysis show that ‘*Product Innovation*’ has a positive and significative effect on the firms’ propensity to internationalize, while ‘*Process Innovation*’ has a positive but non-significative effect, confirming the

hypothesis formulated. Process and product innovation represent two of the most widely studied indicators of innovation output, but their measurement across different sectors is still not consistent as quantitative variables directly representing such innovations are difficult to find. This research limits this endeavour by discriminating only those firms that have developed such innovations from those who have not. Product innovation is found to be much more relevant than process innovation in relation to the impact on the firm's propensity to enter foreign countries. Extant literature provides interesting insights in this regard. Parisi's et al. (2006) research on Italian SMEs unveils the strong positive connection between R&D and product innovation, while process innovation is found to be impacted by a larger variety of determinants related to efficiency and productivity. Rodriguez and Rodriguez (2005) find that product innovations are the materialization of the high-tech knowledge and competences that a firm has, and enable small firms to successfully differentiate their product offering, increasing their competitive advantage and the related effectiveness of internationalization strategies. In the manufacturing SMEs context, literature confirms the existence of a proportional and positive relationships between firm size and the likelihood of introducing a product innovation. Our sample cannot verify if a similar relation subsists also for high-tech small firms since there are only few observations related to larger firms, but it can be stated that product innovation is largely used already by such small firms of context. Especially when analysing the internationalization of knowledge intensive small firms, process and product innovation need to be further contextualized: process innovation is usually related to drastic internal improvements and the benefits are associated to a longer term; product innovation, instead, represents one of the quickest methods that a firm has to increase revenues and acquire market traction. Moreover, investments in product innovation are usually less demanding than the ones for process innovation in the early stages of high-tech firms. Actually, process innovation in relation to our sample hardly represent correctly the concept of process innovation largely studied in the last decades. With the advent of the start-up reality, the early development of high-tech firms has radically changed due to a plethora of factors, and most of the time investments are related to the approval of the backing financial agents. These investors are mainly interested in the exit value of the firm, therefore investments in process innovation are very uncommon, since they are costly, have a long pay-back time and are required once every many years. This,

together with the fact that process innovation is surely more characteristic in the industrial sectors, might represent one of the main reasons to explain the large difference in the adoption of these two innovations in our sample²⁹. The ability to continuously and effectively bring new products to the market undoubtedly represents a strong and sustainable competitive advantage, while at the same time requires a great deal of commitment in R&D and marketing activities that can easily break positive cashflows of fragile new businesses. Entering foreign markets without the necessary preparation can result in very negative outcomes, therefore product innovation strategies should be associated to a comprehensive exploration of the markets. Nevertheless, our findings suggest that knowledge intensive small firms are much more likely to enter the international landscape if they invest in product innovation, while process innovation, even if it has a positive relation with international propensity, seems to be less consistently related to the entrance in foreign countries, given the previous considerations. All in all, innovation output is found to positively affect the internationalization choice of high-tech small and young firms, since it provides strong competitive advantages while being enabled by the firm's innovation input and absorptive capacity.

Now the focus shifts towards the explorative side of this research, by critically confronting the findings for H3-A and H3-B. The results of the econometric model did not provide solid information to clearly state whether the open innovation methods positively impact or not the international propensity of high-tech small firms, even if, specifically, the Outside-In Innovation model seems to positively affect such decision. Still, the goal of this last part of the study is to explore more in detail if it is the direction of the knowledge exchange that affects the propensity to internationalize or if it is just the participation in knowledge networks that matters. Elaborating on the context surely gives additional considerations to help us clarify this concept. Starting from the assumption that knowledge intensive small firms are encouraged – for the many reasons already discussed in this analysis – to make use of open innovation approaches, these innovative firms find themselves in an extremely complicated situation since the early stages. Opening up to external organizations brings a multitude of opportunities and threats at the same time. With the goal of combining the entrepreneurial thrust, internal competences and external

²⁹ 77.4% of the sample has invested in product innovation, while only 37.3 % has invested in process innovation.

knowledge, high-tech small firms are willingly participating into business networks, collaborating with public and research institutions and creating new relationships with complementary sectors. The networking activity is actually fundamental in this context to absorb missing knowledge from the external environment, but it can also be used to generate new revenue streams by exploiting the innovations developed. Especially in consideration of high-tech small firms, the most used practices related to knowledge exchange are also the most informal and unstructured. This is why the measuring of open innovation results particularly challenging in reference of small-sized entities. Joint ventures, IP inward and outward licensing, supply chain management and many other highly structured forms for creating knowledge networks are mainly out-of-scope from this research since they are usually associated with larger and more established enterprises. This might also explain why the Inside-Out innovation approach is so unpopular among our sample³⁰, as outward IP licensing, venturing and external participations – the most common practical representations of such approach – require substantial financial investments and structured administrative and juridical business units to effectively sustain all of the related activities.

It has been demonstrated that those firms that are positioned in high value adding activities inside the product value chain are more likely to participate in international markets (Wan and Wu, 2017), therefore high-tech start-ups should aim to reposition themselves towards the top of the value distribution stream in order to build strong competitive advantage and lower the risks related to foreign markets. Given the set of liabilities associated to the firms sampled³¹, it becomes necessary to put effort in the establishment of external collaborations, so that knowledge intensive small firms are enabled to compete for stronger position in the value chain. On the other hand, though, firms that invest in open innovation activities face a multitude of threats and risks that hinder their survival. Creating and maintaining research partners requires greater dedication to R&D activities and customer relationship management, while the acquired knowledge needs to be further developed to produce marketable outputs. At the same time, the long-term innovative potential is threatened by the loss of control on proprietary

³⁰ Only 12.6% of the sampled firms admit they actively use Inside-Out methods in relation to their business.

³¹ Namely, liability of *newness*, *smallness* and *foreignness*.

knowledge and core competences. Though, closed innovation methods cannot sustain the shorter innovation lifecycle and time to market demanded by contemporary customer needs. Consequently, small businesses operating in knowledge intensive sectors should simultaneously invest both in internal R&D and in external knowledge acquisition. Another problem is related to the organizational and cultural barriers that exist among knowledge networks, meaning that firms are not always able to interpret the acquired knowledge or use it at its full potential (van de Vrande et al., 2009). This implies that R&D and absorptive capacity cannot always provide the necessary dynamic capabilities to effectively interiorize the required knowledge, especially when referring to foreign markets where culture and tradition cannot be easily absorbed by firms. In this context, Chesbrough and Crowther (2006) identify that the Not-Invented-Here (NIH) syndrome is the main obstructing factor for the effective exploitation of external knowledge, while at the same time it represents a market risk. Simultaneously, the Only-Used-Here (OUH) syndrome highlights the difficulties related to the exploitation of proprietary technologies outside the existing market. As a consequence, firms have to assess the right level of proximity to the external environment that can enable an effective knowledge exchange and its exploitation. Cognitive, cultural, administrative, social, geographical, organizational and institutional differences that arise from the assessment of potential partners have to be strategically analysed, since they may transform into competitive advantages or structural handicaps in relation to the firm's behaviour in respect of the external environment. Today, international markets are at the reach of almost every firm, therefore innovative small firms should aim at thoroughly researching their business of reference and absorbing as much knowledge as they can if they want to develop those dynamic capabilities that will enable their survival in such high-competition markets. Developing strong relations with few knowledge suppliers seems to be the most secure way that a young and innovative firm has to firmly position itself on the market while minimizing the risks of losing competitive advantage. In fact, trading internal knowledge to increase revenues is only a short-term eventuality, as the loss of proprietary knowledge eradicates the competitive advantages developed – when IP patenting is not effectively applied. The combination of these two approaches – Outside-In and Inside-Out – is a very demanding project for such young and small firms, while at the same time it requires a solid organization to protect the firm from free-riding and contract breaches. As a matter

of fact, there are no firms that combined these two approaches in our sample, so the impact of firms that channel knowledge from external sources towards external users on their internationalization decision cannot be discovered through this study. What it can be stated is that the acquisition of knowledge from external sources through collaborations with other firms, universities, research centres and public institution seems to positively impact the international propensity of knowledge intensive small firms. This is because the acquisition of external knowledge is a form of innovation input, which we already found to be relevant in this context, but Outside-In innovation also implies no knowledge spill-overs, therefore firms making use of this approach are actually protecting their core competences and IP. Contrarily, Inside-Out innovation can represent a relevant factor to enable internationalization, only when the firm is solidly structured and can effectively protect its knowledge, for example by establishing strong IP patenting systems or by decomposing knowledge into unrelated small components that cannot represent a threat for spill-overs. This is clearly not the case for young and innovative small firms.

Summarizing, the participation in knowledge networks seems to be necessary to enable the effective internationalization of innovative small firms but results from our analysis are not solid enough to prove it. The reason is that young and small innovative companies make broad use of open innovation practices regardless of their international aim, as their resources and competences are too limited to enable the firm's sustainability in a closed ecosystem. Indeed, 75.1% of the firms sampled are participating in knowledge networks, while only 61.3% of the sample registers an international propensity. Considering the high *p-value* (0.535) related to the variable '*R&D Network Participation*', we can imply that the participation in knowledge networks is widely performed also by firms without a clear international program. Therefore, all of the above considered, participating in R&D network could represent a necessary condition to the internationalization of young and innovative companies, but not a sufficient condition. Analysing the direction of the knowledge exchange seems to provide better results, as the unidirectional knowledge flow from the external environment towards the firm is found to be positively related to the internationalization of the sampled firms.

Finally, we provide some considerations regarding the impact of control variables. As already stated, empirical evidence strongly suggests that those firms led by a team with tangible past experience in foreign countries are much more likely to have an

international focus if compared to firms without past international experience among its members. The '*International Background*' control variable is the most relevant regressor from a statistical point of view, meaning that entrepreneurs with past international experience bring a strong advantage to their company in terms of international capabilities. This finding is in line with extant literature (Zucchella et al., 2007; Reuber and Fischer, 1999), which highlights that a past work experience, academic education or even personal development stays in foreign countries are strongly associated to a consequent international orientation when working in a domestic firm. Moreover, it seems that managers and entrepreneurs with an international background usually internationalize their businesses more quickly and more effectively than counterpart firms without this feature.

On the contrary, the control variable "*Average Age*" seems to be totally uncorrelated to the internationalization decision, meaning that young entrepreneurs are not more likely to focus on foreign markets in the early stages than their older competitors. This is not a surprise, considering that even "*Firm Age*" has been found to have a negative impact on the international propensity of high-tech start-ups, even if fragile. Past research found that the experience of firms does not explain the international decision (D'Angelo, 2010; Oviatt and McDougall, 1994), but in our case the range of years of experience is quite narrow therefore this finding can hardly be considered as a relevant confirmation of past research.

"*Firm Size*", on the other hand, seems to be positively related to the internationalization propensity, even if the relatively high *p-value* (0.308) underlines a lack of solidity for this finding. In past literature, the positive relation between size and degree of internationalization has been proved, mainly due to the advantages stemming from the efficiency of larger enterprises and the economies of scope related (D'Angelo, 2010).

The control variable "*Financial Network Participation*" does not seem to impact the internationalization decision. At first, this may appear counterintuitive since the financial constraint is one of the greatest hindrances that high-tech small firms have when facing the decision of entering foreign markets. Though, considering that the vast majority of the firms sampled are *micro-sized* (less than 10 employees), external financial backing

should be considered necessary even for the domestic development of the businesses, or at least not less important. Therefore, this research suggests that the participation of formal financial investors in the equity structure of innovative start-ups does not directly impact the internationalization process of such companies.

Lastly, the differences in geographical location, economic sector and legal entity do seem to affect the firms' propensity to internationalize. Central regions are the more impactful from a statistical point of view, probably because there are fewer local opportunities compared to Northern areas, but still there is a strong tech infrastructure in the area, which is rich of districts highly specialized in the production of very distinctive goods. Unexpectedly, "*Agriculture and Fishing*" is the most internationalized sector, probably because final products in such sector are easily marketable even in foreign countries since the practices and operations related to the sector are very similar throughout similar climatic areas. Legal entities affect the international decision in very different ways, but the results are not very solid from a statistical perspective therefore our findings need to be further validated.

6 CONCLUSION

This study contributes to expanding the empirical evidence related to the internationalization research field from the innovation of young innovative firms' point of view, while enriching the internationalization literature related to the Italian small and micro innovative business. At the same time, relevant findings are provided in relation to the research gap regarding the study of the direction of knowledge exchange, here associated to the effective internationalization of innovative small firms. Results reveal that investing in R&D-related activities is an important factor for the internationalization decision for the firms analysed.

More specifically, the external acquisition of knowledge aimed at developing internal innovation seems to be the most commonly adopted approach in relation to the use of open innovation in the internationalized firms. Instead, the internal development of knowledge and technology aimed at the trade with external entities does not seem to be a popular practice used by such internationalized firms. Contrarily to previous research findings (Sekliuckiene et al., 2016; Toth and Torok, 2013), our analysis finds that firms that enable one-way exchanges – and specifically external acquisition of knowledge – have a higher probability to internationalize rather than those firms that develop relationships in multiple directions. The collaborations on research activities with other firms that include inward and outward flows of knowledge seem to be less beneficial to the internationalization of young innovative firms if compared to inward knowledge absorption activities. This may be related to the fact that due to the shortage of resources and strict limitations the firms sampled are not able to effectively sustain numerous and multi-directional collaborations. The ability to efficiently manage few relationships with R&D suppliers seems to provide competitive advantage for the efficient internationalization of small knowledge intensive firms.

As far as innovation output is concerned, our study suggests that firms that actively invest in product innovation are more likely to internationalize their business if compared to those firms that have invested in process innovation. Considering that more than 2/3 of the sampled firms make use of external knowledge, it can be deferred that open innovation facilitates the product innovation process. By internalizing external knowledge firms are able to shorten the time-to-market lead time related to the innovation development, which

ultimately increases the firms' presence on the market while providing them with improved innovative performance. This finding is line with extant literature (Nieto and Santamaria, 2007).

Collaborations are also beneficial to increase the bargaining power of the firms into the products value chain, especially in relation to international markets where the networking enables innovative small firms to reduce their liabilities. Our study does not provide insights regarding the geographical distribution of R&D networks, but the descriptive analysis of the sample used highlights that 2/3 of outside-in approaches are established with other private firms and the remaining part is associated to universities, research centres and public institutions. This data may represent a starting point for future research aimed at analysing the topic from a policy point of view in order to provide more detailed insights to form policymakers on the factors to focus on to create collaboration incentives. Fostering the cooperation between research institutions and young firms operating in the high-tech industry would definitely increase the international competitiveness of these organizations. In this endeavour, the implementation of policies aimed at sharing and reducing the costs of R&D with external entities could enhance the firms' international propensity.

On the other hand, knowledge intensive small firms should aim at finding the right balance between openness to the outer environment and internal organic development. Companies are constantly demanded to generate value adding products and services faster than the competition, but at the same time they need to protect their IP and create sustainable competitive advantages. This is the modern trade-off that young and small high-tech businesses face when taking into consideration the international avenue. There are clearly too many factors and potential contingencies to provide a definitive solution in this regard: when collaborating in a network, risks multiply as well as the potential payoff, therefore the decision to enter into foreign markets should be made at strategical level rather than economical. A balanced approach seems to be the optimal strategy in this context, but the threshold differs from firm to firm.

6.1 LIMITATIONS AND FUTURE RESEARCH

This research has several limitations, that can be seen as the starting ground for future studies. First of all, as many previous researches pointed out, most of the findings related

to the internationalization of small firms are country-specific. Even in our case, the analysis has been performed taking in consideration only the Italian market: this methodology limits the universality of the findings as they may not be consistent in different social and political contexts. Expanding this view, by analysing samples that comprise many diverse nations, could provide dogmatic evidence in relation to the innovative start-up internationalization.

Another limitation is related to the dependent variable used: analysing international propensity highlights those factors that facilitate the expansion of a business abroad. Though, a research that analyses the performance of these firms over time in the international markets may unveil more important results to be interpreted by policymakers to improve the normative and juridical background. At the same time, studying the effectiveness of the different entry modes used by the firms may reveal important differences at strategy level.

From an econometric point of view, the dataset used in this study has two main limitations. One is related to the collection of the data: surveys are a great tool to build large databases, but the truthfulness of information gathered cannot be verified therefore data may not represent the actual population. More solid data collections can be performed using certified repositories of economic data at firm level. Another problem related to our model is the high number of dichotomous variables. This type of variables is very helpful in many circumstances but working with almost only binomial variables necessarily produces more bias in the analysis of the interactions. Describing a model with more quantitative variables could increase the solidity of the results, other than expanding the field of research.

One last cue for further researches is related to the fact that this study does not take into consideration the protective measures used by firms to defend proprietary knowledge. In the context of reference, knowledge spill-overs represent one of the biggest threats since losing the control of specific expertise may result in the reduction of competitive advantage. As a consequence, firms operating in an open innovation environment tend to experience an inherent paradox stemming from the fact that all firms try to absorb external knowledge while protecting their internal knowledge (Bogers, 2011). This behaviour constitutes a systemic restraint to the openness of the environment

itself. Further research on this direction may provide interesting results for implementing more efficient forms of collaborations, aside from insights for improved policymaking.

Concluding, we are pleased to have shed some light on a theme that has been largely studied but not exactly with such settings, and by doing this we hope to have captured the interest of the reader while serving as a starting point for future research.

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APPENDIX A – Regions Construction

Sigla	Provincia	Regione	Region
AG	Agrigento	Sicilia	Isole
AL	Alessandria	Piemonte	Nord Italia
AN	Ancona	Marche	Nord Italia
AO	Aosta	Valle d'Aosta	Nord Italia
AP	Ascoli-Piceno	Marche	Nord Italia
AQ	L'Aquila	Abruzzo	Centro Italia
AR	Arezzo	Toscana	Centro Italia
AT	Asti	Piemonte	Nord Italia
AV	Avellino	Campania	Sud Italia
BA	Bari	Puglia	Sud Italia
BG	Bergamo	Lombardia	Nord Italia
BI	Biella	Piemonte	Nord Italia
BL	Belluno	Veneto	Nord Italia
BN	Benevento	Campania	Sud Italia
BO	Bologna	Emilia Romagna	Centro Italia
BR	Brindisi	Puglia	Sud Italia
BS	Brescia	Lombardia	Nord Italia
BT	Barletta-Andria-Trani	Puglia	Sud Italia
BZ	Bolzano	Trentino Alto Adige	Nord Italia
CA	Cagliari	Sardegna	Isole
CB	Campobasso	Molise	Sud Italia
CE	Caserta	Campania	Sud Italia
CH	Chieti	Abruzzo	Centro Italia
CI	Carbonia Iglesias	Sardegna	Isole
CL	Caltanissetta	Sicilia	Isole
CN	Cuneo	Piemonte	Nord Italia

CO	Como	Lombardia	Nord Italia
CR	Cremona	Lombardia	Nord Italia
CS	Cosenza	Calabria	Sud Italia
CT	Catania	Sicilia	Isole
CZ	Catanzaro	Calabria	Sud Italia
EN	Enna	Sicilia	Isole
FO	Forli-Cesena	Emilia Romagna	Centro Italia
FE	Ferrara	Emilia Romagna	Centro Italia
FG	Foggia	Puglia	Sud Italia
FI	Firenze	Toscana	Centro Italia
FM	Fermo	Marche	Nord Italia
FR	Frosinone	Lazio	Centro Italia
GE	Genova	Liguria	Nord Italia
GO	Gorizia	Friuli Venezia Giulia	Nord Italia
GR	Grosseto	Toscana	Centro Italia
IM	Imperia	Liguria	Nord Italia
IS	Isernia	Molise	Sud Italia
KR	Crotone	Calabria	Sud Italia
LC	Lecco	Lombardia	Nord Italia
LE	Lecce	Puglia	Sud Italia
LI	Livorno	Toscana	Centro Italia
LO	Lodi	Lombardia	Nord Italia
LT	Latina	Lazio	Centro Italia
LU	Lucca	Toscana	Centro Italia
MB	Monza-Brianza	Lombardia	Nord Italia
MC	Macerata	Marche	Nord Italia
ME	Messina	Sicilia	Isole
MI	Milano	Lombardia	Nord Italia

MN	Mantova	Lombardia	Nord Italia
MO	Modena	Emilia Romagna	Centro Italia
MS	Massa-Carrara	Toscana	Centro Italia
MT	Matera	Basilicata	Sud Italia
NA	Napoli	Campania	Sud Italia
NO	Novara	Piemonte	Nord Italia
NU	Nuoro	Sardegna	Isole
OG	Ogliastra	Sardegna	Isole
OR	Oristano	Sardegna	Isole
OT	Olbia Tempio	Sardegna	Isole
PA	Palermo	Sicilia	Isole
PC	Piacenza	Emilia Romagna	Centro Italia
PD	Padova	Veneto	Nord Italia
PE	Pescara	Abruzzo	Centro Italia
PG	Perugia	Umbria	Centro Italia
PI	Pisa	Toscana	Centro Italia
PN	Pordenone	Friuli Venezia Giulia	Nord Italia
PO	Prato	Toscana	Centro Italia
PR	Parma	Emilia Romagna	Centro Italia
PT	Pistoia	Toscana	Centro Italia
PS	Pesaro-Urbino	Marche	Nord Italia
PV	Pavia	Lombardia	Nord Italia
PZ	Potenza	Basilicata	Sud Italia
RA	Ravenna	Emilia Romagna	Centro Italia
RC	Reggio-Calabria	Calabria	Sud Italia
RE	Reggio-Emilia	Emilia Romagna	Centro Italia
RG	Ragusa	Sicilia	Isole
RI	Rieti	Lazio	Centro Italia

RN	Rimini	Emilia Romagna	Centro Italia
RO	Rovigo	Veneto	Nord Italia
RM	Roma	Lazio	Centro Italia
SA	Salerno	Campania	Sud Italia
SI	Siena	Toscana	Centro Italia
SO	Sondrio	Lombardia	Nord Italia
SP	La-Spezia	Liguria	Nord Italia
SR	Siracusa	Sicilia	Isole
SS	Sassari	Sardegna	Isole
SV	Savona	Liguria	Nord Italia
TA	Taranto	Puglia	Sud Italia
TE	Teramo	Abruzzo	Centro Italia
TN	Trento	Trentino Alto Adige	Nord Italia
TO	Torino	Piemonte	Nord Italia
TP	Trapani	Sicilia	Isole
TR	Terni	Umbria	Centro Italia
TS	Trieste	Friuli Venezia Giulia	Nord Italia
TV	Treviso	Veneto	Nord Italia
UD	Udine	Friuli Venezia Giulia	Nord Italia
VA	Varese	Lombardia	Nord Italia
VB	Verbania	Piemonte	Nord Italia
VC	Vercelli	Piemonte	Nord Italia
VE	Venezia	Veneto	Nord Italia
VI	Vicenza	Veneto	Nord Italia
VR	Verona	Veneto	Nord Italia
VS	Medio Campidano	Sardegna	Isole
VT	Viterbo	Lazio	Centro Italia
VV	Vibo-Valentia	Calabria	Sud Italia

APPENDIX B – Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11
1	1.0000										
2	-0.0778	1.0000									
3	0.0870	-0.2139	1.0000								
4	0.0312	0.0725	0.0288	1.0000							
5	-0.0277	0.0833	-0.0090	0.2145	1.0000						
6	0.0577	-0.0166	-0.0387	0.4591	-0.3199	1.0000					
7	0.0087	0.0334	0.0005	-0.0218	-0.0342	-0.0162	1.0000				
8	0.0008	-0.0130	0.0211	0.0274	-0.0284	0.0420	0.0022	1.0000			
9	-0.0628	0.0443	0.0500	0.0292	0.0028	-0.0511	0.0491	0.0699	1.0000		
10	0.0226	-0.0235	0.0602	0.0298	-0.0072	0.0148	-0.0226	-0.0217	0.1008	1.0000	
11	0.0147	0.0811	0.0201	0.0610	-0.0017	0.0306	0.0477	0.0059	0.0528	0.0354	1.0000

<i>REFERENCE NUMBER</i>	<i>VARIABLE NAME</i>
1	<i>R&D Expenditure</i>
2	<i>Process Innovation</i>
3	<i>Product Innovation</i>
4	<i>R&D Network Participation</i>
5	<i>Outside-In Innovation Approach</i>
6	<i>Inside-Out Innovation Approach</i>
7	<i>Financial Network Participation</i>
8	<i>Firm Size</i>
9	<i>Firm Age</i>
10	<i>Average Age of the Entrepreneurial Team</i>
11	<i>International Background of the Entrepreneurial Team</i>