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"Demand and supply side industrial variety and innovative start-ups: the case of Veneto region"

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Introduction

Innovative start-ups are carving out a leading role for themselves in the world's economic systems. Thanks to the radical innovations they develop, they create economic value for society (A. Mas-Tur, 2015). The ever-increasing number of innovative start-ups has required precise regulation in many countries, among which Italy certainly stands out through Decree-Law 179/2012. Certainly, a favourable ecosystem could bring benefits both in terms of ideas and access to capital (Deeb, 2019), for which a key role could be played by local actors (think of universities). In Veneto there seems to have been a continuous increase in the birth rate of innovative start-ups (Mise, 2020), in line with the Italian trend. The ICT services sector (especially B2B) is the one in which the largest share of innovative start-ups is concentrated. The literature agrees that new entrepreneurial realities accelerate the economic development of a region, especially in terms of employment (Fritsch & Mueller, 2008; Delfmann & Koster, 2016; Jesemann, 2020). How the emergence of new businesses can be fostered is still a matter of debate, but the theory of knowledge spillovers seems to provide a meaningful answer: start-ups can intercept knowledge opportunities that incumbents have not exploited (Audretsch and Feldman, 1996; Audretsch and Keilbach, 2008; Acs et al. 2009). In this case, a key role is played by industrial variety, the variety of knowledge within a geographical territory that enables the creation of new firms (Frenken et al, 2007). In particular, the literature observes that while unrelated variety (unrelated knowledge) favours the birth of innovative start-ups and reduces unemployment in a territory, related variety instead favours employment and the birth of traditional start-ups (Frenken et al., 2007; Boschma and Iammarino, 2009; Bishop, 2012; Van Oort et al., 2015; Colombelli, 2016; Antonietti and Gambarotto, 2020).

Starting from the evidence of the literature, the aim of this thesis is to examine in the Veneto regional context (at the LLMA level) the relationship between unrelated variety and the creation of innovative start-ups, however distinguishing the supply side from the demand side. This is because the traditional literature has been more oriented towards the supply side of the unrelated variety, observing its capacity to generate new innovative firms through the recombination of knowledge inputs. What we ask is whether the demand side of the unrelated variety is also important for the creation of innovative start-ups, i.e. whether there are firms that demand the products and services offered by these entrepreneurial entities.

Chapter 1: The world of start-ups

1.1 The world of YICs and start-ups

The world of young innovative companies (YICs) is gaining more and more value within the economic system. This is a fairly general concept that Scheneider et al. (2010) encapsulate in the definition "innovation active companies that are young and therefore typically of small size". Much more specific is the updated definition provided by A. Mas-Tur (2015), describing YICs as "small, young enterprises with great potential to develop innovations for commercial applications and create value for society".
As can be seen from both definitions, the term they have in common is the word "innovation". Innovation is the driving force behind YICs which, again according to Scheneider et al. (2010), differentiates this type of company from others by the development of important inventions with the aim of reaching as many "potential commercial applications" as possible. However, when we talk about commercial usage we are not only referring to the modification and upgrade of existing innovations, but to "create new products, technologies, or markets and thereby drive economic growth and innovation in the region" (A. Mas-Tur 2015).
In this context, the concept of R&D, the real discriminating element between YICs and traditional companies, is therefore fundamental. YICs are precisely companies that base their success on R&D, spending a large part of their resources on it, becoming to all intents and purposes "companies that are knowledge-intensive and research-based" (Colombelli et al., 2020).
Based on these definitions found in the literature, it is however necessary to clarify some aspects. As Scheneider et al. (2010) state, it is necessary to remember some concepts that fall within the sphere of innovation, but which do not necessarily identify with innovative start-ups.
It is indeed important to mention the New Technology Based Firms (NTBFs), then the so-called "gazelles", "the academic spinoffs" and finally the innovative start-ups.
As far as New Technology Based Firms (NTBFs) are concerned, they are defined "as SMEs in high-tech sectors" (Scheneider et al., 2010), which use technological knowledge to produce goods or services characterised by a high probability of added value. They may have a greater or lesser degree of autonomy in research and development, either by having in-house laboratories or by exploiting external research centres.
The term "gazelles", on the other hand, although no longer used in modern terminology, is intended to indicate "companies [that] are solely defined on fast growth, and need not

necessarily be small, young and innovation-active. In fact, many of the gazelles are not-innovation based" (Scheneider et al., 2010). These companies are thus characterised by fast growth which, although they are very active in high-tech sectors, derives from other competitive factors specific to the company itself.

Another important typology to remember is the “academic spinoffs”, often wrongly identified as the same thing as innovative start-ups. As set out by Ramaciotti (2012), it is true that spinoffs are high-technology enterprises, but the whole thing stems from "the exploitation of academic research" in the university environment. Thus, it may be possible that spinoffs may be reflected in the form of an innovative start-up, but the opposite is not necessarily true. Most start-ups, in fact, "do not derive their business activity from the filiation of a previous organisation" (Ramaciotti, 2012).

In the next section (1.2), the definition of innovative start-ups will be given within the context of Italian legal references, highlighting the characteristics that differentiate them from the traditional ecosystem of existing traditional companies.

1.2 Start-ups: regulatory references

The world of start-ups has progressed rapidly in recent years. Most technological innovations have come about thanks to these companies, which are now spread all over the world.
This rapid expansion has led the legislator to give them a precise definition and place in the regulatory system. The questions we will ask ourselves are: "What is an innovative startup?" and "How is an innovative startup regulated?". We will answer these two questions by referring to the Italian legal system, first of all by proposing the definition found on the website of the Ministry of Economic Development (2021): "a young company, with high technological content and strong growth potential".
This is an illustrative definition, which nevertheless encompasses what was already set out by the legislator in Decree-Law 179/2012, with particular reference to Article 25. In compliance with this legislation, we know that an innovative startup is "a capital company, also constituted in the form of a cooperative" (DL 179/2012, art. 25, paragraph 2), which meets very precise requirements that we can list as follows: (Mise, 2020)

- new or formed no more than 5 years ago
- based in Italy or in the EU, but with a production site or branch in Italy
- with an annual turnover not exceeding EUR 5 million
- is not listed on a regulated market
- does not provide for the distribution of profits
- technological innovation is the exclusive or predominant corporate purpose
- does not result from a merger, demerger or transfer of a business unit

In addition to these requirements, the startup is “innovative” if it meets at least one of the three legal requirements: (Mise, 2020)
1. R&D (and innovation) expenditure equal to "at least 15% of the greater of turnover and cost of production";
2. The staff employed have high qualifications ("at least 1/3 PhD, PhD students or researchers, or at least 2/3 with master's degree");
3. Owns or licenses a patent or software.

The Italian legal system also gives innovative startups the possibility to be classified, in addition, as innovative startups "with a social vocation" (DL 179/2012, art. 25, paragraph 4), if they operate in certain sectors of a social nature. These sectors include the most important ones such as health care, education and environmental protection. This aspect will be further explored in paragraph 1.4.2.

Below are two summary tables on constitution requirements.

OBJECTIVE REQUIREMENTS
new or formed no more than 5 years ago
based in Italy or the EU
annual turnover < 5 million euros
not listed on a regulated market
does not distribute profits
corporate purpose = technological innovation
does not result from a merger, demerger or transfer of a business unit

SUBJECTIVE REQUIREMENTS
1. R&D expenditure = at least 15% of the higher value between turnover and cost of production
2. Staff employed are highly qualified (1/3 PhD or 2/3 with master's degree)
3. Has the ownership or licence of a patent or software

Table 1.2.1 & 1.2.2: Objective and subjective constitution requirements (Source: author's elaboration from Mise, 2020)

Always according to Italian law, the start-up ecosystem is the recipient of a series of benefits, especially in the fiscal and financial fields. These benefits were already formalised in D.L. 179/2012 (art. 26-31) and then further strengthened in the so-called "Decreto Rilancio", approved in 2020. All facilities are available to start-ups that have not been registered for more than five years in the special register of companies.

As described in the national strategy for start-ups and innovative SMEs (Mise, 2020), the Italian government wanted to encourage the creation of a start-up ecosystem at national level by supporting and sustaining start-ups throughout their life cycle. In fact, the benefits can be summarised as follows: those relating to "the start-up of the activity", those concerning the "access to subsidised loans and incentives for investment in venture capital" and those concerning the subsequent consolidation phase, "even in the event of failure of the activity" (Mise, 2020).

Among the various facilities (Mise, 2020), the possibility of setting up a company in the form of a limited liability company (s.r.l.) free of charge, digitally and without having to go to a notary, stands out. Other interesting facilities include: "tax incentives for investing in the capital of innovative start-ups", "free and simplified access to the Guarantee Fund for SMEs", "raising capital through equity crowdfunding campaigns" and the Fail Fast, a simplified procedure in case of business failure (Mise, 2020).

Below is a summary table with the list of facilities in favour of innovative start-ups in Italy.

LIST OF FACILITIES IN THE ITALIAN SYSTEM
Digital and free startup constitution
Tax incentives for investing in the capital of innovative start-ups
Smart & start Italia (subsidised funding for innovative start-ups located in Italy)
Seamless transformation into innovative SMEs
Exemption from chamber fees and stamp duties
Raising capital through equity crowdfunding campaigns
Internationalisation services for companies (ICE)
Derogations from ordinary company law
Rules on flexible work
Extension of the deadline for covering losses
Derogation from the rules on shell companies and companies with systematic losses
Remuneration through equity instruments
Exemption from the requirement of conformity for VAT credit compensation
Fail Fast (simplified procedures in case of business failure)

Table 1.2.3: List of concessions in favour of innovative start-ups in Italy (Source: author's elaboration from the MISE website, 2020)

The last important point of this paragraph concerns the transition from startup to innovative SME status. Always following the Italian law and the document on the national strategy for startups and innovative SMEs (Mise, 2019) we give a concise explanation to describe the transition.

There are two reasons for this:

1) The maximum period of 5 years to maintain the status of innovative startup registered in the special section of the business register has ended;

2) The innovative startup exceeds the turnover threshold of EUR 5 million;

It is important to remember that the transition from innovative startup to innovative SME follows a sequential logic, but must be expressly requested by the company's owner.

Otherwise, the innovative startup will still be registered in the ordinary section of the commercial register.
In both cases 1) and 2) above, however, we are dealing with "mature" innovative start-ups that are probably about to enter a scale-up phase.
In this regard, the Italian State wanted to provide “a very similar set of policy tools” (Mise, 2019) to that provided for innovative start-ups.

1.3 The life cycle of start-ups

Just like any other business, start-ups go through several stages in their life cycle. It is important to list them for two reasons: to better understand what path the innovative idea has to go through to become usable to the public and what are the funding stages to get the money needed for development.

Although there is no single version on how to identify the life cycle of start-ups, in this paragraph we will try to give a perspective that unites different points of view.

The article by J. Stayton and V. Mangematin (2016), who, referring to the creation of new venture companies, identify the life cycle in six different phases, is a good example. Each phase of the life cycle is equal to a funding phase and most importantly describes "how entrepreneurs are assembling resources" (Stayton et al., 2016). From this article a detailed literature on the so-called "startup time" emerges, starting from the first models brought by Galbraith (1982) and Gartner (1985) up to the present day where the most commonly used model is the one widely described in regulations and accepted by venture capital firms.

Below is a table of the most important literature on the life cycle of new venture creation (which for us also equals startups).

Source	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
(Galbraith 1982) Journal	Proof of principle	Prototype	Start-up	Natural growth	Strategic maneuvering	
(Gartner 1985) Journal	Identification of business opportunity	Accumulation of resources	Marketing products and services	Production	Organization building	Response to gov't and society
(Adizes 1988) Management book	Courtship	Infancy	Go-go (growth stage)	Adolescence		
(Bhave 1994) Journal	Opportunity	Technology setup and organization creation	Exchange			
(Reynolds and White 1997) Scholarly book	Conception	Gestation	Infancy	Adolescence		
(Evers et al. 2014) Scholarly book	Inception	Growth	Expansion	Maturity		
(Vohora et al. 2004) Journal	Research	Opportunity framing	Pre-organization	Re-orientation	Sustainable returns	
(Hisrich et al. 2010) Textbook	Identifying and evaluating opportunity	Writing business plan	Determining and filling resource gap	Managing enterprise		
VC-defined Normative, used by venture capital firms	Seed or concept—family and friend funded	Startup—angel funded	First (market penetration) VC funded	Second (profitability) VC funded	Third (mezzanine) VC or specialized funds	Fourth (near harvest) M&A or IPO

Figure 1.3.1: Literature on the stages of new venture creation (Source: Stayton et al., 2016, p.379)

As shown in the table, our analysis will focus on the last row, identifying the six phases as follows: seed or concept, start-up, market penetration, profitability, mezzanine and near harvest. In order to propose a detailed analysis, it is necessary to distinguish these phases into two macro-moments:

1) pre-seed and seed stage;

2) early and growth stage.

As reported by Novoa (2014) and restated here, we can state that:

- Seed and startup = pre-seed and seed stage;
- Market penetration, profitability, mezzanine and near harvest = early and growth stage.

We then provide a detailed analysis of each of these development phases.

As illustrated in Figure 1.3.2, the pre-seed and seed phases are the early stages, generally the ones in which the start-up encounters the most difficulties in raising the necessary capital and resources. Novoa (2014) identifies this phase as one in which "you have an idea, maybe a working prototype and are looking for funding that will allow you to focus on your project full time". There are three sources of funding in this phase (Novoa, 2014):

- FFF (Fools, friends and family) - Business angels - Accelerators/Incubators

FFFs are the ones who mostly support the project in the early stage, however having the disadvantage that they cannot contribute large sums of money. Business Angels (more present in the seed phase), on the other hand, usually fall into the category of investors who decide to bet their personal money on high-risk ventures, ensuring, in case of success of the start-up, large sums of money from the exit. They are defined by Curry et al. (2021) as "high-net-worth individuals who invest in early stage companies".

Accelerators and incubators, on the other hand, have become a well-established reality on the international scene, although their support is also manifested in the growth stage. The job of the accelerators is precisely to provide "services to support the birth and development of innovative start-ups" (Mise, 2020) by having "facilities, including real estate, suitable for hosting innovative start-ups, such as spaces reserved for installing testing, verification or research equipment". Precisely because these accelerators provide essential services for growth during the early stages, they require in return to intervene in the shareholder structure by appropriating a 5/10% share of the share capital (Novoa, 2014).

However, a small distinction has to be made between the pre-seed and the seed phase: while the pre-seed phase, also referred to as "bootstrapping" (Curry et. al., 2021), aims to focus more on the development of the idea, the seed phase, on the other hand, searches for the necessary funding to find a "product-market fit" model (Novoa, 2014).

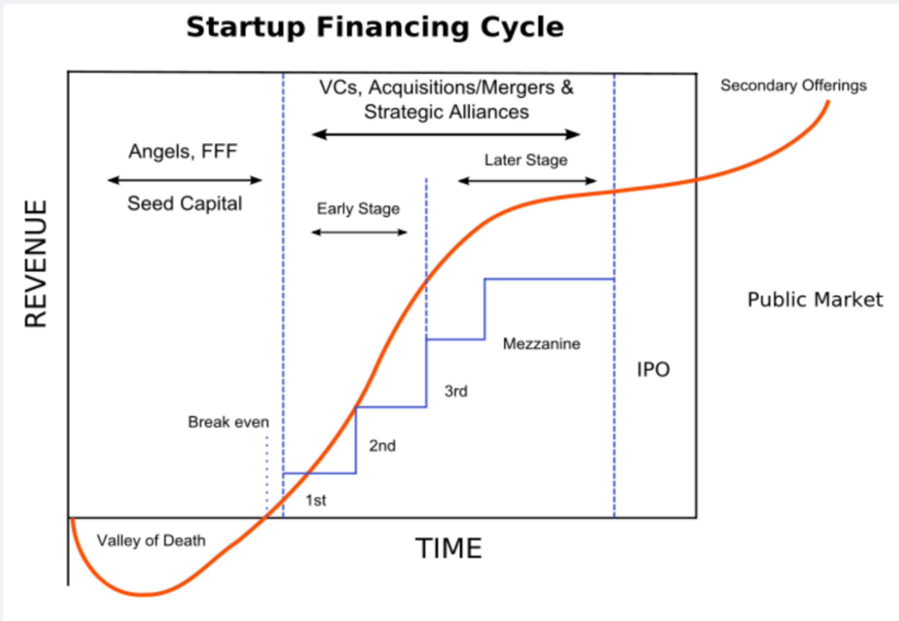

Figure 1.3.2: Startup Financing Cycle (Source: Novoa, 2014)

The seed phase is crucial in the life cycle of start-ups. Being able to find the right sources of funding allows them to reach the “break-even point” necessary to access and penetrate the market. As described above, this phase sees the participation of business angels and the entry of "early stage Venture Capital firms" (Novoa, 2014). These venture capital firms will then be present mainly in later funding rounds, when start-ups are in the early and growth stage (Stayton et al., 2016).

However, the wide diffusion of start-ups and the need to easily build a network between entrepreneurs and investors (before the IPO phase) led to the emergence of a new system, Crowdfunding.

Novoa (2014) essentially recognises two widely used crowdfunding systems for the startup ecosystem: reward-based (1) and equity crowdfunding (2). In case (1), users who invest in a project through these platforms do not receive equity shares in return, but only a reward (material most of the time). Case (2), on the other hand, is very common in those start-ups that are preparing to reach the "break-even point", giving users (who coincide with investors in this case) a shareholding in the company, becoming shareholders in all respects.

As explained in the "National strategy for innovative startups and SMEs" (Mise, 2019), the Italian legal system was the first in the world to introduce "ad hoc legislation" on equity crowdfunding through Consob Regulation no. 18592/2013.

Although it may seem like a simplified process to raise capital through the entry of new shareholders, equity crowdfunding is a far from easy procedure for company founders.
A summary table extrapolated from the article "Start-ups, entrepreneurial networks and equity crowdfunding: A processual perspective" by R. Brown et al. (2019), shows us the activities involved in the equity crowdfunding process.

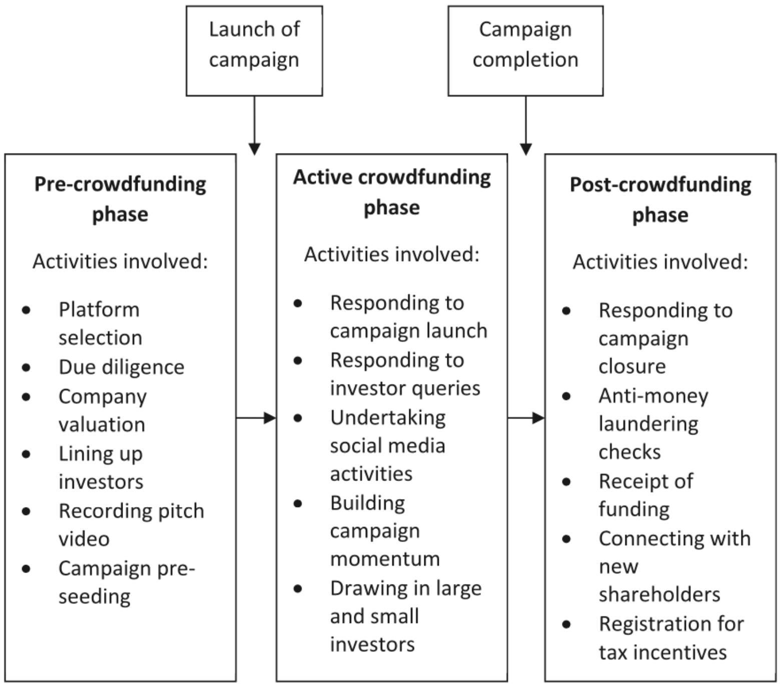

Figure 1.3.3: The equity crowdfunding process (Source: R.Brown et al., 2019)

Start-ups that make it through the "Valley of Death" will then be ready for subsequent funding rounds. As explained by Curry et. al., (2021) the subsequent funding rounds can be summarised as follows: "Series A, B, C and D funding rounds, primarily led by venture capital firms, which invest tens to hundreds of millions of dollars into companies". Series A and B funding rounds are related to market penetration and profitability respectively, are still part of the early stage and lead venture capital firms to invest between 5 and 10 million euros (Novoa, 2014). This investment is clearly corresponded to very high shares of share capital that sometimes turn into actual acquisitions. The last phase, on the other hand, relates to rounds C and D, where, after passing through a scaling phase, start-ups are in the growth or mezzanine phase, preparing themselves as best they can for an initial public offering (IPO).
"A startup may decide to become a public company and open itself up to outside money via an IPO, an acquisition by a special purpose acquisition company (SPAC) or a direct listing on a stock exchange" (Curry et. al., 2021).

1.4 The start-up ecosystem

1.4.1 The start-up ecosystem in the world

As seen extensively in the previous section, the survival of startups is largely linked to funding sources. For this reason, before analysing the statistics on the world's most important startup ecosystems, it is necessary to give an overview of the situation on Global VC Funding in 2019. As exposed by Kpmg (2020) in the Global Analysis of Venture Funding, Venture Capital investments in 2019 remained largely stable compared to 2018, but still significantly higher than those seen in previous years. We briefly describe VC investments in the world's three most interesting areas in this regard (Kpmg, 2020):
- The US continues to lead the global situation, extending its reach outside Silicon Valley;
- Europe, although far behind the US numbers, has its own record of VC investment;
- Asia was down 42% (compared to 2018), due to uncertainties on the Hong Kong stock exchange and a lack of mega deals in China.

The most important result, however, is in the number of "unicorn" births in 2019 (more than 110), i.e. those companies valued at over €1 billion (Kpmg, 2020). The US leads the way with a total of 71 (recalling major companies such as Duolingo and Next Insurance), followed by Europe with a total of 18 (including Vinted and Glovo).

And what exactly is a startup ecosystem? To give a definition we cross an article published in Forbes ("How To Build A Startup Ecosystem", Deeb, 2019) with this image taken from Startup Commons (2013).

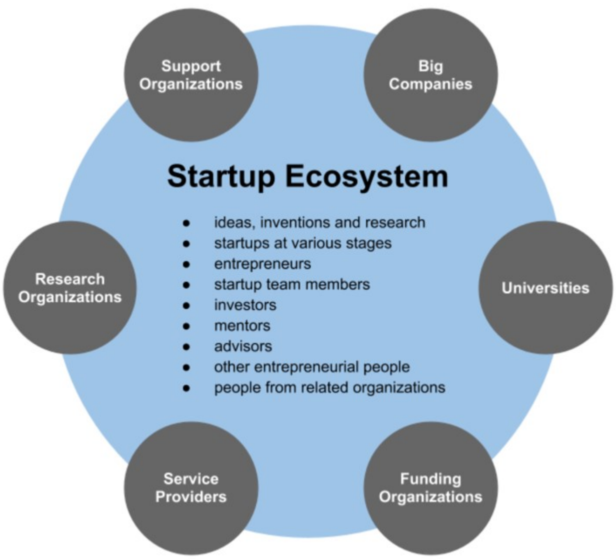

Figure 1.4.1: Startup Ecosystem (Source: Startup Commons, 2013)

As shown in Figure 1.4.1, the startup ecosystem can be defined as the set of actors that interact throughout the startup life cycle (from ideas to a possible IPO). As Deeb (2019) briefly explains, key actors are divided into those closely related to entrepreneurship (such as the start-ups themselves, entrepreneurs, mentors and team members) and the list of organisations related with startup activities (such as universities, venture capital firms, service providers of consulting or coworking spaces etc.). These actors play a key role in the entrepreneurial development of start-ups, precisely because their set represents "the most important ingredients" in the "Access to Great Ideas, Access to Talent, Access to Capital and Access to Customers" (Deeb, 2019).

Having said that, we now turn to the detailed analysis of the global situation on the start-up economy, considering that it is done by ranking the various ecosystems of the world. The statistics for this analysis are conducted with data from Startup Genome (2020) and Atomico (2020).

It must first be said that the economy generated by start-ups globally creates "almost $3 trillion in value, a figure on par with the GDP of a G7 economy" (Startup Genome, 2020). Leaving aside the downturn due to Covid-19, 2019 was indeed a record year for venture capital investment, standing at just over €300 billion (Kpmg, 2020). Then there is the fact that the global economy is increasingly based on technology, just think that "seven of the world's top 10 largest companies are in technology" (Startup Genome, 2020). In spite of this great spread of investments, however, the great problem emerges of the concentration of value produced only in certain ecosystems: almost 75% is concentrated in the top 10 cities of the global ranking (Startup Genome, 2020).

Figure 1.4.2 shows us the ranking (updated December 2019) of the world's top ecosystems of start-ups. For the sake of convenience we only show the top ten positions. The ranking is essentially based on six factors plus one, listed as follows: the performance index, the funding index, market reach, connectedness, talent and knowledge. To these should be added the growth index, which is important for understanding future growth prospects. The results show Silicon Valley firmly in first place, followed by New York and London (tied), Beijing, Boston, Tel Aviv and Los Angeles (tied), Shanghai, Seattle and Stockholm. What is new, however, are the positions after the top ten. Tokyo, Seoul, Shenzen and Hangzhou are part of the emergence of new “R&D powerhouses: those ecosystems growing largely building upon their strengths on research and patent production” (Startup Genome, 2020).

Figure 1.4.2: Global Startup Ecosystem Rankings (Source: Startup Genome, 2020)

In contrast to VC investments, start-ups ecosystems saw significant growth in Asia in 2019, with a share of around 30% of the global top 100 (Startup Genome, 2020). Europe, on the other hand, appears to be struggling, with only Stockholm (after London, no longer in the EU) making the top-ten list, with significant growth in Amsterdam and a bad drop in Paris and Berlin. Berlin, one of Europe's most important hubs in 2018, loses as many as six positions, experiencing problems especially in market reach and knowledge index. Very interesting, however, is the case of Amsterdam:

The ecosystem connected to the Dutch capital is ranked among the absolute top on the Connectedness Index, thanks to its extraordinary logistics and infrastructure organisation. "The country was ranked number one in DHL's Global Connectedness Index" (Startup Genome, 2020).
Let us now look in more detail at the general situation in Europe in 2019.

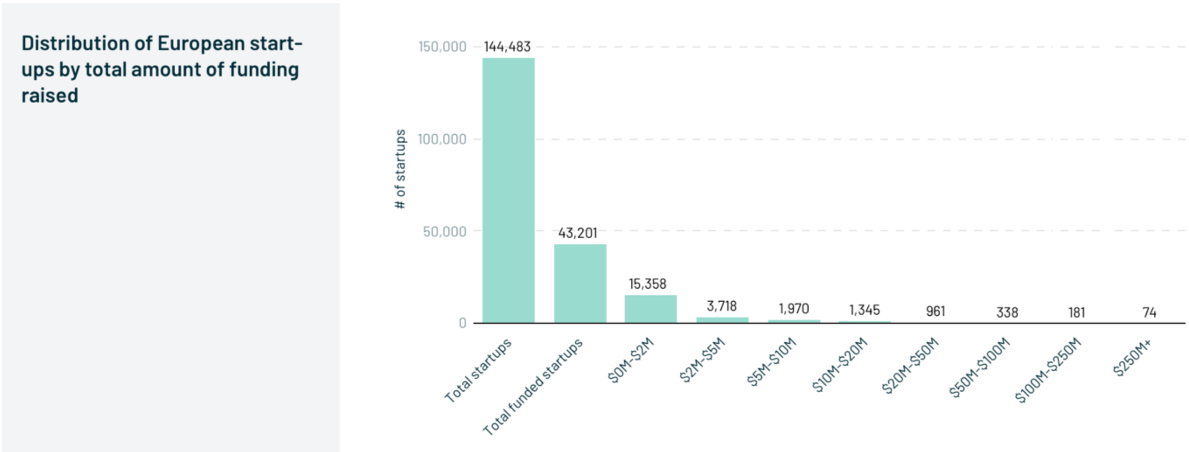

Figure 1.4.3: Distribution of European start-ups by total amount of funding raised (Source: Atomico, 2020)

The number of start-ups in Europe exceeds 140,000, with at least one in three managing to enter at least "one registered funding round" (Atomico, 2020). The problem emerges as one moves forward in funding rounds after the first one, thus attesting to a widespread difficulty in obtaining significant investments to launch on the market. There are only 15,000 start-ups "that have raised between $0-2M", a number that drops even further in the $2-5M range (3,718), down to "only 74 that have raised more than $250M".
It would be easy to conclude that one of the main problems appears to be access to investment rounds, but the spectrum of analysis is certainly wider than that seen within this analysis. In the following chapters we will look at other factors that influence the emergence of start-ups in certain geographical clusters rather than in others.
In the next paragraph, indeed, the analysis will focus on the ecosystem of start-ups in Italy, touching on general aspects and statistics very similar to those illustrated in this paragraph.

1.4.2 The start-ups ecosystem in Italy

After observing the trends related to the ecosystems of start-ups in the world, we descend specifically to analyse the data related to Italy. The analysis is conducted through the data processed by Infocamere (Cruscotto di Indicatori Statistici, 2020) and the Ministry of Economic Development (2020) and are related to the year 2019.
Let's start with some numbers first: innovative start-ups stood at 10,893 at the end of 2019, recording a positive change of +12% compared to 2018 (Infocamere, 2020).
Looking at Figure 1.4.4, the number of innovative start-ups has been on an increasing trend since 2013. This can be attributed to the introduction of numerous facilities to support these companies, especially the possibility of drawing on the guarantee fund for innovative SMEs and numerous loans made available by the state (Mise, 2020).
Of the entire ecosystem of capital companies in Italy, almost 3% are registered as innovative start-ups, without taking into account that start-up status lasts for a maximum of five years, so innovative SMEs (formerly start-ups) are not considered in the calculation.

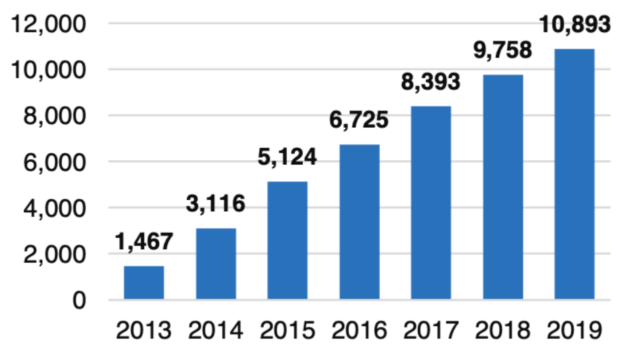

Figure 1.4.4: Number of innovative start-ups 2013-2019 (Source: Mise, 2020, p.19)

Share capital is a very important aspect to take into account. Considering that almost all start-ups are established as limited liability companies, the average capital is around 53 thousand euros (Infocamere, 2020), with a total turnover and production of 1.2 billion euros (Mise, 2020).
The analysis in this section therefore focuses on the following aspects:
- distribution by economic sector (1)
- distribution by type of enterprise (2)
- regional distribution and density (3)
- the number of employees and partners (4)
- the value of production and assets (5)

- the number of profitable and loss-making companies (6)

Starting from the distribution by economic sector (1), it can be observed that the Italian ecosystem of start-ups prefers to focus mainly on B2B services, i.e. those aimed at businesses (74%). Within this category, a significant share is made up of ICT services (47%), confirming what also emerged from the interviews carried out by Mise (2020): "43% of innovative start-ups in the business services sector stated that they operate with 4.0 technologies (ICT, telecommunications, artificial intelligence and green economy)". (Mise, 2020). To this general picture must be added the statistics on innovative start-ups that deal with R&D, about 14% (Mise, 2020), although in this field Italy is not keeping up with the large Asian countries that have entered the world's top rankings of innovative ecosystems (Startup Genome, 2020).

Settori di attività economica	n°	%
AGRICOLTURA	**79**	**0,8%**
INDUSTRIA E ARTIGIANATO	**1.787**	**16,5%**
Fornitura di energia elettrica, gas, vapore e aria condizionata	**83**	**0,8%**
Fornitura di acqua; reti fognarie, attività di gestione dei rifiuti e risanamento	**36**	**0,3%**
Costruzioni	**97**	**0,9%**
COMMERCIO ALL'INGROSSO E AL DETTAGLIO	**370**	**3,5%**
SERVIZI ALLE IMPRESE	**8.112**	**74,4%**
Servizi di informazione e comunicazione	5.165	47,4%
Attività professionali, scientifiche e tecniche	2.546	23,4%
Istruzione	102	0,9%
Sanità e assistenza sociale	74	0,7%
Attività artistiche, sportive, intrattenimento	56	0,5%
Attività servizi di alloggio e ristorazione	59	0,5%
Trasporto e magazzinaggio	30	0,3%
Attività finanziarie e assicurative	22	0,2%
Attività immobiliari	23	0,2%
Altro	35	0,3%
TURISMO	**299**	**2,8%**
Non specificato	**30**	**0,3%**
Totale	**10.893**	**100%**

Figure 1.4.5: Distribution of innovative startups by sectors of economic activity (Source: Mise, 2020, p.24-25)

With regard to the distribution by type of enterprise (2), it is worth remembering three interesting statistics: start-ups with a female presence, "in which at least one woman holds an administrative position or owns a share of the company" account for about 43%, those with a youth presence for 44% and those with a foreign presence for 13% (Infocamere, 2020). Companies with a foreign presence have had a good increase in recent years, mainly due to a programme implemented by the Italian state in collaboration with the EU, the Italy Startup Visa. This programme allows, through "the development of special, simplified and accelerated procedures [...] the granting of entry visas in favour of innovative entrepreneurs from all over the world" (Mise, 2017, Italia Startup Visa).

We now turn to the analysis of regional distribution and density (3).

From the geographical distribution (Figure 1.4.6), one can immediately see the gap between the largest and the smallest regions in terms of number of inhabitants. The gap is clearly the result of the considerable difference in absolute numbers in relation to the number of inhabitants.

More specifically, Lombardy leads the way as the region with the highest number of start-ups in Italy, with around 27% of the national total. This is followed by Lazio, with about 11%, Emilia-Romagna (8.6%), Campania and Veneto with just over 8%. If we then look at the provincial distribution, the absolute numbers are all in favour of the largest and most industrialised cities in Italy: Milan is in the lead with about 19% of the number of start-ups out of the national total, followed by Rome with 10%. The smallest regions by number of inhabitants close this ranking, namely Basilicata, Molise and Valle d'Aosta (Infocamere, 2020).

Classifica	Regione	N. startup innovative 4° trim 2019	% rapporto startup innovative sul totale nazionale
1	LOMBARDIA	2928	26,91
2	LAZIO	1227	11,28
3	EMILIA-ROMAGNA	931	8,56
4	CAMPANIA	896	8,23
5	VENETO	889	8,17
6	PIEMONTE	610	5,61
7	SICILIA	514	4,72
8	PUGLIA	429	3,94
9	TOSCANA	423	3,89
10	MARCHE	343	3,15
11	TRENTINO-ALTO ADIGE	266	2,44
12	CALABRIA	265	2,44
13	FRIULI-VENEZIA GIULIA	231	2,12
14	ABRUZZO	215	1,98
15	LIGURIA	190	1,75
16	UMBRIA	189	1,74
17	SARDEGNA	130	1,19
18	BASILICATA	104	0,96
19	MOLISE	80	0,74
20	VALLE D'AOSTA	22	0,20

Figure 1.4.6: Regional distribution - Ranking of the Italian regions (Source: Infocamere, 2020, p.12)

The number of employees and partners (4) is the fourth point in the Italian analysis of the start-ups ecosystem.

In order to better understand this point, a comparison was made between innovative start-ups and other types of limited companies established less than five years ago. Two significant aspects emerge from the tables of Infocamere (2020): the average number of employees in each innovative start-up is 3.2, while the other types of limited companies have an average of

5.8 employees. Thus, it is more difficult for start-ups to hire new staff, especially since financial resources are scarce in the early stages of their life. The same cannot be said about the number of partners: innovative start-ups have a larger average number of partners than other joint-stock companies. The numbers are in fact 4.7 against 2.1 (Infocamere, 2020). This is probably the result of a business activity (that of the start-up) in which the partners are more directly involved (Infocamere, 2020), unlike other joint stock companies in which there is a greater separation between administration and productive work.
The value of production and assets (5) should also be analysed according to their average. In fact, start-ups have an average production performance of 175 thousand Euros, against new companies that have 350 thousand Euros, twice as much (Infocamere, 2020). The most interesting aspect is that of average assets, where start-ups have a value of 311 thousand euros compared to 800 thousand euros of other companies; however, they have a "high degree of fixed assets on net assets: in 2018 the ratio is 25.2%, i.e. 7 times higher than the average ratio recorded for other new companies, which is 3.7%" (Infocamere, 2020).
The last point in this analysis is the number of profit and loss-making companies (6):

Anno bilancio 2018	Società in utile		Società in perdita		% Totale	Totale
	% sul totale	Valore della produzione totale	% sul totale	Valore della produzione totale		Valore della produzione totale
Startup innovative	47,86	835.970.844	52,14	331.969.972	100,00	1.167.940.816
Nuove società di capitali	68,11	55.290.996.169	31,89	11.129.516.729	100,00	66.420.512.898

Figure 1.4.7: Percentage number of companies in profit and loss (Source: Infocamere, 2020, p.21)

As shown in Figure 1.4.7, innovative start-ups in Italy register higher losses than profits (on average). We are talking about 47.8% against 52.1%. This negative difference is not evident in the case of new joint-stock companies, where about 68% record a profit for the year (Infocamere, 2020). This rather negative trend for start-ups exists for a specific reason, namely the difficulty for those who produce highly innovative and technological products or services to position themselves immediately on the market. We are also aware of the longer research and development time needed to create a high-tech prototype. This means that start-ups do not even reach the market for the first few years, if at all.

1.4.3 The start-ups ecosystem in Veneto

In this paragraph, an in-depth analysis of the ecosystem of innovative start-ups in the Veneto region has been carried out. It is essential to know these statistics in order to better understand what will be presented in the following chapters.

The number of start-ups present in Veneto at the end of 2019 is 889, about 8.17% of the national total (Infocamere, 2020). Veneto occupies fifth place in the national ranking, behind Lombardy, Lazio, Emilia-Romagna and Campania. If we look at the provincial distribution at national level, Veneto brings three provinces out of seven in the top 20. The provinces of Padua, Verona and Treviso are, in fact, respectively in 6th, 10th and 15th place nationally (Infocamere, 2020).

With this overview in mind, let's now see how start-ups in Veneto have benefited from the most important facilities provided by the State.

As emerges from the “Annual Report to Parliament” (Mise, 2020), many start-ups in Veneto have taken advantage of the new online incorporation procedure, drastically reducing the costs and burdens of starting a business. Recall that this facilitative measure was first introduced in 2016, giving the possibility to incorporate online and for free, rather than in the presence of a notary. In the national ranking concerning the "geographical distribution of the new online incorporation method", Veneto ranks second, with 308 start-ups and a percentage of the national total of 11.1% (Mise, 2020). The "incidence of the new incorporation mode with respect to the total number of incorporated start-ups" is 37.4%, which means that more than 1 start-up out of 3 in Veneto preferred the use of this mode with respect to the traditional one.

Another important aspect is that of start-ups receiving subsidised investments (Mise, 2020). In 2018, there were 1510 innovative start-ups in Italy that "received from natural and legal persons at least one subsidised investment in their venture capital" (Mise, 2020). Veneto ranks as the second most funded region in Italy, representing almost 10% of the investments allocated to innovative start-ups. This testifies to a good propensity on the part of Veneto companies to take advantage of external capital, in this case by making the most of subsidies provided by the State.

Another measure that has been very successful and supportive for Veneto start-ups is access to the Guarantee Fund for SMEs, i.e., the "public fund that facilitates access to credit for SMEs by granting guarantees on bank loans", covering up to a maximum of 80% of the loans obtained (Le imprese innovative e il Fondo di Garanzia per le PMI, Mise, 2020). The report also shows that Veneto ranks third both in terms of total amounts financed (EUR 113 million) and total operations (648) (Mise, 2020).

Let us now turn to a more detailed analysis of the following aspects:

- Legal nature (1)
- Provincial distribution (2)
- Sectoral and activity distribution (3)
- Distribution on production and capital values (4)
- Number of employees (5)
- Innovation requirements (6)

The statistics are a personal elaboration, using the database on "registroimprese.it" (Chamber of Commerce, 2020), data as of 2019.

Starting from the legal nature (1), almost 100% of innovative start-ups in Veneto are established as limited liability companies.

It is interesting to note, however, the provincial distribution (2):

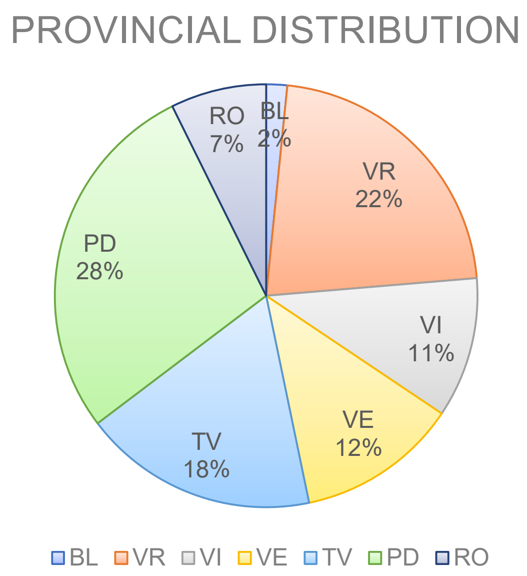

Figure 1.4.8: Provincial distribution of innovative start-ups in Veneto (Source: author's elaboration on data contained in "registroimprese.it", 2020)

As shown in Figure 1.4.8, most start-ups are concentrated in the province of Padua (28%), followed by Verona (22%).

Padua and Verona are also the two cities with the highest number of start-ups established (145 and 98), showing themselves as real clusters independent from the rest of the region. The factors that contribute to the birth and concentration of start-ups in a given place will be investigated in the study conducted in Chapter 3.

The sectoral and activity distribution (3) is the most important point of this analysis.

From Figure 1.4.9 it can be noticed that the most common business object among start-ups in Veneto is related to the service sector (65.4%) and to the industry/craft sector (30.5%). These statistics are more or less in line with the national ones, underlining the growing tendency of innovation to focus on services (especially business services).
More specifically, the most common activities are those falling under codes J62 (software production, computer consultancy) and M72 (scientific research and development). Both J62 and M72 are part of the service sector, accounting for 49% and 21% respectively. These two activities also have the most relevant weight on the total number of start-ups established in Veneto, being 32% and 13.7%.

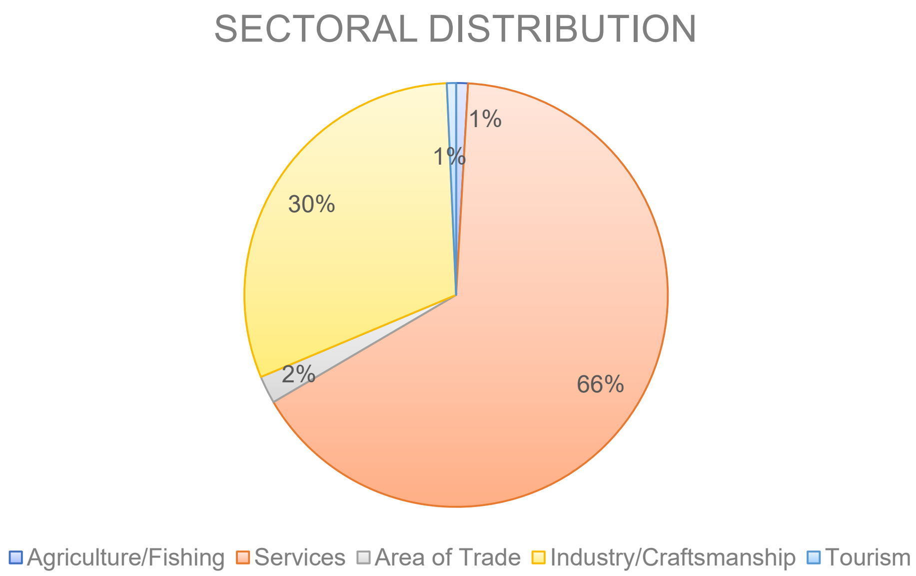

Figure 1.4.9: Sectoral distribution of innovative start-ups in Veneto (Source: author's elaboration on data contained in "registroimprese.it", 2020)

Let us now turn to the distribution over production and capital values (4).
The production values of innovative start-ups in Veneto follow a regular trend that is typical for this type of firm. In Figure 1.4.10 we can clearly see that most start-ups have production values between 0-100,000€ and that, as the turnover increases, the number of firms decreases. In percentage terms we can therefore summarise in this way: between 0-100,000€ are concentrated 43% of the enterprises, between 100,001-500. 000€ 24% and they decrease until the end of the series.
In the distribution of capital classes, on the other hand, it is simply worth mentioning that start-ups prefer to deploy capital between €1,000-50,000.

In the €5,000-10,000 range, 42% of them are located, confirming that companies of this type (in their first 5 years of activity) do not have sufficient capital resources to carry out large operations.

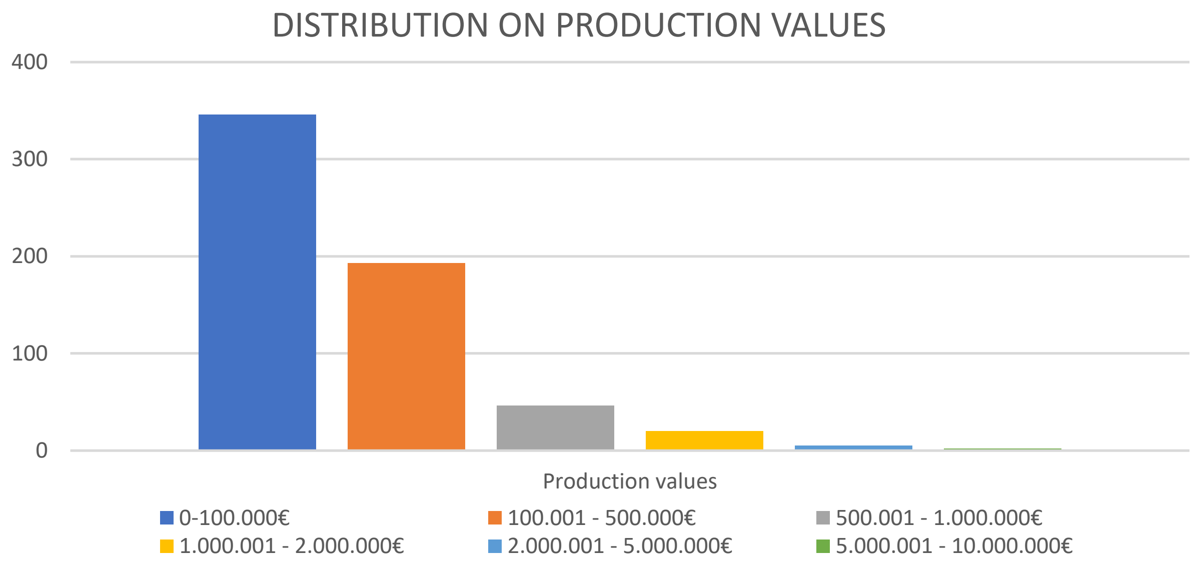

Figure 1.4.10: Distribution on production values of innovative start-ups in Veneto (Source: author's elaboration on data contained in "registroimprese.it", 2020)

As far as the number of employees (5) is concerned, there are no precise estimates, except that 34% of the start-ups in Veneto fall within the range of 0-4 employees. This trend is in line with what has already been explained in paragraph 1.4.2, so the most plausible explanation is that the partners of these companies are more directly involved in the business activities.
The innovation requirements (6) are the last point of this analysis on the ecosystem of start-ups in Veneto. As already stated in section 1.2 on regulatory references, in addition to the objective requirements, a start-up is innovative if it meets at least one of the three subjective requirements imposed by law: expenditure on R&D, personnel employed and patent or software licensing (Mise, 2020).
The start-ups in Veneto are divided as follows: 493 (61%) for the first requirement, 202 (25%) for the second and 184 (23%) for the third. There are also some that meet two requirements at the same time or even all three. In the latter case there are exactly 20, i.e. only 2.4% of the total considered.
As observed in the previous paragraphs, the birth of start-ups in Italy is concentrated in some geographical regions rather than in others. The explanations at the root of this phenomenon are the subject of debate in the literature of scholars, who have tried to identify which local factors may influence the birth of start-ups.

In the next chapter we will give space to the theoretical background that will lead us to the subject matter of this thesis, the analysis on the demand and supply side with reference to industrial variety and innovative start-ups (with the case of Veneto region).

Chapter 2: Background literature: knowledge industry variety and innovation

2.1 Innovation and start-ups: direct effects on regional development and employment

The emergence of new enterprises has important repercussions on the economic system of a region. There is a great deal of literature on the subject and what we intend to do in this chapter is to review the most important sources.

This section first looks at the effects of innovation on economic development and then at the impact that start-ups have had or are having on it.

The first contribution we introduce is that of Solow (1956), considered a milestone in the theories of a country's economic growth.

One question that has always been asked is why some countries (or regions) grow more than others and at a faster rate. Solow (1956) believes that economic growth is actually driven by technological progress, a key factor in explaining productivity growth. Technological progress, in fact, results in a substantial improvement in the conditions of the input mix, which in turn leads to an increase in productivity (i.e. an increase in output per labour hour). The role of technological progress, Solow (1956) explains, also acts as a compensation for diminishing returns on capital. Despite this important contribution, however, the rate of progress is regarded as an exogenous variable, i.e. independent of any other economic variable.

The evolution of Solow's model took place in the following decades, proposing instead technological change no longer as an exogenous variable, but as an endogenous one (Romer, 1990).

Following Romer's theory (1990), economic growth is always sustained by technical progress, but no longer considered as external, but directly related to the other variables of the economy. A fundamental role can be played at this point by the state which, through appropriate economic policies, can promote innovation and, consequently, the economic growth of the country. One of the most important examples of how technological progress can be generated is through "learning by doing" (Arrow, 1962), which is essentially based on learning through continuous experience at work.

Grossmann and Helpmann (1991), as well as Romer (1990), link economic growth to the number of innovations, likewise proposing technological change as an endogenous variable.

They also argue that technological progress is a key element in improving the productivity of capital, since increasing it will result in so-called "capital accumulation".
Both Romer (1990) and Grossman and Helpman (1991) agree that economic growth comes through innovation and technological progress.
They also question how then innovation can be promoted, recognising investment in R&D as the main channel.
Once we have understood the positive relationship between investment in R&D and innovation, which results in economic growth and development, it is natural to ask ourselves which are the channels for the diffusion of technology.
In the endless literature we know, R&D laboratories (both public and private) are an example of such a channel of knowledge diffusion, but it is necessary that economic growth is supported by the entry of entrepreneurs, the real force of the "creative destruction" Schumpeter (1942) talks about.
From what has just been said, it can be deduced that entrepreneurs play a fundamental role, particularly in the creation of companies that make innovation their core business. This type of enterprise, as we shall see, is called innovative start-ups and represents a mechanism for the diffusion of innovation.
The question that we ask in this thesis concerns the conditions that attract the generation of innovative start-ups in one geographical space rather than another and how the presence of spatially close channels can affect the rate of creation of these start-ups.

Author(s)	**Technological progress**	**Impact of technological progress on economic growth**
Solow (1956)	Technological progress exogenous variable	+ Technological progress; + productivity (output x working hours)
Romer (1990) Grossman & Helpman (1991)	Technological progress endogenous variable	+ Technological progress; + Economic growth Capital accumulation

Table 2.1.1: Impact of technological progress on economic growth: exogenous and endogenous models (Source: author's elaboration)

2.1.1 Impact of new businesses (or start-ups) on employment: relevant literature

The presence of start-ups in a territory is very relevant for the effects they generate.
In fact, we can distinguish two types of effects: the direct effect, whereby they generate regional growth and employment (in net terms) and the indirect effect, whereby they generate spillovers due to innovative activity (which turn into interactions with other firms).
In this section we intend to give an overview of the direct effects of new businesses (or start-ups) on employment.
The first important contribution is by Fritsch and Weyh (2006) who, using a panel of West German data from 1984-2002, look at the direct employment effect of new businesses. The results show that first of all these ecosystems are characterised by an increasing trend in employment. However, "typically after one or two years, employment in the cohort tends to stagnate or decline and is quite likely to fall considerably below the initial level after a number of years" (Fritsch and Weyh, 2006), although this trend needs to be contextualised to the sector referred to.
In general, Fritsch and Weyh (2006) argue that employment paralysis is a natural effect in the start-ups ecosystem; in fact, start-ups did not have a very high survival rate (in the period 1984-2002 less than 5 years) and did not become large enough to imply a sustained growth in employment. The birth of start-ups, moreover, has relevant effects also on the incumbents, sometimes driven out of the market if they are not ready enough to react to the innovations brought by new businesses.
In conclusion, Fritsch and Weyh (2006) argue that the effects of the formation of new start-ups on employment fall mainly in the service sector rather than in the manufacturing sector, and this is most pronounced when accompanied by state policies that especially favour innovation and the variety of knowledge.
Fritsch and Mueller (2008) produce a paper that is the natural evolution of the one in the previous point. The analysis here still focuses on regional development and employment, but it concentrates on the differences between regions across Germany and the importance of environmental factors in amplifying or restricting the effects of start-ups on territories.
What emerges from the results is that "the establishment of new firms in a region can have both positive and negative effects on the development of that region" (Fritsch and Mueller, 2008). The findings are very similar to those of Fritsch and Weyh (2006), i.e. the natural stagnation that employment sees after an initial period of growth. However, a central role is played by the incumbents in the regions: the more competitive and innovative they are, the more average productivity in the region increases, driving positive employment effects.

Conversely, if the incumbents in the regions are weak and uninnovative, the creation of new start-ups will drive them out of the market after a few years, leading to a sharp decline in employment in the region. Policy should therefore be concerned with pushing the formation of new businesses, but at the same time protect incumbents by pushing them to innovate and increase average productivity through technology.

Fritsch and Schröter (2009) observe that employment effects vary according to the regions where start-ups are formed. The more regions have lower than average "new firm formation" rates, the greater the impact of start-ups on regional employment development. On the contrary, the impact of start-ups is decreasing or even negative on employment if a certain threshold is exceeded. The basic hypothesis of Fritsch and Schröter (2009) is that "the average quality of regional start-ups decreases with the number of start-ups, while the costs of induced resource reallocation increase". However, this argument only refers to start-ups that do not produce innovation, as similar firms in the territory may imply situations of "overcrowding". The fundamental role in this case is played by start-ups that have superior quality, i.e. innovative start-ups. They generate added value and do not imply problems of overcrowding in the market, since they do not serve the same products/services, but they create new market spaces.

The suggestion to policy by Fritsch and Schröter (2009) is that rather than encouraging the emergence of new businesses in an uncontrolled manner, efforts should be concentrated on creating incentives for innovation and creativity, which are real regional value-adders.

The paper by Delfmann and Koster (2016) concludes a significant analysis of the first strand of research on regional development and employment effects, the period from 2000 to 2010. The article addresses the employment effects of the formation of new start-ups by comparing regions in the Netherlands that experienced a (slow) population decline with other regions that instead experienced a growing trend in the years 1996-2010. The results show that there is a "positive and significant impact on employment change in municipalities facing population decline, despite the adverse circumstances of population contraction" (Delfmann and Koster, 2016). This result could be achieved because market incumbents in regions facing population decline were not affected by new entrants, thus generating employment growth in the medium term. However, this result could raise a red flag, namely that these new start-ups were not able to bring innovation, the so-called "destructive creative processes" (Delfmann and Koster, 2016). The question that remains open, therefore, is whether in the long run the creation of (non-innovative) start-ups in regions of demographic decline can have a significant impact on employment.

To conclude this overview of the literature, it is worth mentioning a very recent article by Jesemann (2020) who, going beyond the mere effects of start-ups on regional development and growth, tries to analyse the support that innovative start-ups can provide to the emergence of new industries.

The paper's analysis focuses first on "five cities in two industrial regions in the United States and Germany and found that technological progress requires industries to establish new products, services and innovative business models in order to remain competitive in the marketplace" (Jesemann, 2020). The comparison covers cases that have been much discussed around the world due to their media resonance.

The paper shows that very industrially active cities that failed to react promptly to the changes imposed by innovation and technology saw their empires crumble, creating unemployment and regional decline. The most important cities reported to have suffered negative consequences are Detroit and Gelsenkirchen.

Jesemann (2020), on the other hand, notes that the investment of some regional districts (linked to the old type of industry) in developing innovation-friendly ecosystems has brought prosperity, employment and regional development.

"The common characteristics of the successfully transformed cities of Pittsburgh, Essen and Bochum are their prestigious universities and the development of new high-tech industries through the promotion of technology centres and startups, especially startups with a focus on the technology sector" (Jesemann, 2020).

However, a key role must necessarily be played by incumbents already present in the region: companies that have invested in technological innovation, for example by acquiring local innovative start-ups or by developing extensive cooperation networks with universities and research centres active in their own region, have not only survived, but have fostered regional development.

The role of policy, explains Jesemann (2020), should be to provide favourable conditions for the emergence of ecosystems of innovative start-ups, both from a regulatory and an industrial point of view, i.e. to push incumbents to use these high value-added realities.

Author(s)	**Reference period**	**Country**	**Direct effects on employment**
Fritsch & Weyh (2006)	1984- 2002	West Germany	Before: + employment; After (2/3 years): stagnant employment
Fritsch & Mueller (2008)	1983- 2002	West Germany	Before: + employment; After (2/3 years): stagnant employment Central role of incumbents: + employment if they innovate
Fritsch & Schröter (2009)	1980- 2003	West Germany, UK, Netherlands	Start-ups: - quality if there are too many of them (overcrowding); - employment if they are over the threshold Innovative start-ups: + quality regardless of number; + employment
Delfmann & Koster (2016)	1996- 2010	Netherlands	- Population (demographic decline); + employment (in the medium term)
Jesemann (2020)	1950- 2016	USA, Germany	+ start-ups and innovation; + employment; + development of new industries

Table 2.1.2: Direct effects of new businesses (or start-ups) on employment (Source: author's elaboration)

2.1.2 Innovative start-ups and development: the Italian case

As already seen in Chapter 1, Italy has introduced since 2012 a series of measures aimed at innovative start-ups, mainly the registration in a special register and a series of facilities to encourage their creation.

At this point, however, after having explored the literature on the impact of start-ups in general on regional development, let us look at a concrete case of development and analyse what are the differences in performance between innovative start-ups and other start-ups in general.

In order to do so, we use the Italian case, as its legislation makes a clear distinction between these two types of companies.

Finaldi Russo et al. (2016) observed that innovative start-ups are "characterised by a much higher ratio of intangibles to total assets (about 16 percentage points higher), the only indicator of innovation available in financial statements; this result is also true when ISUPs are compared with other start-ups in high-tech sectors" (Finaldi Russo et al., 2016).

As can be imagined, the high difference in intangibles is due to the higher possession of patents or registered trademarks, a difference that remains large even with "high-tech start-ups", since the possession of patents or trademarks is one of the "subjective" requirements to form an innovative start-up in Italy.

Innovative start-ups are also much more attentive to liquidity management, recording a 4% higher value than other start-ups, confirming the tendency of these companies to maintain a reserve available for future investments.

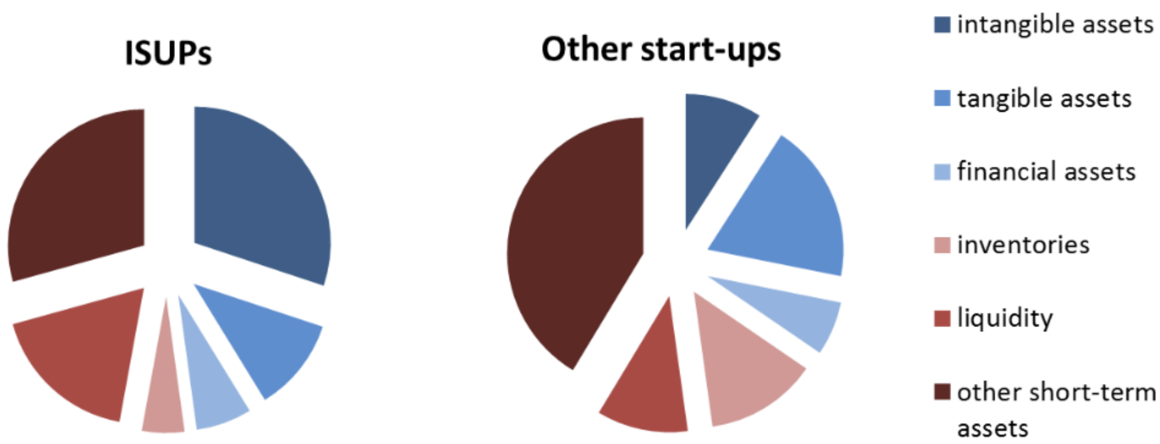

Figure 2.1.1: Asset composition: ISUPs vs other start-ups in Italy (Source: Finaldi Russo et al., 2016, p.14)

The main problem of innovative start-ups always lies in sales and business profitability, which is a characteristic factor since these types of enterprises require more time to develop and market a product.
However, the most important remark concerns the fact that the Italian State has encouraged the birth of start-ups (mind you, we are not talking about ecosystems, but about companies in the strict sense) through a series of incentives that other start-ups cannot take advantage of. Important examples are those related to loans guaranteed by the Central Guarantee Fund, as well as investment facilities for external lenders (Finaldi Russo et al., 2016).
On the basis of the literature examined throughout Chapter 2, namely that technological innovation is a determining factor for the growth of a region, we can conclude that the incentives put in place in Italy go in this direction, i.e. favouring the emergence of start-ups and related ecosystems.
The economic and employment performance of innovative start-ups in Italy is still on the rise, scoring lower than the corresponding traditional companies.
The number of employees, for example, stands at 3.16 in 2019 compared to 5.76 for other start-ups (Infocamere, 2020), thus noting that employment effects exist but are not yet substantial. A further confirmation of the fact that from the employment point of view there have not yet been significant effects in Italy is that innovative start-ups with at least one employee represent just over 40% of the total (Infocamere, 2020).
This means that they have not yet developed a vocation and size that can increase the number of employees (in the strict sense of the term per start-up) in a consistent manner.
Another interesting fact that emerges from Italy is the concentration of innovative start-ups geographically closer to urban centres, particularly Milan and Rome (which together contain almost 30% of the national total), where the probability of knowledge diffusion and contamination is higher (Infocamere, 2020).
The reasons why innovative start-ups are unevenly distributed in space will be analysed in more detail in the following paragraphs.
What we will see is that knowledge is disseminated through channels that use spillovers and how industry variety contributes significantly to the creation of innovative start-ups.

2.2 Indirect effects and knowledge as a key factor for economic growth

2.2.1 Knowledge spillovers and entrepreneurship

Knowledge spillovers are a really debated topic in the field of innovation. A great deal of literature has tried to provide an accurate description of the role they can play, mainly for economic growth and the development of new entrepreneurship.
As stated by Antonietti and Gambarotto (2020), the European Union has tried to focus its strategy towards "the drivers of the entrepreneurial discovery process, one of the most important of which is knowledge spillovers" (Antonietti and Gambarotto, 2020). In particular, the literature has always questioned whether or not knowledge spillovers were a driving force towards the creation of new firms.
The first contribution is certainly that of the "knowledge spillover theory of entrepreneurship" (Acs et al., 2009) in which the birth of start-ups is directly related to the amount of knowledge present at the local level.
All of the unexplored and unexploited opportunities of incumbent firms translate into knowledge that can be intercepted by new entrepreneurs, thus increasing the possibilities of new start-ups (Acs et al., 2009).
Entrepreneurship based on the exploitation of new ideas and technologies needs the discovery and intensive exploitation of local resources of the territory, such as "physical, human, and financial capital, or transport and digital infrastructure" (Antonietti and Gambarotto, 2020). Among these clearly stand out knowledge spillovers.
Within this paragraph we will address the issue of spillovers following the scheme proposed here:

1. Creation of new enterprises and spillovers
2. Sources and nature of knowledge
3. Spillovers and geographical proximity
4. Spillovers, new entrepreneurs and incumbents
5. The paradox of knowledge

1. Creation of new enterprises and spillovers
The relationship between new venture creation and spillovers has been analysed in detail by Ghio et al. (2015). The key questions concern why "new ventures are created as a response to knowledge spillovers and why does knowledge spill over from incumbent firms and research

organisations" (Ghio et al., 2015). There are no clear-cut answers to these questions, but what is certain is that knowledge is free in nature, in economic jargon non-excludable and non-rivalrous, so anyone could appropriate it and come up with new ideas, both at the research level in the strict sense and at the entrepreneurial level.

However, since knowledge in our sphere equals innovation, with possible technological progress and increasing returns, all those who hold it will seek to protect it.

A case in point is that of incumbents in a territory. Since the incumbents hold a superior competitive position over all others, they will prevent new entrants from tapping into their own source of knowledge by imposing a so-called “knowledge filter” (Ghio et al., 2015). This is a real barrier preventing the automatic leakage of knowledge, so the exploitation of spillovers will be a complex matter.

The real challenge for an entrepreneur will be to overcome this 'knowledge filter', which is sometimes protected by intellectual property laws (e.g. patents).

2. Sources and nature of knowledge

The second point concerns understanding the sources from which knowledge is generated. On this point, the literature seems to be fairly unambiguous.

Ghio et al. (2015) report that, according to the "Knowledge spillover theory of entrepreneurship", the sources that generate knowledge in a geographical space are essentially universities, research institutions (private and public) and incumbent firms. However, we can extend this discourse by quoting Antonietti and Gambarotto (2020) who, rather than sources, speak of the ways through which spillovers are generated, including for example also the "density of economic activities, taken as a proxy for urbanization economies". From this it can be deduced that it is indeed the sources in the strict sense that generate knowledge, but this can only be transformed into spillovers thanks to the interactions that are present on a territory.

Another necessary clarification concerns the nature of knowledge. In fact, knowledge can take a dual form, either codified or tacit. The former refers to all knowledge that has been formalised and therefore protected by 'patents, publications and citations' (Ghio et al., 2015), while the latter concerns all knowledge that, being absorbed by human capital (of a company for example), constitutes know-how that is difficult to transfer to third parties.

One aspect that is worth highlighting is that of the incumbents. In fact, since they are incumbents and, in most cases, larger firms than the start-ups that have just been formed in the territory, they hold an advantageous position with respect to them, as they can count on both tacit and codified knowledge matured internally over the years. However, as pointed out by Ghio et al. (2015), this advantage does not necessarily translate into long-term dominance. On the contrary, it has to be considered that knowledge cannot be stored internally forever, as "Investments in R&D today lead to knowledge that spills over [not only] into future periods" (Ghio et al., 2015), but also immediately outside the "boundaries" of the firm itself. This could be the case with both tacit knowledge (think, for example, of the dismissal of an employee who will be hired elsewhere) and codified knowledge (think, for example, of patents and all publications of a public nature).

3. Spillovers and geographical proximity

Once we have seen the sources and nature of the knowledge that results in spillovers, we can consider another relevant aspect, that of spillovers and geographical proximity.

The article from which we take our cue for this reflection is by Audretsch and Feldman (1996), who observed the relationships between R&D spillovers, production and the geography of innovation.

The basic assumptions they make are twofold: first, that R&D generated internally by the sources we saw earlier (Universities, R&D departments and Incumbents) will become available to "third parties" and second, that spillovers will only be intercepted by particular actors. As argued by Audretsch and Feldman (1996), there will be actors who will be more likely to intercept knowledge spillovers.

In fact, they consider that there is a directly proportional relationship between "the ability to receive knowledge spillovers [...] and the distance from the knowledge source" (Audretsch and Feldman, 1996). Therefore, the actors who will have the advantage of geographical proximity to the source of knowledge will be those who take advantage of it. The paper by Audretsch and Feldman (1996) aims to show that there will be some sectors in which a greater "geographical concentration" of innovation will be observed as the importance of knowledge spillovers increases for that sector.

The question that arises, however, is whether the "geographical concentration" of innovation in some sectors is due more to the "concentration of production" or to the role that knowledge spillovers play in that sector.

"Concentration of production" refers to industries which for various reasons tend to cluster together, e.g. a large factory with a production branch in the immediate vicinity. In this case, transport costs, for example, will be considerably reduced.

Audretsch and Feldman (1996) conclude that the main evidence is that there is a relationship between "geographical concentration" of innovation and those sectors where knowledge spillovers are most important. The results also show that these sectors exhibit a significant "concentration of production". However, the main driver of innovation concentration is still knowledge spillovers.

4. Spillovers, new entrepreneurs and incumbents

In the previous sections we have explained many aspects of spillovers. What we have not seen, however, is how the mechanism that allows spillovers to be intercepted and exploited by agents works.

There are three important elements in this analysis: spillovers, new entrepreneurs and incumbents. These elements are causally related to each other, generating a process that we will now see.

Taking the article by Acs et al. (2009) as a basis, the hypotheses that were to be tested in the paper describing "The knowledge spillover theory of entrepreneurship" were essentially three:

1) The presence of a positive relationship between the "knowledge stock" and the presence of new entrepreneurs (Acs et al., 2009);

2) The presence of a negative relationship between the degree of exploitation of knowledge (generated by R&D) by incumbents and the presence of new entrepreneurs;

3) The presence of a negative relationship between "higher regulations, administrative barriers and governmental intervention in the market" (Acs et al., 2009) and the presence of new entrepreneurs.

What emerged from the results was that all three hypotheses proved to be correct.

Therefore, assuming that knowledge, having an endogenous nature, allows the creation of spillovers, agents (new entrepreneurs) will have the possibility to intercept them and exploit them for their business ideas (Acs et al., 2009).

We can therefore conclude that new entrepreneurship is positively related to the "knowledge stock". However, there are two barriers to this positive impact, namely incumbents and regulations in a territory. Incumbents could make the most of R&D knowledge and not leave opportunities unexplored, while regulations will hinder the emergence of new firms if knowledge is made inaccessible.

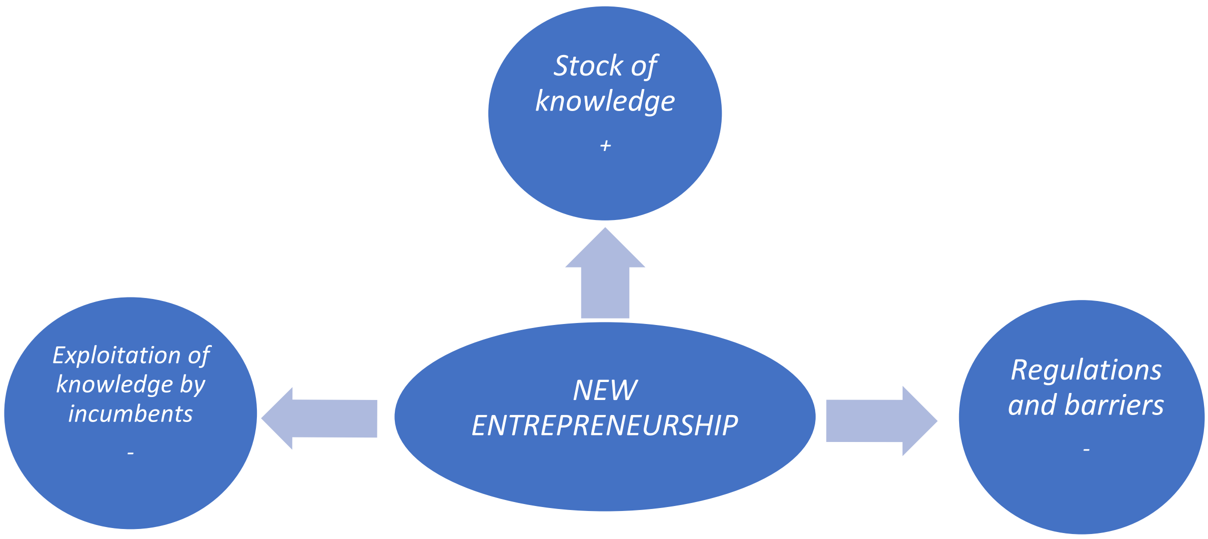

Figure 2.2.1: The new entrepreneurship and its relationships (Source: author's elaboration)

5. The paradox of knowledge (Audretsch and Keilbach, 2008)

We conclude our analysis of knowledge spillovers and entrepreneurship by introducing a topic that has been much debated in recent years, that of the "knowledge paradox". The first paper to introduce this topic was that of Audretsch and Keilbach (2008), who challenged previous theories that investment in knowledge automatically implied balanced economic growth.

What the authors explicitly wanted to demonstrate was that "investments in knowledge are inherently unbalanced, so that competitiveness and growth from knowledge are not equally distributed among individuals, firms and spatial units of observation, such as regions and countries" (Audretsch and Keilbach, 2008). For this reason, the role of entrepreneurship becomes crucial. Let us see how.

First of all, we need to revisit the 'knowledge filter' we introduced earlier (Ghio et al., 2015). As expounded in point 1 of this section, this filter is the main obstacle of access to knowledge for new entrepreneurs. Once this filter is circumvented, all opportunities arising from untapped knowledge will become a new local resource, a resource that will spread through knowledge spillovers.

However, the most important point of the 'knowledge paradox' concerns the fact that knowledge spillovers will be more intensively intercepted by those 'regions with more entrepreneurial capital' (Audretsch and Keilbach, 2008).

The discriminating factor becomes the entrepreneurial capital, a real channeller of the intercepted knowledge. In conclusion, it can be said that the knowledge paradox could be resolved in the following way: the balanced economic growth of a region is achieved through R&D investments that generate knowledge and spillovers, but a crucial role is played by entrepreneurial capital as a means through which the "commercialisation of knowledge" takes place (Audretsch and Keilbach, 2008).

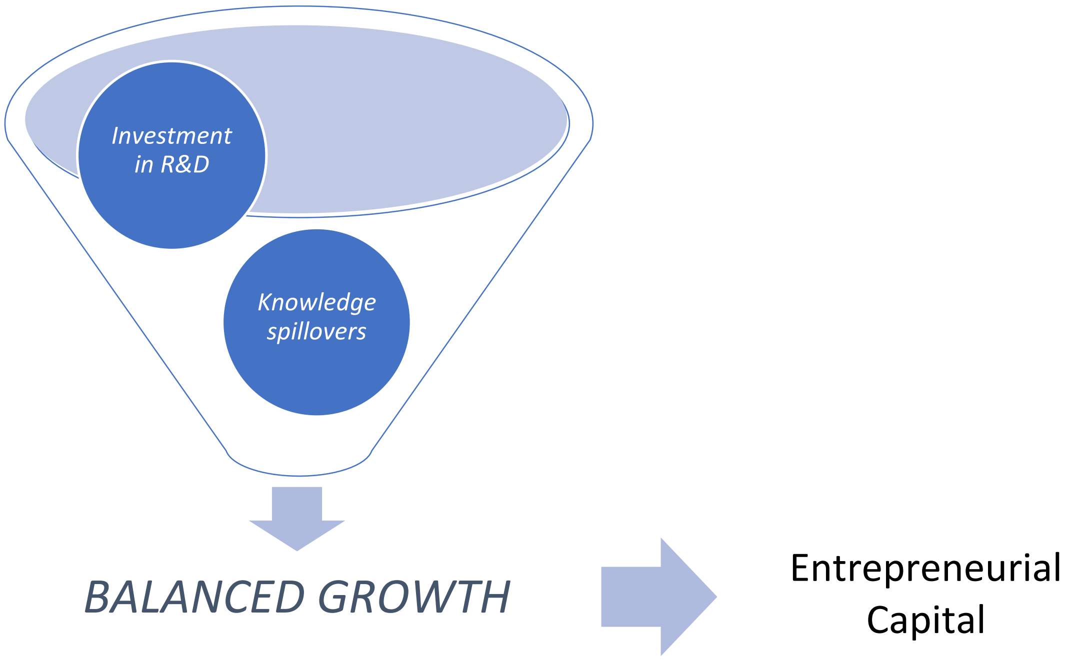

Figure 2.2.2: Knowledge spillovers, Entrepreneurial Capital and Balanced growth (Source: author's elaboration)

2.2.2 University spillovers: a brief overview

In section 2.2.1 we provided a detailed analysis of the nature of knowledge spillovers. Among the various sources of spillovers that we have seen above there is one that stands out and is worth dwelling on, universities. The literature on universities and spillovers is extensive, so we provide an overview of some of the papers that have made a significant contribution to research on this topic.

We divide the points to be addressed into two parts: 1) the relationship between university spillovers, innovation and business creation and 2) the relationship between knowledge spillovers and type of science.

1) The relationship between university spillovers, innovation and creation of firms;

Anselin et al. (1997) accurately describe the relationship between R&D developed within universities and technological innovations in 125 metropolitan areas and 43 states in the USA. The evidence firstly shows that there is a "positive and significant relationship between university research and innovative activity, both directly and indirectly through its impact on private sector R&D" (Anselin et al., 1997). Secondly, it also emerges that the effects of spillovers generated within universities were not limited to the metropolitan areas delimited by the analyses, but also spilled over to an extension of about "50 miles" from them.

This first study provides clear evidence that knowledge spillovers of an endogenous nature (i.e. from university R&D centres and not private ones) have a significant impact on the generation of innovative activities, such as the creation of companies that develop geographically close to the centres from which they originate.

Having outlined this aspect, let us now analyse a second contribution.

Acosta et al. (2011) talk about the relationship between university spillovers and technological start-ups, with reference to the Spanish context.

The specificity is on some aspects of university spillovers and concerns the formation of firms in high-tech sectors in general, thus including start-ups and the whole macrocategory of technology firms. The dataset is quite old (2001-2004: which is why we do not really talk about start-ups) and concerns the ecosystem of 604 firms and 63 Spanish universities (Acosta et al., 2011).

The hypothesis to be tested is whether there is a positive correlation between the emergence of new high-tech firms and the knowledge spillovers generated by universities in the same geographical area. The hypothesis, however, goes into detail about spillovers, citing three sources of diffusion: "knowledge-based graduates, research activities, and technological knowledge" (Acosta et al., 2011).

The results of the paper confirm the importance of university spillovers as a key local factor in explaining the emergence of high-tech firms, emphasising geographical proximity as an essential driver. What is more important to say is that knowledge-based graduates are the main vehicle of the diffusion of knowledge acquired by universities on local Spanish entrepreneurial systems. The same cannot be said, however, for research activities and technological knowledge, from which no significant correlation emerges.

In the case of Ghio et al. (2016) the object of investigation is the birth rate of innovative start-ups, however related to the impact of university knowledge as a local factor influencing it. The theory is based on the possibilities of developing a society thanks to the contaminations caused by knowledge spillovers (Ghio et al., 2016).

However, the paper should be understood by reporting on the two hypotheses that are to be tested:

H1) the presence of universities in a geographical area is positively correlated with the emergence of innovative start-ups in that area

H2) the presence of "individuals with open-minded attitudes (regional openness)" (Ghio et al., 2016) decreases the benefits generated by the spatial proximity of universities and allows university knowledge spillovers to be exploited even if the university is far away.

The results show that the presence of universities in a region (H1) undoubtedly favours knowledge spillovers that positively influence entrepreneurship, especially the creation of innovative start-ups.

This is, however, a positive effect that tends to fade as one moves away from the reference area. It is clear, therefore, that university knowledge shows its limits as one moves further away geographically. This is where H2 comes into play and the importance of "individuals with open-minded attitudes" (Ghio et al, 2016).

The results show (albeit more weakly than hypothesis H1) that their presence weakens the power of university spillovers due to the geographical proximity of the university; this is because “distant knowledge” can also be exchanged due to the presence of the individuals specified above.

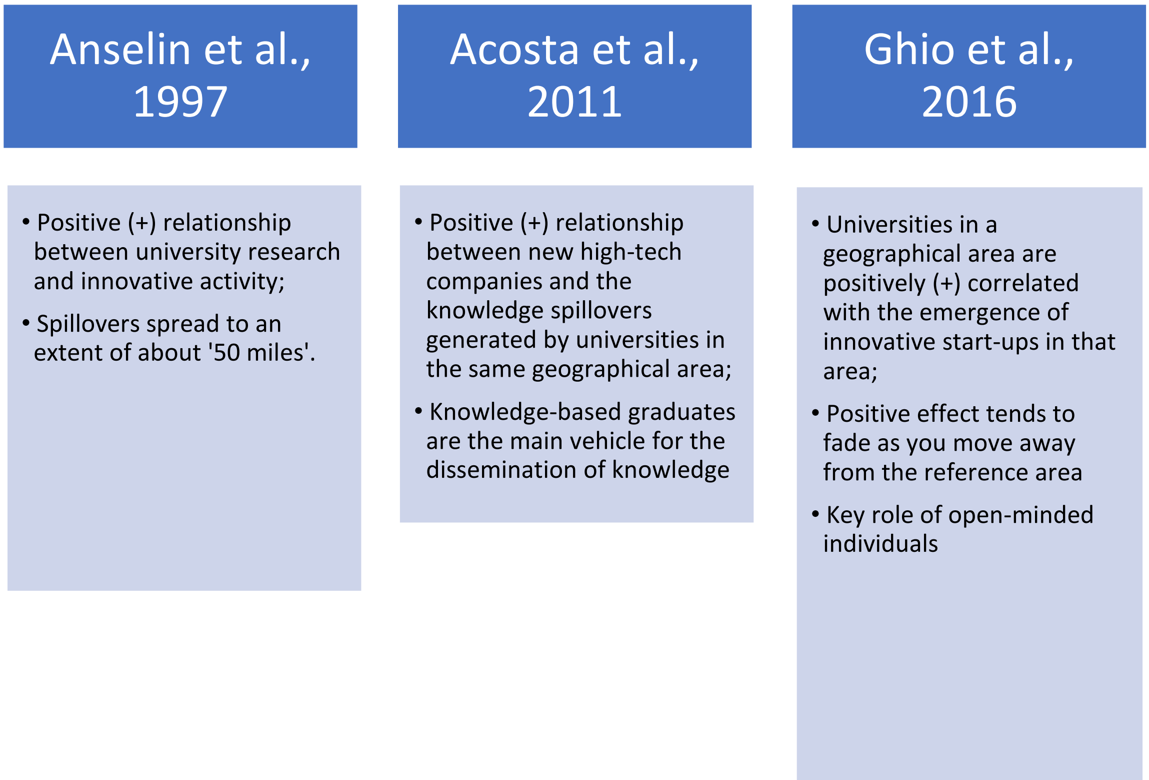

Figure 2.2.3: The relationship between university spillovers, innovation and business creation: a brief overview (Source: author's elaboration)

2) The relationship between knowledge spillovers and type of science;

Assuming that knowledge spillovers generated by universities are of fundamental importance in encouraging new entrepreneurship, it is controversial that the results may change depending on the nature of the science considered. Audretsch et al. (2004) analyse this issue by distinguishing two fields of knowledge, the "natural sciences" and the "social sciences". The analysis focuses on a panel data of "281 publicly listed firms in German high-tech and knowledge industries" (Audretsch et al., 2004), on which we want to test the hypothesis that the geographical allocation of high-tech firms is strongly influenced by the nature of knowledge.
In particular, whether knowledge spillovers generated by universities have a different impact on the geographical proximity of firms (to the universities themselves) depending on the science considered, either social or natural.
Evidence from the paper by Audretsch et al. (2004) suggests that while the social sciences do not imply a need for geographical proximity between universities and high-tech firms, the

result changes when considering the natural sciences. The natural sciences are more specific and imply a higher rate of commercialisation from ideas to innovations (new firms). Audretsch et al. (2004) finally observe that "while young firms tend to locate closer to universities with a high academic output in the natural sciences", the nature of the students participating there (in the formation of firms) appears indifferent to the type of science considered.

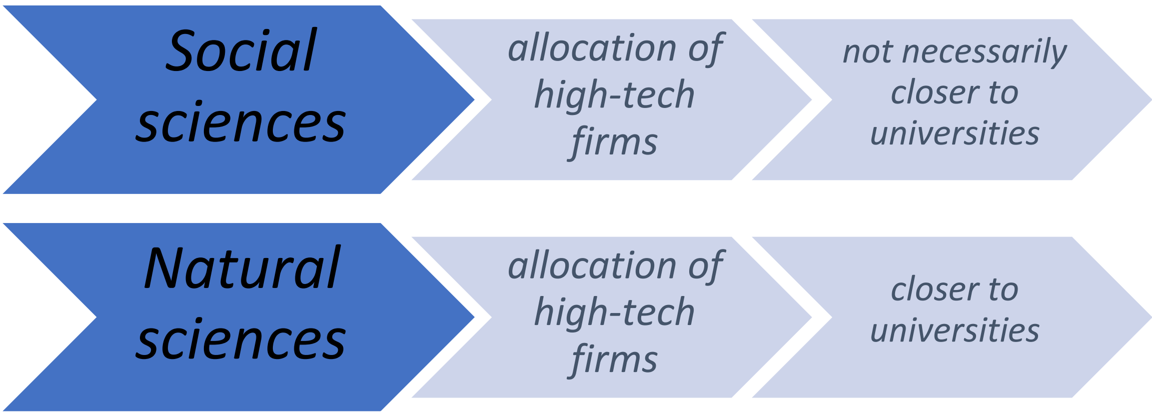

Figure 2.2.4: Type of science and geographical proximity (Source: author's elaboration)

2.3 Industry related and unrelated variety

2.3.1 Related and unrelated variety: a journey through literature

Having carefully reviewed the literature on innovation, regional growth, knowledge and spillovers, we now come to focus on a key aspect of this thesis: industry related and unrelated variety.

The analysis of the literature in the preceding paragraphs has shown that the emergence of innovative start-ups has had both direct effects, i.e. on employment and regional development, and indirect effects, i.e. on spillovers due to innovative activity. We have also seen that start-ups are not evenly distributed in space, and we also wondered what factors could influence this geographical imbalance. They prefer, as in the Italian case (Infocamere, 2020), urban contexts and large metropolitan areas (Antonietti and Gambarotto, 2020).

It is precisely on this topic that a vast literature on geographical agglomeration has emerged, which finds its foundations in the concepts of related and unrelated variety (Frenken et al., 2007).

As we will see in this section, the type of knowledge that an area makes available is fundamental for attracting certain types of firms, as in the case of innovative start-ups, located in places where the unrelated variety is greater (Antonietti and Gambarotto, 2020).

In particular, in this first part of the section we will see how these two elements affect the economic development of a region.

Frenken et al. (2007) point out that research on economic growth has essentially stopped at Solow's model, leaving out "the underlying qualitative nature of economic development, e.g. in terms of the variety of sectors or the variety of technologies" (Frenken et al., 2007).

For this reason, with respect to what has been explained in the previous paragraphs, our analysis will focus on the observation of the main effects of variety on the economic growth of a region.

Frenken et al. (2007) are the first to introduce the “variety, spillovers and growth” approach.

Let us now give a clear definition of what is meant by industry variety, with particular reference to the difference between related and unrelated.

1. DEFINITION

The definition of variety was first given by Frenken et al. (2007), who, starting from the concept of spillovers, state that they can spread not only "between firms within a sector" (Frenken et al., 2007), but also between unrelated sectors.
The underlying hypothesis is that variety plays a key role within regions, since if spillovers come from a greater number of primary sources of knowledge, the chances of new ideas and innovations being developed increase considerably, thus fostering entrepreneurship (Antonietti and Gambarotto, 2020).
When Frenken et al. (2007) introduced the definition of variety, they also focused on the difference between related and unrelated, referring to the possibility of knowledge diffusion and recombination in two different ways: within-industry (related variety) and between-industry (unrelated variety) (Antonietti and Gambarotto, 2020).
Before turning to the relationship between variety and economic growth, it is worth mentioning the conclusion reached by Frenken et al. (2007): while related variety is the best measure of "Jacobs externalities", i.e. network effects that allow the passage of knowledge through educated human capital, unrelated variety is the best measure of protection against "external shocks" through the region's diversified knowledge portfolio.
Let us now look at how the formulae of related and unrelated variety were constructed, referring to Frenken et al. (2007), the first article to develop them.
The technique used is that of "entropy measurement", which is advantageous due to its decomposition characteristic, especially since in the case of variety one works at the level of "sectoral digit" (Frenken et al., 2007).
Ultimately, the former formula "captures knowledge spillovers between firms producing and selling related products and services", while the latter "is a measure of industry diversification" (Antonietti and Gambarotto, 2020).

$$\mathrm{RV} = \sum_{g=1}^{G} P_g H_g \qquad \mathrm{UV} = \sum_{g=1}^{G} P_g \log_2\left(\frac{1}{P_g}\right)$$

Figure 2.3.1: Related and Unrelated Variety: mathematical formulas (Source: Frenken et al., 2007, p.689)

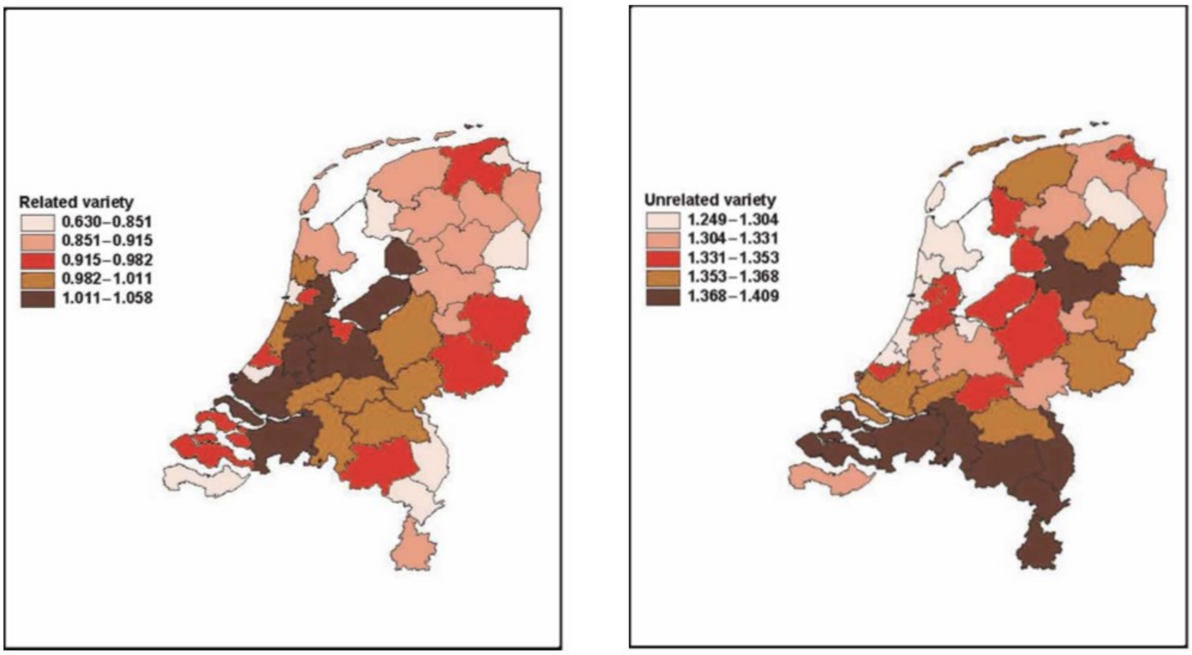

Figure 2.3.2: Maps of indices of related and unrelated variety in the Netherlands (1996-2002) at NUTS 3 level (Source: Frenken et al., 2007, p.690)

2. VARIETY AND ECONOMIC GROWTH

Having defined industry variety, let us now look at its impact on the economic growth of a region. It should be pointed out that many studies have been carried out on this subject, which we will analyse in detail later on, as well as in the last part of this chapter we will analyse the effects of variety on innovative start-ups.

The paper we use to evaluate the variety-economic growth relationship is still that of Frenken et al. (2007). The hypotheses to be tested were related and unrelated variety as independent variables on a test conducted in the Netherlands in the period 1996-2002 (NUTS 3), and employment growth, productivity growth and unemployment growth as main dependent variables (Frenken et al., 2007).

The results of this study are the most recognised and authoritative source on the variety-growth relationship and are still considered an important building block for future research. In particular, related variety is positively correlated with employment growth, becoming an important driver for job creation, while unrelated variety has a negative impact on unemployment growth, thus protecting regions from the “external shocks” seen above (Frenken et al., 2007).

Productivity growth, on the other hand, although it could be essentially related to a variety of factors, can be traced back to the traditional model of technological progress, where a crucial role was played by how much a region invested in R&D.
But let us return to the point just made about related and unrelated variety.
As Antonietti and Gambarotto (2020) state, the related variety-growth relationship in employment comes from the fact that, by exchanging and "combining technologically related activities" (Antonietti and Gambarotto, 2020), a fertile ground for the creation of new ideas and innovations will be prepared. This recombination of knowledge can also be transformed into new entrepreneurship.
This is different for unrelated variety which, as we have seen, is a very powerful weapon in the event of demand shocks in specific sectors. Antonietti and Gambarotto (2020) talk about a portfolio diversification such that, in case of shocks in specific sectors, it is not significantly affected, thus explaining its negative effect on unemployment rate growth.
Precisely because of the diversification of activities and knowledge present with the unrelated variety, it is attributed with greater possibilities of generating "radical innovations" (Antonietti and Gambarotto, 2020).

3. OTHER EVIDENCE: RELATED VARIETY, UNRELATED VARIETY AND REGIONAL DEVELOPMENT

Having seen the main aspects of related and unrelated variety indicators, we now review some of the most important articles developed in this respect.

In general, as stated by Content and Frenken (2016) (who report the evidence from the main 21 studies on related variety), Frenken's (2007) initial hypothesis that related variety generates regional development seems to be confirmed.
In particular, the main effect seems to be on employment, although much evidence suggests that it increases more in some specific sectors (e.g. manufacturing).
Boschma and Iammarino (2009) assess the impact of variety (focusing only on related) on regional growth in the Italian context of provinces, using the NUTS 3 classification.
The test shows results that confirm the theory of Frenken et al. (2007), confirming the positive impact of (related) variety on the economic growth of regions where it is greatest.
The more sectors and firms have related activities, the better the region/province will perform in terms of employment.

Boschma and Iammarino (2009) do not stop at the surface and introduce what can be considered a new source of related variety for a region, "extraregional knowledge". Extraregional knowledge is nothing more than the exchange of knowledge between different regions, which, if it has the form of complementarity required by related variety, becomes an additional source of growth for a region.
Neffke et al. (2014) analyse how structural change in regional economies can take place through new activities as opposed to the historical activities of the incumbents in the region. While regional specialisation on a single sector would entail a risk towards economic decline in case of crises (external shocks), "diversification", understood as unrelated variety, would become a sort of protection towards risks associated with the demand crisis.
Neffke et al. (2014) argue that unrelated variety can play a key role in creating "radical innovations".
Van Oort et al. (2015) also study the relationship that links related and unrelated variety to the growth of a region. Taking as panel "205 European regions during the period 2000- 2010" (Van Oort et al., 2015), the aim of the paper is to demonstrate almost the same hypotheses as Frenken et al. (2007), namely the relationships between related and unrelated variety with employment and unemployment rates, respectively.

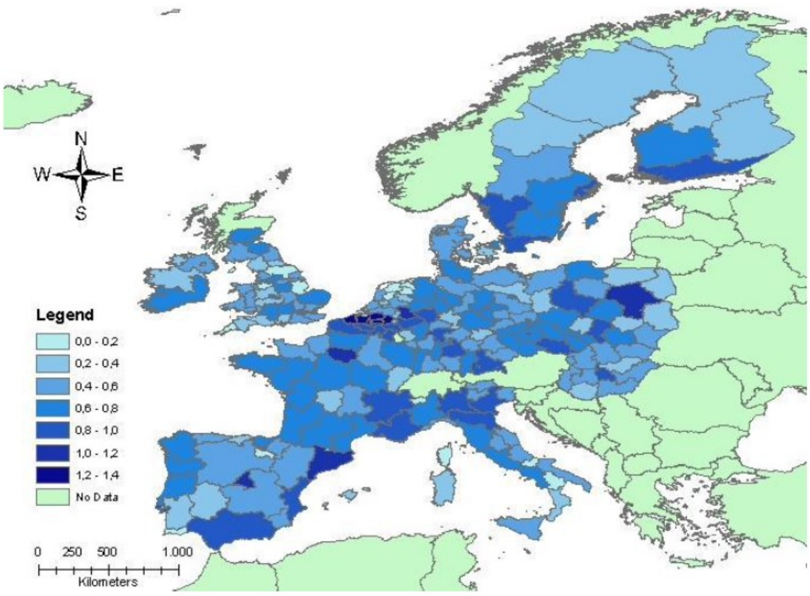

Figure 2.3.3: Related variety across European regions (Source: Van Oort et al., 2015, p.9)

As for the evidence emerging from the results, it is almost the same as that already seen in Frenken et al. (2007), i.e. a positive relationship between related variety and employment growth, but there is no significant relationship between unrelated variety and unemployment growth.

Furthermore, in this paper great importance is attached to the role of specialisation on regional economic growth. The higher the specialisation in “urban regions”, the higher the productivity growth (Van Oort et al., 2015).

The last paper we present is the one by Castaldi et al. (2015), which deals with an entirely new topic, namely the relationships that variety establishes with the creation of innovations. Starting from a panel of data on patents in the US between 1977 and 1999, the results highlight two very interesting aspects.

The first is that related variety does stimulate innovation, but it is incremental innovation, where one exploits knowledge related to activities within one's own sector, those born from the spillovers of related variety.

The second is that unrelated variety is fundamental "to produce a breakthrough innovation" (Castaldi et al., 2015), i.e. that innovation which makes use of knowledge that is totally unrelated to each other, but which would potentially lead to the generation of a "breakthrough" idea, a product or service that opens up a new market.

In section 2.3.2, we will analyse the most recent literature on related and unrelated variety, i.e. that related to the emergence of innovative start-ups.

Author(s)	**Reference period**	**Country**	**Effects of Related and Unrelated Variety**
Frenken et al. (2007)	1996- 2002	Netherlands	Effects on economic growth Related variety: + employment growth Unrelated variety: - unemployment growth
Boschma & Iammarino (2009)	1995- 2003	Italy	Effects on regional growth Related variety: + employment growth Impact of extra-regional knowledge
Neffke et al. (2014)	1994- 2010	Sweden	New start-ups vs incumbents Unrelated variety: protection against "external shocks", generation of "radical innovations"
Van Oort et al. (2015)	2000- 2010	Europe	Effects on economic growth Related variety: + employment growth Unrelated variety: - unemployment growth (not statistically significant) High specialisation: + productivity
Castaldi et al. (2015)	1977- 1999	USA	Effects on the creation of innovations Related variety: + incremental innovations Unrelated variety: + breakthrough innovations

Table 2.3.1: Effects of related and unrelated variety on economic growth (Source: author’s elaboration)

2.3.2 Related vs unrelated variety and start-ups creation

We close this journey through the literature by presenting the role that related and unrelated variety have played in the emergence of start-ups. Specifically, let's see what kind of variety is associated with the creation of traditional start-ups and innovative start-ups, since, as we have seen above, innovation requires different recombined knowledge to develop.
It is important to remember that almost all the literature has focused exclusively on the supply side of the industrial variety-innovative start-ups relationship, which is why the focus of this thesis is on an analysis that covers both the demand and the supply side.
For the sake of convenience and since the analysis conducted in Chapter 3 uses an Italian panel data (specifically from the Veneto region), the articles we cite in this paragraph all use Italian datasets (except for one that uses UK).
We start with an article that paved the way for the literature on the relationship between variety and the birth of start-ups.
Bishop (2012) examined in detail the impact of related and unrelated variety on the rate of entrepreneurship. The analysis was conducted on a database of "408 local unitary authorities and districts in Great Britain over the period 2001- 2007" (Bishop, 2012), where the variable of interest is the birth rate of start-ups.
As just mentioned, the birth rate of start-ups is the dependent variable, while there are a number of explanatory variables from which interesting results emerge. The knowledge stock is represented by a proxy variable that includes HTM ("high-technology manufacturing industry") and KIS ("knowledge intensive services"), referring to the knowledge produced within these sectors. The most interesting variables are instead those of knowledge variety, called respectively KRE and KUE (related entropy and unrelated entropy). The entropy measures are exactly taken on the model of Frenken et al. (2007), adapting the sectoral categories to a 4-digit measure.
Bishop (2012) uses a large number of other explanatory variables, of which, however, it is worth mentioning only PAY and UNEMP, respectively the "gross weekly wage" and the "unemployment level" of the region.
The results show the presence of a positive relationship between the birth rate of start-ups and KIS, as well as for PAY. On the other hand, the impact of HTM and UNEMP is negative. Finally, evidence has shown that both related and unrelated variety (KRE and KUE) are positively correlated with the emergence of start-ups in the UK, but it points out that the effect varies depending on the sector examined.

The effects are different and opposite: from services emerges "a positive impact on new business formation" (Bishop, 2012), while from manufacturing the opposite result.
Instead, we now review two articles that have focused more specifically on the emergence of innovative start-ups, that of Colombelli (2016) and that of Antonietti and Gambarotto (2020). These two articles represent key literature for the purposes of this thesis, as they serve as an introduction to the analysis and tests conducted in Chapter 3, which will look closely at the demand and supply side of industrial variety on the emergence of innovative start-ups.
Colombelli (2016) develops his test on the relationship linking the birth rate of innovative start-ups with "the local knowledge base" (Colombelli, 2016), analysing above all the nature of this knowledge in terms of related and unrelated variety. The panel of data used describes the Italian picture of innovative start-ups present at the regional level (NUTS 3).
As noted in Chapter 1, innovative start-ups have been growing considerably in recent years, bringing with them economic growth and a considerable number of benefits, including employment. Innovation, however, which distinguishes innovative start-ups from traditional ones, is generated through knowledge spillovers. However, as Colombelli (2016) states, spillovers prove to be a necessary condition to generate innovation, but they are not enough to justify the birth rate of innovative start-ups.
A fundamental role is therefore played by both related and unrelated variety, since the process of creating innovative start-ups requires both the recombination of knowledge that is totally unrelated, but at the same time "marked by a high degree of similarity" (Colombelli, 2016).
Let us look in detail at some of the observations considered. The dependent variable is always the number of innovative start-ups, while the explanatory variables are numerous, of which we mention only the most important ones. KSTOCK ("the cumulated stock of past patent applications") is the proxy variable used to assess the stock of knowledge, CD ("cognitive distance") concerns the technological distance between entrepreneurial knowledge, and related variety and unrelated variety are the knowledge diversification variables.
Evidence shows that while KSTOCK is positively related to the creation of new firms, "cognitive distance (CD) is instead negatively and significantly related to the creation of innovative new firms" (Colombelli, 2016). The most interesting result is that of the impact of related and unrelated variety: both positively affect the formation of new start-ups, suggesting greater evidence of unrelated variety to the formation of innovative start-ups.
The last paper we present is the one by Antonietti and Gambarotto (2020), which represents the natural evolution of the article cited above by Colombelli (2016). Starting from the local labour systems and from the data extrapolated by Infocamere on the number of innovative start-ups born on the Italian territory in the period 2012-2015, the analysis always focuses on

the related and unrelated variety, however distinguishing the different impact they have on both traditional and innovative start-ups.

The evidence on the results shows first of all that innovative start-ups tend to locate in very large urban areas, where both the availability of related and unrelated variety is significantly higher.

Evidence then shows that, while unrelated variety has a higher positively significant impact on innovative start-ups - since "breakthrough innovation" is generated where the knowledge portfolio is highly diversified - related variety instead has a higher positively significant impact on other types of start-ups, where incremental innovation simply requires similar knowledge (Antonietti and Gambarotto, 2020).

Author(s)	**Reference period**	**Country**	**Effects of related and unrelated variety**
Bishop (2012)	2001- 2007	UK	Effects on the emergence of start-ups Related & unrelated variety: + new start-ups
Colombelli (2016)	2009- 2013	Italy	Effects on the emergence of innovative start-ups Related & unrelated variety: + new start-ups
Antonietti & Gambarotto (2020)	2012- 2015	Italy	Effects on the emergence of innovative start-ups and traditional start-ups Related variety: + new traditional start-ups Unrelated variety: + new innovative start-ups

Table 2.3.2: Effects of related and unrelated variety on start-ups creation (Source: author's elaboration)

Chapter 3: Empirical analysis: demand and supply side unrelated variety and innovative start-ups

3.1 Introduction

The issue of the effects of industrial variety on the economic development and growth of a region has been extensively described in chapter 2. We have seen that industrial variety can be broken down into related and unrelated (Frenken et al., 2007) and that these two indicators have different impacts on regional development. There is almost unanimous agreement in the literature that related variety produces positive effects above all in terms of employment growth in those territories that have a significant amount of it (Frenken et al., 2007; Boschma & Iammarino, 2009; Van Oort et al., 2015) and which stimulates the creation of innovations at an incremental level. On the other hand, unrelated variety represents, through the diversification of the knowledge portfolio, an effective mean to counteract the growth of unemployment in a region (Frenken et al., 2007; Van Oort et al., 2015), mainly because it stimulates the creation of innovations at a radical level and favours labour reallocation across industries (Neffke et al., 2014; Castaldi et al., 2015).

The most recent literature has also sought to reveal the impact of industrial variety on the creation of new firms, distinguishing between traditional and innovative firms. Evidence has suggested that both related and unrelated variety have a positive impact on new firm formation, however, attributing to the former a higher impact on traditional start-ups and to unrelated a higher propensity for innovative start-ups (Colombelli, 2016; Antonietti and Gambarotto, 2020). This is because they are associated with incremental and radical innovations respectively.

In this thesis we want to focus specifically on the relationship between unrelated variety and the generation of innovative start-ups. The analysis was conducted at the local labour market area (LLMA) level in the Veneto region, distinguishing unrelated variety from the demand and from the supply side. Traditionally the literature on the variety-entrepreneurship nexus has provided a supply-oriented explanation of unrelated variety: a higher capability to create new firms is linked to the possibility to (re)combine different knowledge sources, or inputs, and consequently introduce new products, processes, or business opportunities into the market.

In this thesis, we argue that a highly diversified portfolio of demand is important too. Specifically, we posit that the creation of innovative start-ups is not only the outcome a well-diversified portfolio of local knowledge sources, but also of a well-diversified portfolio of other firms and industries which demand the products or services provided by the innovative start-ups. In other words, we ask whether, ceteris paribus, a higher local variety of business opportunities is also conducive to a higher generation of innovative start-ups.

The focus of this empirical activity is therefore to show the different effects played by the distinction of the unrelated variety indicator from the demand and the supply side on the births of innovative start-ups in the Veneto region. Merging data from the national business registers from the Italian Ministry of Economic Development and the Italian Chamber of Commerce and the regional input/output tables (Thissen et al., 2018), we find that the unrelated variety on the demand side matters and is even a stronger predictor of innovative start-up creation than that on the supply side.

3.2 Data

For the analysis conducted in this chapter, a dataset was constructed by combining information from different sources. The empirical analysis mainly concerns the impact on the birth rate of innovative start-ups at the level of the Veneto region, using as focal regressors the unrelated variety both on the supply side and on the demand side, while controlling for a series of other local confounding factors.

As illustrated in section 3.1, the literature has mainly concentrated on analysing this aspect from the supply side, neglecting the effects on the demand side.

To empirically assess the role of these latter, we build a dataset that integrates these elements: the list of innovative start-ups in the Veneto region in the period 2015-2019, the input/output tables at sectoral level for the Veneto region, and a series of additional information on the characteristics of the LLMAs in the Veneto region (according to the 2011 ISTAT classification).

Let's take a step-by-step look at how our dataset was constructed and then used to build our econometric model and the estimates.

First of all, the data on the number of innovative start-ups at the level of the Veneto region have been retrieved from the "business register" created in collaboration between the Italian Ministry of Economic Development and the Italian Chamber of Commerce (2021). The raw data included many descriptive items, but they were filtered by considering only the Veneto region and leaving as the only items of interest the name, the province, the municipality, the date of registration to the section of innovative start-ups (for the period 2015-2019) and the "ateco" code reduced to 2-digit. The total number of innovative start-ups registered in the special register amounts to 800 (between 2015 and 2019).

In this regard, let us briefly recall what are the requirements in Italy to acquire the status of innovative startup, as we have already described in paragraph 1.2.

Following Decree-Law 179/2012 eligible innovative -ups must fulfil the following criteria: new or created no more than 5 years ago, based in Italy or in the EU, but with a production site, or branch, in Italy, with an annual turnover not exceeding EUR 5 million, not listed on a regulated market, [they don't] provide for the distribution of profits, technological innovation is the exclusive or predominant corporate purpose, [they don't] result from a merger, demerger or transfer of a business unit" (Mise, 2020 and par.1.2 of chapter 1). Moreover, R&D (and innovation) expenditure equal to "at least 15% of the greater of turnover and cost of production, the staff employed have high qualifications ("at least 1/3 PhD, PhD students or

researchers, or at least 2/3 with master's degree") and [it] owns or licenses a patent or software (Mise, 2020 and par.1.2 of chapter 1).
The total number of innovative start-ups created in Veneto in the period 2015-2019 is 800, while the annual flows are as follows: 122 start-ups in 2015-2016, 205 in 2017, 231 in 2018 and 242 in 2019, as shown in Figure 3.2.1. As we can see, the flow has grown significantly compared to 2015, testifying to the fact that the support measures put in place by the Italian state have had a positive impact.

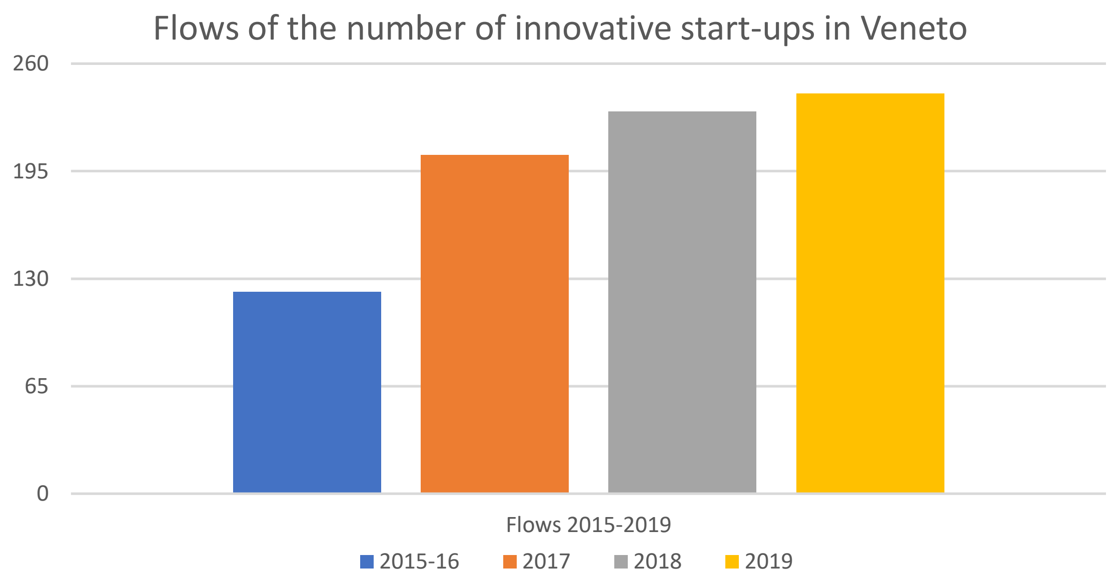

Figure 3.2.1: Flows of the number of innovative start-ups in Veneto (2015- 2019) (Source: author's elaboration)

After filtering the list of innovative start-ups by year within the Veneto region, we linked to each municipality the corresponding LLMA (according to the last census of 2011) to which it belonged, taking care to exclude those LLMAs that did not have any start-ups registered in their territory (ISTAT, 2011). The data on LLMAs, after being filtered by the target region, showed that, associated with the 582 municipalities of the Veneto region, there were a total of 49 LLMAs. From these, 6 LLMA were excluded that either did not register any start-ups or belonged predominantly to the non-regional territory.
The use of the LLMA is advantageous because it eliminates spatial boundaries defined by provinces (and regions), implying a more correct and less rigid analysis.
To sum up, the sample so far consists of 43 LLMAs and 800 innovative start-ups.

The central part in the construction of the dataset was instead obtained from the input/output (I/O) tables available for the Veneto region (Thissen et al., 2018).
These tables, which represent the so-called "PBL EUREGIO database" (Thissen et al., 2018), have been constructed according to the NUTS2 classification of regions and refer, in our specific case, to the Veneto region in the year 2010.
I/O tables are very useful for assessing "the share of intermediate (business-to-business) economic activity taking place within a specific region" (Grabner, 2021), precisely because they give insight into how much in a region the relationships between inputs and outputs intersect across sectors (an example of how an I/O table is structured is shown in Figure 3.2.2).
The use we made of them was relevant for the calculation of certain indicators, such as OUTPUTxSALES and OUTPUTxSUPPLIES, the various weighted weights (Pj) associated with sectoral final demand and supply, and the unrelated variety indices on the demand side. This provided insight into the extent to which sectors have established backward linkages or forward linkages with each other (Grabner, 2021).
Precisely through the calculation of the weighted weight (Pj) associated with the demand and supply of the sectors on the total flows produced at regional level (OUTPUTxSALES and OUTPUTxSUPPLIES), it is possible to observe what percentage of inputs and outputs are offered and sold internally in Veneto. The total sum of the calculated Pj's will be equal to 1.
As already mentioned above, however, our focus is mainly on the demand side. For this reason, the calculation of the unrelated variety, coming from the combinations calculated in the I/O tables, refers only to the final demand, splitting it, as we will see in paragraph 3.3 on the variables, in unrelated variety that includes in the calculation the same sector (on itself) and in unrelated variety that excludes from the calculation the same sector.
One problem encountered in the construction of the dataset was the correspondence among different industry classifications.
As we said before, in the filtering relative to the register of innovative start-ups, they were reduced to 2-digit, but, in order to standardise the data with those relative to the I/O tables, we had to convert them into the reference system of the PBL sector classification code. In the latter there are 15 sector classes, named ss1, ss2 etc.
The operation that was carried out was precisely to match the 2-digit ATECO codes with the 15 sectoral classes. To do this, it was necessary to compare the Italian ATECO2007 classification to that of the PBL Euregio database (Thissen et al., 2018). In Table 3.2.1 the conversion list from "ateco" 2-digit into the 15 reference sectoral classes.

	PBL sector classification code	ATECO codes
ss1	Agriculture	1+2+3
ss2	Mining_quarrying_and_energy_supply	5+6+7+8+9+35
ss3	Food_beverages_and_tobacco	10+11
ss4	Textiles_and_leather_etc	13+14+15+16+17+18
ss5	Coke_refined_petroleum_nuclear_fuel_and_chemicals_etc	20+21+22+23+24+25
ss6	Electrical_and_optical_equipment_and_Transport_equipment	26+27+28+29+30
ss8	Other_manufacturing	31+32+33
ss9	Construction	41+42+43
ss10	Distribution	45+46+47
ss11	Hotels_and_restaurant	55+56
ss12	Transport_storage_and_communication	from 49 to 53 + 58 to 63
ss13	Financial_intermediation	64 to 66
ss14	Real_estate_renting_and_busine_activitie	68 to 75
ss15	Non-Market_Service	from 77 to 96

Table 3.2.1: Conversion table Ateco codes- PBL sector classification code (Source: author's elaboration)

Region Name	IO row Code	IO row name				
			R148	R148	R148	
			ITD3	ITD3	ITD3	
			Veneto	Veneto	Veneto	
			ss1	ss2	ss3	
			Agriculture	Mining_quarrying_and_energy_supply	Food_beverages_and_tobacco	**OUTPUT PER SALES (DEMAND)**
Veneto	ss1	Agriculture				
Veneto	ss2	Mining_quarrying_and_energy_supply				
Veneto	ss3	Food_beverages_and_tobacco				
		OUTPUT PER SUPPLY				**TOTAL**

Figure 3.2.2: Example of an I/O table (Source: author's elaboration)

To summarise, the construction of the dataset was carried out first of all starting from the sample of innovative start-ups in the Veneto region (2015-2019), to which the reference LLMAs (2011 classification) were then associated according to the municipality they belonged to. The second operation took place instead on the I/O tables from which, once the

weighted weights (Pj) associated to the demand on the total regional demand were calculated, we obtained the estimates of demand-side unrelated variety associated to the sectoral dimension. The final operation was then the construction of a single dataset that combined both the database of start-ups, the associated LLMAs, and the estimates of sectoral demand-side unrelated variety obtained from the I/O tables. At this point, however, we are still missing a very important aspect, the one that associates the distribution of the sector within the individual LLMAs, i.e., the one that allows us to obtain indices of unrelated variety on the demand side that are both sector and LLMA specific, i.e. that capture both dimensions of interest, the spatial and the sectoral. To solve this problem, it was necessary to resort to the share of employment in sectors by LLMA at the year 2011 (ISTAT, 2012). The operation was to extract the 2011 local unit employment, aggregate it at the 2-digit level and then match it with the ss codes (ss1...ss15) mentioned above. Finally, the weights (Pj) of each individual ss sector on the total number of employees in the LLMA were calculated.
Having constructed the reference dataset, let us look at the variables of interest in our econometric model.

3.3 Empirical strategy and variables

To test our hypothesis, we estimate the following econometric model:

$$Y_{it} = \alpha + \beta_1 UV_{i2011} + \beta_2 UVD_{i2010} + \beta_3 LP_{i2011} + \beta_4 INCUB_{i2011} + \beta_5 UNIV_{i2011} + \beta_6 UNEMP_{i2011} + \mu_R + \delta_t + \varepsilon_{it} \quad (1)$$

where Y_{it} is our dependent variable and represents the share of innovative start-ups (*isu*) in LLMA *I* and year *t* expressed in three different forms, i.e. as the annual flow on the total number of firms in 2011, as the annual stock on the total amount of firms in 2011, and as a measure of density, expressed as annual flow, or stock, per km^2.
More in detail, *isu_lu* represents the share of innovative start-ups on the total number of plants in 2011 in each LLMA. For convenience, we have multiplied all these variables by 1000. The variable *stockisu_lu* has been calculated as the ratio between the annual cumulative sum of innovative start-ups on the total number of plants in 2011. The other two variables, *den_isu*

and *denstock_isu* represent, respectively, the annual number of innovative start-ups per km^2 (x 1000), and the annual cumulative number of innovative start-ups per km^2 (x 1000).
The term a is the constant, while μ_R is a vector of dummies that control for unobserved fixed effects specific of the NUTS 3 region, i.e., the province (capturing, for instance, the quality of institutions or the availability of infrastructures). δ_t controls for fixed effects at a temporal level, as it includes five annual dummies (for the period 2015- 2019) that capture the business cycle and other macroeconomic shocks that can affect the dynamics of innovative start-up creation in the Veneto region.
We now turn to the description of our focal regressors, those concerning measures of unrelated variety. In this regard, we must distinguish between UV_{i2011} and UVD_{i2010}, since to the former we give an interpretation of unrelated variety from the supply side, calculated at the year 2011 as employees in the sectors in the relevant LLMA, as we see from the model constructed following ASIA data (ISTAT, 2012) used by Antonietti and Gambarotto (2020). The second is instead the unrelated variety on the demand side, calculated from the panel data obtained in Section 3.2 to the year 2010. We have given it two specifications, *uv_nosector* and *uv_sector*. Starting from the data obtained in the I/O tables, in the first case the reference sector was not calculated for itself, while in the second case it was also calculated for itself.
In this regard, we would like to point out that the indicators of unrelated variety were obtained by following the literature of Frenken et al. (2007).

$$\mathrm{UV} = \sum_{g=1}^{G} P_g \log_2\left(\frac{1}{P_g}\right)$$

As already described in 2.3.1, this index not only makes us understand how much "industry diversification at LLMA level" we have (Antonietti and Gambarotto, 2020), but it is also a valid measure of entropy due to the possibility of intrinsic decomposition (Frenken et al., 2007), since we worked first on 2-digit sectors and then on their conversion into "ss".
In general, it estimates how diverse knowledge can be within a region, in this specific case at the LLMA level.
Let us now look at the other variables in the econometric model, which are important to control for their effects on the variable's estimates Y_{it}, although it is not possible to control for all other endogeneities that have not been considered.

LP_{i2011} represents labour productivity, calculated as value added per employee in the year 2011 in each LLMA. This variable was calculated using ASIA data (ISTAT, 2012) and is also highly correlated to labour costs, since higher productivity levels correspond to higher wages. As we will see in Table 3.3.1, this performance indicator is measured through four categories, in the ISTAT (2012) data, vary from 1 to 5, depending on whether productivity is low, medium-low, medium, medium-high, and high. The categories contain the following values (expressed in thousands): low up to 22.4, medium-low from 22.5 to 33.6, medium from 33.7 to 44.9, medium-high from 45.0 to 56.1 and high above 56.1. In our data, only the first four bands are considered, since innovative start-ups in the Veneto region do not perform beyond band 4, i.e., over 56.1.

Labour productivity is an explanatory variable of particular interest, as it could stimulate the creation of innovative start-ups. Specifically, LLMAs with a higher value added per employee, or a high labour cost, could stimulate entrepreneurial activities of our type, precisely due to the high availability of financial and human capital resources. We therefore expect this indicator to have an impact on the emergence of innovative start-ups, taking advantage of the internal geographical proximity to certain types of LLMAs.

We then present a couple of other control variables for our econometric model, namely the presence of incubators ($INCUB_{i2011}$) and universities ($UNIV_{i2011}$) in the LLMAs for the year 2011. Both are dummy variables that can take the values 0 and 1 depending on their presence or absence in the LLMAs considered in the Veneto region. We expect them to have a positive impact and to encourage the birth of innovative start-ups (Colombelli, 2016). Business incubators, whether public or private, are very few in the Veneto region but, despite this, they could attract a good number of innovative start-ups to the LLMAs in which they are present, since they provide co-working spaces, professional advice for the development of the innovative idea and, sometimes, the liquidity needed to start up and enter the market. Universities, on the other hand, have not only boundless human capital to gather unrelated knowledge and form new entrepreneurial realities based on innovation, but could also represent potential clients willing to pay for this kind of services (Antonietti and Gambarotto, 2020). The effect of the presence of incubators and universities could therefore have positive connotations on the emergence of innovative start-ups.

The last control variable we introduce is the unemployment rate in 2011 ($UNEMP_{i2011}$). We do not expect this variable to have significant effects on the emergence of innovative start-ups, as the literature also inclines towards ambiguous answers (Bishop, 2012; Antonietti and Gambarotto, 2020). The unemployment rate could encourage job seekers to become entrepreneurs, in our specific case founder of an innovative startup, also taking advantage of the measures put in place by the state and regions. However, this figure can also be read in the opposite way, since we have seen that innovative start-ups are born mainly in favourable areas from the point of view of knowledge, financial and capital resources. For this reason, LLMAs with higher unemployment in relation to the population may not be able to offer a favourable environment for entrepreneurship and innovation (Antonietti and Gambarotto, 2020).

Table 3.3.1 below shows the summary statistics of the variables considered. In Table 3.3.2 we show a correlation matrix to check for multicollinearity problems that might arise between the variables. As can be seen, the low pairwise correlations reveal that multicollinearity should not be an issue.

Variable	Obs	Mean	Std. Dev.	Min	Max
isu_lu1000	215	.2474797	.3695786	0	3.064624
stockisu_lu~1000	215	.5357516	.7878379	0	5.596269
den_isu1000	215	6.555978	11.02993	0	57.09721
denstock_isu~1000	215	14.80911	27.63016	0	186.268
UV2011	215	4.793358	.423193	3.191125	5.288949
uv_nosector~a	215	.2044555	.0104786	.1769451	.2257271
uv_sector_~a	215	2.004108	.0836393	1.821645	2.239782
LP	215	2.348837	.6443036	1	4
INCUB	215	.0697674	.2553492	0	1
UNIV	215	.0697674	.2553492	0	1
UNEMP	215	.0294932	.0050477	.0137518	.0431341

Table 3.3.1: Summary statistics (Source: author's elaboration)

	uv2011	uv_nosect~a	uv_sect_~a	labprod	incubat	univ	unemp_
UV2011	1.000						
uv_nosect~a	-0.173	1.000					
uv_sect_~a	-0.250	0.771	1.000				
LP	0.093	-0.105	-0.359	1.000			
INCUB	0.313	0.271	0.130	0.277	1.000		
UNIV	0.309	0.326	0.209	0.277	0.642	1.000	
UNEMP	0.454	-0.129	-0.267	-0.179	0.119	0.042	1.000

Table 3.3.2: Correlation matrix (Source: author's elaboration)

To estimate Equation 1, we use the random effects estimator. This is because all our explanatory variables are time-invariant, and a fixed effect estimator (or a first difference transformation) would exclude them from the regression. To control for time and region fixed effects, however, we include a series of seven NUTS-3 region dummies and five year-specific dummies. Moreover, to control for arbitrary within-group correlation among the error terms, we clustered the standard errors at LLMA-level.

3.4 Results

Table 3.4.1 shows the results of our estimates, considering only the impact of focal regressors on the dependent variable Y_{it}. The focal regressors, as described in the previous section, are the indicators of unrelated variety which, in our estimation model, are found in the first three rows (*UV2011_std, uv_nosector_weighted_std, uv_sector_weighted_std*). The first row refers to the unrelated variety on the supply side, the second and third rows refer to the demand side, distinguishing the case where the reference sector is not controlled for itself and the opposite case.

Columns (1) to (4) represent the dependent variable related to the number of innovative start-ups, respectively as a flow (and hence annuality) measure (*isu_lu*) and as a stock (and hence cumulative sum of the entire period) measure (*stockisu_lu*). Columns (5) to (8) represent instead the case of the dependent variable expressed as a density measure, again first as a flow measure and then as a stock measure (*den_isu* and *denstock_isu*).

As regards our focal regressors, as can be seen from Table 3.4.1, they are accompanied by the abbreviation *std*, which means that all variables have been standardised to mean 0 and variance 1. The coefficients of the estimates are instead accompanied by three asterisks (***) if their significance level is very high (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$).
N=215 indicates the number of LLMAs considered in the sample (43) for the five-year period (2015-2019).
We begin by looking at the estimation results in Table 3.4.1 starting with columns (1) to (4), i.e. those in which the dependent variable is expressed first as a flow measure and then as a stock measure. The estimated coefficients of unrelated variety on both the supply and demand sides are all positive and statistically significant. In particular, if we first compare *UV2011_std* (supply side) with *uv_nosector_weighted_std* (demand side excluding the control of the same sector), their coefficients are almost identical, thus confirming in the first instance that both demand and supply components matter. Indeed, in both cases, a unit increase in the unrelated variety (both supply and demand side) corresponds to an increase of 0.08 in the dependent variable (*isu_lu*). The same effect is found in column (3) (*stockisu_lu*), where the increase is more substantial than in the previous case (about 0.22 both in the case of *UV2011_std* and in that of *uv_nosector_weighted_std*), given that Y_{it} is expressed as the cumulative sum of the number of innovative start-ups in the period 2015-2019. If instead we go to compare *UV2011_std* with *uv_sector_weighted_std* (demand side where each sector is also controlled for itself), i.e. columns (2) and (4), the level of significance is lowered on the demand side, while the estimated coefficients deviate from each other more markedly.
The impact of the two types of unrelated variety on the number of innovative start-ups is also confirmed in the case of columns (5) to (8), where Y_{it} is specified as a measure of density. If we look at the coefficients associated with *uv_nosector_weighted_std* in columns (5) and (7) we can even see that in this case they are larger than those associated with *UV2011_std*, noting a slightly higher effect on the demand side than on the supply side.
Again, as can be seen in columns (6) and (8), the effect and significance decrease if in the unrelated variety on the demand side each sector is also controlled for itself.
The R^2 *between* and *overall* coefficients, being all quite similar, show that the model as a quite high goodness of fit.
What we can conclude from this first analysis of the results is that the number of innovative start-ups is positively influenced by unrelated variety. We know from previous literature (Bishop, 2012; Antonietti and Gambarotto, 2020) that this influence is definitely captured on the supply side, but our estimates also show a significant, sometimes even greater, impact on the demand side.

DEP. VAR.	(1) isu_lu	(2) isu_lu	(3) stockisu_lu	(4) stockisu_lu	(5) den_isu	(6) den_isu	(7) den_stockisu	(8) den_stockisu
UV2011std	0.0832***	0.0919***	0.2267***	0.2398***	4.489***	4.744**	10.66***	11.17**
	(0.0206)	(0.0281)	(0.0470)	(0.0682)	(1.427)	(1.971)	(3.336)	(4.604)
uv_nosector_weighted_std	0.0862***		0.2178***		5.059***		12.22***	
	(0.0325)		(0.0715)		(1.482)		(3.421)	
uv_sector_weighted_std		0.0741**		0.1409**		3.016**		6.714**
		(0.0308)		(0.0686)		(1.422)		(3.338)
Year dummies	✓	✓	✓	✓	✓	✓	✓	✓
NUTS-3 dummies	✓	✓	✓	✓	✓	✓	✓	✓
N	215	215	215	215	215	215	215	215
R^2 within	0.264	0.264	0.513	0.513	0.256	0.256	0.363	0.363
R^2 between	0.418	0.399	0.481	0.415	0.560	0.426	0.575	0.420
R^2 overall	0.316	0.309	0.501	0.475	0.434	0.357	0.474	0.393

LLMA-clustered standard errors in parentheses. The estimates also include a constant term. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3.4.1 Unrelated variety and innovative startup: random effects panel estimates (Source: author's elaboration)

	(1) isu_lu	(2) isu_lu	(3) stockisu_lu	(4) stockisu_lu	(5) den_isu	(6) den_isu	(7) den_stockisu	(8) den_stockisu
UV2011_std	0.054*	0.057*	0.158***	0.158***	2.271***	2.273***	5.407***	5.333***
	(0.028)	(0.026)	(0.054)	(0.054)	(0.773)	(0.807)	(1.711)	(1.780)
uv_nosector_weighted_std	0.081**		0.221***		3.968***		9.837***	
	(0.033)		(0.070)		(1.039)		(2.267)	
uv_sector_weighted_std		0.108***		0.0002***		3.833***		8.823***
		(0.033)		(0.0001)		(0.997)		(2.429)
LP	0.045	0.102***	0.182***	0.182***	3.218***	4.880***	8.550***	12.16***
	(0.037)	(0.037)	(0.058)	(0.058)	(1.048)	(1.255)	(2.172)	(3.048)
INCUB	0.029	0.028	0.017	0.017	4.871	5.653	11.46	13.79
	(0.065)	(0.061)	(0.133)	(0.132)	(4.085)	(4.733)	(8.307)	(10.21)
UNIV	0.120*	0.097*	0.220*	0.220*	11.33***	11.42**	25.39***	26.16**
	(0.067)	(0.055)	(0.114)	(0.114)	(4.346)	(4.806)	(8.708)	(10.50)
UNEMP	8.223	14.20	20.54	20.54	289.5*	457.6*	721.8*	1080.6**
	(8.245)	(8.808)	(17.80)	(17.80)	(176.2)	(234.9)	(393.3)	(548.5)
Year dummies	✓	✓	✓	✓	✓	✓	✓	✓
NUTS-3 dummies	✓	✓	✓	✓	✓	✓	✓	✓
N	215	215	215	215	215	215	215	215
R^2 within	0.264	0.264	0.513	0.513	0.256	0.256	0.363	0.363
R^2 between	0.469	0.508	0.557	0.556	0.799	0.778	0.825	0.789
R^2 overall	0.333	0.346	0.530	0.530	0.579	0.567	0.604	0.585
Max VIF	2.63	2.97	2.63	2.97	2.63	2.97	2.63	2.97
Mean VIF	2.04	2.09	2.04	2.09	2.04	2.09	2.04	2.09

LLMA-clustered standard errors in parentheses. The estimates also include a constant term. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3.4.2 RE controls estimates (Source: author's elaboration)

Table 3.4.2 shows the estimates considering the effect of both the focal regressors and the other control variables described in section 3.3 on the dependent variable Y_{it}.
The variables of unrelated variety occupy the first three rows just as in the table above. The same applies to the specifications of Y_{it} which always occupy columns (1) to (8). The added variables are LP, INCUB, UNIV and UNEMP.
What we can notice is that the coefficients associated with the indicators of unrelated variety have dropped considerably, precisely because we assume that part of the effects on the number of innovative start-ups are captured by the control variables.
Specifically, the impact of *UV2011_std* even loses significance in columns (1) and (2), while the coefficients estimated in relation to the dependent variable as a measure of density (columns (5) to (8)) are halved compared to the coefficients seen in Table 3.4.1.
On the demand side, however, we observe a very interesting fact: despite having inserted new control variables in the estimation panel, the coefficients associated with *uv_nosector_weighted_std, uv_sector_weighted_std* do not differ so much from those in Table 3.4.1, indeed if we consider those of *uv_sector_weighted_std* they are even higher than those seen previously. What is even more interesting is that in this estimation model the unrelated variety on the demand side is clearly higher than on the supply side, in some cases almost twice as high, as we can observe especially in columns (5) to (8). The impact of unrelated variety on the demand side on the number of innovative start-ups at the LLMA level in the Veneto region over the period 2015-2019 not only counts but may even be higher than that exerted by unrelated variety on the supply side. This is especially true in the case of Y_{it} expressed as a density measure, both as a flow and as a time stock measure.
The labour productivity explanatory variable (LP) is always positive and statistically significant (except in column (1)), thus stimulating the emergence of innovative start-ups in LLMAs where it is higher. This confirms our hypothesis in Section 3.3 that high value-added LLMAs have a positive impact on innovative start-ups.
As can be seen in Table 3.4.2, this impact is always greater (almost always double) than that of the unrelated variety on the supply side, while it is very similar to that of the unrelated variety on the demand side.
As for the explanatory variable INCUB (incubators), it never statistically differs from zero. The prediction we made in section 3.3 was therefore wrong, as we expected a positive impact on the emergence of innovative start-ups. In contrast to what we observed in Antonietti and Gambarotto (2020), who conducted an analysis at the NUTS-2 level in Italy, our analysis, focusing only on the Veneto region at the NUTS-3 level, could only capture a small number

of incubators when compared to national data. We conclude that our estimates do not show any effect linking incubators with the emergence of innovative start-ups.

The variable university (UNIV) does not seem to have any particular effect if we consider Y_{it} in columns (1) to (4), where only weakly positive relationships are present. The significance increases if Y_{it} is instead considered as a measure of density, in this case UNIV has a very positive impact on the birth of innovative start-ups. The last control variable considered in our model is UNEMP, i.e. the unemployment rate in the reference LLMA. As we already predicted in Section 3.3, its impact on the birth of innovative start-ups is ambiguous, since it never statistically differs from zero except in weakly positive relationships in the cases of columns (5) to (8).

In Table 3.4.2 we also used a further measure to test for multicollinearity, the variance inflation factor (VIF) mean. This indicates whether there is a highly collinear relationship between the variables in the model, which is not the case in our panel estimates as it takes constant values (2.04 and 2.09) less than 5.

Conclusions

The objective of this thesis was to examine the impact of unrelated variety on the creation of innovative start-ups. More specifically, we wanted to distinguish the impact of unrelated variety on the supply side from the demand side. The first two chapters were used to describe the world of innovative start-ups and the literature on industry variety and knowledge spillovers.

We first started with a numerical-descriptive analysis, observing the world of innovative start-ups at the level of the ecosystem (the world ecosystem, the Italian ecosystem and finally the one in Veneto), legislation (Decree-Law 179/2012) and life cycle (the funding phases). This general framework has served as an introduction for an effective understanding of how the world of innovative entrepreneurship is evolving more and more, to the point of influencing the economic growth of the regions. In the second chapter, we reviewed the literature linking the emergence of traditional and innovative start-ups to regional development and employment, highlighting that related variety is positively correlated to employment growth (Frenken et al., 2007; Boschma & Iammarino, 2009; Van Oort et al., 2015), while unrelated variety to employment reallocation between different sectors (Neffke et al., 2014; Castaldi et al., 2015). It is important to remember that while related variety (stimulating incremental innovations) favours the emergence of traditional start-ups, unrelated variety (stimulating radical innovations) favours that of innovative start-ups (Colombelli, 2016; Antonietti and Gambarotto, 2020). The entrepreneurial theory of knowledge spillovers offers us an important observation in this regard, the decisive role of untapped knowledge opportunities by incumbents that are captured by start-ups (Audretsch and Feldman, 1996; Audretsch and Keilbach, 2008; Acs et al. 2009). In this context, related and unrelated variety means that knowledge recombinations favour the emergence of new firms (Frenken et al, 2007).

After reviewing the literature, we constructed an econometric model to examine at the LLMA level in the Veneto region the impact of unrelated variety on the emergence of innovative start-ups. The supply side and the demand side were observed separately and this produced some very interesting results. Let us see them in detail.

By unrelated variety on the supply side we mean the ability to recombine (unrelated) sources of knowledge to give birth to new businesses, both at the service and product level. More generally we mean the ability to recombine inputs.

However, the question we asked ourselves is whether the creation of innovative start-ups in a given territory is also the result of a reverse mechanism, i.e. the demand/demand by other firms for products and services from innovative start-ups. More generally, we intend to understand whether the birth of innovative start-ups is also encouraged by a demand mechanism.

We expected from the empirical evidence that high portfolio diversification on both the supply and demand sides would have a positive impact, but we wanted to distinguish the two aspects to observe which one matters more. In the Veneto regional context, the evidence clearly shows us that both of these two focal regressors matter, but the demand side has an even stronger effect than the supply side. Basically, unrelated variety on the demand side should be considered as a fundamental driver for the creation of innovative start-ups.

From our results we can outline some policy indications on how to stimulate the creation of new innovative activities and on which levers one can act. First of all, since the creation of innovative businesses is closely related to unrelated variety, policy should encourage the diversification of knowledge sources from different sectors. The important support of the European Union through the Smart Specialisation Strategy works at a general level, but the aspect of specialisation prevails more than that of diversification. According to our evidence, however, the diversification of knowledge portfolios is crucial to foster the creation of innovative start-ups, both on the demand and on the supply side. A policy suggestion could therefore concern mechanisms that more easily connect the demand for goods and services by a sector with the creation of innovative start-ups.

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