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Do AI start-ups perform better than others? Evidence from the Italian startup ecosystem

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ABSTRACT

I have conceived this thesis to monitor the Italian startups' situation and how entrepreneurship is evolving inside the county. The focal scope is to study the diffusion of this network to decide if the country's measure taken to promote the born of a new company and boost the creation of innovation are performing as desired. The core of the research is to understand if the effects are different for a different type of focus of the companies. What I wanted to answer was, "are startups based on AI performing better than other ones? And on what metrics?"

The thesis is divided into two major parts: the first one is based on literature to understand better the startup world and the metrics used to evaluate the startup's performances. In this part will also be analyzed what AI means and its relationship with startups.

In the second part, instead, I pass to analyze the data. These are taken making a matching between the database on innovative startups given by the Italian Government and the database on startups extracted from AIDA.

I will present some descriptive analysis of the startup situation and diffusion in Italy, distinguishing between AI-based and other startups.

The final step of the analysis will look at the performance metrics identified as relevant and search for a significant difference in values between the AI-based startups and the control group.

Creating this thesis aims to understand how AI drives performance and if this indicator could be a predictor of superior ones. It could be useful for all the stakeholders interested in startups' business.

INTRODUCTION

In approaching this thesis, the idea is to investigate if AI startups are performing better or not than non-AI ones. It means that I want to find out if AI can be a factor that influences some important outcome metrics and if this influence is positive or negative.

To arrive to extract the conclusions, I've had to divide the work into different phases.

The first part of the paper focuses on a literature review looking at the two main concepts involved in this work: startups and Artificial Intelligence.

Looking at startups, I focalize on how the term is defined, reporting some of the most credited definitions and differences with other types of businesses. It is important to investigate why startups are fundamental to an economic system and why it is significant to focus on them and on their ability to generate innovation and economic growth.
After this first part of introduction on new ventures' central role, I focus on the traits that generally are used to value a startup. In this context, in my opinion, there are two main focus points: the evaluation a priori of the potential of a startup and the valuation ex-post of the performance that a startup is having.

In the first case, I have looked at all those factors identified in the literature as good predictors for a successful outcome for a startup, distinguishing them between external and internal factors and linking these to the theoretical background in strategic management and startups.

In the second case, I've looked through literature at all those factors found as central ingredients to have success in the fluid world of startups.

In the second part of the chapter, I have focused on Artificial Intelligence, trying to look at the various definitions we can find on this concept and how the idea of copying the human reasoning ability has been born. In this part, I've tried to look at the main components of AI and how it has been classified. Furthermore, I've added some data to give the idea of the expansion it's having in recent years and why my thesis focuses on it.

Finally, I've looked at the startups' situation in the environment of AI, the challenges they are facing, the contributions they are giving, and the characteristics of an AI startup.

Successive sections are divided as follows: an Italian situation review, looking at strength and weaknesses of the Italian market and at the measures government have put in place to incentive both startups and AI. I've focused mainly on the "startup act" and on its effect on the startup environment in Italy analyzing the positive results and also the possible improvements.

Then the final part is focused on the DB building and the analysis done on the data. I've explained the methodology used to individuate AI startups among all startups and how data have been treated to arrive at the final version of the database. The analysis part is divided into two other sections. I have analyzed some descriptive statistics showing the differences between AI and non-AI companies, as the first instance. Then I've done a more in-depth analysis trying to understand if and how AI affects startups' performance attempting to verify the Hp previously generated.

In the end, there is a results analysis (that are not in all cases the ones expected) and some justification for what has been found. I have also searched for possible improvements in the research method and what could have been done better to improve the results.

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STARTUPS

In this thesis, I focused on startups in Italy, trying to monitor different performance measures and how they influence and involve different Italian business network actors.
But two questions need to be posted at the beginning of this entire process of analysis:

1. What is a startup?
2. Why is it important to study this type of company?

Let's go one per time and start by answering the first question.

WHAT IS A STARTUP?

The word "startup" has been used since Carmel used it the first time in his article "Time-to-completion in software package startups" in 1994.

The topic here has been discussed a lot in the last 20 years. In a market in which always more these types of organizations grow, both in number and both in perspective and fund attraction, there isn't still a clear and unique definition.

What is sure is that startup is linked with innovation. It is commonly recognized that they are the right form of business to achieve innovation thanks to their agility and nature that is, at least at the beginning, focused on innovatively solving a problem. As Eric Ries stated: "*[a startup] is a human institution designed to create a new product or service under conditions of extreme uncertainty".*

The most famous and accredited formalization of what a startup is, however, has been given by Steve Blank, considered one of the most prominent and early expert in the startup world, who defined it as a *'[…] temporary organization with the goal of finding a business model that is scalable e repeatable'.*
In this definition, different words have become part of everyday jargon for those who work in a startup world:

- *Organization:* it means it includes human, technological and financial resources that combine under established rules to reach a goal
- *Temporary:* a startup is not designed to be stable in time. Its life is generally short and its nature is to be volatile and mutable

- *With the goal of finding a business model*: here is the startup's essence in this definition. A continuous chase at the winning model to be successful in business implies the possibility of frequently changing the scope, the final market, the structure, etc. The ability to pivot in order to find the right business model. But what is the right business model? It has to be:
    - *Scalable*: meaning it has to have the possibility to grow. Win or go home. There shouldn't be other results possible
    - *Repeatable*: in different places and with different people without losing efficacy and power

The previous is just one of the most shared definition of what a startup is. In reality, there are thousands of interpretations; it is an evolving world and players involved in it has their own perception being them researchers, entrepreneur or investors.

The term is generally used in association with words like "ambiguity", "uncertainty" or "fast-moving". A startup is a type of company that is generally born with the need to solve an existing problem in environments where big players are not interested in action because of the difficulties of evaluating the market potential or the focused scope of activity. Entrepreneurs in these companies must be able to move forward through uncertain and unexplored terrain.

As said earlier, a startup search for a scalable business model. But what does this mean practically? It is recognized in the literature that one of the factors characterizing these types of business is the capacity to pivot to follow the market opportunity and evolve the initial generated idea. In this terms in literature it's mentioned the fact that a business model is rarely fixed and most of the time, being the startup agile and reactive, this can be changed several times thanks to trial and experimentations until a growth path is found (Camuffo, Cordova, Gambardella, & Spina, 2018).

Following the concepts of fast-moving and continuous change, one of the most famous theories of the last 10 years about startups is the Lean Startup model conceptualized by Ries in the notorious book "The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Business".
It has been a turning point in the entire discussion about startups because it has linked the definition of a "lean business", already existing in the industry world thanks mainly to the Toyota innovative process, to startups' nature.

This theory roots in the idea that most of the time, a business in an early stage does not have a clear and fixed business model with the capacity to sustain the company's long-term goals. Generally, startups start their activity based on an idea that could be innovative and brilliant, but not always the initial use of the idea is the one that will be brought till the end. Starting from this point, the entire theory looks at startups as living beings that can live and prosper as much as they are able to adapt and change, following the opportunities and the market evolving with them. The market in which these types of companies operate is fluid and young. It has been demonstrated that one of the most frequent reasons why a startup fails is because they are not able to understand what the needs of their customer are. The problem is that neither the customer knows what their needs in such a new environment are. That's why a company needs to be able to pivot on the base idea and test and experiment really fast to find the correct way to satisfy emerging needs. (Ries, 2011)

Startup's definition is variegated and complex. Try to give a unique description is not simple because there are plenty of aspects you could focus on. Someone has tried to define metrics to discriminate a startup from something else.

One of these metrics, for example, is time. Paul Graham (co-founder of Viaweb and Y Combinator) has tried to define the time limitation we should consider to effectively be able to talk about a startup stating that "*a company 5 years old can still be considered a startup. A 10 years old company would be a stretch*". In opposition to this, joking on the argument, Jan Koum (founder of WhatsApp) told the journalist Nastya Chernikova "*I think [a startup is] not connected with time. They say that age it's not the number, but how it feels*.".

Others have tried to limit what is the capital value over which a company can no more be considered a startup or the number of employees or other statistics that give the idea of the venture's dimension. But these types of limitations are never-ending stories where there is always someone who tries to define and someone who says it is not possible.

Following Homejoy's CEO, Adora Cheung, *"[A] startup is a state of mind. It's when people join your company and are still making the explicit decision to forgo stability in exchange for the promise of tremendous growth and the excitement of making an immediate impact*". This reassumes the part of a startup that can be identified as pure passion. It is a state of mind, defined as the place where you always challenge the established to follow the unknown. Following this definition and vision, when a company settles and stops running, that's the moment in which it ends to be a startup.

Finally, it is imperative to look at the definition that the Italian Government gives to a startup because this is inserted in the Start-up Act, the law that manages the startups in Italy (that in the end are the base for this thesis). In the Art.25 of the d.l 179/2012, the act defines an innovative startup as a "*company that is not quoted on the market, that is newborn (or at least constituted since less than 5 years), with HQ in Italy or another EU country (but with an operative site in Italy), with annual revenue lower than 5 million of euros with a focus on products at high innovative vocation and not being the result of join or split of other companies*". It is clear that when looking at laws giving some limitations is mandatory and these are taken in terms of age of the companies, location, capacity to generate revenues and to bring innovation.

Some experts are then defining some classifications that fall under the same term but allow them to differentiate. Steve Blank, for example, has divided the various startups proposing a sort on the base of their scope:

- *Lifestyle Startups*: entrepreneurs who work by themselves and live their preferred life, following their passion
- *Small Business Startups*: examples are small stores, bakers and small shops in town. The business is not run to be scalable
- *Scalable Startups*: the BORN-TO-BE-BIG ones. They are created to change the market rules and establish themselves to have a significant role in the economy
- *Buyable Startups*: these companies born and grow to be bought by a major company. The goals of investor are not to have an IPO but to gain on the selling
- *Large Company Startups*: these are born to innovate for the mother company. But to do so, they need to be a different type of organization, able to move fast and change direction even more quickly. That's why they are separated from the mother company.
- *Social Startups*: the mission here is not to generate profits at all costs but instead to create benefits for people and the environment and have an impact on the world

As far as we have understood until now, a startup is a self-living creature. It's difficult to define and every definition seems to bring something that is personal, an experience, knowledge of the business or whatever. When searching for a startup definition, generally, the first two lines are similar to the following: "a startup is not a small version of a big company".

So, what are the main differences between a startup and a typical business? Why should we differentiate and why is it important to do so?

BIG COMPANY: a startup and an established company differ under multiple perspectives. A startup is a lean and fast-moving company with the final goal of scale-up, bringing innovative products into the market. It is projected to risk and is in a situation of "win or go home". With respect to a big company, a startup owns the ability to be fast and follow the market needs super reactively. It is not interested in distributing dividends. Its final goal is to reach a critical mass as soon as possible. On the contrary, a big company has to respond to many stakeholders, which brings to be much slower to follow an innovative part of the market. Every change in the organization comport high cost and needs time to adapt the entire organization. The final goal of a company is to generate revenue and distribute dividends to investors. It tries to do this by increasing its market share and creating more value for customers in an already established market where there isn't the risk of fast changes.

Also, management techniques are different because big companies adopt a so-called "perspective-planning" working in case of existing, predictable and well-understood markets. Instead, startups embrace a step-by-step concept that helps to relalize innovation in aapidly changing, uncertain environment (Ripsas, Schaper, & Troger, 2015).

A big company with respect to startups has higher costs but also much higher sources of capital and possibilities to spend money. On the other side, a startup has a more remarkable ability to penetrate into uncertain markets and drive innovation. Each one has what the other needs.

In conclusion, we cannot treat them in the same way. A startup needs to be evaluated on opportunities it has, while a big company needs to be assessed on what it is currently and how and how much it is producing revenues.

SMALL COMPANIES: startups and small businesses are closer one to the other with respect to the relation startups-big companies. But in the same way, it is not the same thing. Here the big difference is in the goal they have and how they want to reach it. A small business, in fact, can be seen as a miniature version of the bigger one. It competes in a market that is generally established and relatively stable. Even if the goal is to scale-up, it is a slow process. The business and the company are generally more structured then a startup and not as lean and agile as a startup. On the other hand, a startup is super flexible and the scope is generally the one to find a scalable market and serve needs that no one

else is doing. For these reasons, they need to be treated differently from a perspective point of view and both from an accountability one.

A further distinction is posed in the term of entrepreneurship. This is the term used to identify generally the category of people that run their own business. Of course, it is strictly related to the startup world, and these two concepts are most of the time studied together. What is interesting is that also in this field, startups tend to be different from SME. Actually, there is a distinction in the wider term of entrepreneur between the ones who own a company and are self-employed *per se* and the ones that are instead affiliated to the concept of a startup. These are real entrepreneurs, persons who are continually pursuing economic value through the growth and are always not satisfied with what they reach and with the status quo. Self-employment per se cannot be considered entrepreneurship. Self-employment plus aspiration usually is. This is a significant difference between people who are running startups and people who are running small businesses with no aspirations to grow. (Isenberg, 2011)

WHY IS IT IMPORTANT TO STUDY THESE COMPANIES?

INFLUENCE OF STARTUPS ON ECONOMY

Startups are pushed a lot in the last years. Many countries around the world are creating ad-hoc policies to promote the implementation of startup ecosystems, which means they are investing very much. But what are the effects of startups on the economy and why is everyone investing in them?

As evident, startups bring innovation. They are born and live with the scope of bringing something new to the market or giving the same services but in a better way. It is clear that promoting an entrepreneurial ecosystem can push the generation of new ideas and that among those, there could be the winning one. They have also been labeled “agents of change” (Audretsch, 2002).

Innovation is a crucial player in the modern economy. As we see, the trend drives always more the value from the productive assets to the knowledge. This shift has been noticed since the beginning of the 2000s when people and companies, thanks to globalization, started understanding that moving production out of industrialized countries could have reduced the cost of production. These brought everyone on the same level and always more what was valuable in a product or in a process was the idea that stayed behind it. The ability to generate knowledge and to innovate on the product. It has been found that in industries that are mostly based on data, such as computers and process control

instruments, small firms provide the engine of innovative activity (Audretsch, The Dynamic Role of Small Firms: Evidence from the U.S., 2002). Information are nowadays the most valuable asset a company has. We have examples of this. The most prominent companies in the world are those which treat data and information. In this context, the capacity to innovate the startups have is an enormous value-added for a country that needs to develop its economy.

Still, some studies highlight that there is little evidence that incumbents firms innovate less than startups. Also, if we consider young firms, it seems they obtain more significant performance benefits from R&D at the upper quartile of the growth rate distribution but face declines at the lower quartile (Coad, Segarra , & Teruel, 2016). But it can be argued that even if startups are not able to innovate more than already in the market companies, they create competition that pushes incumbents to innovate not to die, which is positive for the country's economy.

We always have more examples worldwide of startups that have grown and have become part of the world's top companies. These are generally called "unicorns" and are identified as those startups that are able to raise more than 1mld $ of capital through investments. This is the results that everybody follows, from the entrepreneur himself to the VC fund that gives him the money, passing, of course, also from the state. From a political point of view, a similar result means to bring occupation, money and power in an international perspective and last, but not least, it attracts future investments in the country.

This last point, the capitals invested, is one of the most important from a governmental point of view. Having a network of valuable startups brings investors to look deeply inside it and move their investment in the country. This is positive for startups and the state because more money means more taxes and growth in the economy. In fact, international studies have proved that economic growth at the regional and local levels related to startup businesses' presence (Matriciano, 2020). This is not only provided by the capacity of the startup themselves to generate economic growth. Since a long time, new entrants' dynamism in a market is a driver of aggregate and overall productivity growth (Henderson, 1993). Actually, entry and exit in a market are drivers for redirection of labor and capital away from inefficient firms to highly productive firms. The growth of a few companies with high potential can more than compensate for those startups that do not take off. (Calvino, Criscuolo, & Menon, 2016)

Another factor in which the government has an interest is the increase in employment. In fact, as sign of good welfare in a country, the employment level is one of the most looked at metrics. Governments

are sensible to this topic and investing in entrepreneurship is a way they are pursuing to generate more work opportunities. Startups on this guarantee the increase of employment level and there are multiple examples of this in the US and Europe (Audretsch, Thurik, Verheul, & Wennekers, 2002). This increase in employment generates welfare and significant tax revenues that can be reinvested to sustain the ecosystem (Isenberg, 2011). In addition, as a result of empirical evidence, new ventures and young firms are pivotal in creating new job opportunities. It is demonstrated that their contribution to creating new job opportunities is way higher than their share in total employment. On average, firms younger than 5 years old account for 21% of total employment but are instead responsible for 47% of job creation. (Criscuolo, Gal, & Menon, 2014)

The concept of "spillovers" expresses another benefit that is not always taken in consideration and not easily valuable. It is recognized in the literature that entrepreneurship generates more entrepreneurship. Entrepreneurs who reach success are inspirational for others and can move from one experience to another, becoming business angels, investors, or advisors for new ventures. This ,in the end, generates more knowledge and entrepreneurial activity. (Isenberg, 2011)

Finally, it is possible to argue that entrepreneurship (and in particular innovative entrepreneurship) can promote and facilitate inclusiveness that nowadays is on the top of policy agenda due to the growing concerns that social cohesion is being undermined by social inequality (OECD, 2018)

STARTUPS PERFORMANCE

When we talk about startups, the first idea we have is of a fast-changing environment. Being this world so variable and variegated, it isn't easy to understand if a startup is performing well. Instead, in corporate finance, looking at the different metrics we have at our disposal, we already know (or at least have a clue) if a company is performing positively or not. We can understand what drives the increase of one value on the balance sheet by looking at the others and, over everything else, we are able, looking at the market and the internal values of a company, to understand if it's going to have success or to decline.

This is possible because companies generally operate in markets where the variability is low or at least known. This is not to say that the company's future is foreseeable, we are far from it and many examples in the economy's history show this. But for sure, it is a totally different business from the startups type of action.

Startups generally operate in markets in which the unpredictability reigns. Often, the market itself is something new, created from zero. This leads to the impossibility to foresee the future development of the environment. So it requires startups to have the ability to change rapidly or the capacity to generate ideas strong enough to be able to be the change that others must adapt to.

As found in the literature and discussed below, there are many measures available to startups and are looking at different metrics that can be taken into consideration. However, startups are by nature temporary organizations and with limited resources. Consequently, it is difficult for them to monitor all the aspects of their business simultaneously. In addition, compared to major companies, startups need to update their measures more frequently due to their dynamic nature. (Moores, 2001)

A consistent part of researchers and academics argue that randomness and luck overshadow by far the systematic components of growth and performance (McKelvie & Wiklund, 2010) (Coad, 2009) (Geroski, 2002). This is partly mitigated by studies that shows opposite evidence, explaining that even if unobservable characteristics and luck can influence the success of entrepreneurs, we can still rely on observable metrics differences in ex-ante firm's characteristics to explain the difference in performance and the effects on post-entry (in the market) of new ventures (Guzman & Stern, 2016).

The topic so is quite complicated and hereafter I'd try to answer two questions I posed myself in the creation of this thesis: what should we look at to understand if a startup is going to excel? And what instead we should look at to understand which startups are performing better than others?

It's fundamental to identify current and future successful business and ventures to understand more in-depth the entrepreneurial process and to be able to guide policies taken by the government to improve the success rate of startups (Simon, 1995)

FORESEE PERFORMANCE

Let's suppose we are an investor and we need to put our money on one startup. What are the factors we should look at?

What emerged from the literature is that being startup so new and in continuous improvement, it is difficult to look at something fixed and easy to measure. Several factors could influence the success of a startup and they are more or less specific and measurable. However, there is a supra-distinction accepted universally: some internal factors and some external factors exist. Let's follow this distinction between internal and external factors to dive deep.

EXTERNAL FACTORS

STARTUP ECOSYSTEM

One of the major concepts emerging in the last years in the startup world is the startup ecosystem. It is gaining importance following some successful examples of implementation, Silicon Valley over all the others.

A startup ecosystem is an aggregation, in a constrained area, of a pull of resources and stakeholders that pursue a unique scope to make the startups grow. The assembly of factors allows better utilization of resources and easier sourcing of them. Furthermore, this type of system's central point is that there should be a series of positive externalities between the actors involved. For example, this can be more competition that drives startups to go over difficulties to succeed, an easier way to attract capital and capital's owner because of more possibilities of investment, a more fluid and active market for labor where experts will focalize because of more opportunities for them.

Following Cuckier et al., in the case study of New York City case, a startup ecosystem could be defined as:" *a limited region within 30 miles (or one-hour travel) range, formed by people, their startups, and various types of supporting organizations, interacting as a complex system to create new startup companies and evolve the existing ones*". (D. Cuckier, 2015)

In this definition it is clear the territorial scope part of an ecosystem and its scope: make startups born and grow.

So why build an ecosystem instead of a non-related and divided number of startups?

Ecosystems make it easier for startup companies to grow and survive in the market and to prosper. The possibility to have easier access to financing sources, in fact, improve the capacity of companies to survive and grow in the market. It has been demonstrated in several studies that one of the first causes of failure for a startup is a financial shortfall. In addition, it has been shown that access to financial capital is a foster for good performance, especially for SMEs. (Wiklund & Shepherd, 2005) (Bøllingtoft, 2005)

Another fundamental aspect is the culture. According to some studies in this field, the presence of an entrepreneurial culture (that include innovation propension, ability to accept failures and to extract learning point from them, social acceptance of entrepreneurs and so on) and a propension in the

population for risk has a profound impact on the success of a company or organization (Gudmundson & Hartman, 2003). This is something that is difficult to control but can be driven in the long term through ad-hoc policies and governmental plans. Creating an ecosystem, a pool of all the necessary resources, helps create a mindset that could have a positive impact on the companies involved and lead to an escalation of generation of new projects.

The culture also has an influence on the other facet of a successful business: the market. Entering a market where the buyers are not searching for what a startup can give is obviously deadly for a startup. We have many examples of great idea developed in the wrong place that has not succeeded due to the lack of customer. A population driven by curiosity and willingness to discover new technology and invest in futuristic ideas is, on the opposite, the best marketplace where a startup can grow. This type of mindset is generally challenging to create from zero, but once again, the government can push on it using financing policies that give customers some advantages or by promoting creating event and seminars on the topic.

An ecosystem that includes entrepreneurs, investors, workers, universities, government, accelerator, incubator and many other actors facilitates enormously creating startups thanks to the reduction in search problems. Everything is in the same place. Investors don't need to spend on searching the right startup around the country, the entrepreneur doesn't need a super-effort to find someone investing or employees with a startup mindset. Agency problems, in fact, as said earlier, are among the first causes for a startup's failure.

For example, Isenberg identified six different domains that need to be present and developed to drive the success of a startup ecosystem: finance, market networks, culture, supportive factors, a policy of leadership and government and human capital. (Isenberg, 2011)

Looking at the various components that constitute an ecosystem, we can find some categorized players that are of particular importance in the development of an ecosystem:

- ENTREPRENEURS: they are the fundamental component in a startup ecosystem, creating and running the startups. They are helped in their role by the other actors and are one of the major factors contributing to startup success. Really important is that they have the right mindset to be able to evolve and seize or create opportunities.
- BUSINESS SUPPORTERS: they are the ones who help the startup take the right decision and to develop the necessary skills to be able to survive in a fast-moving and uncertain environment. In particular, we have:

- INCUBATORS: they have an essential role in the early stage of a business. Their goal is to help the entrepreneur build a concrete business plan around his idea and achieve it through mentorship to the founder. They give the possibilities to create discussion and improvement working in co-working spaces and can be financed by the government or private investors.
- ACCELERATORS: their role comes after the incubator's one, when and if the owners have developed an innovative idea and a solid business plan. The goal they have is to help the entrepreneur accelerate his business and sprint to reach some form of investment. They try to understand together with the startup's founder how good the business plan is, checking what the potential market is. Furthermore, they do mentor on topics that could help to increase the probability of success.
  In case of lack of investors in some ecosystems, they can cover this by being directly the first investors in the startups they are supporting. The program they manage typically has a duration of 3-6 months.

- GOVERNMENT: it has a crucial role in various aspects. It is the first creator of a startup ecosystem and has different levers to action to make this happen. It can operate on policy, investments (directly on startup or on other entities), cooperation with big established companies, implementation in collaboration with universities program to develop entrepreneurial capabilities and creating a market through incentives for customers. I'll discuss all the types of actions that a government can do to help develop this form of business more in detail in the next chapter.
- INVESTORS: they are a central part of the entire ecosystem. Without them, startups wouldn't have the resources to expand and reach the market. Several types of player could have this role and for different reasons:
  - ESTABLISHED COMPANIES: they generally look at the startup environment to be able o assure the innovative part. They invest in startups because their structure doesn't allow them to be as flexible as the one of a startup and so they aren't able to pursue innovation internally. In recent years, the acquisition of startup has become a common practice for big players, especially in the tech world. Some of the biggest (like IBM and Google) have their own startup ecosystem in which they help startups grow and finance them directly. They always search a win-win solution.
  - VENTURE CAPITAL: they are the most cynical investors. They generally enter in series A or B round of investment. These companies have the possibility to bring in a massive amount of capital, but in return, they pretend above-average returns and a

high amount of stocks in the company. The final goal of venture capitalists is to find the startup that reaches an IPO and bring them high returns.

- BUSINESS ANGELS: they are private investors that finance the startups in a relatively early stage, generally in the seed or pre-seed phase. Their interest is to gain on startups but are generally driven also by the will to create something from zero and see an entrepreneur succeed. Business angels are always more aggregating in groups to have more power of investment and be able to enter in more advanced stages of development.

  They are generally persons with an entrepreneurial experience that finance the startups and do mentorship and help the owner take the right decision.
- BANKS: they are not the first investor when thinking about startups, especially when they need to grow a lot and requires a high amount of capital to be invested in something risky. But in the first stage, when the investor needs the money to start implementing his idea, banks are still one of the most used financial means. In addition, always more banks are adapting to the startup environment creating ad-hoc products for these types of investment. Furthermore, some banks are creating their own section for investment in later stages in startup, acting as a VC fund.
- OTHER: many other actors could bring investment to startups. As said, the government itself could decide to intervene directly. The customer could be the first investor, or better to say financier, of a startup. In fact, various forms of crowdfunding allow everyone interested in investing in startups having in exchange something (could be equity, the products, nothing and so on).

- UNIVERSITIES and RESEARCH CENTERS: The focal role of these institutes is to prepare in one case and provide and enlarge in the other case the necessary knowledge. Universities can create tomorrow's entrepreneur forming students with an entrepreneurial mindset and able to deal with uncertainty and aware of the risks and opportunities that a startup gives. On the other side, research centers are where a lot of times the innovative ideas are born thanks to the focus on innovative products and techniques. They are fundamental to prepare high skilled workers able to accept the challenge of creative environments.

GOVERNMENT ACTIONS

Having talked about the effects of startups on the national economy, let’s see the other side of the medal. What are the actions that governments can take and their impact on startups?

Policymakers can play a crucial role in the development of startups and the environment that favors their born and growth. In fact, as suggested by empirical evidence, startups are more exposed to the policy environment than incumbents (Calvino, Criscuolo, & Menon, 2016). The government can use different levers to help directly or indirectly the companies.

These programs are mainly divided in direct support to the companies (mostly grants) and indirect support (tax incentives). It has been noticed that small firms that still don't have high costs of R&D suit better with a financial policy that have the goal of increase the public expense (grants and direct investments). In contrast, on the other side, those companies that were already performing R&D activities are helped more by tax incentives, leading to an increase of their innovative activities (Busom, Corchuelo, & Martinez-Ros, 2014).

In any case, it has been demonstrated that, whatever the mix of the direct or indirect help a government decide to adopt, they have a positive effect on SME performance (even if direct grants seems to produce more results) (Radas, Anic, Tafro, & Wegner, 2015)

It has also been demonstrated that similar companies in the same environment perform differently if they benefit from the programs promoted by the country or not. In addition, those who generally decide to use the support given are inclined to evaluate different support sources and use them all mixed (Manna & Sager, 2006).

Some other studies have gone more in the specific finding that for a sustainable startup, there should be suitable legal policies that include tax incentives in the first 3-5 years (Le Trinh, 2019).

Following Kumar and Liu, the government can lead to entrepreneurial development by deploying resources that include the provision of an environment conducive to business that will greatly promote entrepreneurship (Kumar & Liu , 2005)
Some scholars have also asked themselves if it is optimal to finance and promote entrepreneurship without any barrier, posing the idea that only the successful (or those that are forecasted to be successful) should receive the help. In this way, the country could be able to focus the efforts on the winners. In a provocative essay, Shane stated that "*policy makers should stop subsidizing the formation of the typical startup and focus on the subset of businesses with growth potential*" (Shane, 2009). This is a great strategy, in theory, but it has several limitations. Supposing we would be able to predict the success of new entrants looking at the data (and we are not at 100%), we still have the problem that there is a lack of detailed data "ex-ante". In fact, many of these new firms are tiny entities with limited public information to use for analysis (OECD, 2018).

The alternative solution to go around this issue would be to adopt a “let one hundred flowers bloom” approach. In this context, the policy maker's role would be to facilitate both the entry and the exit of businesses and design an insolvency regime that is not “too” punitive. In this way, the entrepreneurs would be able to experiment with various innovative strategies and technologies and at the same time, have the ability to scale up or down (OECD, 2018).

Policymakers can then decide to act on what support startups. They could, in fact, decide to use direct or indirect incentives to help universities, accelerators/incubators, investors, etc. All these actions could go directly to influence one or another factor missing in the market. For example, financing university there is more probability to have more skilled personnel available. Giving tax incentives to investors allow to reduce their risk on investments and so to invest more giving more capital to the companies

In addition to all these types of help, governments worldwide, especially the most developed countries, have noticed that the comparative advantage of the high-cost states, like North America and Western Europe, is increasingly based on knowledge-driven innovative activity. Therefore, a new policy approach is emerging, intending to enable the creation and commercialization of knowledge. Examples of such policies include encouraging R&D, venture capital, and new-firm startups. (Radas & Bozic, 2009)

Always more countries are creating support programs for small innovative businesses in order to sustain their development and drive innovation to grow. There are plenty of examples of them, including the US, France, Germany and Italy too. For example, the government in India is investing hard in startup creation. In Hong Kong the government improved legal procedures to make them more conducive for startups. In Finland, it is cooperating with large companies like Nokia to support both local and foreign startups. In Brazil, instead, government is giving direct grants to support startups directly but also to private accelerators.

INDUSTRY AND MARKET

Industry and market are two fundamental variables that need to be considered when computing the potential value of a startup. They influence the capacity of the product or service produced to be sold and gives an idea of how the startup can grow in the future.

It has been demonstrated that industry structure affects the valuation of a new venture (Miloud, Aspelund, & Cabrol, 2012).

There are two critical elements in the relationship between industry and startups: product differentiation and industry growth. Looking at the first one, in strategic management history, the more there is product differentiation and the more the performance of companies islvated (Caves, 1972). This is beneficial for startup companies that aim to bring to the market mainly new products, achieving competitive advantage through product differentiation with respect to incumbents.

On the other side, considering the industry growth rate, it has been demonstrated that it is positively associated with industry profitability. In particular, growth rates are usually high for industries in an early life cycle. It is simpler for new ventures to enter and acquire market power thanks to lower entry barriers and easiness of reaching a minimum scale (Porter, 1980). All this put together highlights the importance of the industry of application in the valuation ex-ante of the opportunities to grow that a startup has. In fact, VC usually gives higher valuations to new ventures operating in developing markets. Also, this type of situation allows the entrepreneur to have more room for mistakes. Consequently, the investments are less risky thannvesting in a new venture operating in a low growth market (Miloud, Aspelund, & Cabrol, 2012).

This view connects with Porter's five forces used to analyze an industry and a market to decide if it's convenient or not to enter. Following this theory, considering internal assets as fixed and consolidated, a company can value different opportunities in the market, deciding to pursue the most interesting ones based on its strengths and to enter and exit based on the profitability of the market, its possibility to overcome the performance of incumbents and looking at the factors that affect it: competition level, presence of substitute products, bargaining power of suppliers and customers (Porter, 1980). Looking at a startup with this concept in mind, it's easy to understand that we could foresee the possibility to success it has, valuating the idea is bringing on. What is the destination market, how valuable it is, the potential of growth, and who are the actors already in the market? A strong business plan can answer all the questions above and the stronger it is, the higher the possibility the company will succeed.
But in reality, success does not come only from the theoretical goodness of a position. Startups need to be able to execute the strategy they planned and to change it if necessary. In this term, Porter's theory cannot entirely explain the success of a startup because it is looking mainly at the outside of the company. This is not always easily applicable to a startup and probably it is not even the right thing to do. In fact, startups, especially those born to be big, have the final scope to create their own market to satisfy those needs that people already don't know to have. This status is the so-called "blue-ocean", when a company is able to reach a market in which it has no rivalry at all. To give a more complete view of the possibilities and value of a startup, a lot of research focuses on studying

startups' internal side of the company, which is considered to be even more critical for the startup's success.

INTERNAL RESOURCES

Following the Resource-Based View theory (RBV), what really matters for a company to be successful is the implementation/ownership of valuable, rare, inimitable and organized (VRIO) resources. This means that the competitive advantage a company has with respect to the others is not driven (only) by its strategical positioning choices but, instead, it's based on how it develops, acquires and uses its internal resources. To stress the theory to its limits, we can say that internal resources are the primary determinant and possibly unique sources of a firm's superior competitive advantage. (Barney J. , 1991) (Wernerfelt, 1984).

A lot of studies have focused on this point, not only for startups. What has emerged is that internal resources matter for the development of all types of firms, from low-tech to high-tech ones, and also positively affects the firm survival capacity. (Barney J. B., 1991) (Cefis & Marsili, 2005)

This theory particularly applies when speaking about a market characterized by high uncertainty and variability. Using internal resources, a company can pivot between different industry sticking to its core to create different products or services.
Various types of resources can be valuable: human capital (high skilled employees), natural resources, access to financing, patents and so on. In this contest, a startup that owns a patent on its products has an advantage over the others. It has been demonstrated, in fact, that startups which own at least one IP are generally performing better than others and, in particular for Information Technology startups, the number of patents applied by a startup is positively related to the likelihood of venture capital investment (Conti , Thursby , & Thursby, 2013).
This is true especially for companies operating in sectors with strong Intellectual Property regimes, while the same does not apply to sectors characterized by lower patent intensity. (Furman & Seamans, 2018)

Complementary to RBV is the vision of KBV (Knowledge Based View) that takes the same concept of RBV but focuses particularly on knowledge as the primary asset and most valuable resource in the company. As in the RBV, in this theory, knowledge is considered the primary factor of production from which a firm can derive a competitive advantage (Villar, Alegre, & Pla-Barber, 2014).

In the case of startups, knowledge increase and enlargement are mainly driven by innovation. So, the company's capacity to create innovative products is part of the competitive advantage it can have on competitors. As mentioned by Paradkar, Knight, & Hansen, "*start-ups that are ultimately successful compete with rival firms by creating entirely new benefits for customers or by significantly improving existing ones*". (Paradkar, Knight, & Hansen, 2015)
The ability to bring innovation has been recognized as one of the primary driver of organizations' survival and success. Furthermore, it helps in the development of new capabilities that allow to achieve and sustain better performance or superior profitability in the increasingly complex, competitive and rapidly changing environment. (Hyrynsalmi, Aarikka-Stenroos, & Seppoanen, 2017)
Innovative companies, creating and introducing new products and technologies, can generate extraordinary economic performance and have even been seen as economic growth engines (Wiklund & Shepherd, 2005).

Focusing on technology-based firms, resources that affect the most the startups' ability to survive and the capacity to perform well are R&D capability and employees' know-how (Esteve-Perez & Manez-Castillejo, 2008) (Stuart, 2000).

The next step in the RBV theory is to recognize that resources by themselves do not affect the company's performance. They need to be used together and in an efficient way. This bring to the creation of the so-called "competencies". In fact, companies with a similar bundle of resources can have results that are at the opposite based on their ability to exploit them. Following this theory, the competitive advantage is not only given by the resources that a company owns, but it is mainly provided by how a company is able to exploit them through the creation of routines and the interconnection between the different resources.
On this theory, there is a fascinating study done by C.Yang et al. in which he looks at three fundamental resources (R&D capabilities, high skilled employees and internal financing availability) and how they interact, demonstrating that the startups who owns at least two of them contemporary have better survival than those which only owns and use one (Yang , Bossink, & Peverelli, 2017)

HUMAN CAPITAL

Human Capital is generally recognized in an individual as the sum of personal attributes such as knowledge, experiences, personality traits, abilities etc. When we talk about this concept, we end up

always talking about the topic of knowledge. In fact, knowledge can be of various types, explicit or implicit, tacit or shared, etc. However, it has a strong relationship with the person and the different knowledge that two individuals have can make the difference in an unpredictable environment.
Referring to startups, human capital becomes the sum of personal knowledge, attitudes and experiences that the various staff members own.

Having a startup sustained by a great idea and a significant competitive advantage is not enough in an environment that strives to innovate at all costs and that changes so fast. Your advantage today could be no more the same tomorrow. As it was studied, human capital has a more substantial influence than anything else on a startup's ability to survive and succeed. In fact, a valuable and well-composed leading team has the ability to establish a vision and plan a path, step by step, to reach the goal passing through difficulties and changes in strategy. (Cantamessa & Colombelli, 2016) (Crook , Todd, Combos, & Woehr, 2011)

Skilled-workers affect the survival and performance of a company. An explanation for this phenomenon is that their capabilities, skills and knowledge are most of the time of a tacit nature making them difficult to imitate. During the years, different studies found out contrasting results on the utility and the influence of high-skilled workers for a company (Appunhami, 2007). In 2001, Hitt et al. found that there is a curvilinear relationship meaning that initially, the influence of skilled employees on firm performance is negative, but it turns positive at a higher level of human capital (U-shaped curve). (Hitt, Biermant, Shimizu, & Kochhar, 2001)

It has been demonstrated by some studies that the entrepreneur’s and founding team’s human capital can largely influence the startup’s ability to succeed through, for example, the capacity to attract venture capitals (Beckman, Burton, & O'Reilly, 2007). One of the most famous models in this is the phenomenon of Tesla and SpaceX, where the presence of Elon Musk has pushed enormously early phase investment because the investors trusted the ability of the founder in making a company grow. It has also been noticed that education and experience (two human capital variables) positively impact the company's profitability (Coleman, 2007).

Education itself has been at the center of many studies focused on the relation between the education level of an entrepreneur or the leading team of a company/startup and its performance. It has been found that entrepreneurs with a college education are dramatically less likely to fail than those who are not; in addition, College-educated entrepreneurs have greater access to loans from banks. In other

terms, having a higher educational level generally influences heavily the company's capacity to survive and grow. (Coleman, 2007)

Another central factor affecting human capital is experience. There can be various fields in which an entrepreneur team has experience: in the same industry, in another startup, in a particular role or even in starting a business from zero. All of them positively impact performance (Carter, Williams, & Reynolds, 1997), reducing sensibly the probability of company default. Furthermore, subsequent studies highlighted that entrepreneurs' previous experience drives the company to higher prospects for profitability, survival, and growth. (Bosma, van Praag, Thurik, & de Wit, 2004)

So it seems simple. It should be enough to select the right people. But how to understand who is the right entrepreneur or how to compose the perfect leading team?

ENTREPRENEUR AND LEADING TEAM

It is tough to understand the profile of the right entrepreneur. It has been recognized, for example, that new ventures founded by teams have better performance than the ones launched by a single entrepreneur (Klotz, 2014). This is given by the fact that different experiences and knowledge are combined to achieve the final goal. But let's look at what are the elements that make a team the right one (Cantamessa & Colombelli, 2016):

- DIVERSITY: a crucial point is to have a diversified team so that they are able to stimulate one another with different perspectives and will have more weapons to overcome obstacles. Diversity can be in various forms: age, nationality, culture, background and knowledge. These are just some example, but the topic can be expanded.
  At the same time, however, too much diversity could bring to problems in communication and worse performance.
- TEAM DIMENSION: the dimension of a team can vary in a range. The larger it is, the more it can be variegated and include different capacities from the various members. At the same time, though, if it is too large, it can bring to problems of governance and decision-making ability
- TEAM TENURE: team tenure is a solidity measure of the team. How much does the team member knows each other and how much they have worked together in the past years. It has been demonstrated that the higher the team tenure, the higher the performance that can be reached

There are also other characteristics that a team should own to be successful that are defined as behavioral dynamics. These are not specific for startups but have a broader scope for groups in general. For example, part of these dynamics is the "cognitive conflict", namely the ability to create a constructive discussion starting from different ideas and position. Other important characteristics are cohesion among the team members and a trusted environment.
It has been studied that turnovers (changing team members or simply adding new team members) positively impact team chemistry if this brings to a reduction in damaging conflict or the enrichment of competencies.

Another fundamental part of a leading startup board is for sure the figure of the Entrepreneur. As studied by Schmitt-Rodermund, in periods of high uncertainty and when a decision needs to be taken, what really matters is the ability and experience of the group leader that can give the right direction to the venture (Schmitt-Rodermund, 2004). More than having a good idea or the right business plan.
The competencies an entrepreneur needs to possess to succeed are generally split into four macro-areas: personality, motivation, competencies and social network ability.
In fact, a good entrepreneur needs to be the perfect mix between soft skills (ability to relate with the environment and with other people effectively, energy, profound determination in reach the goal over difficulties etc.) and hard skills (knowledge of the market, the technology, experience and management abilities).

EVALUATE PERFORMANCE

Evaluating the performances of startups is tricky due to the numerous variables that need to be assessed. As said earlier, for a startup, it is difficult to both have the data for the right measures and extract valuable information from them.

Hereafter, I present some measures used as performance measures on other research or that have been studied as startups' performance, giving them some positive and negative aspects of their utilization for startups.

Evaluating the performance in the following section I've partially followed the schema proposed by (Cantamessa & Colombelli, 2016).

FINANCIAL MEASURES

INCOME STATEMENT AND CASH FLOW MEASURES

This family of indicators is instrumental when describing a big company. It includes a wide variety of indicators that are able to look at multiple aspects of a company. But are they right in evaluating startups? Is it reasonable to look at them to assess the performance of a small venture focused on innovation?

The positive side of these indicators is that they have the capacity to show if a company is able to generate a margin on the product it is selling and to self-sustain its business. They can indicate the profitability of the idea, which can be an attractive measure for investors. Moreover, the analysis of cash flow for new ventures in the initial stage of their lives gives an insight into the financial needs it will have.

On the other side, there are some adverse effects on the use of these types of measures. In fact, a new company could still not be profitable in the early phase of its life because they are still developing the idea and trying to bring it to the market. This could lead to value erroneously the potential of a company and of the concept it's bringing on. (Cantamessa & Colombelli, 2016)

Some authors argue that these type of indicators have limited applicability to the startup reality and also could not be able to reflect sustained improvements on competitive performance because they are hard to obtain and difficult to interpret for startups (Caseiro & Coelho, 2018)

But let's see, among these, which ones are the most used and what literature says about them.

Revenue – Used in (Hyrynsalmi, Aarikka-Stenroos, & Seppoanen, 2017)

Revenues are often used as a measure for growth. It is a value easy to obtain from companies and explains how the company is surviving. According to some scholars, it is the most effective indicator to use as it can be translated and compared across countries and industry contexts. In addition, it seems to be the metric of choice for entrepreneurs (Hoy, McDougall, & Dsouza, 1992) (Sexton & Kasadra, 1992)

As previously said, it has some major downturns when trying to evaluate startups. In fact, especially in the early phases, a new venture could not be producing significant revenues because it is not selling

the product yet. This indicator doesn't evaluate the business's perspective of goodness but takes only immediate success (Sigal & Arie, 2005).

Despite this, it can still be considered a good indicator if not used alone, but instead in conjunction with other indicators. In addition, as the venture progress in the lifecycle, it always gains more importance and it becomes ever more meaningful.

Profitability – Used in (Qian, 2017) (Coleman, 2007) (Hyrynsalmi, Aarikka-Stenroos, & Seppoanen, 2017)

Profitability is seen as one of the major performance indicators for a company (Sigal & Arie, 2005) (Du Rietz & Henrekson, 2000) . It is crucial because it gives an idea of the feasibility of the business. It foresees the capacity of the company to gain more than what it spends to create the product. It has been used in several studies as a dependent variable indicating if one or the other variable affected performance.

Porter defined profitability as one of the significant long term performance measures due to its ability to foresee the company's capacity to stay in the market (Porter, 1980). Besides, a number of studies during history have promoted the firm's ability to generate profit as an important indicator of success.

As described for revenue, profitability has some downturns when looking at the early phase of the lifecycle for startups. New ventures in fact, could not be profitable for a long time but still be successful because of a great perspective in the future thanks to a well-structured business plan. It is the case of some of the most famous startup successes, like Tesla and Uber, that still struggled to be profitable after years from foundation and several investments runs. This could also depend on the market in which a company is operating and the type of product it is developing

BALANCE SHEET MEASURES

Balance sheet value

Looking at the total value of the balance sheet for a company can result in a good indicator of resources that the startups have created. It includes the most different things, from investments received to bank loans to the value of the patents owned. It is not a specific indicator that allows you to understand why a company is well-performing or not (and not even if it is performing well or not). But it is useful to compare the company to some other startups. In fact, it doesn't have limitations in

comparability between different markets, the business model used, or the financial strategy adopted because it's an overall indicator.

The downturn of this indicator, especially at the beginning of a newborn company, is that it fluctuates a lot due to the cyclical receiving of investments and using of resources to establish the business model and create the idea.

Investments Received -Used by (Audertesch, 2002)

One of the first measures we can look at to understand if a startup is performing well is to look at investments it has already received. Among the primary goals of a startup business, there is the one to receive capital to finance the growth. So, looking at this metric can give us an idea of how the market and experts in startups evaluate the entire business (idea, leading group, prospect, etc.). The ability to attract capital is one of the most considered when trying to understand a startup's success. It has been used as a dependent variable in many researches that tried to assert the importance of one or the other factor to the company's final success.

If other investors have invested a lot, there will be for sure something promising for its future. In addition, if these investments came from VCs, we know that they will help the company succeed through mentoring, driving decisions, and introducing essential tools to allow the company to overgrow. How do we know this? Simply because this is the last goal of a VC. This concept was called "interactive system" by Simon (Simon, 1995).

It has also been demonstrated that financial capital provides companies the possibility to experiment with new strategies and innovative projects that could not be done in a resource-constrained environment. The outcome is that a higher amount of capital links directly to higher innovativeness (Wiklund & Shepherd, 2005).

Intangible Assets & patents

Intangible assets are the right indicator you need to look at for startups. In fact, this type of company bases its power on ideas and knowledge, where they can compete with major companies. In a world where knowledge is taking over physical assets in terms of value for a firm, the intangible assets have the scope to quantify its value. There are included voices like patents, brand, trademarks and so on. This should be the indicator of the value of the knowledge of a company.

Patents are one of the main components of this indicator for startups because, as highlighted in the literature, they can be seen as the level of innovation brought to the market by the company (Kaiser & Khun, 2020). Considering that innovation has been recognized as one of the main goals for startups, the value and number of patents are precious as performance indicators. This is useful especially for policymakers that promote entrepreneurship intending to generate innovation.

On the other side, not all the innovations are patentable (Kaiser & Khun, 2020) and, more than other, not all the inventions are patented. This is sometimes driven by a strategic move from the entrepreneur that doesn't want to share the knowledge with others and neither give them the possibility to develop new solutions taking the idea from his/her innovation.

Patents are not the only valuable part of intangible assets. Also trademarks and software are part of it and, especially the last one is acquiring always greater importance in the IT area.

NUMBER OF EMPLOYEES

Employment is really considered from a political perspective. In fact, governmental policies are often built to create new employment opportunities to satisfy the needs of a country. Having high employment rates is one of the goals of a country to guarantee welfare to the nation.

It is then crucial for new ventures to be able to generate new employment and grow through the years in the number of employees. Furthermore, it is seen by different scholars as an indicator of success for a startup because it implies that the business is growing (Kaiser & Khun, 2020). In any case, there are examples of startups that have grown a lot in other indicators keeping a low number of employees. This is typical of high-tech startups, like Instagram, that had less than 20 employees since the moment of the acquisition by Facebook.

GROWTH

Whenever we talk about a company's success, it's normal to talk about the growth it has had. Furthermore, growth has been recognized often as a proxy for business performance (Wiklund & Shepherd, 2005). But the concept itself is a debated one. In fact, in the literature, there are distinctions between the various type of growth a company can have and on the implications they have. It is neither correct to say that all the types of growth can co-exist. It could be that some firms

classified as high-growth firms looking at one metric are not the same looking at another one. This means that an increase in sales could be caused by an action that leadso a decrease in profitability and vice-versa (Murphy, Trailer, & Hill, 1996).

Looking at growth instead of absolute value is useful to have a numerical idea of the evolution of a company and its prospects. This is of particular importance for startups and gives a possibility to evaluate them. Their sizes could be different and change a lot YOY, making difficult a direct comparison between them. That's why the growth rate they have in different metrics assume a high level of importance.

All the precedents metrics analyzed can be used to look at the company's growth for different aspects. There are huge debates on which one is better to capture correctly how new ventures are developing and among the most used measures in different researches I have found sales levels, revenues, number of employees, capital raised and market share (Shepherd & Wiklund, 2009) (Gilbert, McDougall, & Audertsch, 2006)

SURVIVAL

Survival is intended as the capacity of the business to stay on the market for multiple years. It is calculated in years, looking at the difference between the start date and the final date of the activity. It has always been considered an important performance measure, especially for startup, because it indicates that a company can sustain itself. This is a measure that most stakeholders consider when evaluating a startup, but it can be more critical for some of them in particular. For example, banks will look at it before giving a loan to the company. The government as well is interested in seeing how startups survive and it is, somehow, the result of the policies that it applies to help them grow (Kaiser & Khun, 2020)

Even if some researchers think it needs to be treated to something different then a performance measures, it is still an often-used metric thanks to the easy availability of data and its significance for multiple parties involved.

Looking at the OECD (Organization for Economic Co-operation and Development) data, more than half of the new ventures fail within five years from the foundation. Considering that in different countries we have considerable differences in this survival rate in 5 years (from 18% in Lithuania to the 63% in Sweden), it is clear that from this data we can extract some feedback. (OECD, 2018)

IS IT RIGHT TO USE THE SAME METRICS FOR ALL THE STARTUPS?

Until now, I have analyzed metrics for startup performance without the use of any type of distinction between startups themselves.

Some scholars indeed argue that we should evaluate the performance differently based on some clusters to divide startups based on some control variables. “Startup” is a wide concept that includes many different types of companies and businesses inside. It is a sort of horizontal group that identifies actors with different characteristics that have some common factors but not all. To differentiate, we can use various metrics such as the company's age, market sector/industry, investment rounds, level of capital raised etc. There is a wide variety of clusters that can create more granularity on performance prediction and evaluation.

One thing emerging for example is that we should not look at the revenues generated in an early phase of the startup’s life. In this phase in fact, it’s too early and difficult to understand what’s driving this and not necessary a company which is not generating revenue will grow less than another one in the opposite situation

Different authors tend to distinguish between different phases in the lifecycle of a startup. As said earlier, there could be a distinction given by the stage of financing reached by the company (pre-seed, seed, series A, etc.). But this is not the only one. Among the most famous there is the distinction proposed by Ries in his book “Lean Startups” where the author identifies five main stages: empathy, stickiness, virality, revenue and scale (Ries, 2011).
The idea is that at every stage, we should look at some different measures to understand if a startup is performing on average or outperforming.

Because of this difference, some authors have tried to go more specific to identify the startup performance metrics. For example, Croll and Yoskovitz studied and identified the metrics to use in 6 different types of startups: e-commerce, software as a service (Saas), mobile apps, media suites, user-generated content and two-sided marketplaces. For each of them, they identified different measures to look at to understand which was the actual performance of startups and to foresee future development (Croll & Yoskovitz, 2013).

Of course, the more we go in the specific and the more we can be accurate in predictions. But on the other side, the more we go on the particular and the less the results and the method can be applied to various situations.

In addiction, some studies found out that creating clusters can be detrimental, even more if these distinctions bring to sector-based policy applications. This in fact, has been defined as antithetical concerning entrepreneurship. (Isenberg, 2011)

The idea that measures need to follow the startups' stage, moreover, is not universally shared. Some studies demonstrate there is not a significant relationship between the success of a startup and its measures in various stage of life. (Nopadol, 2017)

ARTIFICIAL INTELLIGENCE

AI HISTORY AND DEFINITION

Artificial Intelligence (AI) is a term that always more is becoming part of our daily vocabulary. We hear about it from the news, read about it in articles on technology, and see it implemented in everyday objects. Most of the time, we use it as a defined concept, but it is not in reality.

Artificial Intelligence is not a single technology but a family of different technologies (MGI, 2018) that have something in common. There are different categorization types for these technologies and we'll look at them later in this chapter.

Besides, it has been recognized that having a precise characterization of AI is problematic because it changes based on the specific context of application and research (MGI, 2018)

But first of all, what are the definitions of AI broadly?

In the mid-80s, Roger Shank interrogates himself about the term's nature, trying to put it under a macro area. Is it mathematics? Software engineering? Linguistic? Or maybe psychology? In the end, it is all of them but nothing in the specific. The first word of the term Artificial Intelligence that needs to be analyzed is "Intelligent". What do we mean when we say a machine is intelligent?

Following the same study, Shank distinguished between different aspects that an intelligent entity should possess:

- ***Communication***: it is not an essential feature of intelligence. But it is proven that the easier it is to communicate with an entity and the more intelligent it seems.
- ***Internal Knowledge***: we expect that an intelligent entity has full or partial knowledge of itself. To understand what a smart entity knows, our only choice is to ask and observe. If the answers we receive seems satisfying, we are inclined to believe the entity we are examining has some degree of intelligence
- ***World Knowledge***: an essential part of intelligence includes being aware of the outside world and utilizing the information on the outside world. It also implies being able to use past experiences (and so having memory of them) as a guide for future ones
- ***Internationality***: This is to analyze the goal-driven behavior that means knowing when one wants something and a plan to reach what he wants. In this aspect, we define intelligent entities

that are able to allow a plan constructed for situation A to be modified and adapted for situation B.

- ***Creativity***: every intelligent entity is assumed to have some degree of creativity. This means not only creativity in various types of art but also the ability to adapt to changes and to be able to learn from experiences (Schank, 1987)

Looking at the dictionary, we have different definitions of AI. The English Oxford Living Dictionary, for example, gives this definition: "*The theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.*" While he Encyclopedia Britannica states, "artificial intelligence (AI), the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings."

One of the most credited definition looks at AI as a system that can learn how to learn. (Corea, 2017) In practice, this means that it is a series of instructions included in an algorithm that allows computers to build and write new algorithms even if they are not explicitly programmed for it. It is "Artificial" because it is based purely on data, differently from human thinking. In fact, it is a process that tries to emulate human thought. Still, while human beings start from observing the physical world and connecting cause and effect in natural phenomena, AI is moved entirely by data and has no prior knowledge of the natural environment and neither of the relationship among those data.

Some streamlines link more AI to the human being, defining it as "*the discipline which studies the design, the development and the realization of systems able to simulate the ability, the reasoning capacity and the behavior of human beings"* (Fabbri, 2020) and in also "*AI is a science and a set of computational technologies that are inspired by – but typically operate quite differently from- the ways people use their nervous systems and bodies to sense, learn, reason and take action"* (Stone, et al., 2016)

Not always AI is considered the trial to copy human capabilities. A line of thought sees AI splitted into two aspects: the first one is the attempt to reproduce human capabilities. In contrast, the other one aims to expand human abilities to make better decisions thanks to computers' power. (Markoff, 2016)

On the other side, some scholars suggest avoiding giving a unique definition of AI because it is a broad concept that includes different disciplines. The more we try to provide a scientific definition that is all-around and all-encompassing, the more we risk ending in a too simplified and trivial one.

So far, we have understood that AI is a concept used to identify all those technologies and machines that have the scope to imitate the human ability of reasoning and creating connections of cause-effect and so that can adapt and respond to stimulus given from the outside.

But AI is not all the same. It has been found that it can be divided into two substrata: strong Artificial Intelligence and weak Artificial Intelligence.

Strong AI is defined as all those technologies also called "expert systems". They are software with performance and knowledge levels comparable to those of experts in a specific field. These systems are characterized by the ability to analyze and understand the language used and interact with the external environment.

On the opposite, are part of weak AI those systems that are used mainly for problem-solving. They do not have knowledge of the human's cognitive process and don't use them to process their data. It is as if they only figure to be intelligent, but in reality, they are not. (Fabbri, 2020)

Among the many definitions of AI we have today, it's interesting to go back a little in time and see how this term was born. AI is a continuously improving field where technologies evolve with policies, ethics, economy, and society. But where did everything begin?

The first time we've encountered the term "Artificial Intelligence", it was used in1955 by the mathematicians and informatics John McCarthy, Marvin Minsky, Nathaniel Rochester and Claude Shannon in an informal document.

But this was not the beginning of everything.

In fact, it is commonly known that the idea to simulate human reasoning through the use of a computer was born with the discovery of how synapsis inside our brain works. In 1943, McCulloch and Pitts demonstrated with a mathematical model that electric impulse between neurons could be set to calculate the three elementary logical operations: AND, OR NOT. From that point on the idea that a computer could have copied human brain took off.

The first and famous researcher in this technology has been Alan Turing. He implemented the so-called Turing test to define what AI is: "*We place something behind a curtain and it speaks with us. If we can't make difference between it and a human being then it will be AI*" (Turing, Intelligent machinery, 1948) (Turing, Computing machinery and intelligence, 1950) (Turing, Can a Machine Think, 1956)

After a first period of great enthusiasm around the topic, the researchers found a wall given by technology limitations. This brought the development in this field to freeze, at least until the mid-

'80s and is now living its most significant expansion thanks to the support given by technology improvement.

TYPES OF AI

AI, as said, is a comprehensive term that includes a wide variety of technologies inside. These technologies are distinguished based on different parameters (components used, type of algorithm, etc) and this leads to not having a unique distinction on the various forms of Artificial Intelligence.

A first schema finds five significant groups in terms of what AI does (Fabbri, 2020):

- ***MACHINE LEARNING***: it includes all those technologies that are able to learn automatically. It is the ability of the machine to learn and execute some tasks based on algorithms that iteratively learn from data analyzed and produced. It has a significant expansion in the last ten years. This is mainly driven by the massive quantity of data that are now available on which it can apply and test the mathematical model that supports it. In fact, to learn it has to consume very high quantities of data in order to see most of the possible scenarios.
- ***DEEP LEARNING***: it is a sub-category of machine learning. Also for this type of technology, the scope is the one of learning from data and being trained. The characterization of this branch is that its structure tries to emulate the one of the human brains. It is indeed based on artificial neural network technology. The real power of the algorithm for deep learning is given by the ability to train the neural network and make it acquire experience. This generally comes in 3 steps:
    - Learning phase
    - Test phase
    - Production phase
- ***NATURAL LANGUAGE PROCESSING:*** also named NLP, the scope of this part of the AI is to give to the Informatic System the linguistic knowledge to:
    - Assist human in tasks linked with language
    - Interact naturally with humans
    - Extract information automatically from texts and media in general

This use of AI is based on the previous two. It has great expansion thanks to the development in technology that has allowed a tremendous potentiality for machine learning and deep learning algorithms.

- ***IMAGE RECOGNITION*:** the field of image recognition (also said "computer vision") is one of the most pushed parts of AI of the last years. Thanks to the neural network and increase computing capacity, many efforts have been directed toward this field. This technology allows recognizing objects, persons, animals and whatever they are instructed to acknowledge from images and videos. These types of algorithms are used for a variety of scope that can go from identifying defects on pieces in a production plant to identifying people in a city.
- ***AUGMENTED REALITY & VIRTUAL REALITY***: These are the types of algorithms that create visual modifications of reality.
    - ***Augmented reality***: it represents the reality we have around us but is able to insert virtual 3D objects understanding the dimensions of the environment through the use of sensors and algorithms.
    - ***Virtual reality***: it simulates an environment completely. The user enters this new reality where everything around him is virtually created. It can be "immersive" or "not immersive" based on the type of visors the user uses to enter the reality.

This is not the only classification for AI categories, but it gives an idea of what it can do and how. A slightly different division is the one provided by McKinsey that, in its annual report, identified five broad categories of AI technologies: computer vision, natural language, virtual assistants, robotic process automation and advanced machine learning (MGI, 2018).

The "Osservatorio del Politecnico di Milano" instead, analyzing the AI solutions implemented in Italy, especially in the northern regions, fin out eight different class of solutions that they defined as follows (Osservatorio del Politecnico di Milano, 2018):

- ***Intelligent data processing***: all those types of implementations that use algotithms of AI on data to extract information and action consequently. In this are included:
    - Pattern discovery
    - Predictive analysis
    - Fraud/Anomaly detection
    - Contents/Design creation
    - Monitoring &control

- ***Virtual assistant/chatbot***
- ***Recommendation***: these are those software that have the scope to drive preferences, interests or, more generally, users choices based on the information provided
- ***Image processing***
- ***Autonomous Vehicles***: this category includes all the projects about self-driving cars but also the ones which focus on drones for transportation or the cargo ships
- ***Intelligent objects***
- ***Language processing***
- ***Autonomous robots***

GROWING IMPORTANCE AND RESEARCH

AI is driving always more the interest of researchers, entrepreneurs, investors and all the other players in the economic field.

Some interesting statistics can explain who much the involvement in this phenomenon is growing. The AI Index, a non-profit project built to track activity and progress in AI, found out that (Perrault, et al., 2019):

- between 1998 and 2013, the volume of peer-reviewed AI papers has grown by more than 300%.
- Attendance at AI conferences continues to increase significantly. In 2019, the largest, NeurIPS, had
  13,500 attendees, up 41% over 2018 and over 800% relative to 2012
- In the US, the share of jobs in AI-related topics increased from 0.26% of total jobs posted in 2010 to 1.32% in October 2019, with the highest percentage in Machine Learning (0.51% of total jobs)
- In 2019, global private AI investment was over $70B
- Counts of patent applications with the term “artificial intelligence” in its abstract have also increased dramatically; applications in 2016 and 2017 were roughly double the average applications in 2002-2015
- At the graduate level, AI has rapidly become the most popular specialization among computer science Ph.D. students in North America, with over twice as many students as the second most popular specialization (security/information assurance)

These are just some data pills, but they give an idea of how much and how fast AI is evolving, including always more people and investments around the world.

In fact, investments have been continuously increasing since 2012 and they've grown by over 40% between 2013 and 2016 (MGI, 2018).

This progress is also facilitated by the contemporary evolution of technology that allows to run always more complex algorithms. The main contribution to AI has arrived from 3 areas (Fabbri, 2020):

- High increase in computing power and capacity. Today's GPUs are 40 to 80 times faster than the quickest version available in 2013
- Explosion of availability of data worldwide that allow to have food to feed the algorithm to test them and make them learn. It is estimated that there may be 163 zettabytes of data by 2025 (10 times higher than 2016)
- Algorithms are progressing a lot, being continuously improved

These are some data looking at past years, but what does projection say?

The future for AI is flourishing. The perspective for the applications of AI are yet to come, but almost all the analysts see AI as the future. It has been estimated that by 2030 it could deliver globally an additional 13$ trillion as economic activity, which is nearly a 16% increase in cumulative GDP compared with today. This is a massive increase.

As brought out by some studies, the evolution and the diffusion of these types of technologies could have the classical S-shaped curve, with a slow start due to high costs and investments needed at the beginning but with a subsequent acceleration driven by the cumulative effect of competition and improvement in complementary capabilities. (Fabbri, 2020) (Osservatorio del Politecnico di Milano, 2018)

All this potential is generating opportunities and preoccupations. Indeed, it has been calculated that those countries that will be able to take advantage in the initial phase (the front-runners) will be able to benefit disproportionately. This could increase the already existing gap between countries. This theory is also valid for companies themselves. Companies that will be able to establish as AI

leaders can potentially double their return by 2030, achieving a significant competitive advantage over competitors that would fall behind. (MGI, 2018).

In all this optimism high growth projections, where is Italy placed?

In Italy, AI is still moving its first steps. If for the rest of the world the S-curve has begun its sloped part, starting to invest heavily in AI and delivering results, in Italy we are still at an initial phase. (Osservatorio del Politecnico di Milano, 2018). In fact, only 15% of Italian companies have already deployed AI beyond early-stage pilot and also Italy invested in 2017 and 2018 only 20M€ in AI development (AmCham, 2019).
This Italian delay is due to a series of factors, both economic and cultural. One of the main difficulties is the scarcity of human capital. The population does not meet the need of high skilled worker and there is a poor digital working culture (especially in southern regions) (AGID, 2019)

EFFECT OF AI ON ECONOMY

As seen up until now, AI includes a wide variety of aspects and can be defined in multiple ways. It is difficult to understand if it is more an entirely new area of application or, instead, a tool that can be used in a variety of different areas (Furman & Seamans, 2018). On this topic, some studies highlight that AI seems to be transforming into a general-purpose technology (GPT) and that the adoption of it could generate major social welfare and benefits in productivity for countries around the world. It is also believed to drive innovation across different sectors. (Perrault, et al., 2019)

Regardless of this, we need to understand why it is useful to study it from a policy perspective and invest in it. What are the effects that this field can have on the economy?

AI falls, as seen, under broader categories such as Information Technology (IT) and automation on processes. In fact, implementing AI has the scope of automating some actions that were previously done by humans.

Leaving aside the ethical discussion that is going on on AI, because it is not the scope of the thesis, the automation topic is discussed in the literature under the point of view of occupation.

Historically, automation appears to have different effects on the occupation. On the one hand, for example, in the 80s and 90s, it led to market labor polarization when middle-skilled jobs were

displaced by automation (Katz, Kearney, & Autor, 2006). But on the other hand, there is evidence that this process has not continued in the last ten to twenty years (Schmitt, Shierholz, & Mishel, 2013).

However, it has been noticed that technology is replacing specific tasks rather than entire jobs, which means that still is remaining space for humans. Instead, not only will employment remain stable but humans will also have more supporting tools given by AI innovation. This is confirmed by the evidence presented by the unemployment rate in the US. Even if we've had significant improvements in technology in the last decades, it has stayed stable, cycling around 4 and 5 percent (Furman & Seamans, 2018).

So, in the end, there is no clear evidence that AI intelligence and automation, in particular, is increasing the level of unemployment. What is sure is that the roles are changing and that machines now execute some tasks that were done by humans. But this has led to the opening of different positions for humans. There is no clear evidence on this topic, and labor effects are mixed (Furman & Seamans, 2018).

If we look instead at economic and financial measures, there is quite a high level of optimism.

It has already been demonstrated that Information Technology, in general, has a broad positive impact on productivity (Oliner, Schiel, & Stiroh, 2007) (Jorgenson, Dale, Mun, & Stiroh, 2008). Indeed, they do boost productivity growth (Furman & Seamans, 2018). It has been forecasted that AI can be the engine of growth for the next year and that its contribution may be 3 or 4 times higher by 2030. In the end, AI may produce an activity growth annually on average of 1.2% between now and 2030 (MGI, 2018).

Moreover, AI is recognized as one of the fields driving more innovation recently. It has been demonstrated that there is a close relation between AI and innovation rate. In this sense, we have a double connection. In fact, AI is a field in which there is a lot of R&D and this lead to have multiple patents that, in the end, are the metrics of innovation. On the other side instead, AI promotes directly technological innovation, being able to accelerate the creation of knowledge and technology spillover, improving learning and absorptive capacities and increasing R&D and talent investment (Liua, Chang, Forrest, & Yang, 2020).

As already showed in the previous chapter, innovation is generally linked to higher performance, especially for startups, as confirmed by several studies (Romer, 1990).

SECTORS OF DIFFUSION

As already said in the definitions, AI is a field that is useful for all the sectors. It serves as a service to improve the processes and the outcomes for the other type of industries and can be used for various scopes.
In 2018 it was used in supply chains, fixed assets maintenance, R&D and sales and marketing (MGI, 2018).

The sectors that use the most AI and in which we've seen the major evolutions are (Fabbri, 2020):

- ***Public/Private Health***:
    - It uses AI for the analysis of big data and for the clinic history of patients using machine learning
    - There are big promises on the ability the AI will have in the prediction and prevention of disease or pandemics on a large scale
    - Multiple applications for the patient, starting from the live monitoring of general health through the use of some wearable design, to arrive at routine tests without the intervention of the doctor. Finally, it can be used to calculate probabilities that a customer is affected by a specific disease. It can also support all the studies in genetics
    - In 2018 Accenture conducted a market analysis forecasting that the USA could save $150B in health care by 2026 thanks to AI applications
- ***Automotive and Autonomous Driving***:
    - There are plenty of AI applications in the automotive environment, from autonomous driving to the management of all the robotics that is used inside production plants
    - Regarding autonomous driving, there are still a lot of concerns, especially from an ethical point of view. But still, there are many other different devices in a car that are based on AI, such as the intelligent cameras used to detect if the driver is tired and if he/she needs a break. Also, there are a growing number of services to support the driver: anti collisions systems, recognition of pedestrians or cyclists in the road, etc.
    - Following the giant in finance BlackRock, in 2025, 98% of vehicles will be connected and in 2035, 75% of them will be an autonomous driving one
- ***Finance and Stock Market***:
    - AI in finance can have a significant role with the ability to recognize and predict some trend and so to follow them

- In a research done by Accenture in 2018 (involving 100 CEOs and top managers and 1300 employees worldwide involved in financial sectors), they found out that 76% of CXO of the bank institutes thinks that AI adoption by 2022 will be a critical success factor in this market

These are just three sectors with a particular interest in AI applications but also the other ones are improving. If we think at all the application that we are seeing in e-commerce or in customer relations with chatbot, suggestion on what to buy, etc., we can have an idea of how much AI is evolving and growing almost in all the sectors.

For startups on this end, if we consider European new ventures, we can see that the trends by industry of application in 2019 see the majority of companies involved in B2B services (70%) with almost 35% using AI for general/cross-sectional applications (Roland Berger, 2019).
Following instead the research done from the Osservatorio of Politecnico di Milano, we see that the most active sector in AI in Italy is banking, finance & insurance one. If we put the focus on the functions instead, the processes that are most interested in projects in AI are the ones focused on final customer relations like marketing, sales and customer services. (Osservatorio del Politecnico di Milano, 2018)

POLICIES AND MARKET PERSPECTIVE

AI is always more characterized by few big players when we talk about countries and areas. This field doesn't differ from other industrial sectors where the two main forces contending worldwide are the USA and China. To support this thesis, it is enough to know that North America accounts for over 60% of global AI patent citation activity between 2014 and 2018 (Perrault, et al., 2019).

China has already posted its objectives: create a domestic market of 1 trillion renminbi (150 billion dollars) by the end of 2020 (stated in 2018) and become a world-leading AI center by 2030. The central government is pushing hard to reach supremacy in the AI market but also the private sector is investing a lot. Three internet giants – Alibaba, Baidu and Tencent- have created a "national team" to develop AI in specific sectors of applications such as autonomous vehicles, smart cities and medical imaging. (Furman & Seamans, AI and the Economy, 2018)

On the other side, the dominator of the market, at least for the moment, is still the USA. Multiple plans have been made in the last two years to support AI research and implementation of solutions. 2019 has marked the most significant year in funding in the US, considering both federal and private investments. For 2020, the President's Budget prioritizes AI as one of four key industries of the future. The federal expenses for non-defense-related AI research are set to jump to $1 billion. (Perrault, et al., 2019)

Following these two superpowers, there is the EU, that is starting to invest heavily in R&D. EU commission in 2018 set up a plan with the scope of investing up to $24 billion in research by 2020.

Also, the single state themselves are creating ad-hoc plans to push on AI development. In France, for example, in 2018, Macron unveiled a €1.5B plan to bring the country to compete as a global leader in AI. This plan is structured to give around 700 million to research, €100 million to AI startups and companies, €70 million annually through France's public investment Bank and €400 million to industrial projects in AI. Also Germany in 2018 launched its Artificial Intelligent Strategy and allocated €3B for investment in AI R&D. (Perrault, et al., 2019)

The EU still has a delay with respect to the US and China, which is due to several factors. They started the development later and have less availability of funding. Besides, policies on data, that in the EU are more stringent, do not facilitate data use to improve the AI algorithm.

Following Roland Berger analysis, there are some actions suggested that could improve the EU ability to attract funding and to make a sprint in the run to leadership in AI (Roland Berger, 2019):

1. Develop a pan-European fund
2. EIF (European Investment Fund) should play a major role in supporting late-stage funding
3. Build a standardized tax framework for venture capital across the EU to facilitate the mobility of capital
4. Build a tax depreciation schema for corporate because corporate venture capital has become a significant investor in AI
5. Member states should grant tax breaks to business angels
6. Facilitate access to cross-border crowdfunding
7. Create a European Startup Visa to be able to attract more talent from outside Europe

Italy in this world division is still playing a limited role. As highlighted by some reports in fact in the EU area is still unbalanced, meaning that most of the activity on AI is focused on 3 countries: France, UK and Germany. As a matter of facts, these three countries only are the source of 52% of AI patents granted in the EU (Roland Berger, 2019)

However, the government has launched a plan to increase research activity in Italy. It provides €1B of public investments by 2025 for the strategy implementation. The expected effect is that public investments will create a leverage effect on private investments of the same amount for a resulting total investment volume of €2B. (MISE, 2019)

These are some high-level plans and numbers regarding the AI sector in general that make us understand the attention that countries worldwide are dedicating to this argument. But in this context, what is the startup situation? What is the role of startups in the AI environment and how are they treated?

STARTUPS: SITUATION AND NEEDS

Startups in AI are facing a great increase in investments in the last years. According to 2019 data from the National Venture Capital Association, 1,356 AI-related companies in the US have raised $18.46B.

Moreover, it has been found that globally, investments in AI startups are having a continuous increase passing from a total of $1.38B raised in 2010 to more than $40.4B in 2018 alone. Funding has increased with an average annual growth rate of over 48% between these years (Perrault, et al., 2019).

Looking at EU startups, this percentage increase has been even higher if we look at funds received per year from 2014 to 2019, reaching an annual average of 55% for each country. An interesting statistic in the EU is that the four leaders countries (UK, France, Germany and Israel) attract 80% of the total amount of funds raised in the sector between 2009 and 2019 ($8.6B on the total of $10.8B) (Roland Berger, 2019).

As highlighted above, the disparity we saw in the overall market is still present also in startups. This is also confirmed by the results of the research done by CBInsight in 2017 that showed that $15.2B were invested globally in AI startups and nearly half of them (48%) went to China. Another 38% was invested in the US. (MGI, 2018) Looking at numbers, the US has the leadership in terms of active startups in the field while London and Boston demonstrates how talent, money and infrastructure are the main reasons of success for their AI ecosystems becoming success cases (Corea, 2017)

As already seen in previous chapter startups are main drivers of innovation and AI is not an exclusion in this term. Startups in fact, are financed and supported a lot in this field. However, AI startups have a slightly different structure and needs with respect to other startups.

In fact, it has been noticed that, being AI still in an evolution phase, it needs high upfront investments and a long period of research in order to be able to achieve some results. These bring startups to have a long pay-back period and so to be less palatable for investors. In addition, being their technical nature tough to understand and explain to investors leads to scarcity of investments in the early-stage company (Corea, 2017). This is mitigated, especially in recent years, by the importance that AI is acquiring at a worldwide level.

Looking at data of investment made in AI startups in recent years is easy to understand that these types of companies can give a strong acceleration to the local economy. They are not only able to innovate in high tech sectors, but they have shown to be able to attract an incredible amount of capital. In addition, they could have the potential to enforce the local position in the worldwide panorama of AI that is rapidly growing and moving always more money and power. Having a strong R&D in fact, is one of the way the AI ecosystem cements its position internationally (Roland Berger, 2019)

Considering the metrics that investors are analyzing to decide where to allocate their money for startups, have emerged a profile for the "good startup of AI" in which invest. The first early sign of good potential is the CEO/founder team's expertise in technical matters. It should prove to have the right mix of technical understanding, technology exposure, access to a broader network and vision and leadership in order to be able to attract the most brilliant talent to work for the startup. The second important point is to compose a multidisciplinary and diverse team. Finally, startups that are people-centric are ex-ante more likely to succeed. In addition, if they can create a developer community and make products easy-to-use and understand, they can experience less friction in adoptions of their products. (Corea, 2017)

Even if startups are strongly financed, they are facing some serious challenges in the field of AI. It has been already said that this technology needs a lot of time to be implemented and in particular, to make the algorithm learn. This action requires that the algorithm consumes enormous quantities of data. Even if a startup can implement the best algorithm possible, it will be useless without a large dataset for the initial training and the fine-tuning. (Furman & Seamans, 2018)
This is a major concern highlighted by other authors. It has been noticed that big companies (Facebook, Google, Amazon, etc.) have a tremendous competitive advantage in being able to have large quantities of data extracted from their commercial activities. In the end this could bring to an

absence of competition into the market and so to performance generated by AI that won't be as high as expected.

In addition, the collection of data could cause another major problem for AI: the creation of bias. It means that a company acquiring data could be subject to bias in collection and this would affect the results of the training of the algorithm and so the validity of the results.

Scholars have identified some policies and measures that could be applied to solve all these problems related to data.

One of the points stressed is the portability of the data. This concept already implemented in the EU says that the user is free to take its data to the preferred company to have a determined service. The user is the owner of its data and no matter what the company is, it always has the possibility to give or remove the permission to the company to operate with its data. With this policy in place, users are not bounded to stay with one company but can decide. This mechanism favors competition among firms simplifying the portability of data.

Apart from the positive theoretical effect that this theory has on a startup's business, there are also some downturns, among which 2 are the dominant ones:

- Startups would need to induce multiple individual to port their data to the startups
- Problem to understand where the data of the users will reside. This has implications for the data's security and consumer's privacy.

A solution for this last point would be to have a trusted third party to work as a repository for all the data collected that would allow conditional access to large datasets for AI-enabled startups. It could also have a secondary positive effect because collecting data from diverse sources and integrating them together may allow for identifying bias or skew in the data. (Himel & Seamans, 2017) (Mitchell & Brynjolfsson, 2017)

Other than this solution, there are a range of existing policies and approaches that can help the entry and development of AI-enabled startups, such as litigation strategies against big tech companies alleging anticompetitive conduct or consumer harm (Himel & Seamans, 2017)

The relation with tech giants is still something controversial in AI. The big players operating in the market of technology seem indeed to have understood the potential to innovate of young startups, which is changing the latter's growth model. In the last years big corporates are applying aggressive acquisition policies. They prefer to buy the startups instead of competing against them. After

acquisition, they tend to maintain elements of the startups' original brands and retain the entire existing team; we talk in this case of "acqui-hiring" strategy (Corea, 2017)

This type of strategy is also demonstrated by the fact that many startups in the AI field are experiencing an exit. In most cases, these are company acquisitions. In EU, in fact, in the last 5 years the number of exits has bumped, increasing by 64% overall (CAGR) and in the same period the acquirers have been in the majority of the cases corporates (92%) (70% of them were tech companies) followed by equity firms(5.5%) and finally investment companies (2.5%) (Roland Berger, 2019).

HYPOTHESIS

Arrived at this point, I have already exposed the two main topics of this thesis and how they can interact together. The scope I have from now on is testing if being a startup operating in AI is a predictor of better performance with respect to not be it. This question is well founded in all the theory exposed earlier, especially considering the type of market that AI is and its expansion. In fact, AI is becoming the new GPT (General Purpose Technology) and it's going to shape the world, so what I want to understand is if these effects are already evident in Italian startups. These could give signals to government to apply specific measures or not, to entrepreneurs to understand if it's the time to get involved in projects to develop this type of technology and to investors to value where to put their investment. In literature we find different studies that analyse high tech startups performance, but the case of AI is quite specific and unexplored.

REVENUE

The first metric I'm looking at is revenue. It is often used in literature to evaluate the companies' performance and gives a clear short-term indication of the company's ability to generate money and spread across different sectors and industries (Hoy, McDougall, & Dsouza, 1992). It is essential to consider that AI technology requires time to be implemented due to the need to teach the algorithm "how to think" and a significant amount of data (Furman & Seamans, 2018). In addition, considering the problems AI startups could have in acquiring data, I'm expecting that:

H1.a: AI affects negatively revenues

On the other side, AI is a fast expansion sector that is gaining even more importance worldwide. It is still in an early stage of life (Osservatorio del Politecnico di Milano, 2018) and it is growing really fast. As already found out, it is the best condition for a company to grow (Porter, 1980) and gives the possibility to entrepreneurs to be more flexible and have the space to make errors and so to learn and find the right way to improve their business (Miloud, Aspelund, & Cabrol, 2012). Considering all these foundings:

H1.b: AI affects revenue growth positively

INVESTMENTS RECEIVED

AI market is gaining always more interest from investors that are understanding the growth potential it can have. On one side, it has been found that high market values are associated withI even before we see some effects on productivity or revenues, suggesting that investors are anticipating future returns (Tambe , Hitt, Rock, & Brynjolfsson, 2019). Besides, AI's market is growing really fast and it has been demonstrated that this lowers the risk for investors because there is more space for mistakes in the management (Miloud, Aspelund, & Cabrol, 2012). This is bringing me to state that I'm expecting

H2.a: AI affects positively investments grow rate

On the other side, looking at literature it has been found out that this is not always true. As reported earlier, Corea in his book supported the opposite idea that AI startups have difficulties in receiving investments due to their complexity and the difficulty in explaining to investors the benefit

andotential of their product (Corea, 2017). Also, as already discussed, startups need time to develop a valuable product, which leads to aigher risk for investors (Paternoster, Giardino, Unterkalmsteiner, Gorschek, & Abrahamsson, 2014). If this is the prevailing phenomenon:

H2.b: AI in the early phases of life negatively affects investments received

INTANGIBLE ASSETS

Intangible assets have been recognized as part of the most looked metrics for a startup by literature thanks to their ability (or assumed ability) to give a valuation to the company's knowledge. AI, by definition, has its value in the algorithm and in the data it consumes and that it is able to generate. It has been found that Big Data technology is part of the transition from tangible assets towards intangible assets (Mihet & Philippon, 2019). In addition it has been demonstrated that intangible assets value overall in the economy has started to grow since 2010 and this is due to the coming of a wave of innovations based on data science, big data and AI (Tambe , Hitt, Rock, & Brynjolfsson, 2019).

Finally intangible assets can be used up to a certain point to value the innovativeness of a startup. It is recognized as one of the most important outcomes of a startup's production. It has been found that in industries mostly based on data, small firms provide the engine of innovative activity (Audretsch, 2002), more than in others. In fact, by definition, AIs a sector in which innovation is at the center, mainly because it's still a young industry in expansion (Osservatorio del Politecnico di Milano, 2018). This brings me to hypothesize that

H3.a: AI affects positively intangible assets values

H3.b: AI affects positively intangible assets growth rate

EMPLOYMENT

Finally, I've valued employment level for two reasons: it is one of the most used measures for growth in various articles on startups and it is vital from a governmental point of view. A lot f discussions are open on the role AI is having on employment. There are some evidences that say that AI is reducing employment due to its ability to replace activities done by humans (Katz, Kearney, & Autor, 2006) and other that, instead, confirms that employment level has not reduced due to AI implementation (Schmitt, Shierholz, & Mishel, 2013). There is no clear evidence in the literature to state that AI is a determinant factor for the employment level, so:

H4.a: AI does not affect the employment level

Instead, let's look at employment level under the growth perspective as done by different studies (Kaiser & Khun, 2020). It is possible to directly link employment to the other performance measure. If this s the case, as stated earlier, being AI a market that is experiencing high growth it is easier for the startups in this sector to grow accordingly (Miloud, Aspelund, & Cabrol, 2012). This brings me to formulate my last hypothesis:

H4.b: AI affects employment growth rate positively

STARTUP POLICIES IN ITALY

In this chapter, I want to look at what is the Italian environment for startup growth, what are the policies applied by the government to favor the startup business and what are the results by far of these policies and what could be done better (especially in the optic of favoring AI startups' characteristics).

ITALIAN ECOSYSTEM SITUATION

Italian economic environment is suffering from dualism on startups' topic.

On the one hand, it desperately needs a new wave of innovation to be able to give a push to economic growth and to re-start the Italian engine that is suffering in the last years. In fact, since the 1990's, Italy is facing a lack of productivity growth caused by several historical institutional frictions. These have resulted in a fragmented productive system with firms that have difficulties in scale-up and, in the end, are smaller and older than their counterparts in other developed countries (Criscuolo, Gal, & Menon, 2015). Furthermore, resources are less efficiently allocated than in other economies (Andrews & Cingano, 2014).

On the other hand, this market immobility and how it is structured bring young firms and new ventures in Italy to grow less and for a shorter period with respect to other developed economies, not allowing a space for new ventures expansion (Criscuolo, Gal, & Menon, 2014).

Moreover, there is another significant problem for developing young and innovative startups in the Italian market and it is a mix between structural and cultural one. It has been recognized that the characteristic of the Italian business sector tends to depress the domestic demand for innovative goods or services. Small firms have lower demand for innovative products and services because they don't have the resources to bear the risk of innovation and Italy is based on average on small companies (Pagano & Schivardi, 2003). In addition, many SMEs in Italy are family-owned and managed, which reduces the propensity to risk of the companies. (Cucculelli, 2018)

To solve this issue of the lack of a market for innovations in Italy there are different possibilities, but in the end, it is a cultural trait of the Italian population that has always been recognized as conservative and quite risk-averse. One way to change this trend could be to have a direct intervention of the state in this type of market. It could take the role of the promoter of change and also give the opportunity to the company to survive and grow without receiving direct help but creating the demand for the product. It has in fact been demonstrated that public procurement can be an essential driver of innovation. Generally, public procurement concentrates on sectors like health, defense, education and public administration (Appelt & Galindo-Rueda, 2016). Curious to notice that these are among the most important sectors of diffusion of AI worldwide.

Finally, a last ex-ante problem for the evolution of young firms in Italy is the high taxation level. They can be a barrier to growth for productive businesses, primarily due to high levels of income taxes and security contributions. Looking at numbers, Italy has a tax-to-GDP ratio of 42.9% that is

way higher than the average of OECD countries that equals 34.4%. Italy is ranked 6th out of 35 in terms of tax-to-GDP ratio among OECD countries.

In the last 5-10 years Italian Government has tried to reverse the trend of loosing of productivity and growth and also to push innovation with a series of measures. The most famous for startups is the "startups-act" that we are going to analyze hereafter. Some of the most notable measures in favor of innovation are:

- ***Smart & Start Italia***: it is a fund created by the "Ministero dello Svilubbo Economico" in 2014 that has the scope of finance new venture. They can ask to have financing between 100k and 1.5M euros. The financing is given in a program that foresees to have an interest-free mortgage for the 70% of the amount granted. The entire program is managed by Invitalia and has the scope to facilitate access to finance for young firms
- ***Italia Startup Visa & Italia Startup Hub***: the first program, launched in 2014, introduced the possibility to give the visa to EU citizens to enter in Italy to start an innovative startup and have a financial availability not lower than 50k euros. Instead, the second program, Italia Startup Hub, based on the previous model added the possibility to get a visa also to the non EU citizens that are already in possession of a residence permit and want to stay in the country to open a startup. The scope of these two measures is to simplify the process to get a visa through easy-to-follow online procedures.
- ***Investor Visa for Italy program***: it has been introduced in 2017 and provides the possibility to investors coming from outside the EU to get a 2-year visa if they demonstrate that they will invest at least 500k euros in innovative startups capital. The scope is to facilitate the procedure to enter the state to investors from the outside and reduce agency costs for Italian startups.
- ***R&D tax credit***: introduced in 2015 gives a fiscal advantage to all the Italian companies that have had incremental expenses in R&D between 2015 and 2020. It provides a 50% reduction in cost for R&D for startups and innovative SMEs.
- ***Iper-deprecation to acquire machines and technologies "Industry 4.0"***: it gives a greater annual deduction for depreciation related to the costs of acquiring goods, material and technologies that could transform the productive process in industry 4.0.
- ***National Fund for Innovation***: introduced in 2019 by the Ministry for Economic Development, it is a fund used for governmental venture capital investment in startups. It can directly invest in startups or indirectly by investing in funds that finance startups. The value of the fund should arrive near 1B euros.
- ***Plans for the development of AI***: some measures have been applied to follow the increasing importance of AI. In particular, it has been created a fund valuing 45M euros to finance the development of AI, blockchain and IoT. In addition, the government created an expert group on AI to discuss from now on effective plans to put in place in order to focus attention on AI and understand what the needs of this particular field are.

With all this being considered, the Italian government has created an ad-hoc policy to favor the diffusion of startups and an entrepreneurial mindset in general. It is called the "Startup Act".

THE "START-UP ACT"

Even with all the difficulties in implementing a good environment, the startups ecosystem in Italy is one of the most developed in Europe, it cannot compete with much more mature market like the English, German or French ones, but it is growing in last years driven by governmental actions and with the fulcrum in the city of Milan and Rome.

In Italy, the government has instituted in 2012 the Startup Act and created what is officially recognized as the "Innovative Startup" category.

Through this Act the government wants to promote the creation of an ecosystem of startups in Italy and to spread an entrepreneurial mindset in the country. The idea is that by creating a fast-moving environment of new companies also innovation will grow accordingly. From a societal perspective, instead, the legislator is pointing to an increase in occupation level, in particular between young generations. In addition, they are trying to create higher social mobility. Finally, there is the theme of attraction of both investment and talent, in order to revert the trend that is characterizing the country for years.

But what are the measures taken and the advantages for the newborn startups?

First of all in the Art.25 of the d.l 179/2012 the act defines an innovative startup as a "company that is not quoted on the market, that is new born (or at least constituted since less than 5 years), with HQ in Italy or in another EU country (but with an operative site in Italy), with annual revenue lower than 5 million of euros with a focus on products at high innovative vocation and not being the result of join or split of other companies". If a company satisfies all these conditions can be considered an Innovative Startup in Italy. But this is not enough to be included in the Registro Imprese and have all the benefits; in fact, there is a final and characterizing point. The company must satisfy at least one of the three following requisites:

1. At least 15% of the greatest between annual revenue and costs in used for R&D
2. The workforce is made by at least 1/3 by Ph.D. students or researchers, or alternatively, at least 2/3 is made by graduates with a master degree
3. The company own a registered patent or a protected software

If a company satisfies these requirements can access the benefits granted by the government. These are multiple and various. Mainly they go to influence:

1. the easiness of creation of the company giving the possibility to follow an online process completely free
2. the management of employment, removing some restrictions on contracts and on type of remuneration they have to give
3. tax payment, the government gives the possibility to these societies to be excluded from some tax impositions
4. easier management in case of failure of the company
5. a fiscal incentive for those who invest in the company
6. more possibilities to have funding from the banks through the creation of a fund to guarantee the loans

Reassuming, the state is giving incentive to the companies themselves and to the first stakeholders they need to interact with to be able to grow. On one side is doing this by removing costs and pressure on the entrepreneurs trying to push in this way the proliferation of new companies. On the other side, instead, they are applying measures to generate the investments to supply for the newborn demand for funding. They are achieving this in different ways, attracting new investors, reducing the fiscal pressure on investments, and being themselves the first provider of liquidity.

The Start Up Act has been only the beginning of various plans and incentives that Italy is putting on the field to push the Italian startup ecosystem's development. All these actions and documents are included in the governmental site of the Ministry for Economic Development (www.mise.gov.it). In addition, the results of these actions and all the startups that are now registered as innovative startups are included in the apposite section of the Registro Imprese (http://www.registroimprese.it/start-up-innovative). It is a public register that contains all the data about whatever company in Italy. It includes all the main public information of a company and the changes it occurs. It therefore is fundamental to elaborate indicators at a national level for economic and entrepreneurial scope.

EFFECTS OF THE POLICY

To build this chapter I based my data mainly on the results presented by the OECD report on policy effect in 2018 titled "*THE EVALUATION OF THE ITALIAN "START-UP ACT*"" (OECD, 2018).

The first thing to notice about this entire policy is that it has given the possibility to study the startups, their composition and their performance. This is not something taken for granted. In fact, before implementing this Act and the system created with the Registro Imprese, it was challenging to have

information on young companies because the data were not publicly available. Instead, the measure obliged the companies that want to access the benefits to give the information by compiling a format to be inserted in the register and recognized as “innovative startups”. This generates an important asset not only for the state (that can have a base of data to drive future policies) but also for many other stakeholders such as researchers, investors and entrepreneurs themselves.

Moving to an overview of the performance of the startups included in the plan, evidence shows that the policy positively affects a number of different metrics. It has been found that several balance sheet variables have improved, including book value of capital, assets, the ratio of intangible investments over tangible, investments and value added. Also patent filing probability and productivity have shown an increase.

As we can see from the figure below extracted from the OECD report, the positive effect of the policy materializes after the first year of registration into the system. The image shows, in fact, the effects of the policy decomposed in time (2 years before they enter the policy, 1,2 and 3 years into the system and finally, the results after losing their eligibility). In this analysis, the baseline values are taken from the year before the registration and the losing of eligibility could be due to end of 5 years inside the policy or because the companies don’t respect one or more criteria anymore.

Looking at assets, the value increases slightly in the second year but afterward, it becomes statistically not significant. Considering instead value-added, it shows how the positive effect remains pretty constant through the following years. This behavior is also noticed in revenues and book value of capital.

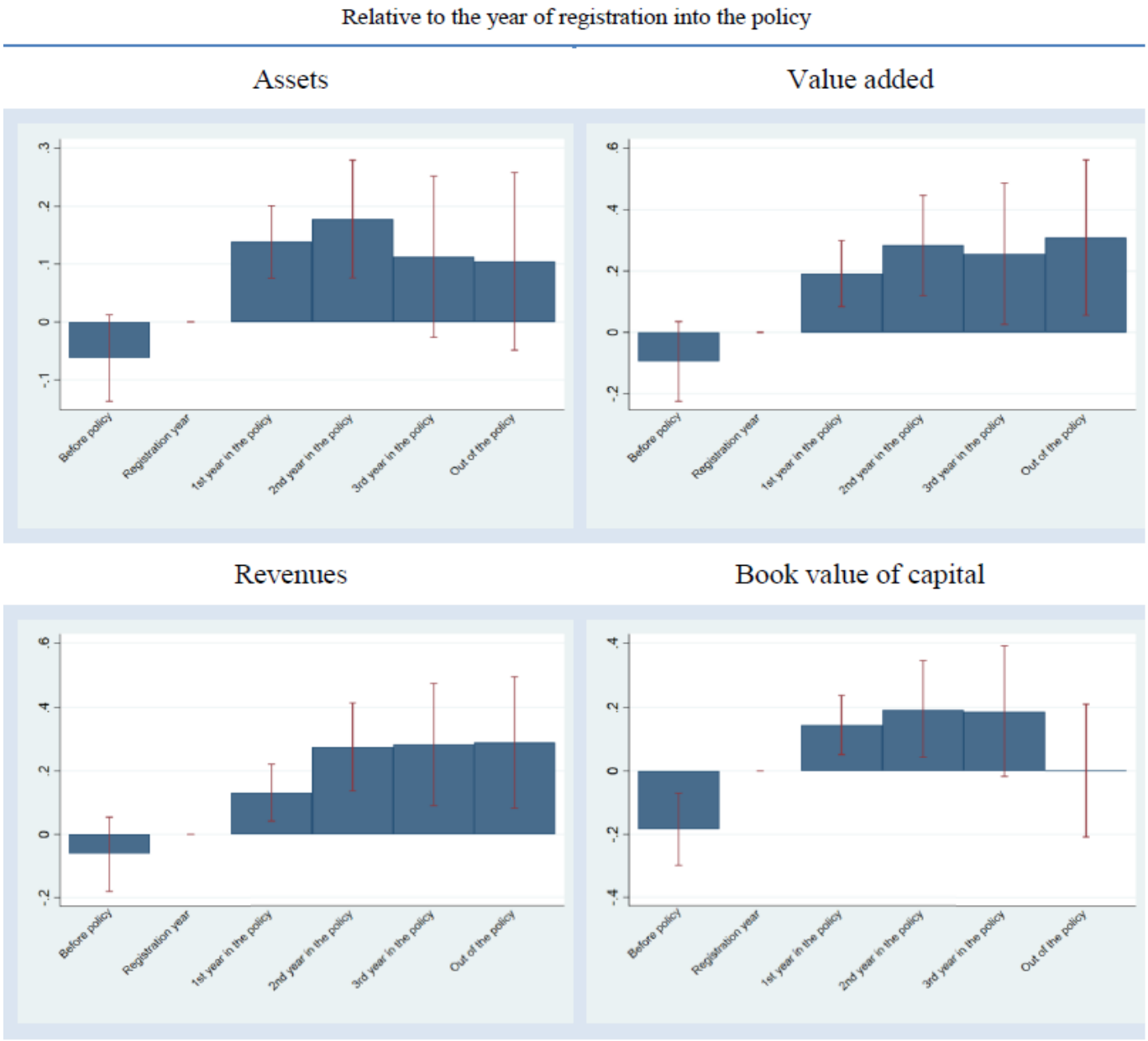


Figure 1 Results of Italain policy on performance

From a performance perspective, we have a positive impact on startups that is certified by data. But the analysis of results has made emerge some other evidences that are not positive, especially from a perspective of AI startups.

It has been found that a major miss in the startup ecosystem in Italy is the availability of VC deals in the financing of the startups and this is driven more by a lack of funding rather than by a lack of demand for it. This is partly a cultural trait and the supported idea is that Italy has a relative "specialization" in debt finance rather than equity. This is demonstrated by the fact that historically

the debt-to-equity ratio of non-financial corporations has been higher than in most OECD countries (Pisu, 2017).

It is known that finance for startups can take two main forms: debt or external equity. Moreover, finance itself is a fundamental component of the growth of startups. In the specific, innovative startups tend to be (and prefer to be) financed through equity investments due to the nature of these types of ventures that have a high-growth potential on one side and a high risk of failures on the other. These types of funding generally arrive through VC investments (Cosh, 2009). It is usually difficult to find innovation financed through bank credit because intangible innovative capital (patents for example) can hardly be consideredollateral goods for a loan (Mann, 2014).

What are the reasons driving this trend? Why VC has such a problematic diffusion in Italy?

One of the first blockers for VC diffusion in Italy is the weak contract enforcement system present. In fact, Italy has a juridical system affected by long-term conclusion for business activity practices, which lower the capacity to enforce a contract in case of a dispute. This is scaring VCs, especially foreign ones, which don't have enough "relational capital" (the possibility to have relations among companies, institutions, etc., inside an ecosystem) that could compensate for weak contract enforcement. Furthermore, for foreign investors, information asymmetry is even higher. It is needless to say how important investors are from outside the country, especially considering the type of investors present in Italy. For them, the weakness of contract enforcement and the fact that juridical procedures are long and unpredictable impose an extra-cost on risk (Calvino, Criscuolo, & Menon, 2016).

These issues added to an uncertain political environment and frequent policy reversals may negatively affect Italy's risk pricing. This brings to have an uncertain economic climate and entrepreneurs tend to specialize in less risky industries with a less risky structure at the expense of growth (Schivardi & Michelacci, 2011).

To fill some number to validate these suggestions, it is enough to notice that in Europe in 2016, companies located in France and Germany have been able to raise around $1B each while in the same period in Italy VC financing reached only $96M.

Related to this lack of VC funding, we can find a particular sub-issue that is quite relevant, especially for AI startups. In fact, as discussed in the chapter about AI, among the first investors in AI there are the companies that are acting as an incumbent in the market. VC funding coming from corporate can be a major source of financing for startups and between the top EU countries, Italy is the one that

experienced the least amount of capital invested ($40M) and there are no cases where a corporation is the lead investor.

As a result of what has since here discussed, startups in Italy tend to be underfunded compared to the welfare-maximizing level of funding. This is particularly true for new ventures that develop innovations which are characterized by a longer time to market (like AI).

In this situation government could be a game-changer in different ways. First of all, it could provide tax breaks to large corporations for acquiring domestic startups. In this way, it would facilitate the investment and it would reduce the cost of the risk from the companies' side. A second action could be to become a venture capital, especially for companies that operate in sectors with an informational comparative advantage. This type of action could serve as direct financing but also as signal for the startup quality to other investors (Lerner & Schoar., 2005).

This last option could be someway risky for the state because Government VC investments could lead to a crowding out of the private sectors, especially if the investments of private VC are targeting the same kind of companies (Brander, Du, & Halleman, 2015). This is a theoretical consequence. There are studies that confirm its validity (Cumming & MacIntosh, 2006) and studies that contradict it and instead demonstrate that governmental intervention promotesreater investments as a whole (Leleux & Surlemont, 2003).

Anyway, this is just a risky weapon the Italian government could decide to play, but if we look at the best financing source, private VCs are the best option. Actually, it has been demonstrated that private VC-backed companies perform better than public VC- backed ones looking at total investments received and successful exits (Brander, Du, & Halleman, 2015), sales and employee growth (Grilli & Murtinu, 2014) and innovation output (Bertoni & Tykvová, 2015). Following these studies, it results that the investments that generate the highest performance from the companies are the ones that mix public and private investors.

DATA ANALYSIS

DATABASE CREATION

The creation of the database has included several steps to finally reach the most complete possible set of records, able to properly describe the Italian startup situation. The database has been created in collaboration with another student with the scope of not limiting it to this analysis but with the idea that it can be used further.

The database used for the analysis have been created merging 2 different sources. The first one is AIDA, and it is a vast repository of data about companies in Italy managed by Bureau Van Dijk. It gave me the possibility to have various financial metrics and I was able to filter directly on "innovative startups" to download the DB. The second source instead has been the MISE website's section for innovative startups that allow downloading a database containing all the startups that are under the governmental program with several metrics such as the requirement of access accomplished to enter the program, if there is a majority of female, young people or foreigners and many others.

At this point, the DB was composed by a unique table with all the fields on the column and the companies on the lines. In the end, we have a database containing 12014 startups in total.

To extract from the database the companies that are doing artificial intelligence, we have used a query that went to pick information from the "object" field. In this field, the companies describe briefly what they do and how they operate. So, we exploited these texts, searching for some focal words used generally to describe an AI company and found in the literature.

With a query built in SQL, we have searched for keywords like {intelligenza artificiale, machine learning, deep learning, artificial intelligence, reti neurali, neural network, computer vision, 3d reproduction, facial scan, riconoscimento facciale, eye tracking, photo editing, audio processing, social behaviour, augmented analytics, drug design, predictive, nlp, sentiment analysis, speech to text, text to speech, multi agent systems, guida autonoma, automated vehicles}. The query developed was the following:

```
SELECT * FROM mytable
WHERE oggetto_sociale LIKE '%intelligenza artificiale%'
  OR oggetto_sociale LIKE '%machine learning%'
  OR oggetto_sociale LIKE '%deep learning%'
  OR oggetto_sociale LIKE '%artificial intelligence%'
  OR oggetto_sociale LIKE '%reti neurali%'
  OR oggetto_sociale LIKE '%neural network%'
```

```
OR oggetto_sociale LIKE '%computer vision%'
OR oggetto_sociale LIKE '%3d reproduction%'
OR oggetto_sociale LIKE '%facial scan%'
OR oggetto_sociale LIKE '%riconoscimento facciale%'
OR oggetto_sociale LIKE '%photo editing%'
OR oggetto_sociale LIKE '%eye tracking%'
OR oggetto_sociale LIKE '%audio processing%'
OR oggetto_sociale LIKE '%social behaviour%'
OR oggetto_sociale LIKE '%augmented analytics%'
OR oggetto_sociale LIKE '%drug design%'
OR oggetto_sociale LIKE '%predictive%'
OR oggetto_sociale LIKE '%nlp%'
OR oggetto_sociale LIKE '%sentiment analysis%'
OR oggetto_sociale LIKE '%speech to text%'
OR oggetto_sociale LIKE '%text to speech%'
OR oggetto_sociale LIKE '%multi agent system%'
OR oggetto_sociale LIKE '%guida autonoma%'
OR oggetto_sociale LIKE '%automated vehicles%'
```

Analyzing the results given by this query, we saw that at least one of these words was present in 1577 lines. It implies that potentially 1577 out of the 12014 total startups were developing a business focalized or that included AI.

After the extraction, the next step has been, for each of the 1577 startups found, to search for further information from different sources to confirm or discard the hypothesis that these companies were effectively doing AI. At this scope, we searched for the websites of these companies reporting information on the company, the services/products and the technologies used. Our research has been conducted in three different ways:

1. search on the search engine of the startup name (Google and Bing)
2. search of the VAT number (partita IVA in Italian) on search engines (Google and Bing)
3. search of the VAT number on Startuplus, a site that contains and show data on Italian startups

This further analysis brought our sample from 1529 to 837 companies that actually have an active website.

At this point we used a shortcut to analyze the 837 lines. We used a spider to scan all the sites automatically from the list, searching for the following words {intelligenza, artificiale, machine, learning, deep}. As a final result, we obtained 228 startups that develop AI for their business.

As a final action to improve our classification, we manually visited the website to classify what they do per domain and activity. At this scope, we used a paper produced by researchers of the Politecnico

di Torino that created a classification to distinguish the various types of AI in different domains of activity.

The result we've had is the following (summarized with STATA):

```
. tab dominio
```

dominio	Freq.	Percent	Cum.
	88	27.76	27.76
	1	0.32	28.08
communication	24	7.57	35.65
integration and interaction	8	2.52	38.17
learning social behaviour	12	3.79	41.96
perception	18	5.68	47.63
planning	12	3.79	51.42
services	154	48.58	100.00
Total	317	100.00	

```
. tab attività
```

attività	Freq.	Percent	Cum.
	88	27.76	27.76
	1	0.32	28.08
3d reproduction	1	0.32	28.39
audio processing	3	0.95	29.34
augmented analytics	35	11.04	40.38
chat analysis	20	6.31	46.69
computer vision	11	3.47	50.16
connected and automated vehicles	1	0.32	50.47
consulting	76	23.97	74.45
document analysis	2	0.63	75.08
drug design	1	0.32	75.39
eye tracking e mouse tracking	1	0.32	75.71
facial scan	2	0.63	76.34
nlp	1	0.32	76.66
optimisation	10	3.15	79.81
predictive machinery maintenance	26	8.20	88.01
robotics and automation	7	2.21	90.22
searching	2	0.63	90.85
sensor monitoring	16	5.05	95.90
social behaviour	12	3.79	99.68
speetch to text	1	0.32	100.00
Total	317	100.00	

.

Figure 2 Classification of AI startups

After all this has been done, to be able to use the database for the analysis, we have transformed it in a panel version where each line was uniquely identified by the VAT number and a newly generated variable defined as time. This was set considering it equals to 0 in the foundation's year and progressively growing in the subsequent years.

METHODOLOGY

I have used two ways to test the HPs generated.

The first one has been to use a t-test on averages, making a test for each dependent variable to see if there was a significant difference between AI and non-AI startups on the dependent variable selected. The test has been structured with the null hypothesis set as AI = non-AI. It has been used as a

preliminary test to give the first answer to our questions. In fact, the t-test has some commonly known advantages:

- The simplicity of interpretation. It is immediate and does not leave space for interpretation
- Robustness. It assumes that two populations are normally distributed and have the same variance but the first assumption can be stretched and in regarding the second case, we have used t-test for populations with unequal variance calculating it with STATA's command

  "ttest `var', by(ai) unequal"

- Ease of gathering data.

The issue for this research is that the t-test simply gives you the difference between two averages without taking in consideration what is causing it or if there is a relation between the variable tested and the variable used to distinguish the two populations.

To get over this issue, I have decided to apply a regression in order to be able to understand the degree of connection between the dependent variables and the independent ones.

The initial idea has been to use the OLS method for multiple linear regression because it is one of the most used and simple regression models. Unfortunately, it has a drawback that, looking at my data, was really significant. Considering squared residuals, it tends to give too much importance to observations with very large residuals. Consequently, it distorts the parameters' estimation in the case of outliers in the data (Verardi & Croux, 2009). In particular, I have tested:

- **Presence of outliers:** these could be influential in terms of prediction of the regression line
- **Distribution of Residuals**: residuals should be normally distributed but in our case, they are not and have instead some long tails that disturb the prediction of the line
- **Homoscedasticity**: it is essential to verify it because, even if OLS remain unbiased as method, it loose the ability to predict the model (Breush-Pagan test)
- **Multicollinearity**: the presence of multicollinearity between two or more variable can make coefficients of the regression for those variables unstable and, in the end, does not explain correctly the model

I have then decided to adopt a regression model that minimizes some of the previous errors working on the residuals. It is a Robust Regression. It is known to be an excellent method to use when you would like to use OLS but you have the presence of outliers or high leverage data points and if it's quite sure that these points are not an error of data entry and so it is not possible to delete them (UCLA Statistical Consulting). Furthermore, it helps reduce problems of heteroscedasticity (Verardi & Croux, 2009)

There are various types of robust regression. In this research, I have decided to adopt the one implemented in STATA that can be activated through the command '**rreg**'. This method works per iterations. First of all, it runs the OLS regression and gets the Crook's D [1] for each observation and every time this value is above 1 it gets dropped. At this point, the iteration process starts. The basic concept is to weigh the observations differently based on how well behaved these observations are.

[1] A measure that combines the information of leverage (a measure of how far a variable deviates from its mean) and residual of the observation

The weights are calculated based on absolute residuals. This regression uses two different methods to weigh the observations Huber method and Tukey biweight function (see Appendix A for models). They are used in sequence, first Huber and then biweights in order to be effective and minimize the weaknesses of the models taken singularly. The iteration stops when the maximum change between the weights from one iteration to the next is below tolerance. (UCLA Statistical Consulting, s.d.) (Verardi & Croux, 2009)

This method has brought to a higher significance level of the independent variables used to estimate the model and to a better prediction of the regression line.

VARIABLES CONSIDERED

We have then set the variables to test the HPs generated by dividing them between dependent, independent and control variables.

Dependent variables: Having extracted the database from AIDA, it was possible to have the financial metrics themselves. It has been decided to select 4 main dependent variables: revenues, share_capital, employment_level and intangible_assets. Revenues and intangible_assets are directly linked to two of the hypotheses. Share_capital will be used to understand the level of investment received and employment_level, which is used for number of employees, is a simple head count. To have a more clearer view, I have added to all of these variables also their growth rate to remove possible differences in firms dimensions. These have been calculated as the percentage increase of the corresponding variable YOY.

Independent variable: 'ai' is the independent variable that will be used to test the HPs. It is a dummy variable that indicates "yes" if the startup has been identified as an AI startup with the method described above and "no" otherwise. In particular, to be able to use it in the functions, I have created 2 new dummy variables 'AI' and 'no_AI', using the command 'tab ai, gen(v)' so that 'AI' variable presents '1' when 'ai==yes' and '0' otherwise.

Control variables: in order to create a more robust model and a better predictor of the dependent variable, I have decided to introduce some control variables. Following literature and analyzing what could affect a startup's performance, I have decided to submit the following: time, province, activity, req1, req2, req3 and yr_construction. The first one is a numerical measure of the age of the startups of the observation. It is a generated variable that takes the value '0' in the year of the foundation of the startup and progressive values for the years after. The second one indicates the province of Italy where the startup is based. A dummy variable has been created for each province in the database. They have been called 'province_dum*'. This is linked to the fact that there are differences in dimension and performance of the company in Italy depending on where they are based. I have then created in the same way a dummy variable for each different activity available in the database, calling them 'activity_dum*'. These are used to identify the activity in which the ventures declared to be operating. I've also considered the information I had available on the three requirement of access because they are connected to the companies' internal characteristics that have already been demonstrated to be influential on performance (Matriciano, 2020). Finally, I've also included the year

of the foundation of the startup, supposing there could have been a difference in the performance in the various year due to market expansions, contractions and evolutions.

It is finally necessary to note that I've also used some of the different dependent variables as control variables for the other (e.g., employment level used to predict revenues).

In the end, it is possible to notice that we have different type of variable to be included in the model. Dependent variables, time and yr_construction are all continuous variables while AI, province_dum, activity_dum and the three requisites are dummy. This is not a problem for the analysis because it is possible to have all of them in regression as predictors. The main difference in having dummy variables as regressors is that the coefficient assigned to each factor is the difference with respect to the omitted one, which in the end for AI is what we want to study.

I have also tested the correlation between variables to be surer that two of them are not correlated.

Table 1 correlation matrix

	revenues	employ~l	share_~l	intang~s	gw_rev~e	gw_emp~l	gw_sha~l	gw_int~s	time	req1_num	req2_num	req3_num	AI
revenues	1.0000												
employment~l	0.5682	1.0000											
share_capi~l	0.0621	0.0768	1.0000										
intangible~s	0.1715	0.1295	0.1536	1.0000									
gw_revenue	-0.0081	-0.0136	0.0010	0.0025	1.0000								
gw_employm~l	0.1888	0.1950	0.0050	0.0184	0.0331	1.0000							
gw_share_c~l	0.0143	0.0182	-0.0018	-0.0078	-0.0017	0.0014	1.0000						
gw_intangi~s	0.0326	0.0286	-0.0150	-0.0020	0.0445	0.0127	0.0040	1.0000					
time	0.0715	0.0357	-0.0057	0.0311	-0.0608	-0.0218	-0.0111	-0.0141	1.0000				
req1_num	-0.0695	-0.0330	-0.0260	-0.0247	-0.0004	0.0363	0.0127	-0.0430	-0.0080	1.0000			
req2_num	-0.0281	-0.0439	-0.0060	0.0130	-0.0121	-0.0320	-0.0076	0.0358	-0.0024	-0.4466	1.0000		
req3_num	0.0602	0.0572	0.0407	0.0428	0.0028	0.0010	-0.0145	-0.0168	0.0078	-0.4462	-0.1919	1.0000	
AI	0.0274	0.0078	-0.0234	-0.0035	0.0055	0.0270	-0.0037	0.0061	-0.0277	0.0774	-0.0283	-0.0292	1.0000

As it can be noticed, we have not a high level of correlation between variables. There is a strong correlation if r>0.8 and in our values, this is never the case.

Another thing to notice about data and the dependent variables is that the database we created, as normal when talking about startups and companies not quoted in general, presents several missing values. It has been done an analysis of them to understand what could be the impact on the final outcome of my research. The results for the dependent variables are expressed in the table below:

Table 2 Missing values

Missing Value Analysis							
year	2013	2014	2015	2016	2017	2018	2019
share_capital	34,59%	20,80%	17,51%	16,69%	18,48%	21,37%	23,83%
revenues	34,59%	20,80%	17,44%	16,64%	18,45%	21,34%	23,81%
employment_level	34,59%	23,15%	19,71%	19,68%	21,63%	24,57%	26,91%
intangible_assets	34,59%	20,80%	19,51%	16,89%	18,48%	21,37%	23,83%
gw_share_capital	48,87%	37,61%	37,20%	39,26%	44,62%	50,87%	55,83%
gw_revenues	62,41%	55,32%	53,66%	56,85%	61,81%	66,92%	70,26%
gw_employment_level	89,47%	70,68%	70,81%	75,29%	79,73%	83,02%	84,73%
gw_intangible_assets	64,66%	57,43%	59,44%	63,90%	71,76%	77,71%	79,96%

As we can notice there is an high rate of missing values in first years of the project and the last ones. This was partially expected because in the first years it was something newly implemented and to be

refined, while last years could be too recent to have all the data yet. We'll see here after that this is not going to impact severely on the analysis thanks to the method adopted.

Looking at variables for growth we have much more missing values and this is due to some reasons: in first year of life we don't have value for growth because it is measured as (final_value – initial_value)/initial_value and missing values highly influence it in the middle years of a company.

DESCRIPTIVE ANALYSIS OF THE SAMPLE

Before proceeding with the analysis of the regression's results, it's interesting to look at some variables given by the database extracted from MISE's website.

SUBSCRIPTION TO THE REGISTER

Considering the year of the entrance, we can immediately notice that AI startups are a more recent trend than non-AI ones. For non-AI startups we have a smooth increase over time of the number of startups entering the register with a peak in 2019 where more of the 20% of the total number have entered the register. Instead, AI startups have had a peak in 2018 with near to 30% of the total number to enter that year. What we can understand here is that AI startups are on average younger than the non-AI ones.

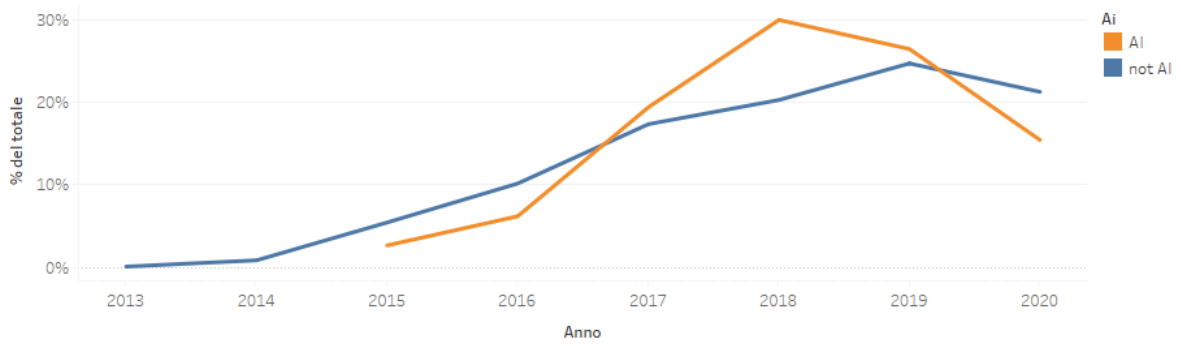


Figure 3 % of total companies entering into the program

GEOGRAPHICAL DISTRIBUTION

Considering geographical distribution in % of the startups by region, it is possible to notice that overall, the distribution that the 2 populations have is quite similar. There are in fact some focal nodes in Milan and Rome (Lombardy and Lazio) that takes most newborn startups and some minor node in the other regions like Veneto, Emilia Romagna and Piemonte.

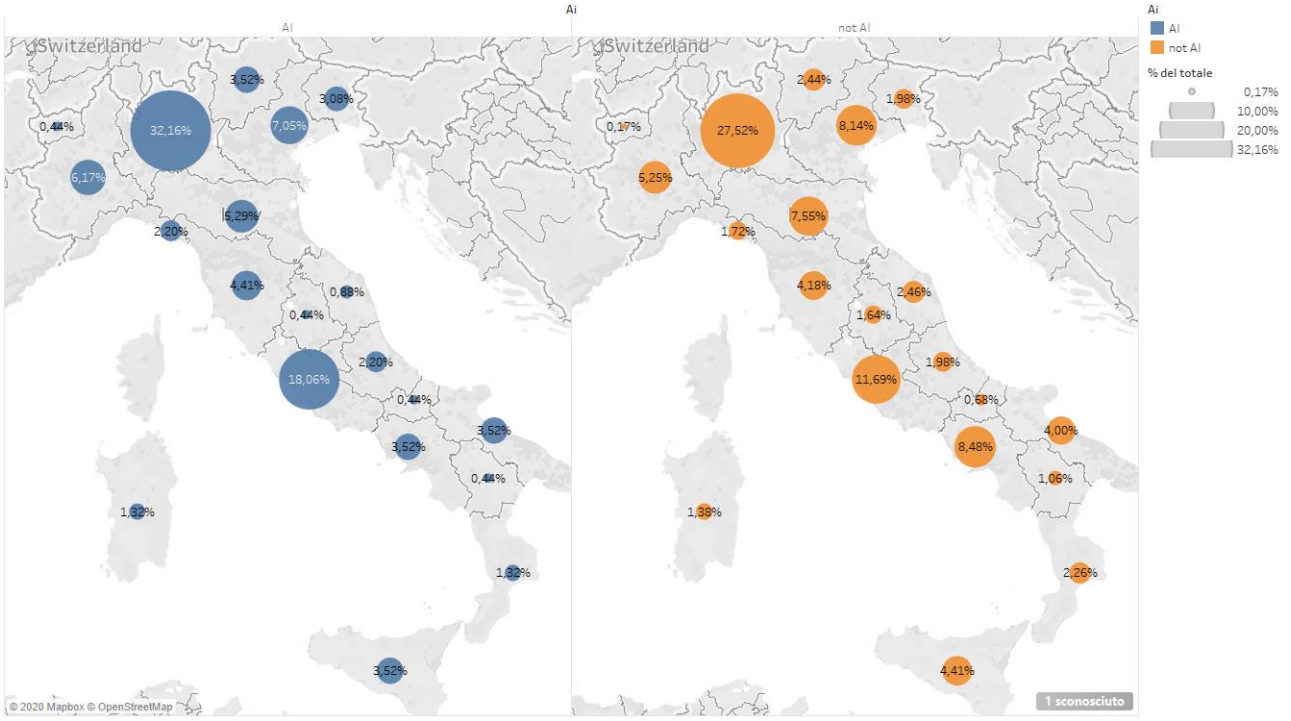
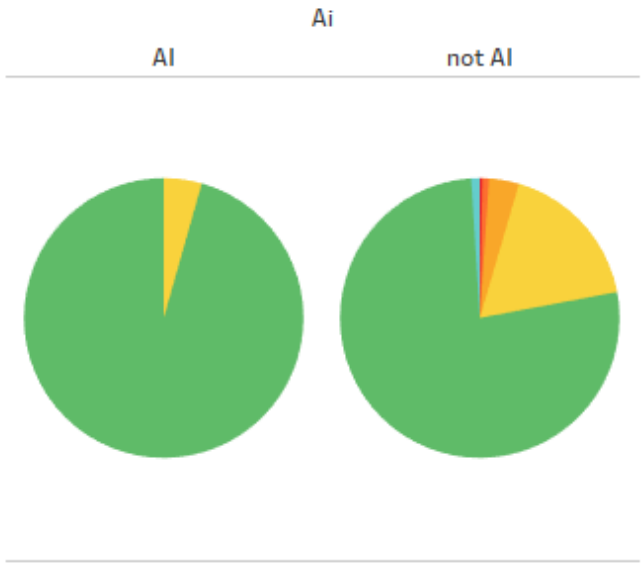


Figure 4 diffusion of startups in Italy

Apart from these similarities there are also some differences if we look at data in the specific. In fact AI startups are more concentrated in % around the cities of Milan and Rome, denoting the fact that they are the poles of development for these types of applications. In addition, if we look at the distribution of startups based on north, center and south of Italy, we can notice that AI startups are more unbalanced towards the north (59.91%) than non-AI (54.77%). The biggest difference in distribution percentage is in the south of Italy, where AI has 13.64% of startups located there and non-AI, instead, 21.59%. This means that AI implementation in startups is expanding more in the north of Italy than in the south. This could be driven by a higher number of investors and companies that can generate a market for these types of applications. Maybe also a more European mindset of entrepreneur could be driving this.

SECTOR AND ACTIVITY

Looking instead at the sector in which the societies operates, AI startup is really focalized on services (96%) with fewer that practice in the industry sector (4.41%). On the other side, also non-AI companies are mainly operating in the services sector (76.98%) with a lower part that focuses on industry (17.50%) and commerce (3.47%). This is quite surprising for the AI startups considering the fast diffusion of AI in the e-commerce sector, but this values could be the result of the type of classification and given by the fact that companies implementing AI are not directly involved in commerce but work more as a support to various type of applications.

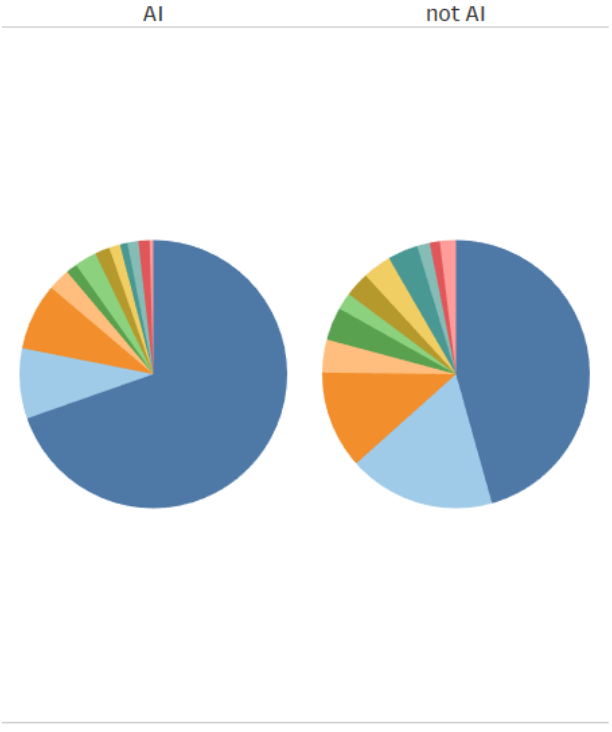


Settore
- NULL
- AGRICOLTURA/PESCA
- COMMERCIO
- INDUSTRIA/ARTIGIANATO
- SERVIZI
- TURISMO

Settore	AI	not AI
NULL		0,29%
AGRICOLTURA/PESCA		0,76%
COMMERCIO		3,47%
INDUSTRIA/ARTIGIANATO	4,41%	17,50%
SERVIZI	95,59%	76,98%
TURISMO		0,99%

Figure 5 Division of startups by sectors

What is not surprising instead is to find that the majority of AI startups have as main activity the one of producing software and informatics consulting (69.64%) with a minor part of the companies focused on activities such as R&D (8.48%) and information and other services (8.04%). In the activities, there is quite a big gap from the non-AI startups which still have production of software as a primary activity (45.66%) but that is more distributed on a various type of other activities such as R&D, services, production of equipment and other scientific, professional and technical activities (17.74%, 11.77%, 3.99% and 3.96%)



Attività
- J 62 PRODUZIONE DI SOFTWARE, CONSULENZA INFORMATICA E
- M 72 RICERCA SCIENTIFICA E SVILUPPO
- J 63 ATTIVITA' DEI SERVIZI D'INFORMAZIONE E ALTRI SERVIZI
- C 28 FABBRICAZIONE DI MACCHINARI ED APPARECCHIATURE NCA
- M 74 ALTRE ATTIVITA' PROFESSIONALI, SCIENTIFICHE E TECNICHE
- J 58 ATTIVITA' EDITORIALI
- M 71 ATTIVITA' DEGLI STUDI DI ARCHITETTURA E D'INGEGNERIA;
- M 70 ATTIVITA' DI DIREZIONE AZIENDALE E DI CONSULENZA
- C 26 FABBRICAZIONE DI COMPUTER E PRODOTTI DI ELETTRONICA E
- M 73 PUBBLICITA' E RICERCHE DI MERCATO
- P 85 ISTRUZIONE
- C 27 FABBRICAZIONE DI APPARECCHIATURE ELETTRICHE ED

Attività	AI	not AI
J 62 PRODUZIONE DI SOFTWARE, CONSULENZA INFORMATICA E	69,64%	45,66%
M 72 RICERCA SCIENTIFICA E SVILUPPO	8,48%	17,74%
J 63 ATTIVITA' DEI SERVIZI D'INFORMAZIONE E ALTRI SERVIZI	8,04%	11,77%
C 28 FABBRICAZIONE DI MACCHINARI ED APPARECCHIATURE NCA	2,68%	3,99%
M 74 ALTRE ATTIVITA' PROFESSIONALI, SCIENTIFICHE E TECNICHE	1,34%	3,96%
J 58 ATTIVITA' EDITORIALI	2,68%	2,08%
M 71 ATTIVITA' DEGLI STUDI DI ARCHITETTURA E D'INGEGNERIA;	1,79%	2,98%
M 70 ATTIVITA' DI DIREZIONE AZIENDALE E DI CONSULENZA	1,34%	3,46%
C 26 FABBRICAZIONE DI COMPUTER E PRODOTTI DI ELETTRONIC..	0,89%	3,66%
M 73 PUBBLICITA' E RICERCHE DI MERCATO	1,34%	1,54%
P 85 ISTRUZIONE	1,34%	1,21%
C 27 FABBRICAZIONE DI APPARECCHIATURE ELETTRICHE ED	0,45%	1,95%

Figure 6 Division of startups by activity

REQUISITES FOR THE ACCESS

Monitoring the requirements the companies have satisfied to be able to access the section for innovative startups in the Registro Imprese, we notice that there isn't a huge difference between the two groups. In fact, both in 1st requirement, the one regarding the amount of R&D, have a high percentage of YES (near to 65% for both the group) and for both the group this one is the criteria most used to have access to the benefit of the policy. The other two requirements show some small differences among the two populations. Req 2, the one looking at the formation of the team and the skill level of it, have higher percentages of yes for AI companies (33.04%) than for non-AI (25.52%) this means that a team with high instruction level backs a higher rate of startups involved in AI. Looking at req 3 instead, we see an opposite tendency. In fact it is non-AI here that have a greater percentage (17.11%) of startups which own (or have the exclusive use of) an IP at the moment of entrance in the innovative startup section. In fact, only the 12.33% of AI startups satisfied this requirement. This last point can be explained by the fact that AI is based mainly on algorithm that are more complex to use as asset for a patent or an IP in general. Furthermore, sometimes companies prefer to keep them as a secret to avoid others to copy or take spillovers from their work, also because it's hard to enforce and defend the right on an algorithm or on software.

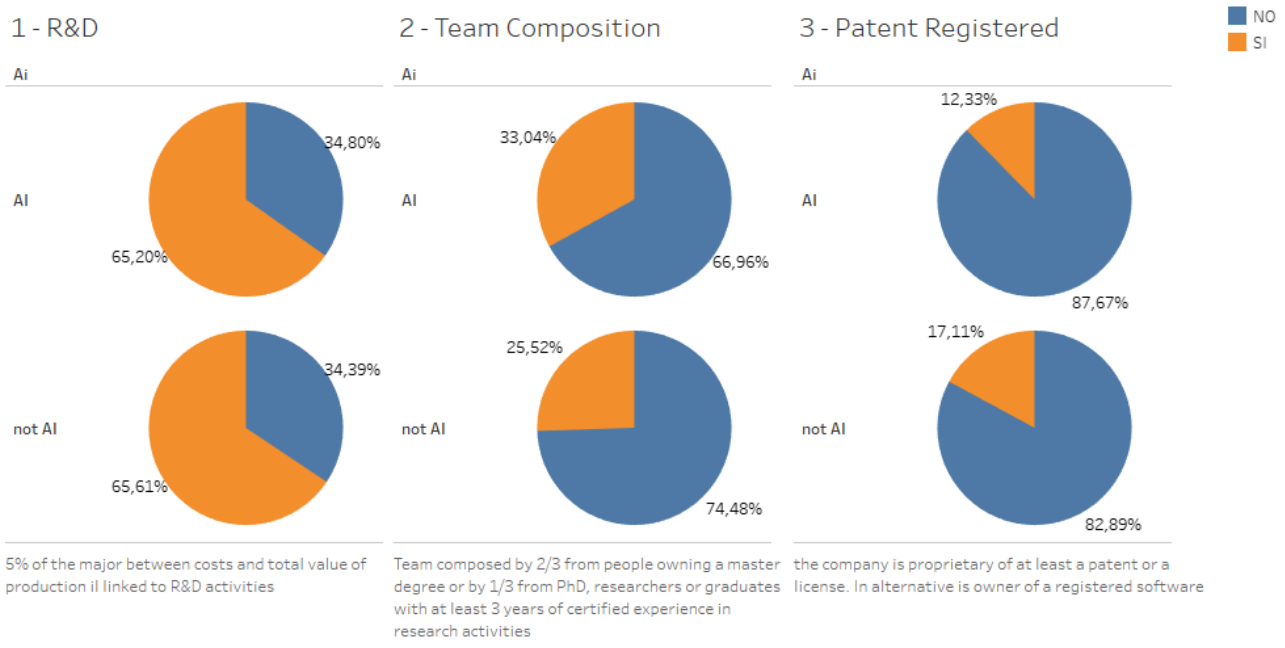


Figure 7 Percentage satisfaction of entrance requirements

RESULTS

The analysis have been done on the database in panel version with id given by VAT and variable time. I have also excluded startups that entered in the program in 2020 because we didn't have the financial values for them (the financial data are presented every year in December). Hereafter there is a table that summarizes the variables included and some data of the panel.

Table 3 Descriptive statistics of the variables

Variable	Obs	Mean	Std. Dev.	Min	Max
codicefisc~d	26,292	5838.819	3405.245	2	12014
time	26,292	1.167998	1.211607	0	6
revenues	20,033	116.2316	338.5265	0	10197.74
employment~l	19,218	1.33708	4.51547	0	246
share_capi~l	20,027	46.43758	244.8604	0	9000
intangible~s	20,027	74.12948	694.3934	0	63076.27
gw_revenue	7,820	177.1182	14027.32	-1	1240005
gw_employm~l	4,014	.3411115	1.246181	-1	29
gw_share_c~l	11,614	144.5491	11672.75	-1	1249999
gw_intangi~s	5,270	22.91101	1342.745	-2	97443

T-TEST

As described earlier the first analysis done has been to verify the average of the two samples (AI and not-AI) for each of the dependent variables. The results are reported on the table below.

Table 4 T-tests results

H0: diff = 0 -> AI-not_AI=0	t value	Ha: diff < 0 Pr(T < t)	Ha: diff != 0 Pr(|T|>|t|)	Ha diff > 0 Pr(T > t)	confience interval	result
revenues	-1,935	0,0269	0,0538	0,9731	95%	AI > not_AI
employment_level	-1,1627	0,1229	0,2457	0,8771	95%	we cannot reject null HP
share_capital	6,3609	1	0	0	95%	AI < not_AI
intangible_assets	0,361	0,6409	0,7182	0,3591	95%	we cannot reject null HP
gw_revenues	-1,0215	0,1551	0,3102	0,8449	95%	we cannot reject null HP
gw_employment_level	0,9325	0,8244	0,3511	0,1756	95%	we cannot reject null HP
gw_share_capital	1,0558	0,8544	0,2911	0,1456	95%	we cannot reject null HP
gw_intangible_assets	1,029	0,8483	0,3035	0,1517	95%	we cannot reject null HP

At a first look there is already something surprising. Looking at averages, we can see that revenues are higher for AI startups, which is in contradiction to H1. In the same way, share capital is definitely in favor of not-AI companies. This could be led by several reasons, among which the most important is that not-AI startups are on average older and could then be in a more advanced phase of life. In this case, having a regression that keeps in consideration time can be really helpful to understand if this relation is still so skewed or not. Looking at other variables, it seems that employment level cannot be said to have different levels in the 2 populations and this would go in favor of the Hp generated, for intangible assets at the same way there is no clear difference and this is quite unexpected following

the idea created before looking at the data. Regarding the growth rate of the variables, we cannot say anything.

To go deeper into these relations, the results of the robust regressions have been analyzed. What has emerged in general is that, even if with the robust regressions variables have become more significative, R-squared for some variables of performance analyzed is still quite low. Another thing to keep in mind is that the robust regression is an iterative process that starts removing values which have Crook's D higher than one. This influence the number of observation kept in consideration by the successive iterations and can be seen in the "N" variable of each regression

Looking at dependent variables one by one, the results are hereunder reported.

REGRESSIONS

To have a better view and a fast interpretation of the results, I've included all the variables in two tables, dividing them between absolute values and growth rate. In the first table are presented the results of the robust regression on the dependent variables.

The first evident thing is that the values of the coefficient for the employment level are absent. This is because running the 'rreg' command the answer received by the system in SATA is "all weights went to zero; no observations remained". This denotes a wrong regression strategy and that the model developed does not predict the number of employees. However, this is anyway a useful information because it means that AI does not influence employment level measured as headcount. I have included in Appendix B the model for employment level with the OLS estimators method and it confirms partly this conclusion showing that the significance level of the variable AI is >0.1 and so it is not a significant preditor. This confirms what has been found for t-test; AI does not influence employment.

comparison variables robust regression models

	(1) revenues	(2) employment_level	(3) share_capital	(4) intangible_assets
AI	4.6803***	-	0.4834	-1.5573***
	(0.001)		(0.146)	(0.006)
time	4.5951***	-	0.2257***	1.1128***
	(0.000)		(0.000)	(0.000)
employment_level	9.6828***	-	0.0141	0.0672***
	(0.000)		(0.214)	(0.001)
share_capital	-0.0123***	-		0.0033***
	(0.000)			(0.000)
intangible_assets	-0.0004	-	0.0077***	
	(0.119)		(0.000)	
N	19212	-	19212	19210
R^2	0.781	-	0.640	0.102

p-values in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Looking at revenues, instead, the result is a high significance level of the variable AI with a p-value=0.001. The coefficient is positive and this demonstrates that AI affects revenues of a company positively. In addition, R2 is the higher found in the regressions meaning that the model is a good predictor of the variable.
Moving on to share capital, the result of regression denotes a low significant level for the variable AI, meaning that even if a difference in the averages of the two samples exists, it is not caused by being an AI startup or not.
If we consider instead intangible assets value we see that AI is significant and that its coefficient is negative. This is quite surprising but can be driven by multiple causes. In addition, if we look at R2 we can notice that it is really low meaning that the model as it is structured, is able to explain and predict with an accuracy of only 10% the values of intangible assets.
Finally it's interesting to notice that N is in all the cases lower than the 26,292 lines we have in total and this is partially due to missing values on the variables and partially because of deleted values from the regression.

If we have a small reduction in the number of observations looking at the previous variable, we have a much greater one considering the observations' growth rate variables. Here, in fact, as already highlighted, the missing values are numerous and they affect the number of observations at disposal.

Growth rates are the most important statistics to evaluate in our case, because the database in use includes startups of different dimensions and in different conditions. It is then important to understand if AI is a promotor of growth, more than values in an absolute term.

comparison grow rate robust regression models

	(1) gw_revenue	(2) gw_employment_lvl	(3) gw_share_capital	(4) gw_intangible_assets
AI	0.1224	0.1067*	-	-0.1841**
	(0.355)	(0.079)		(0.019)
time	-0.4032***	-0.0277***	-	0.0764***
	(0.000)	(0.005)		(0.000)
revenues	0.0004***	0.0001***	-	-0.0001**
	(0.000)	(0.000)		(0.014)
share_capital	-0.0000	-0.0000	-	0.0000
	(0.627)	(0.649)		(0.626)
employment_level	-0.0026	0.0310***	-	0.0005
	(0.407)	(0.000)		(0.762)
intangible_assets	-0.0000	-0.0000**	-	0.0001***
	(0.726)	(0.018)		(0.009)
N	7354	4008	-	4960
R^2	0.657	0.300	-	0.668

p-values in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

As in the previous table, there is an empty column, in this case for the growth rate of share capital. The issue faced is tha same as I had for employment level, so the conclusions are also the same. This means that AI is not affecting share capital growth significantly. Once again, I've reported the

OLS regression for this variable in Appendix B. Like the first case it confirms the findings because R2 is really low and AI is not significant.

Looking a the other variable, we see that for revenue growth, AI is not significant. P-value is 0.355, meaning that the coefficient we see is not generalizable. It is good to notice that the model created can predict the variable at 65.7% and that, even if not enough significant, AI has a positive coefficient.

Moving to analyze employment growth we see that AI is significant and that the coefficient is positive, meaning that it positively influences the growth of the number of employees YOY. This is contrasted by the fact that the capacity of prediction of the model is pretty low (R2= 0.3).

Finally, looking at intangible assets growth rate we can notice that AI has a negative influence on it. This is confirmed by the lo p-value (0.019) and the high R2, meaning that the model can predict the results and that the coefficient for the independent variable is significant. So it confirms what emerged in the regression for the intangible asset values indicating a negative role of AI on intangible assets.

CONCLUSIONS

Table 5 Results of the analysis

Hp	description	t-test	regression
H1.a	AI negatively affects revenues	rejected	rejected
H1.b	AI affects positively revenue growth	rejected	rejected
H2.a	AI affects positively investments grow rate	rejected	rejected
H2.b	AI affects negatively investments received	accepted	rejected
H3.a	AI affects positively intangible assets value	rejected	rejected
H3.b	AI affects positively intangible assets grow rate	rejected	rejected
H4.a	AI does not affect employment level	accepted	accepted
H4.b	Ai affects positively employment growth rate	rejected	accepted

Looking at the outcome of the analysis, it is possible to see that AI startups are not receiving more investments than other startups. Even more important, the investments are not growing more than for other companies. It is a sign the time is not ready for AI in Italy; there are few investors and the risk related to a technology that is still evolving is somehow creating a lack of resources for these companies. This is also linked to the fact that in Italy there is a low amount of investments granted by VC, as highlighted by the study of OCSE about the effects of the active program in Italy. This also links to the theory expressed by (Corea, 2017) for which AI companies have difficulties in raising capital due to the complex nature of technology implemented. Indeed, VCs are specialized investors who are more able than others to understand these complex realities' value.

It can also be caused by a lack of capacities and the fact that the technology level is still too immature to attract investors from outside Italy. Finally, it could also be driven by a cultural fact; Italy is notoriously a risk-averse people on average.

In addition, intangible assets are negatively impacted for the companies that works with AI both in total values and in growth. There could be two main explanations for this: the first one is that the assets produced by AI companies are difficult to evaluate, more than other ones. In this could also influence the fact that AI works mainly on software that are difficult to be granted for an IP right and even more is less risky to keep them as a secret not to disclose any spillover for other companies. The second explanation could be that AI startups in Italy are not producing enough assets. AI is really wide; the condition could be that these companies are implementing a basic solution that does not generate great knowledge. A new study that focus on the type of AI produced by startups in Italy could clarify this point.

What is surprising to me is the greater ability of AI companies to generate revenues with respect to others. It is surprising because it means they reach the market earlier than others and with a valuable product. Considering theory and AI implementation, this is evidence that goes against Hp generated and the theory brought to support them. This could be linked to the fact that, being them part of software implementation companies, they're able to enter the market with some MVP that are limited to small function and then expand them through time, they don't need the complete product to sell it as it could be for startups producing something physical. The study suggested earlier to analyze what AI startups are producing could also clarify this point to have a more specific demand.

Considering employment, the HPs stated have been confirmed. It is once again the confirmation that is a technology in the early phase of development in Italy, showing that it is not gaining a high momentum (like it is doing outside of Italy) for the moment but that is giving a small signal of development. In fact, the growth rate on employment is positively affected by being AI (even if the coefficient is low) and if we follow theory and look at it as a performance indiator, it means that AI startups are starting to grow at a higher level than others.

In the end, what emerged from this analysis is that AI in Italy is still an immature technology. It does not have yet the ground to grow and this is confirmed by the low number of startups that do AI. There is a lack of funding for these solutions and also of experts in the field. The government, as highlighted, is already putting in place measures to push on the development of AI. Still, probably it should do something more in order to not start on this new technology with a handicap. Looking from a startup perspective, the two main factors that are missing in the environment are investments and availability of big data that a new venture has difficulties in generating and getting. Policymakers can influence both of them.

To conclude and answer to my question, "are AI startups performing better than others?" I would say that: It depends on what measure of performance you look at. They are having better revenues; investments are not influenced by AI such as employment. Intangible assets are negatively influenced but on average, the two samples have the same amounts.

The next question to answer and continue this trend is "Do AI startups have higher potential than others?"

POSSIBLE IMPROVEMENTS

The method adopted for this thesis is for sure not perfect. Evidently, I was not able to find the perfect variables in order to describe and predict the model and so to have more meaningful results. For sure, this is a possible improvement, maybe through a survey or taking some other data from different databases containing more non-financial information and integrating the database I've used. In my thesis in fact, the fact of labeling a startup with "AI" had the claim to recognize in it some internal capabilities that were maybe not really present. I've done a sort of biased characterization.

Also the identification of AI itself has some weaknesses, we have used descriptions given by the teams to present themselves and what they do. This could lead to two biases in data: the first one is that startups declared to do AI to attract more interest but that the solution implemented is not really AI. The second one is the opposite problem, a company doing AI that doesn't use any of the term searched in the object. The first point could be solved with a direct contact with the team of each startup that declares to do AI to understand what they really implemented. For the second one there is the need to find another way to understand which are the AI startups.

Another focal point that can be improved is the addition to the analysis of patens. They have been recognized as metrics for innovativeness and would be really interesting to analyze the variances between the two champions in terms of patents produced.

Finally, a problem afflicting this research that it is territoriality because it is based on startups in Italy. It would be interesting to conduct a similar work on a larger basis in order to have more generalizable results and also to reduce the single influences of each state.

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APPENDIX A

HETEROSKEDASTICITY: Test for heteroscedasticity of residuals. If prob > chi2 is small it means we cannot refuse the null Hp that the variance of residuals is homogeneous. Therefore, if the p-value is very small, we would have to reject the hypothesis and accept the alternative hypothesis that the variance is not homogenous

Revenues

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of revenues

         chi2(1)      =  7816.36
         Prob > chi2  =   0.0000
```

Employment

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of employment_level

         chi2(1)      =  3962.20
         Prob > chi2  =   0.0000
```

Share_capital

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of share_capital

         chi2(1)      =   951.77
         Prob > chi2  =   0.0000
```

Intangible_assetts

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of intangible_assets

         chi2(1)      = 18104.17
         Prob > chi2  =   0.0000
```

MODELS FOR REGRESSIONS (Verardi & Croux, 2009)

Rreg in stata computes a highly efficient M-estimator. It is done by a loss function, in this case the Tukey biweight function:

$$\rho(u) = \begin{cases} 1 - \left\{1 - \left(\frac{u}{k}\right)^2\right\}^3 & \text{if } |u| \leq k \\ 1 & \text{if } |u| > k \end{cases}$$

Where *k=4.685.* To get the starting value of the iterative algorithm is taken to be a monotone M-estimator wih a Huber ρ(·) function:

$$\rho(u) = \begin{cases} \frac{1}{2}(u)^2 & \text{if } |u| \leq c \\ c|u| - \frac{1}{2}c^2 & \text{if } |u| > c \end{cases}$$

With c=1.345

APPENDIX B

comparison variables OLS models

	(1) gw_revenue	(2) gw_employment_lvl	(3) gw_share_capital	(4) gw_intangible_assets
AI	165.7912	0.0448	-26.8409	0.7398
	(0.890)	(0.758)	(0.978)	(0.997)
time	-201.4871	-0.0961***	-191.3724	-48.8318
	(0.305)	(0.000)	(0.187)	(0.120)
revenues	0.2804	0.0001***	-0.1678	-0.0021
	(0.468)	(0.005)	(0.616)	(0.966)
share_capital	0.6135	0.0001	1.4201***	-0.0256
	(0.304)	(0.155)	(0.001)	(0.701)
intangible_assets	-0.0317	0.0000	1.2709***	0.0307
	(0.940)	(0.517)	(0.000)	(0.532)
employment_level	1.3200	0.0337***	-11.7242	-1.4483
	(0.963)	(0.000)	(0.637)	(0.704)
N	7355	4009	11002	4960
R^2	0.186	0.129	0.013	0.016

p-values in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

comparison growth variables OLS models

	(1) revenues	(2) employment_level	(3) share_capital	(4) intangible_assets
AI	30.6325*	0.0515	-16.0152	4.4224
	(0.053)	(0.808)	(0.234)	(0.903)
time	52.7197***	0.0624**	3.1927*	23.3677***
	(0.000)	(0.030)	(0.079)	(0.000)
share_capital	0.0235***	0.0006***		0.3327***
	(0.006)	(0.000)		(0.000)
intangible_assets	0.0150***	0.0002***	0.0458***	
	(0.000)	(0.000)	(0.000)	
employment_level	39.0486***		2.3569***	4.9909***
	(0.000)		(0.000)	(0.000)
revenues		0.0070***	0.0169***	0.0785***
		(0.000)	(0.006)	(0.000)
N	19212	19212	19212	19212
R^2	0.343	0.317	0.097	0.190

p-values in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$