Università
Ca'Foscari
Venezia

Master's Degree

in Management, Accounting and Finance

Final Thesis

# Drivers of Venture Capital across countries

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2021/2022

*“The future cannot be predicted, it can only be discovered”*

*Vinod Khosla - Venture Capitalist*
*from “The Power Law, Venture Capital and the making of the new future”*
*by Sebastian Mallaby, 2022*

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**ABSTRACT**

Starting with an introduction of the main features of venture capital and the state of the global industry, this dissertation intends to investigate further the determinants of venture capital in countries by building an empirical model that test whether specific selected factors help explain the level of venture capital investments. The model includes already studied factors to prove and confirm their influence, but also add new determinants with the modest goal of expanding the already existing field of research. We use aggregated market data from the Refinitiv Eikon Venture Capital database as well as macroeconomic data, to estimate a panel data model with random effect (RE) and feasible generalised least square (FGLS) techniques of analysis. The results confirm some of the already studied factors and highlight relations with new variables.

# INTRODUCTION

Venture capital is an incredibly important investment asset class that plays a crucial role in the economy: it allows the financing of new innovative ideas and their development into fully mature companies. It therefore appears rational and strategic for a country to commit some of its resources to the developing of such industry and sustain new-born companies in their early stages of life (Associazione Italiana del Venture Captial (AIFI), 2021). It is in this field that we would like to contribute, trying to deepen the already existing knowledge around the drivers of venture capital investments in countries.

In order to pursue a research of this type it is firstly needed to fully understand what is venture capital and its most important features (chapter 1). Venture capitals are the financial resources provided by funds or individual investors to young enterprises under the form of equity and characterized by a high level of illiquidity and long-term growth potential (1.1). The investments focus on the initial phases of the lifecycle of firms, which can be divided in seed phase, early stage and later stage, and usually happens in rounds, classified as class A, B, C, etc. (1.2). The investors are usually funds that raise money from individuals or organizations, typically referred as limited partners and opposed to venture capital firm management which goes by the name of general partner (1.3).

After this brief introduction on Venture Capital the thesis focuses on analysing the movements and trends of the global venture capital industry (chapter 2). It appears that the regions with the most developed industries are North America, Asia and Western Europe, which in 2021 absorbed respectively 57%, 28% and 11% of the market share. Still, we highlight how Latin America, Central America, Middle East and Australasia are gaining popularity, growing faster than North America, Asia and Western Europe (2.1).

Trend wise, all the regions experienced a substantial growth in the studied years (2009-2021) with a global CAGR of 23.8%, an incredible growth that has skyrocketed especially in 2020 and 2021. The discussion than switch to the central theme of the analysis, presenting a literature review of all studied drivers of venture capital and divide them in groups: macroeconomics conditions (e.g. unemployment, GDP growth, interest rate levels), capital market state (e.g. stock market growth, volume of IPO), taxation (e.g. taxation of entry and exit, corporate tax, personal income tax), legal structure and investor protection (quality of the legal system, IP protection, legal rights level), cultural factors (entrepreneurial culture, education), innovation output of the society (R&D expenditure)

specific to the industry ones (venture capital investments, venture capital disinvestments) (2.2). With all the gathered information we are than able to build an empirical model that tests whether specific factors help explain the level of venture capital investments in countries (chapter 3). The included predictors consist in already studied factors like GDP growth, R&D expenses, stock market growth, taxation, and patents applications in order to prove and confirm their influence, but also new ones, such as the quality of management school, the quality of education, the inflation rate, the contribution of tourism to GDP, the collaboration between industry and universities in R&D and the bureaucracy inefficiency in government activities (3.1.3).

To perform this analysis, we collected data from the Refinitiv Eikon venture capital database and macroeconomic data from multiples databases, to estimate a panel data model. On the basis of what has been done in the past (e.g. Jeng and Wells (2000), Felix et all (2013) and Namji (2019)) and numerous statistical tests we found appropriate to use technique of analysis such as random effect (RE) and feasible generalised least square (FGLS) (3.2).

The results we obtained with both methodologies confirm the positive impact of GDP growth and R&D expenses but not in case of taxation, stock market growth and number of patents applications. Out of the new group of factors instead, the quality of management schools and the contribution of tourism to GDP showed to be very relevant to venture capital investments (3.3). The first one highlight how important are good business schools, and more in general universities, in creating a richer national environment for start-ups which than relate to higher levels of venture capital investments, meanwhile the relation with tourism can be explained by the country GDP sector composition: venture capital investments usually targets sectors with higher level of innovation and start-ups birth rate (2.1).

While chapter 2 and 3 focus on the global venture capital industry, section 3.4 gives its attention to one precise country: Italy. The country, despite experiencing a huge growth in recent years and thus following the global trend, still presents an industry that is underdeveloped if compared to other Western European countries. The low attractiveness of the country under a venture capital point of view is explained by a lower level of investors protection and corporate governance with also a human and social environment found to be inferior to the Western European average (Groh, Liechtenstein, Lieser, & Biesinger, 2021). This result, with respect to Western Europe, is also explained

by relevant factors found in the analysis performed in chapter 3: Italy has on average a negative GDP growth in 2011-2021, lower R&D expenses and quality of management schools and higher contribution of tourism to GDP (3.4.2).

# CHAPTER 1: INTRODUCTION TO VENTURE CAPITAL

Before entering the main topic of this paper, we would like to give the reader a brief presentation of venture capital and its most important features. It is indeed very important to present the key concepts around this unique investment asset class to allow a proper comprehension of chapters of 2 and 3.

In this first chapter we are going to introduce the subject by explaining what is venture capital (1.1), the targeted phase in the firm financing lifecycle (1.2), the structure of venture capital funds (1.3) and its history (1.4). In the end we will also explain why this type of capital is important for the economy and why countries should actually care about building a solid venture capital industry (1.5).

## 1.1 WHAT IS VENTURE CAPITAL?

In the vast world of investments individuals and institutions have many possibilities when it comes to investing their capital. According to personal preferences, such as return expectations, risk tolerance and liquidity, one can decide to allocate capitals in different investment asset classes. The most acknowledged ones are equities, fixed income and cash or cash equivalents. Anyway, there is also another class, recognized as alternative investments, which contains investments in real estate, venture capital, private equity, cryptocurrencies and more, all united by one common thing: the illiquidity premium. Investors are in fact keen to abandon the immediate liquidity of market-based investments and venture in illiquid investments to achieve higher long-term returns. Among all of them there is one which intrigues us particularly and that will be the central theme of the thesis: investments in start-ups or very young firms, also defined as Venture Capital. This dynamic investment field is the main source of financing for many innovative business models and played a crucial role in turning young firms into engines of economic growth (Deutsche Bank Chief Investment Office, 2021). More precisely we can describe venture capital as the financial resources provided by investors, under the form of funds or individual investors, to young firms and small businesses with innovative business models and strong growth potentials. The target businesses are commonly known as Start-ups, companies that have a unique and disruptive business model who aim to take over the market (Statista Research Department, 2022).

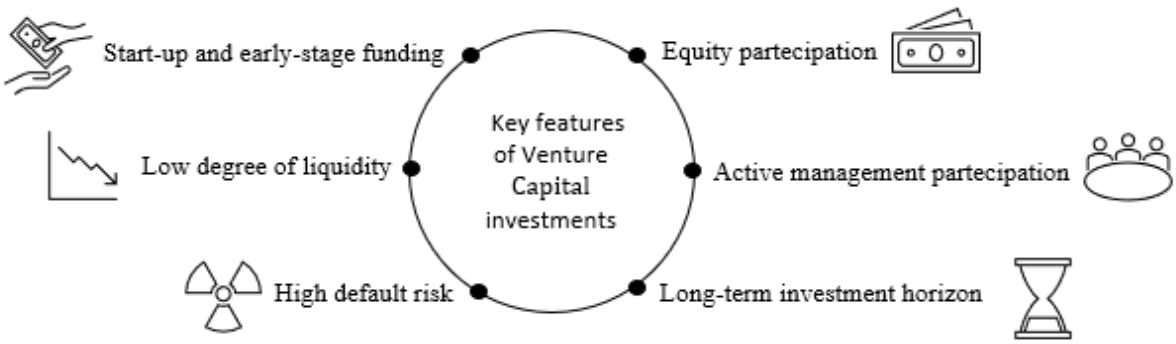
Venture capital is not just important because it promotes innovation, but also because it

covers a crucial role in the financing lifecycle of businesses. It is in fact very hard for very young businesses to obtain capital from the traditional bank system, which main focus is more mature and stable businesses with constant and positive cash flows. It is exactly the very high risk involved with investments in start-ups to be the reason of their difficulty in finding financing. According to Shikhar Gosh, 30 to 40 percent of investors lose most or all of their money, 70 to 80 percent of them fails to see the projected return and 90 to 95 percent declared a projection and then fall short of meeting it (Gage, 2012). The funding needs of young business are therefore fulfilled primarily by venture capitalist, who provide funds in exchange for an equity stake in the company, hoping that this investment will grow and produce a high return.

Venture capital can be set up high net worth individual investors, commonly known as "angel investors" or can be private capital organized as a fund or institution. Alternatively, it can also be delivered by subsidiaries of corporations, banks or other financial institution that are created on purpose to fulfil this need. Anyway, in this case objectives could go beyond higher returns and aim to create synergies to the corporation and the venture capital firm (Deutsche Bank Chief Investment Office, 2021).

The main key features on venture capital can be summed up in figure 1.

**Figure 1 : Key features of venture capital investments**



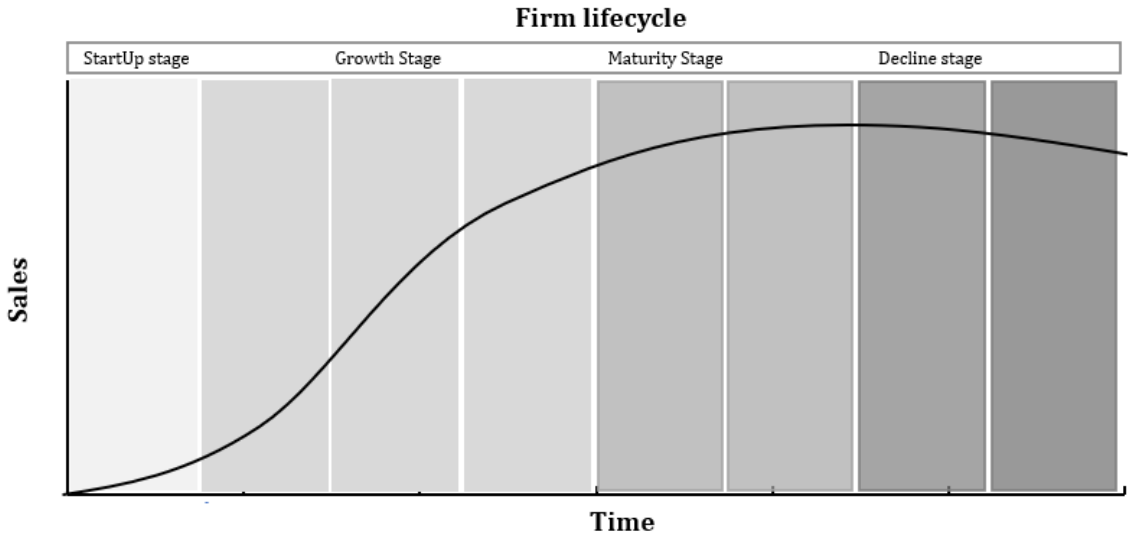

Source: Deutsche Bank Chief Investment Office, 2021.

### 1.2 LIFECYCLE OF VENTURE CAPITAL INVESTMENT

The general firms' life cycle can be divided into four main stages: Start Up stage, growth stage, maturity stage and decline stage (Zider, 1998). In the start-up stage, the possible

sources of funding are mostly self-finance, family, friends, colleagues and angel investors (also known as "love money"). The risk of failure and not transit into the next stage is very high. In this phase there are very few employees, mainly just the founder and some key personnel, the product is usually not defined or is in process of developing and sales are very low with also a small growth rate.

**Figure 2: Firm lifecycle's stages, sales vs time**




Source: Zider, 1998.

The companies that survive to this phase goes into the so called "growth stage", a phase that features more professionals' employees and more natural and formal operations with increasing revenues but still low levels of profitability. It is here that venture capital make its entry and become the main source of financing. The more the companies goes towards maturity the more it start to rely on high skilled and specialized employees, the risk become lower, revenues start to show some kind of stabilization and the first profits are made. Here, venture capital is still one of the main source of financing but goes along with other actors such as banks and other strategic investors. The growth phase usually ends with an IPO or an acquisition and mark the start of the maturity stage, a phase where companies have stable revenues and are profitable. This phase it's not usually on the radar of venture capitalists but it is used by them to exit from their investments through the previously cited IPO or M&A deals (Tariq, 2013).

We can now see more clearly where and how venture capital firms operates. They scout for opportunities in the growth stage, where they make long term equity investments, and

exit through IPO and M&A operations in the maturity stage after the investee company has developed. Despite the presence of some exceptions, around 80% of the money invested by venture capitalist goes into the growth stage, also known as the "adolescent phase" of businesses (Zider, 1998).

Defined the general period of time in the firm lifecycle in which venture capitalists invest their money, we can zoom in even more and focus specifically on the financing stages of venture capital (figure 3).

As we previously said, the investments in the very first span of life of a start-ups are covered by very two important sources of funding:

- Love money: capital provided by the founder, colleagues, family and friends;
- Business angels: private individuals, with a high net-worth and business experience, who directly invest in new and growing private businesses.

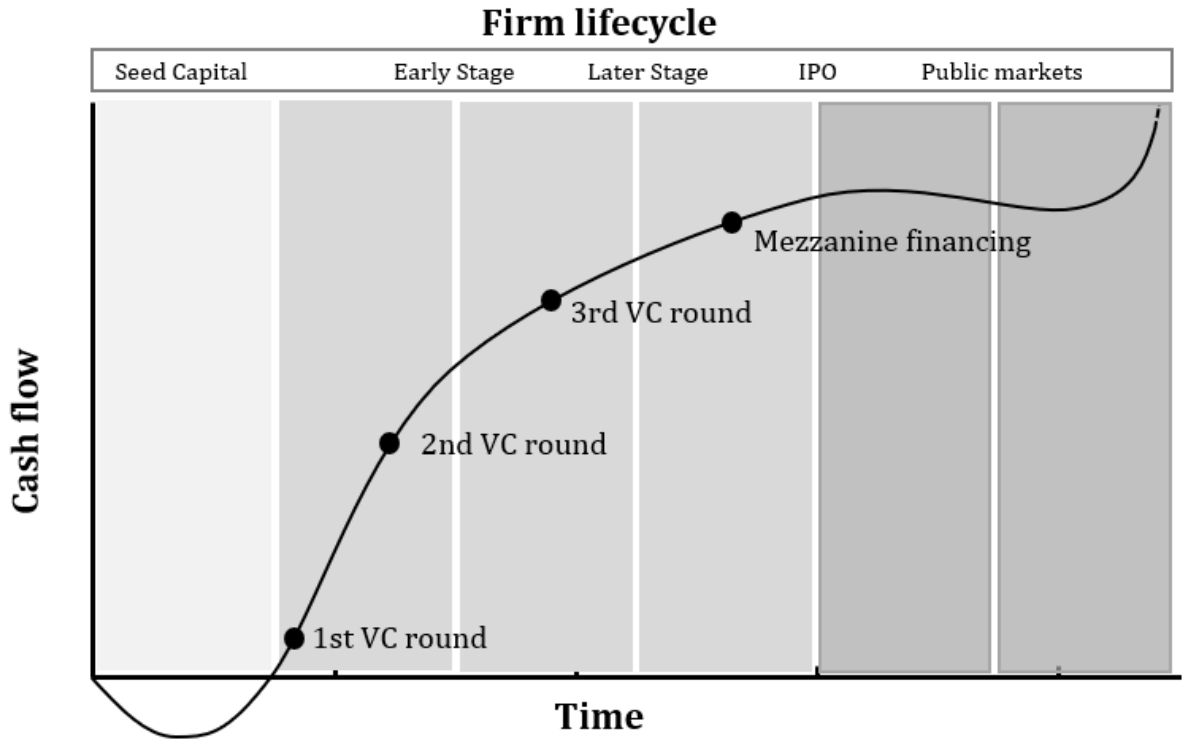
Anyway, recently also venture capital firms started to invest in this very early phase. Known as seed funding this type of capital is mainly invested in research and development, aiming to develop further the already existing product of a company. Businesses in this stage are usually characterized by significant negative cash-flow and seed capital is the only source of funding on which the company can rely. The investments that come after this period are referred as early-stage investments and are provided in "rounds". They usually occur every two years and are equity deals, with the shares allocated among the investors and based on an agreed valuation of the company. Usually each round serve both as an investment opportunity and an exit opportunity and involves growing amounts of capitals. Once start-ups achieve some recognition in terms of sales or users they are in the position to ask for additional funds from an early-stage investor. Through a first round of venture capital financing (sometimes also referred as series A) the company raise new money that tend to be several times higher than during the initial seed capital stage. The early-stage financing usually end with the 2nd round (series B) where companies, that now shows product market fit and have strong user growth, raise capital to invest in sales and marketing with the goal to scale even further.

After these two first rounds we enter the phase of late-stage financing, where we found the third and fourth investment rounds (series C and D). Here companies are no longer early-stage businesses and aim to collect capital to continue their expansion through investments. The focus here it's to achieve strong and sustainable growth.

We than enter in an area known as mezzanine or pre-IPO financing. Here, late-stage

companies usually remain unprofitable and continue to raise capital through other rounds and ultimately achieve an exit opportunity. The last round of funding before an exit is often referred to as a "Pre-IPO round" (or Series E+) (Deutsche Bank Chief Investment Office, 2021).

**Figure 3: Venture capital financing rounds**




Source: Deutsche Bank Chief Investment Office, 2021.

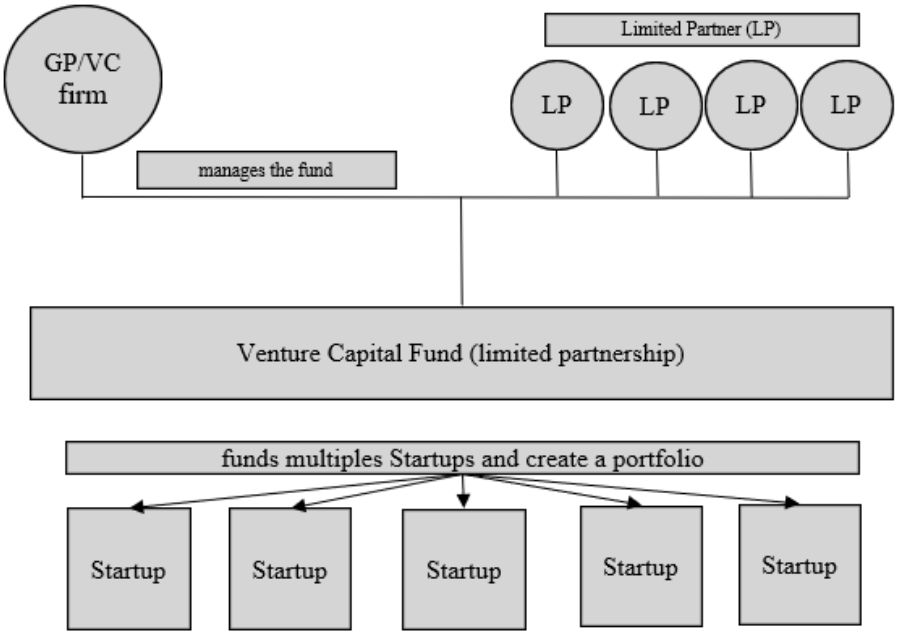
### 1.3 THE STRUCTURE OF A VENTURE CAPITAL FUND

In the end what happens is an investor that buys a stake in an entrepreneur's idea, nurtures it for a short period of time, and then exits with the help of an investment banker (Zider, 1998). But venture capital is more than just investing in a portfolio of companies and then sell them to make capital gains, the true competitive advantage of a fund comes from the expertise and the guidance they provide. After the investments are made, the fund actively collaborates with the companies to provide strategic and operational guidance, a cooperation that is key to the success of a venture capital firm (National

Venture Capital Association (NVCA), 2022).

But how is all of this happening? Typically, a venture capital firm will create a limited partnership, with the investors as known as limited partners (provide the capital) and the firm itself as the general partner (take care of the management). Some examples of limited partners are public pension funds, corporate pension funds, insurance companies, family offices, endowments, and foundations.

**Figure 4: General structure of a venture capital firm**




Source: National Venture Capital Association (NVCA), 2022.

The money taken from limited partners are made through capital calls that happen very early in the life of the fund. Over the next three to eight years, partners from the venture firm will invest these collected capital and work with entrepreneurs to grow their company. The potential payoff comes only after the companies are acquired or goes public.

Reassuming:

- Venture capital firms serve as an intermediary between investors and entrepreneurs. Venture capital raises funds from many sources and invests them in target companies;
- Venture capital firms provide finance for privately held companies. A general

partner (GP) on behalf of a group of investors (LP) manages venture capital.

- Venture capital firms provide capital generally in the form of equity or long-term convertible debt.

## 1.4 HISTORY OF VENTURE CAPITAL

Entrepreneurs in search for capital has always existed, saying that the act of financing new risky ideas did not exist one century ago it's a bold statement. It can be indeed traced back to many years ago, with the American whaling voyages in the 19th century or even in the 15th century with Genoese merchants.

It is incredibly interesting to read how Nicholas (2019) compares the New England whaling industry from 1800s the to the modern venture capital one. The similarities are indeed visible and recognizable, the payoffs distribution are incredibly similar: the whaling agents intermediated between the wealthy individuals who provided funds to the sheep with its captain, exactly how today's VC's general partners collect capital from limited partners to then invest it in a portfolio of companies.

Despite the whaling industry been one of earliest and purest form of venture capital financing the true modern industry was born in 1946 when Professor Georges Doriot from Harvard Business school formed the American Research & Development Corporation to finance young enterprises developed in World War II. The professor laid the foundations to most of the main principals of venture investing: the scrutiny of business plans before financing, the provision of oversight and not only capital, the staged financing investing and the final return of capital with profits to the initial financier. Following these principles venture capital firms like Sequoia Capital, Kleiner Perkins and New Enterprise Associates started in the 70s to invest in semiconductor and computer companies but realistically just in the early 80s the industry really kicked off. In that moment of time pension funds began to allocate their capital in this new asset class, mainly thanks to the clarification of a rule know as ERISA (Employment Retirement Income Security). The law initially stated that managers of pension funds had to invest the managed capital following the care of a "prudent man", interpreted as investing in very low-risk opportunities such as bonds. This changed when the Department of Labour clarified that fund managers could actually invest part of their portfolio into illiquid funds such as venture capital, provided that the "prudence" was taken into account with portfolio diversification.

Soon the trend started to see some success also in US public pensions and other sovereign funds around the globe. Years later, also private funds and other type of investors started to believe in this form of investment asset class, allowing the industry in the following forty years to become an established source of financing for promising Start-Ups sponsoring new risky ideas.

### 1.5 VENTURE CAPITAL RELEVANCE FOR THE ECONOMY

Now that we have covered the main aspects of what is venture capital the attention should shift on an important question: why should we care about venture capital and why should countries? The answer to these questions is pretty simple. Firstly, as we highlighted in 1.1, this type of investment class fills a crucial role in the financing lifecycle of firms, covering the period of time in which normal financing tools or mechanisms are short in supply. Secondly, venture capital firms help start-ups to accelerate the time to develop, market and sell a product, not only by financing them but also providing a strong source of expertise. Lastly, venture investing has generated billions to investors and their institutions, created millions of jobs around the world, but more importantly, the impact on countries' economy through venture-backed firms made significant contribution to the national gross domestic product. Furthermore, venture capital has also helped many companies to scale, go public, become household while generating skilled jobs and create much monetary benefits for countries' economies than just increasing the gross domestic product (National Venture Capital Association (NVCA), 2022).

A way to assess the impact on the economy is in fact by evaluating the effectiveness of venture capital funds in producing large and successful companies. In USA, for instance, 7 out of 10 of the largest public companies (by market cap) have been venture capital financed (table 1).

Anyway, if we look at some of the companies stated in table 1, like Google or Microsoft, we cannot say that venture capital has been the causal agent of their success and tremendous impact on the society, these companies could have had just as much impact and success in the absence of venture capitalists. A 2021 research on the economic impact of venture capital tried to clarify this unclear link. Gornall & Strebulaev (2021) looked at public companies founded in the last 50 years in US and discovered that, out of the 1,677 companies that went public in that period od time, half of them were venture capital backed. These 834 companies represented 77% of the total market capitalization, 92% of

R&D spending and 81% of total patent value. After this first finding, they addressed the problem by looking at the historical regulatory development and international comparison. Before the 1940 just a few successful companies were venture capital backed, but after 1970 they became much more thanks to regulatory changes[1] that transformed the allocation of long-term investment capital in the US and allowed venture capital firms to flourish.

**Table 1: Top 10 public US firms by capitalization**

| Company | Year of foundation | **VC backed** | IPO date | Market Cap (mln) |
|---|---|---|---|---|
| Apple | April - 1976 | Yes | December -1980 | 2.129.322 |
| Microsoft Corp. | April -1975 | Yes | March -1986 | 1.853.183 |
| Alphabet | September - 1998 | Yes | August -2004 | 1.415.605 |
| Amazon.com | July -1994 | Yes | May -1997 | 1.080.726 |
| Tesla | July -2003 | Yes | June - 2010 | 673.697 |
| Berkshire Hathway | January - 1839 | No | March -1980 | 592.100 |
| Johnson & Johnson | January - 1886 | No | September -1944 | 445.917 |
| Meta Platforms | February -2004 | Yes | May -2012 | 443.133 |
| UnitedHealth group | January -1997 | No | October -1984 | 424.110 |
| NVIDIA | April -1993 | Yes | January -1999 | 397.000 |

Source: Refinitiv Eikon, 23/06/2022.

These changes were confined to the US and even today many countries lack a well-developed venture capital industry. So, they used the regulatory reforms as a natural experiment and compared the creation of successful companies in the member of G7 (Canada, France, Germany, Italy, Japan, the United Kingdom, the United States and the European Union).

With a difference-in-differences[2] method they compared the decade before and the decade after the regulatory changes, selecting for each of the non-US country the 50 largest public companies and then compared them with the 300 biggest public us companies. They found out that the decade before the regulatory changes the US was very similar to the other countries but the decade after was very different and able to create a lot more successful companies. They also found that, in the American sample, 88 out of

[1] ERISA reforms, see section 1.4 for more details.

[2] The difference-in-differences method is a quasi-experimental approach that compares the changes in outcomes over time between a population enrolled in a program (the treatment group) and a population that is not (the comparison group). It is a useful tool for data analysis.

300 where venture capital backed, meanwhile, in the non-US g7 sample only 11 out of 300. This correlation suggest that when the regulatory changes came to life the US started to produce large new companies at a far higher rate and those companies were VC backed. The evidences show that the venture capital industry is an integral part of the growth engine of the US economy and regulators around the globe should not ignore the importance of it.

# CHAPTER 2: INDUSTRY ANALYSIS AND DRIVERS REVIEW

As we saw in chapter 1, venture capital is a very niche form of risk capital with unique features that covers an important role in the economy. But what really drove our attention toward this type of capital it's not just its peculiarity or importance, but its movements and destinations.

Venture capital investments seems to prefer some specific locations to others and these preferences are not static but instead very mutable. This fascinating behaviour brings with itself some interesting implications: there are probably factors that somehow attracts this type of capital and consequently, if discovered, countries can use them as levers to attract early-stage investments.

The goal of this chapter is to develop our knowledge on this topic and study the related literature. To do so we will firstly analyse the movements of venture capital from a geographical standpoint, trying to understand which are the countries with the highest level of venture capital activity and what are the most recent trends, intended as the capacity of countries to change their status from low to high levels of venture capital activity (2.1). Then, we will focus on the literature and by doing a complete review of what are the most relevant studies around this topic we will try to find out what are the key factors that influence the researched topic (2.2).

## 2.1 VENTURE CAPITAL HISTORICAL GEOGRAPHICAL TRENDS

The discussion on venture capital trends introduced in section 1.4 will be continued in this chapter by looking at a time range of 13 years (2009-2021) and multiples countries all around the world.

The analysis of trends will take in consideration only the volume of venture capital investments and not other expressive measures of venture capital activities like the number of deals, fundraising levels or start-ups valuation levels. We chose this approach because we believe that the volume of venture capital investments is the best way to describe the industry and its movements, since it incorporates the other three variables.

Venture capital investments are not easy data to collect, the main reason being the given definition by the entity who collects the data. For example, the OECD database gives a definition that comprehends seed, early and late-stage financing, meanwhile other entities include just seed and early or even post-maturity stages, creating in this way

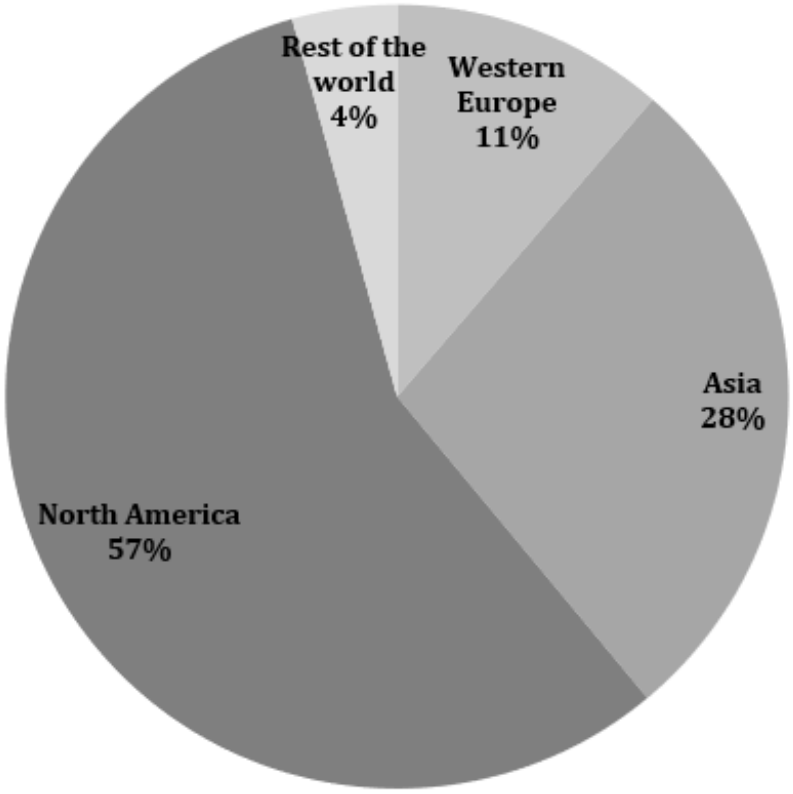
discrepancies between data. Since there is no harmonised definition of venture capital and what stages to include, I decided to follow the Refinitiv Eikon definition, who classify as "pure venture capital deal" those pertaining to seed, early, expansion, and later stages. By collecting all the deals happened in the researched countries in the studied years and summing their deal value (total amount of equity capital invested in a company for a particular round, expressed in millions of dollars) we were able to obtain a solid representation of our researched measure. This analysis will be also very helpful in chapter 3, venture capital investment is in fact the numerator of our dependent variable (3.2.2) and its study can give us numerous hints on what could be the factors that drive the venture capital activity. To have a realistic and truthful representation of the global venture capital activity we tried to include as many countries as possible. We were able to reach a total number of 105 countries pertaining to 9 macrogeographical areas:

- North America (United States, Canada);
- Central America (Mexico, Panama, Costa Rica, Honduras);
- Latin America (Brazil, Colombia, Argentina, Chile, Uruguay, Ecuador, Peru, Paraguay, Bolivia);
- West Europe (United Kingdom, France, Germany, Sweden, Spain ,Luxembourg, Italy, Netherlands, Switzerland, Denmark, Ireland, Belgium, Finland, Norway, Austria, Portugal, Iceland, Monaco, Greece, Malta);
- East Europe (Russia, Latvia, Poland, Ukraine, Estonia, Hungary, Croatia, Turkey, Romania, Czech Republic, Slovakia, Belarus, Albania, Bulgaria, Slovenia);
- Africa (Nigeria, Egypt, Senegal, Kenya, South Africa, Morocco, Ghana, Ethiopia, Algeria, Zambia, Sierra Leone, Rwanda, Zimbabwe, Uganda Tunisia Tanzania, Mozambique, Liberia, Madagascar, Mali, Burkina Faso, Libya);
- Middle East (United Arab Emirates, Israel, Kuwait, Jordan, Saudi Arabia, Bahrain, Qatar, Lebanon, Iraq, Oman, Iran);
- Asia (China, India, Singapore, Taiwan, South Korea, Indonesia, Hong Kong, Malaysia, Philippines, Thailand, Vietnam, Bangladesh, Pakistan, Myanmar, Sri Lanka, Cambodia, Mongolia, Afghanistan, Nepal, Japan);
- and Australasia (Australia, New Zealand).

The global venture capital industry in 2009-2021 grew substantially. According to our data, venture capital investments increased at a 23.8% compound annual growth rate (CAGR) reaching, from an initial value of 32,10 billion of dollars, a total value of 514,10

billion. At the end of 2021, North America had the biggest market share, accounting for 57% of the total deal value in 2021, followed by Asia with 28% and West Europe with 11%. The rest of the world (Africa, Middle East, Central America, Latin America and Australasia) accounted just for the 4% of the venture capital investments in 2021.

**Figure 5: Venture capital investment market share by region, 2021.**

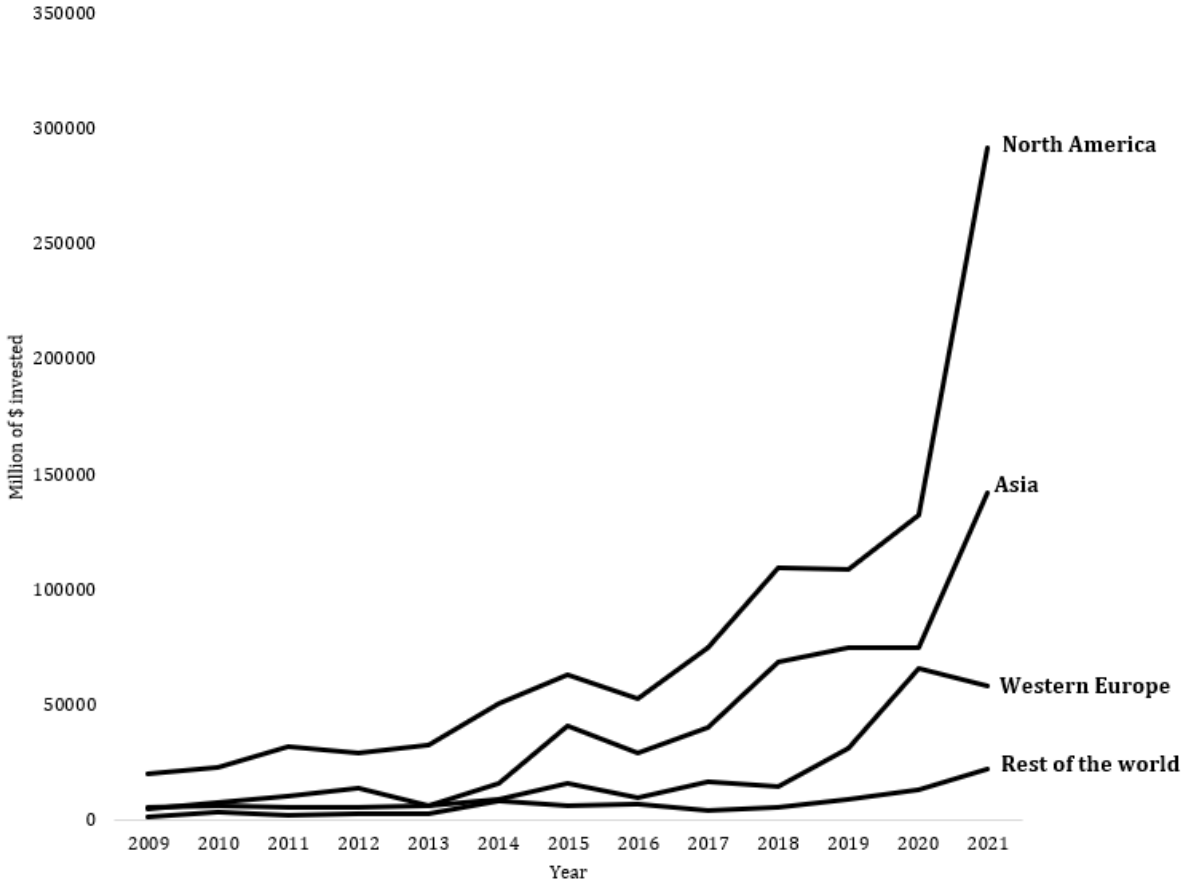



Source: Refinitiv Eikon, 2022.

Trend wise, all the regions experienced a substantial growth in 2009-2021. North America grew by the 22.9%, Asia by 29.2% and West Europe by 19.4%. The other regions grew even faster, Latin America increased at an astonishing CAGR of 44%, Central America at 30.4%, Middle East at 29.8% and Australasia at 26%. The regions which grew less are Africa at 12.1% and East Europe at 6.5%.

Despite the growth being relatively stable across the year, 2019, 2020 and 2021 saw an exponential growth. This is particularly true for 2021 which has been a breaking record year for the venture capital industry.

**Figure 6: Venture capital investments trend, 2009-2021.**

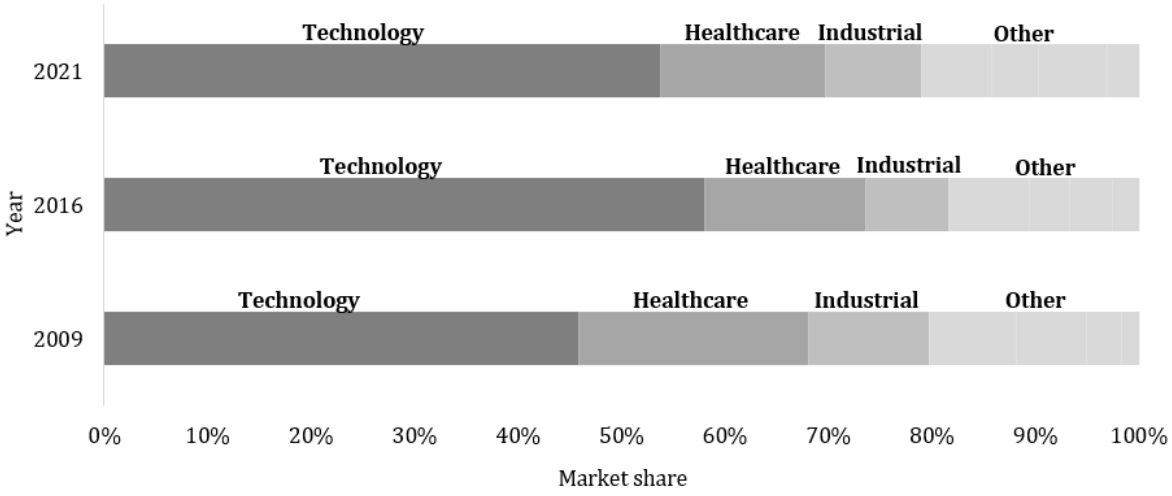



Source: Refinitiv Eikon, 2022.

Sector wise, the global venture capital industry placed the majority of its deals in technology, which correspond to 50% of total deals, healthcare, that accounted for 22% in 2009, 16% in 2016 and in 2021, signalling a decrease in the volume of capitals invested in this sector, industrial, always around 10% and consumer cyclical which stays around at 8% in all the studied years. The high share pertaining to tech is not surprising, as intrinsic of the venture capital world to finance innovative ideas related to new technologies.

Regarding the record-breaking year 2021, the Start-Ups that received the funding pertained mainly to technology services, finance, commercial services and health technology. A noteworthy mention goes to Fintech's industry which has risen with incredible importance in the venture capital horizon.

**Figure 7: Composition of venture capital investments by sector, 2009-2016-2021**




Source: Refinitiv Eikon, 2022.

Notes: The graph show the market the market share of the three main sectors: technology, healthcare and industrial. "Other" regroup all the sector with a smaller market share: academic & educational services, real estate, utilities, institution-associations-organizations, government activity, basic materials and energy.

The huge positive trend that characterized 2020 and 2021 looks like started its slowdown in 2022. The venture capital investments and number of deals have declined due the political uncertainties, supply chain issues, increasing inflation and interest rates rise. This was an expected consequence, given the geopolitical and macroeconomic uncertainties which affected 2022, and this downward pressure on the venture capital market is likely to continue further and consequently impact the level of venture capital investments. Venture capital deals will likely take more time to be completed as the due diligence process becomes more complex. FinTech, supply chain and logistics, cybersecurity and alternative energy will remain significant. Despite the significant turbolence across the market, the industry has not collapsed yet, there are still multiples factor that keep pushing dealmaking in the venture capital space, such as high capital availability and high valuations (KPMG, 2022).

## 2.2 DRIVERS OF VENTURE CAPITAL ACROSS COUNTRIES

By looking at venture capital trends it is easy to see that the distribution of venture capital investments is not homogenous around the globe. Regions like North America, Western

Europe and Asia absorb 96% of all the venture capital investments. Still, it is also clear that countries can move across the board and start attracting more and more capitals.
A clear example is Latin America which in the last 13 years has seen a CAGR of 44%. Understanding the reasons why some countries are more successful than others in attracting this type of capital has always fascinated academics and researchers. The study of factors that have an impact on venture capital has been researched in America (Gompers & Lerner, 1999), in Europe (Marti & Balboa, 2001 or Félix, Gulamhussen, & Pacheco, 2013), on emerging markets countries (Groh & Wallmeroth, 2016) or even just in the G7 countries (Najmi, 2019). These researches has not only an academic purpose, but they also provide to country's regulators hints on what are the potential factors they can manipulate to attract venture capital investments. Understanding the drivers of venture capital investments is also the goal of this work, which needs to start with a proper scouting of the already studied ones.
A first key point to keep in mind before addressing the literature of the researched theme is how the level in investments in venture capital actually changes. The nature of the business, which collects funds to then invest, suggest that the level of investments might be influenced by two aspects, the demand and the supply of venture capital (Gompers & Lerner, 1999). The supply is intended as the desire of investors in putting money into venture capital funds and the demand as the desire of entrepreneurs to be finance with venture capital. This distinction is very important because it amplifies the scope of investigation of the drivers, now extended to the factors that drives the demand of venture capital investments and those who facilitate and promote the collection of capital.
The review of the literature will suggest us multiples factor that we'll split in different groups. The clusters are the following:

- Macroeconomics conditions (unemployment, GDP, GDP growth rate, state of economic development, interest rate levels, exports and import levels, …)
- Capital market state (market capitalization growth rate, stock vs bank centred countries, number of IPOs, state of the M&A market, price to book ratio, private pension levels and growth rate, …) ;
- Taxation (prudent man rule, taxation of entry and exit, personal income tax, corporate tax, capital gain tax, …);
- Legal structure and investor protection (quality of the legal system, level of investors protection, IP Protection, legal rights levels, …);

- Cultural factors (entrepreneurial culture, education, barrier to entry for start-ups, …);
- Innovation output of the society (R&D expenditure, bureaucracy, TEA);
- Specific to the industry (VC disinvestments, VC investments, IPO disinvestments, …).

A presentation of the factors already studied by the literature can be seen in table 9 and 10 in the annex section, which also differentiate them by author and technique of analysis.

### *2.2.1 Macroeconomic factors*

Macroeconomic factors are influential fiscal, natural or geopolitical events that broadly affects a national economy; examples include economic output, unemployment rates, interest rates or inflation. Out of this group, one factor that has been widely studied by the literature has been GDP, especially in his form of growth rate. Gompers & Lerner (1999) affirms that out of all the macroeconomic variables, real GDP growth rate is the only one really important. Increases in this variable should lead to greater commitments of venture capital, especially the demand side of it, strong economic growth creates new opportunities for entrepreneurs who will ask for more capital. The importance of GDP growth is sustained also by other authors, such as Jeng & Wells (2000), Marti & Balboa, (2001), Romain & Pottelsberghe (2004) and Félix, Gulamhussen, & Pacheco (2013) who all included this variable in their analysis sustaining the thesis expressed firstly from Gompers & Lerner (1999). GDP growth is not the only through which the economic output has been studied, Cumming, Johan, & Zhang (2014) included in their research also GDP per capta, sustaining a positive relationship with entrepreneurship which levels are strictly related to venture capital investments. Another interesting variable researched by Gompers & Lerner (1999) and also Romain & Pottelsberghe (2004) is the level of interest rates in the economy. Bonds are an alternative investment to venture capital funds, if interest rate rise their attractiveness will too and consequently those of venture capital funds will decline, impacting in this way the supply of venture capital. While Gompers & Lerner (1999) only studied the impact of the one-year interest rate, Romain & Pottelsberghe (2004) studied also the ten-years one and the spread between the two rates. Going on with the list of economic factors considered to be impactful on the venture capital investment levels we find unemployment. Firstly introduced by Félix, Gulamhussen, & Pacheco (2013), the number of unemployed people is believed to

positively affect the demand of venture capital and negatively the supply of it. The higher the unemployment the higher will be the number of people that have incentive to become entrepreneurs, but at the same time, the lower will be the amount of people that are seeking to invest and so provide capital to venture funds. Cumming, Johan, & Zhang (2014) also studied the impact of macroeconomic indicators like exports (divided by GDP), which they believed to positively impact entrepreneurship levels and so the number of start-ups and the level of capital requested.

### *2.2.2 State of the capital market*

A second really important group of factors that drive VC investing regards the state of the capital market and its depth. A first aspect of it, that has been largely addressed is stock market capitalization growth. Félix, Gulamhussen, & Pacheco (2013), but also many other authors (Gompers & Lerner (1999), Jeng & Wells (2000), Najmi (2019)), state that the market capitalization growth of a country strongly reflects the expectations of investors about the economy and consequently creates a more favourable environment for investors. An increase in market capitalization should so correspond to an increase on the available funds for venture capital investments.

Jeng & Weng (2000) also believed private pension funds to be a really important source of venture capital funds, especially in the US. Raising money from this type of institution provides numerous advantages to venture capitalists who can quickly raise large amounts of capital very quickly and economize the amount of time expended on keeping investors apprised of the fund activities. Furthermore, Jeng & Weng (2000), opened the discussion on factors related to exit mechanisms. The main risk faced by venture capitalists is to not get their money back, thus the presence of viable exit mechanism in a country is vital for the development of the venture capital industry. Consequently, factors like the number or volume of IPO should have a positive effect both on the demand side, by giving entrepreneurs an additional incentive to start a company, and on the supply side, where large investors are more incline to supply funds if they know it will be more likely to get back their investments. On the same line of thinking, Groh & Wallmeroth (2016), concluded that the M&A investments volume have a positive impact on the level of venture capital.

Félix, Gulamhussen, & Pacheco (2013) also considered the price to book ratio to be a

strong determinant of venture capital investments, companies and industries with higher ratio are in fact more attractive to investors which are more propense to invest when the ratios are high and in this way boosting the supply of venture capital.

### *2.2.3 Taxation*

Another element that cannot be excluded is taxation. It is in fact reasonable to think that something like this, in the vary and multiples forms in which it present itself, can influence venture capital activity.

Gompers & Lerner (1999) confirmed this belief, showing that a decrease in the Capital Gains Tax Rate have an important and significant effect on the commitment to provide funds to VC firms. Also Romain & Pottelsberghe (2004), included the corporate tax rate, sustaining that a higher rate should increase the return expectation of investors and consequently having a negative effect both on demand and supply of VC, but, in this case, finding no significant correlation. But despite the taxation and its impact on investments being a very much discussed topic (Bruce, (2002), Djankov, Lopez-de-Silanes, Shleifer, & Porta (2008)), in reality the relation between tax and the venture capital investments level might not be that straightforward and need to be taken accordingly. This is because usually developed countries with higher taxations also have higher level of VC and oppositely some undeveloped countries with low levels of taxes might have no VC activities.

So we might conclude that venture capital is much more influenced by other factors rather than taxation that overshadow its effect (Groh, Liechtenstein, Lieser, & Biesinger, 2021).

### *2.2.4 Legal structure and investor protections*

Part of the literature on the researched topic focus on the relationship between venture capital investments and the legal structures or the protection of property rights. As for all type of investments, doing business in a country without proper legal protection and enforcement possibilities become very costly and risky. The venture capital industry is particularly exposed to this type of risk because of its peculiarity to be based on long-term investment where the capital source and the target country where the investment happen might be very distant between each other. The limited partners of funds rely on general partners that in turn rely on the management team they back. It is quite reasonable to think that if investors are worried that their claims are not protected in a particular

country they will be resilient to allocate the capital (Groh, Liechtenstein, Lieser, & Biesinger, 2021)

Jeng & Wells (2000) introduced the quality of accounting standards as possible element affecting negatively venture capital, sustaining that bad accounting standards would create problems of asymmetric information that will consequently flow in higher asked risk premiums by investors resulting in more expensive funding for venture firms.

Expecting a positive effect on the supply side, they instead found a negative one, justifying it as the consequence of using standard for public firms which are just a proxy of the ones used by smaller private firms.

Groh & Wallmeroth (2016) heavily extended the research to the legal structure of a country and its impact on investments of venture capital, including multiple index able to evaluate its quality (legal right index, disclosure index and shareholder suits index) and generally finding a positive correlation. Also intellectual property protection levels have been found to have a strong positive relation with the studied variable, a higher level of IP protection should promote a safer environment for venture capitalists which aim to make gains on innovative ideas on their portfolio of start-ups.

Both Jeng & Wells (2000) and Romain & Pottelsberghe (2004) found that high labour market rigidities impact negatively venture capital investments. Higher labour market rigidities reduce the demand of venture capital by making hiring employees much harder for companies, especially the smaller ones.

Namji (2019), tried also to assess the easiness to start a business by including the "ease to start a business" index, stating that low ease of starting business index means fewer procedures, time, cost and capital to open a new business, and finding a strong positive relation.

### *2.2.5 Culture*

One characteristic of countries that might be taken too lightly but that in reality strongly affects venture capital activities is culture. There are countries around the globe where the society is built and developed in a way that promotes innovative solutions and entrepreneurial behaviours. Baughn & Neupert (2003) point out how the rate of new businesses start-up change dramatically around the globe; adults involved in starting new businesses in the USA was found to be five times the Sweden one- and ten-times Japan. In the perspective of finding an explanation to this difference, they found out that the

cultural dimension of individualism and uncertainty avoidance favourite hardly the creation of new start-ups. Félix, Gulamhussen, & Pacheco (2013) tried to evaluate this relationship by inserting in the performed regression the index TEA (total entrepreneurial activity) but found it to not have statistical significance and coefficients not consistent.

Another cultural element relevant for our discussion regards education (w.r.t. schools, universities and research institutions), element that turn out to be very important to boost and foster a growing venture capital industry (Megginson, 2001).

### *2.2.6 Innovation output of a society*

One of the first things that comes to mind when thinking about factors influencing VC investing in a country is without doubt the innovation capacity and research output of a country which flow in a more dynamic entrepreneurial and start-ups environment that means more opportunities and deals for VC funds. Indeed, literature studies and research by multiples authors confirmed this statement. Gompers and Lerner (1999) indicate that R&D expenditure, especially by industrial firms, strongly affects venture capital movements; Romain & Pottelsberghe (2004) findings shows that indicators of technological opportunity and innovation like R&D investments growth rate, stock of knowledge and the number of patents relates heavily to investments on venture capital.

A different approach has been followed by Groh & Wallmeroth (2016)which decided to include an index, called "innovation index", that measure how innovative is a country (in it is included R&D expenditure), to have a more general view on the matter. They found it to have a strong and relevant correlation with venture capital investments explaining that higher levels of innovations attract more investments and increase both the supply and demand of venture. Namji (2019) also elaborated on the relation between government and R&D by looking at the government financial subsidiary for new technology development and technology transfer but did not find significant correlation.

### *2.2.7 Specific to the industry*

One last group of variables that has been studied by the literature is composed by specific related venture capital factors. Marti & Balboa (2001) expanded the field of researched factors by considering elements and topics more related to how the industry works. As explanatory variables of venture capital investments they focus on the ability of managers

in a given country to raise money and consequently invest them. They found that investments are very important in explaining the flow of new funds raised, or in another words, the higher the amount invested the easier to collect new funds for managers. This happen because the market value the ability to wisely invest the total amounts that investors have committed. Also disinvestment have been considered, as expression of the managers abilities to exit and cash out their investments; surprisingly this time the relation appeared to be negative. Overall, their contribution stands in the fact that also elements outside macroeconomic, environmental, cultural or innovation world and closer to the features of the industry must be considered when analysing the flow of venture capitals in a specific country.

# CHAPTER 3: EMPIRICAL MODEL AND INTERPRETATION

## 3.1 INTRODUCTION AND STATISTICAL QUESTION

In chapter 2, we saw that venture capitalists have specific preferences towards countries into which they allocate their money. North America, Asia and West Europe have altogether 96% of the total venture capital investments market share, proving them to be the preferred locations by funds. Still, we saw that some regions, such as Latin America, are becoming more attractive and slowly increasing their investments. Understanding why some countries are more successful than others in attracting this form of capital is what really drive our attention and will be the central theme of the incoming analysis.

Understanding why and how some locations have successfully created a favourable venture capital environment will be done by trying to identify, at a country level, possible factors that have an impact on the level of venture capital investments. This factors as we saw in chapter 2.2 pertain to multiple fields, not only peculiar aspects of venture capital, such as entrepreneurship and innovation, but also taxation, exit-opportunities, bureaucracy, state of the economy, unemployment, corruption and so on. We will try further develop this field of research by performing a similar analysis to the ones put in place by Jeng & Wells (2000), Romain & Pottelsberghe (2004), Félix, Gulamhussen, & Pacheco (2013) and Namji (2019), and in which we will analyse the impact of some variables, already researched or totally new, to venture capital investments. This research will be applied on our new dataset and could confirm or not existing relations and possibly discover new ones.

This said, we can state the statistical question behind incoming analysis as:

*"What are the factors that impact the level of venture capital investment in countries?"*

And the hypothesis as:

- $H_1$: there is a positive relation between a growing economy and venture capital activity;
- $H_2$: higher levels of taxations correspond to lower venture capital activity;
- $H_3$: there is a positive relation between research and development expenditure and venture capital activity;
- $H_4$: to a growing stock market corresponds a growing level of venture capital

activity;

- $H_5$: inefficient bureaucracy at a government level negatively impact venture capital activity;
- $H_6$: the presence of high-quality management schools positively affect venture capital activity;
- $H_7$: higher quality of education corresponds to higher venture capital activity;
- $H_8$: collaboration between universities and industries in research and development brings higher levels of venture capital activities;
- $H_9$: higher is the contribution of travel and tourism to the GDP lower is the venture capital activity;
- $H_{10}$: higher inflation reduces venture capital activity;

### *3.1.1 Dataset*

Many of the studies that we have been through in the literature review section (2.2) focused only on specific areas of interest (Namji (2019) only on G7 countries, Félix Et al. (2013) on Western Europe, Groh & Wallmeroth (2016) on emerging countries) but it won't be the case in our research. We decided to include as many countries as possible, to broaden the scope of the analysis and consider beyond Europe and America, whose data are relatively easy to collect, also areas like Africa and Asia which we find particularly interesting under a venture capital point of view.

The database used to perform the analysis is the same used in section 2.1 but with fewer observations. This is because, considering the data from all the dependent variables, is really hard to not have missing values. Some data are available just for specific countries for certain years, and, with a starting dataset of 105 countries and 13 years, is just impossible to not have missing values. So, to have a reliable group of observations and solve the missing values problem, the database has been cleaned by excluding some years and some countries, obtaining in this way a total number of 268 observation for 36 countries[3] in 9 years (2009-2017). Further, it's important to say that this database pertain

[3] United Kingdom, France, Germany, Sweden, Luxembourg, Italy, Netherlands, Switzerland, Denmark, Belgium, Finland, Norway, Austria, Portugal, Greece, Latvia, Poland, Ukraine, Hungary, Czech Republic, South Africa, Israel, Australia, New Zealand, India, Singapore, Indonesia, Malaysia, Thailand, Brazil, Colombia, Argentina, Chile, United States, Canada, Mexico.

to the category of panel data or longitudinal data, that is to say, data that contains observations about different entities across time, allowing us to build a dataset with one observation for each year in each country, containing values of all the selected variables. As for the source, the data have been collected mainly from Refinitiv Eikon, The World Bank database and The World Economic Forum databases. A more precise description of the data source is given in table 13, found in the annex section and where we give a presentation of the studied variables, their sources, previous results and expected ones.

### *3.1.2 The independent variable*

The first step in building an analysis that wants to understand what the drivers of venture capital are, is to decide which is the independent variable that best suits the theme of investigation. In our case we will use the yearly total dollar value of venture capital investments in countries. To obtain this measure, we summed the value of venture capital deals pertaining to early, start-up and later investment stages for each year in analysis and for than dividing them by investee country.

But, with the specific purpose of developing a regression (see 3.2 for more details on the methodology used), we cannot use pure venture capital investments like in section 2.1, we need to properly adjust the variable by diving it by GDP[4]. The same has been done by authors like Gompers & Lerner (1998), Romain & Pottelsberghe (2004) and Félix, Gulamhussen & Pacheco (2013). This is essential to have a true representation of the level of venture capital activity for three main reasons. First of all, the differences between countries, in the size of the economy and its rate of growth, might create heterodasticity effects. Second, it is reasonable to expect higher levels of venture capital investments in bigger economies and, normalizing our variable by GDP, we will be able to properly assess the venture capital investment level in a specific country. Third and last, prices level might alter our capability to address changes in the level of investments: increases in the measured variable might correspond just to an increase in prices and not a true increment in the level of venture capital. By dividing the variable by GDP we will also be able to solve this third issue. In the end, what we will have is the percentage share of venture capital investment to GDP, a corrected measure that truly represent the intensity of venture capital in countries.

[4] Also referred in this thesis as VC intensity.

If we now look at this new variable, we can rapidly assess which are the regions with the highest concentration of venture capital investments. I expect these results to not vary significantly from the ones obtained in section 2.1 but the normalization by GDP could still affects them slightly. As anticipated, North America is the country with the highest levels of venture capital activity, followed by West Europe and Middle East (table 2).

**Table 2: Average Venture capital intensity 2009-2021, by region.**

| Rank | Continent | VC intensity |
|---|---|---|
| *1* | North America | 0,27% |
| *2* | West Europe | 0,10% |
| *3* | Middle East | 0,09% |
| *4* | Asia | 0,07% |
| *5* | East Europe | 0,05% |
| *6* | Australasia | 0,04% |
| *7* | Latin America | 0,02% |
| *8* | Africa | 0,02% |
| *9* | Latin America | 0,01% |

Source: Refintiv Eikon screening.

The position of North America it's not surprising, the country's venture capital industry is in fact recognized to be the most developed and admired in the world. What surprise us is the position of Middle East and West Europe above Asia, which in section 2.1 we found it to be second only to North America. The higher score obtained by West Europe can be justified if we take in consideration the much higher GDP of Asia, which decreases the intensity of venture capital in the region. A totally different discussion is the one of Middle East, whose results of are biased by small countries like Israel with surprisingly high levels of venture capital investments compared to GDP. The situation remains similar to those prospected in the section 2.1 also from a singular country point of view (table 3). Anyway, in this case, the dimension of countries creates a bias that alters the results for very small nations and boost their score up the ladder of the countries with highest level of venture capital investments (it's the case of Israel, Singapore, Estonia, Iceland or Jordan, place in the top 10 ranking). The countries that really shine are United States, India, China, United Kingdom and Sweden, whose high share of venture capital investments to GDP can

be considered a truthful representation of the situation.

**Table 3: Top 10 countries by VC intensity, 2009-2021.**

| Rank | Country | VC intensity |
|---|---|---|
| 1 | Israel | 0,54% |
| 2 | Singapore | 0,53% |
| 3 | Estonia | 0,39% |
| 4 | United States | 0,38% |
| 5 | India | 0,26% |
| 6 | China | 0,22% |
| 7 | United Kingdom | 0,22% |
| 8 | Sweden | 0,21% |
| 9 | Jordan | 0,19% |
| 10 | Iceland | 0,18% |
| 36 | Italy | 0,02% |

Source: Refintiv Eikon.

**Table 4: Top 10 European countries by VC intensity, 2009-2021.**

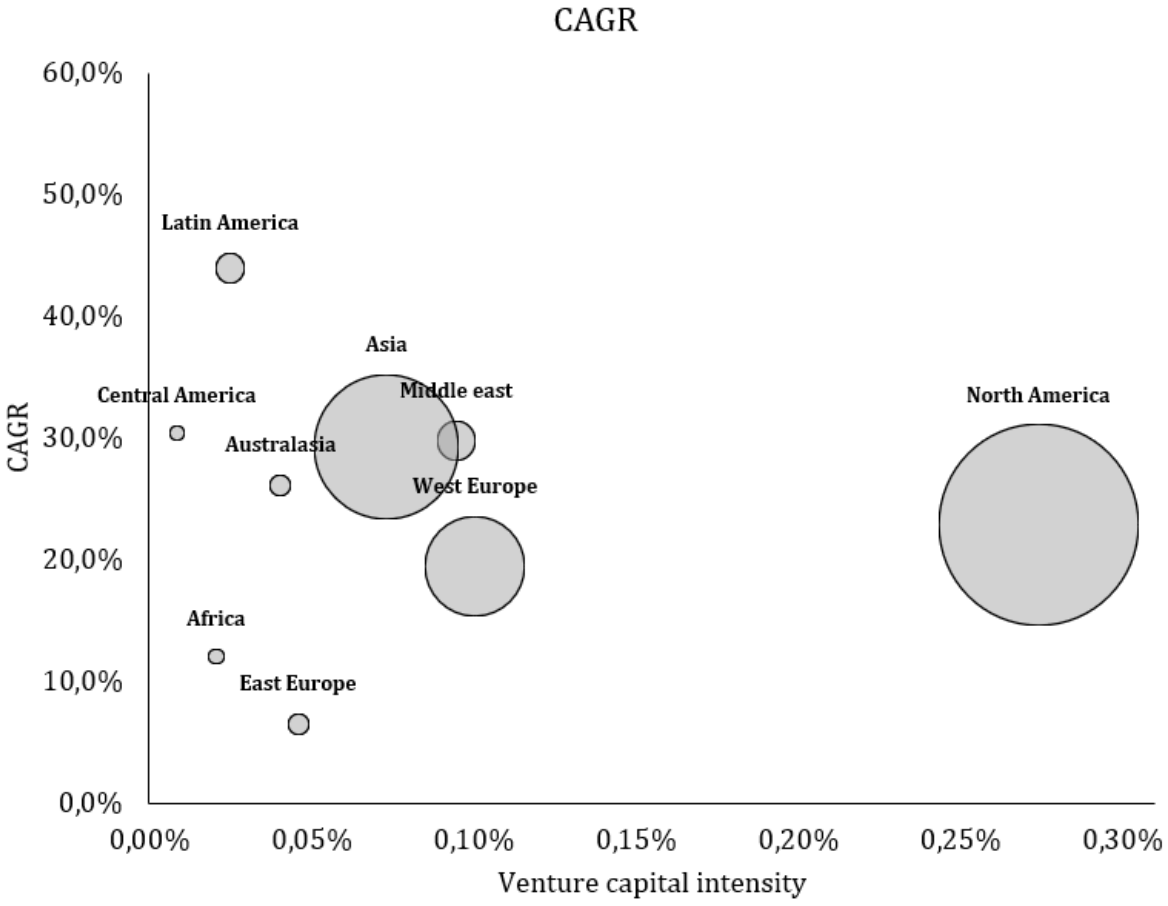
| Rank | Country | VC intensity |
|---|---|---|
| 1 | United Kingdom | 0,2169% |
| 2 | Sweden | 0,2094% |
| 3 | Iceland | 0,1781% |
| 4 | Monaco | 0,1552% |
| 5 | Luxembourg | 0,1526% |
| 6 | France | 0,1502% |
| 7 | Finland | 0,1409% |
| 8 | Ireland | 0,1035% |
| 9 | Denmark | 0,0999% |
| 10 | Switzerland | 0,0991% |
| 19 | Italy | 0,0200% |

Source: Refintiv Eikon.

In table 3 we also included Italy as special guest, which score is not one of the bests. The Italian venture capital investments average share of GDP in the studied years is only 0.02%, a score that place the nation 36$^{th}$ in the global chart and last but one in the

European one (see table 4). The European ladder is dominated by countries like the United Kingdom and Sweden, that are also present in the global chart with a score of 0.22% and 0.21%, followed then by France (0.15%), Denmark (0.01%) and Finland (0.14%). A better understanding of the Italian venture capital industry and its level of venture capital investments will be done in section3.4 , where we will investigate and present the state of the industry and the reasons of the very low scores obtained in table 4. Lastly, we believe helpful to have a visual representation of our independent variable with the studied CAGR and volume of venture capital investments in section 2.1. Please refer to figure 8 for a comparison between regions under three aspects: CAGR (vertical axe), venture capital intensity (horizontal axe) and volume of venture capital investments (size of the bubble).

**Figure 8: Graphical representation of CAGR, venture capital investments and venture capital intensity, by region.**




Source: Personal elaboration of data collected from Refinitiv Eikon database.

Notes: CAGR, VC intensity and volume of venture capital investments are calculated as average of the studied years.

### *3.1.3 Dependent variables*

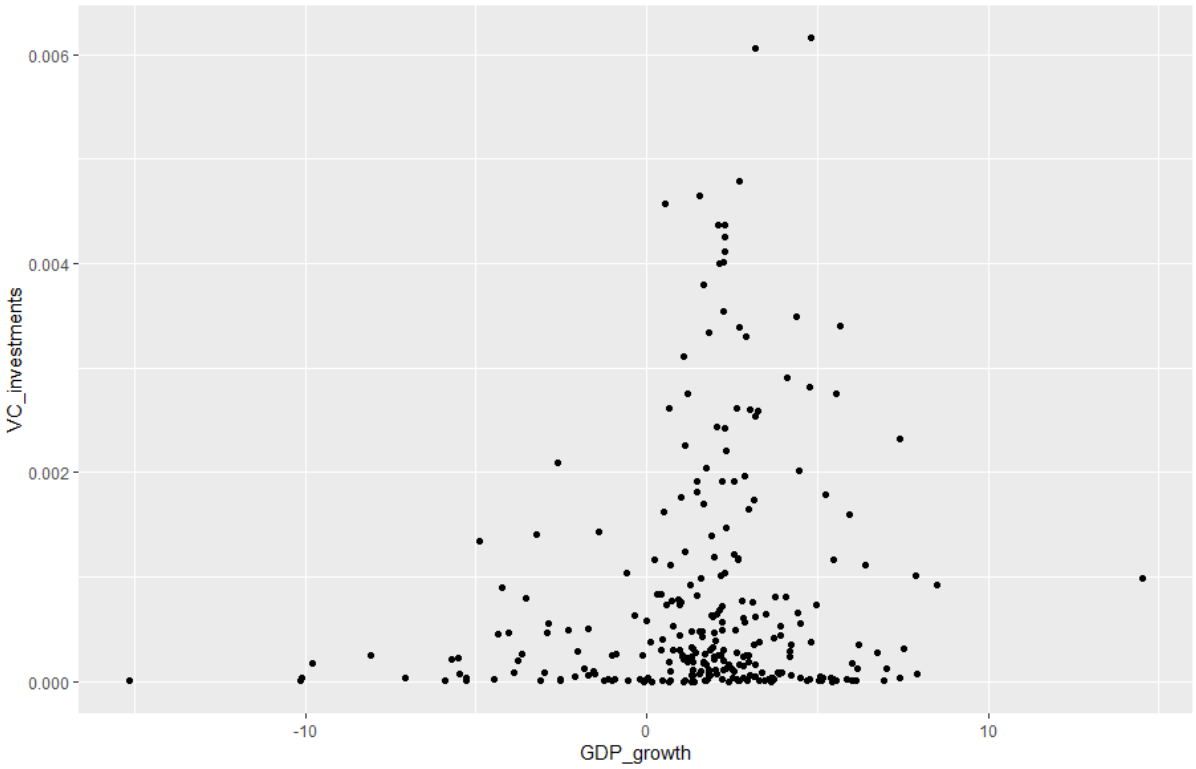
As for the dependent variables my starting point has of course been the literature review performed in chapter 2. The numerous studies in this field has covered multiples areas, spacing from macroeconomic factors, such as GDP per capta, GDP growth and unemployment, to taxation, the state of the market capital, culture and many more. As one could expect, I decided to include just some of them of them. The criteria with which we chose them are related to relevance to the independent variable, the lack of data and personal preferences. Further, I decided to implement variables for which we did not find evidence in previous studies with the goal to discover possible new relations or deny the influences of such factor on venture capital investments.

Next sections will present, one by one, all the predictors included in the analysis and, for each of them, a brief description will be given, followed by a stated expected relation also visually represented. Please refer to table 13 for a summary presentation of all the variables, their sources and expected relations.

#### 3.1.3.1 GDP annual growth rate

The GDP annual growth rate represent the yearly change in a nation's gross domestic product. The correlation between GDP growth and the level of venture capital investments comes from the belief that an economy in expansion phase will require more investments and provide more opportunities to investors. Thus a higher GDP growth should correspond also to a higher level of venture capital investments (Félix, Gulamhussen, & Pacheco, 2013).

**Figure 9: Plotted graph, GDP growth rate vs VC investments.**



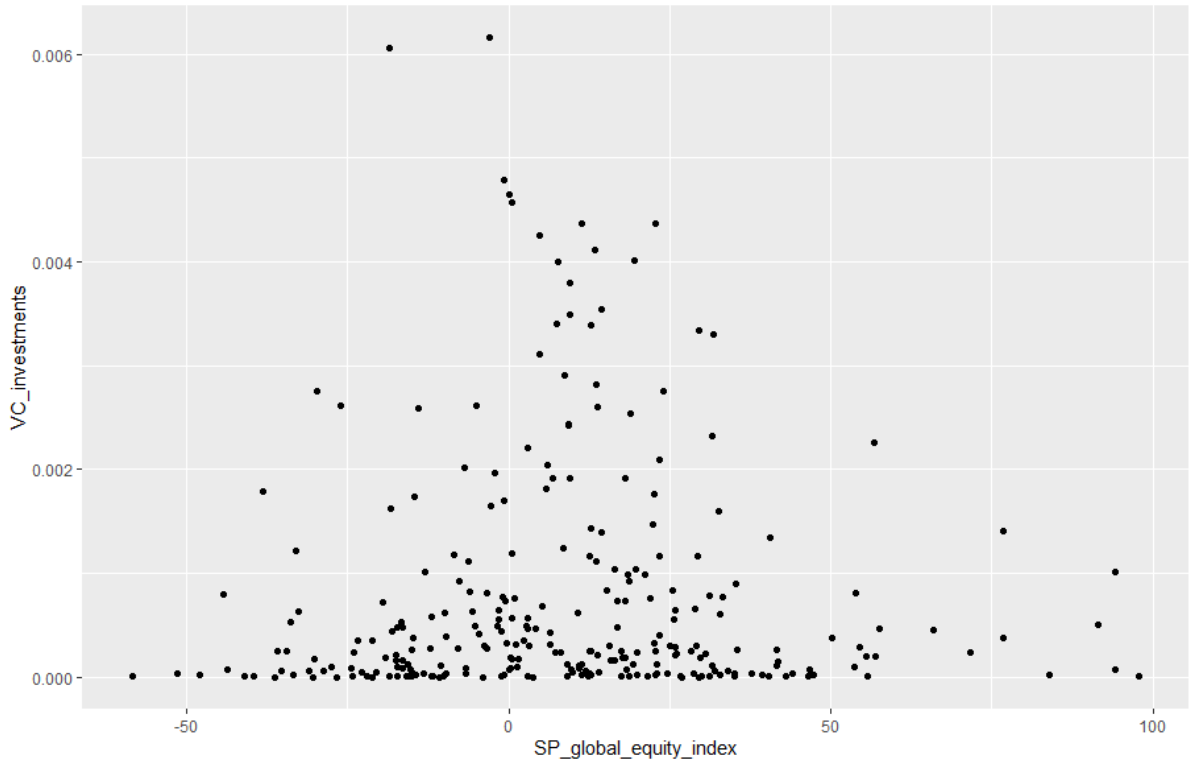

Source: Refinitv Eikon Database, World Bank Data (World Bank national accounts data, and OECD National Accounts data files).

### 3.1.3.2 S&P global equity index

Authors like Jeng & Wells (2000) or Félix Et al. (2013) believe that the market capitalization growth reflects the expectations of investors about the economy and that a growing market capitalization should create a more favourable environment for all kind of investors, including venture capital. To represent the stock market capitalization growth of countries, we chose to use the S&P global equity index, an index that track the slices of the developed and broader world market, including indices that specifically look at the largest stocks in each country and global revenue exposure. It expresses the annual U.S. dollar price change (%) in the stock markets covered by the S&P/IFCI and S&P/Frontier BMI country indices, in this way expressing the state of the capital market in each country per year.

The expected relationship is positive, a growing stock market should correspond to higher levels of venture capital investments.

**Figure 10: Plotted graph, S&P global equity index vs VC investments.**




Source: Refinitv Eikon Database, World bank Data (Standard & Poor's, Global Stock Markets Factbook and supplemental S&P data).

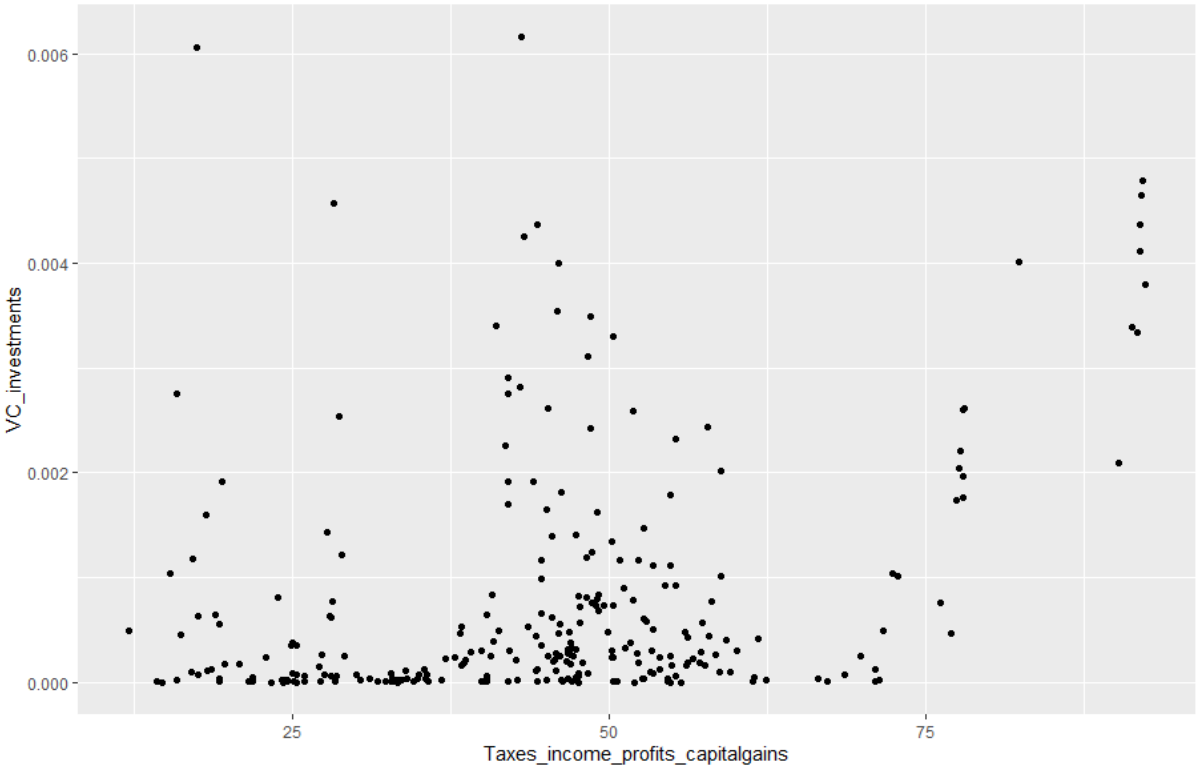
#### 3.1.3.3 Taxes on income, profits and capital gains

This variable expresses the percentage of total taxes that pertain to taxes on income, profits and capital gains in a country. Its value is levied on the actual or presumptive net income of individuals, on the profits of corporations and enterprises, and on capital gains, whether realized or not, on land, securities, and other assets.

Like all types of investments, venture capital has to deal with taxation and it's negatively or positively affected by it. This relation is sustained by authors like Gompers & Lerner (1998), Romain & Pottelsberghe (2004) and Groh & Wallmeroth (2016) who studied the impact of corporate tax, income tax and the capital gain tax.

Here, we expect a negative relation: high percentage of "Taxes on income, profits and capital gains" should correspond lower levels of venture capital investments.

**Figure 11: Plotted graph, taxes on income, profits and capital gains vs venture capital investments.**




Source: Refinitv Eikon Database, World bank data (International Monetary Fund, Government Finance Statistics Yearbook and data files)

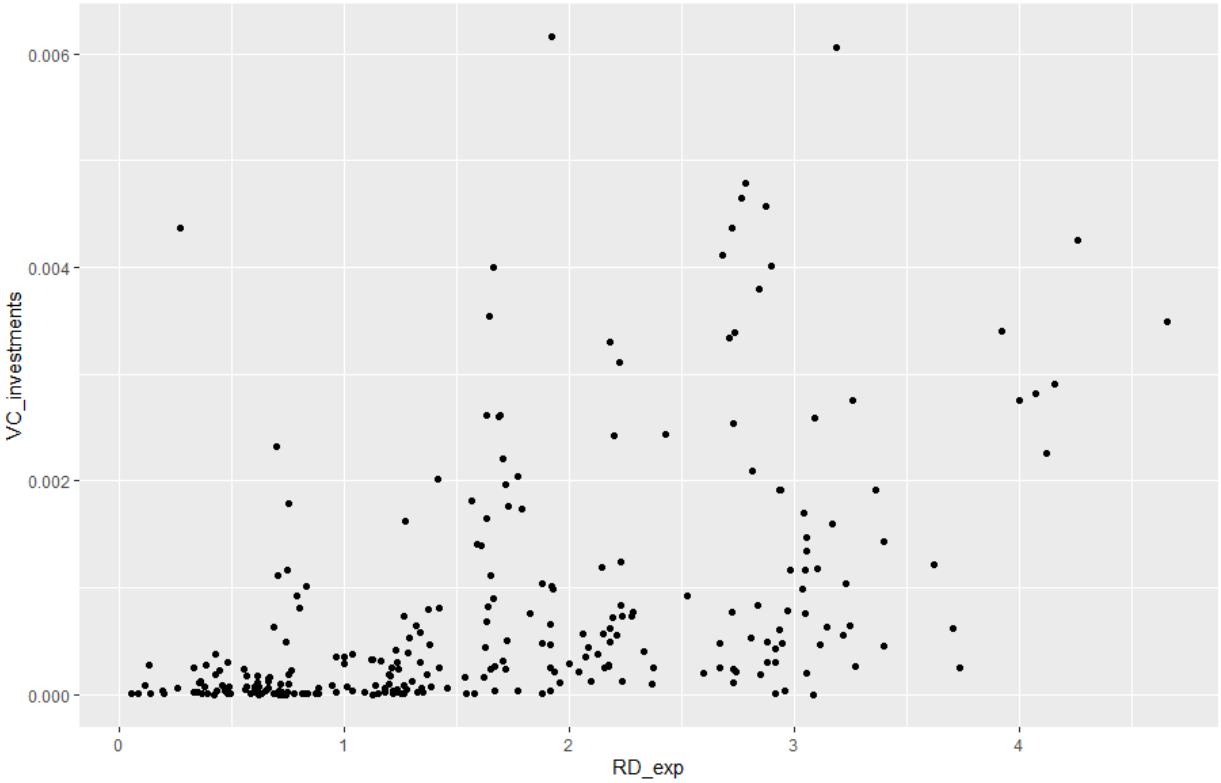
### 3.1.3.4 R&D expenditure

R&D expenditure is a variable that express the gross domestic expenditures on research and development, expressed as a percent of GDP. It included both capital and current expenditures in four main sectors: business enterprise, government, higher education and private non-profit. R&D expenditure covers basic research, applied research, and experimental development.

The correlation between R&D expenditure and venture capital activity is highly acknowledged by multiples author (see section 2.2) and recognised as one of the main force of it. Given its importance we decided to include it in the analysis.

We expect a high positive correlation with the independent variable.

**Figure 12: Plotted graph, R&D expenditure vs VC investments**




Source: Refinitv Eikon Database, World bank data (UNESCO Institute for Statistics).

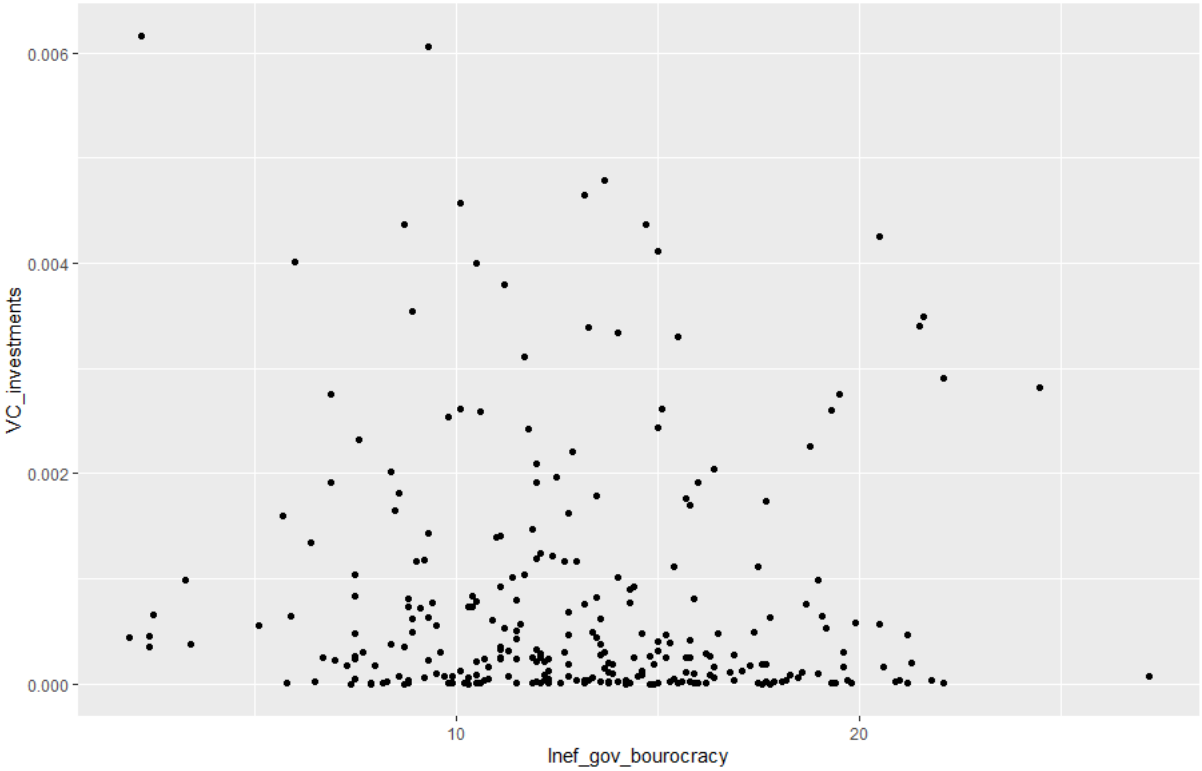
#### 3.1.3.5 Inefficient government bureaucracy

The Inefficient government bureaucracy variable expresses the inefficiency in bureaucracy practices, element considered relevant by the literature (section 2.2) which impact we'd like to investigate further.

The researched relation here want to assess if elements related to government, such as effectiveness and bureaucracy, have some kind of impact on our independent variable.

We expect the government effectiveness to be positively correlated and the inefficiency in government bureaucracy to be negatively correlated to the independent variable.

**Figure 13: Plotted graph, inefficient Government bureaucracy vs VC Investments.**




Source: Refinitv Eikon Database, Worldwide government indicators

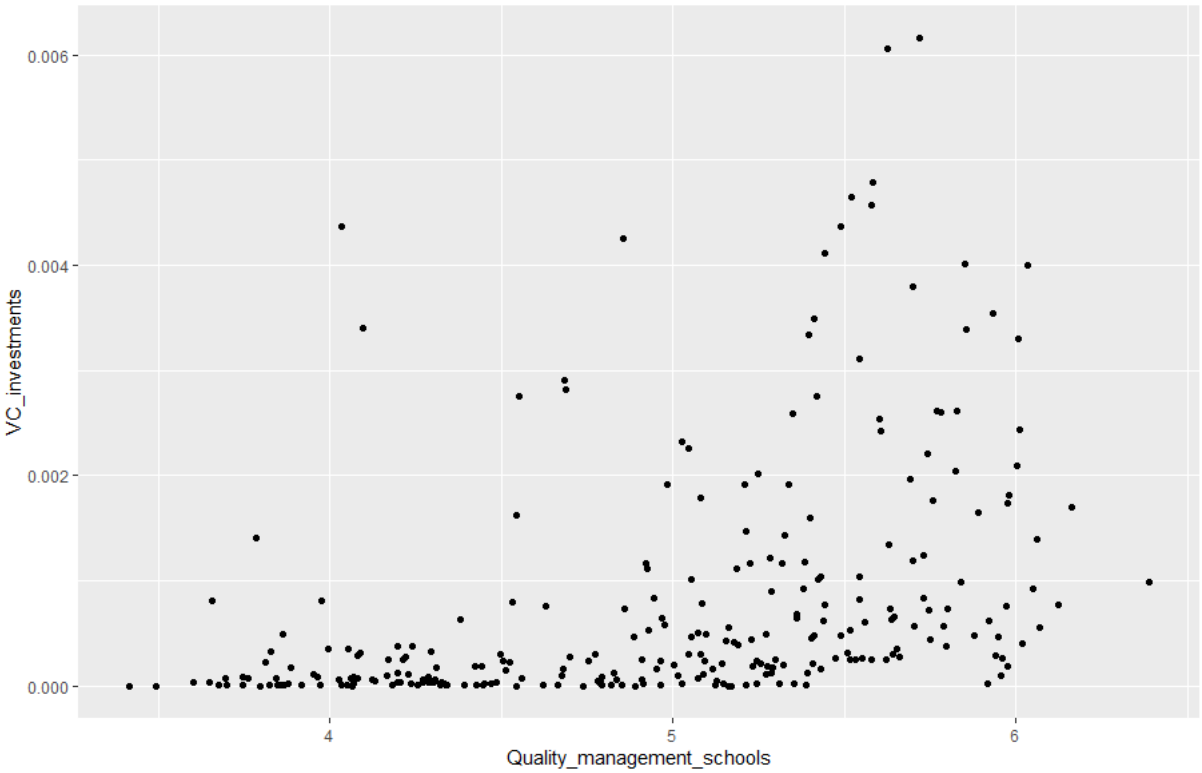
### 3.1.3.6 Quality of management schools and quality of education

The "quality of education" and "quality of management schools" give a value from 1-7 to the quality of countries' education systems and to management schools.

The purpose of these two variable is to assess whether a better education system can impact the level of venture capital investing by forming a more prepared and cultured population from which, hypothetically, a higher numbers of innovators and entrepreneurs can emerge and bring to life new start-ups that will require more venture capital investments.

Thus, we expect both these variables to be positively correlated to venture capital investments.

**Figure 14: Plotted graph, quality of management schools index vs VC investments.**



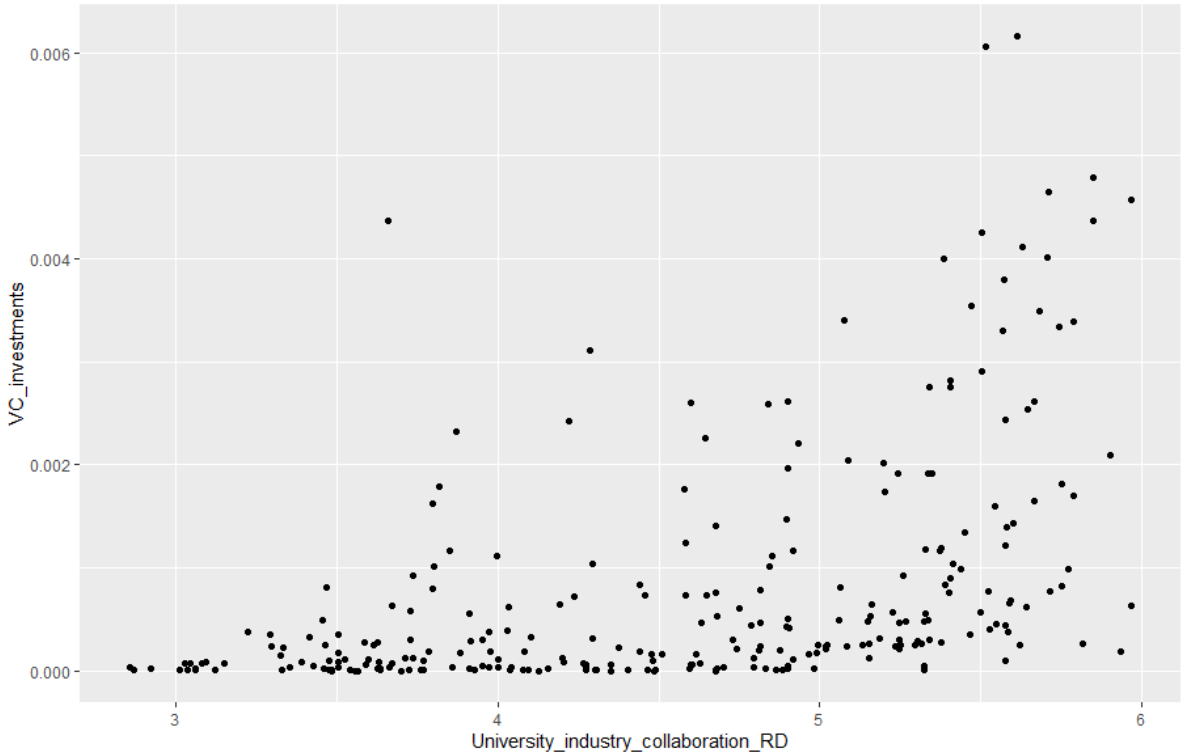

Source: Refinitv Eikon Database, TC360data (world economic forum).

### 3.1.3.7 University-industry collaboration in Research & Development

Like the previous two variables, this one consists in an index that assume a value from 1 to 7 based on the level of collaboration between university and industry in research and development. Being R&D a known predictor of venture capital demand we are curious to see if also this aspect of R&D has an impact on venture capital.

We expect a positive relation to the independent variable.

**Figure 15:Plotted graph, university-industry collaboration in R&D index vs VC investments.**



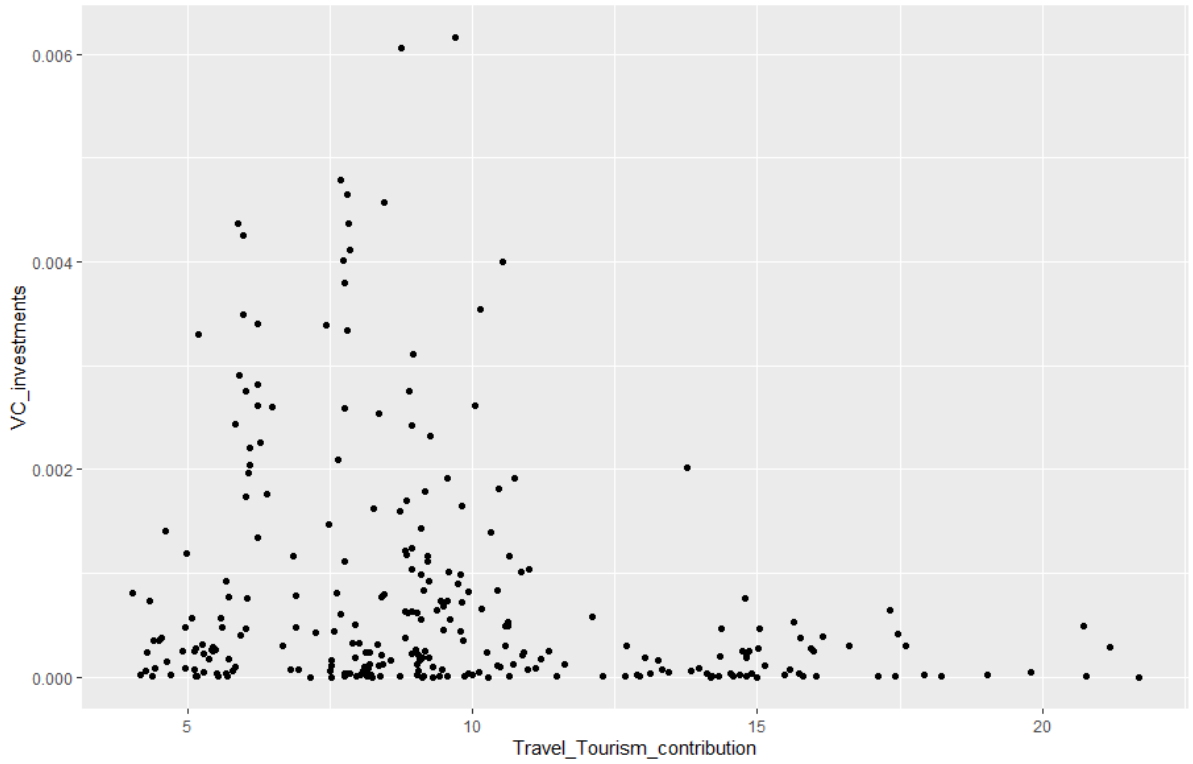

Source: Refinitv Eikon Database, TC360data (World Economic Forum Global Competitiveness Index).

### 3.1.3.8 Travel and Tourism total contribution

The total contribution of travel and tourism to GDP reflects GDP generated directly by the travel and tourism sector plus its indirect and induced impacts. Expressed as a percentage of GDP, this variable pertains to an unresearched area which we would like to investigate further. The connection between tourism and venture capital activity might not immediately come clear to mind but stands in the hypothetical thinking that countries' economies too much reliant on tourism could negatively affect innovation and consequently start-up creation and venture capital demand. With this statement we are not suggesting that start-ups are not present in the tourism sector but that the heart of innovation stand in sectors like pharmaceutics, engineering, chemicals and fintech, where we can also find the majority of new start-ups.

Still, having no literature backing this statement, we cannot be sure that to countries with more dominant tourism related economies correspond lower levels of venture capital activity, but the expected relation is negative.

**Figure 16: Plotted graph, tourism travel contribution vs VC investments**

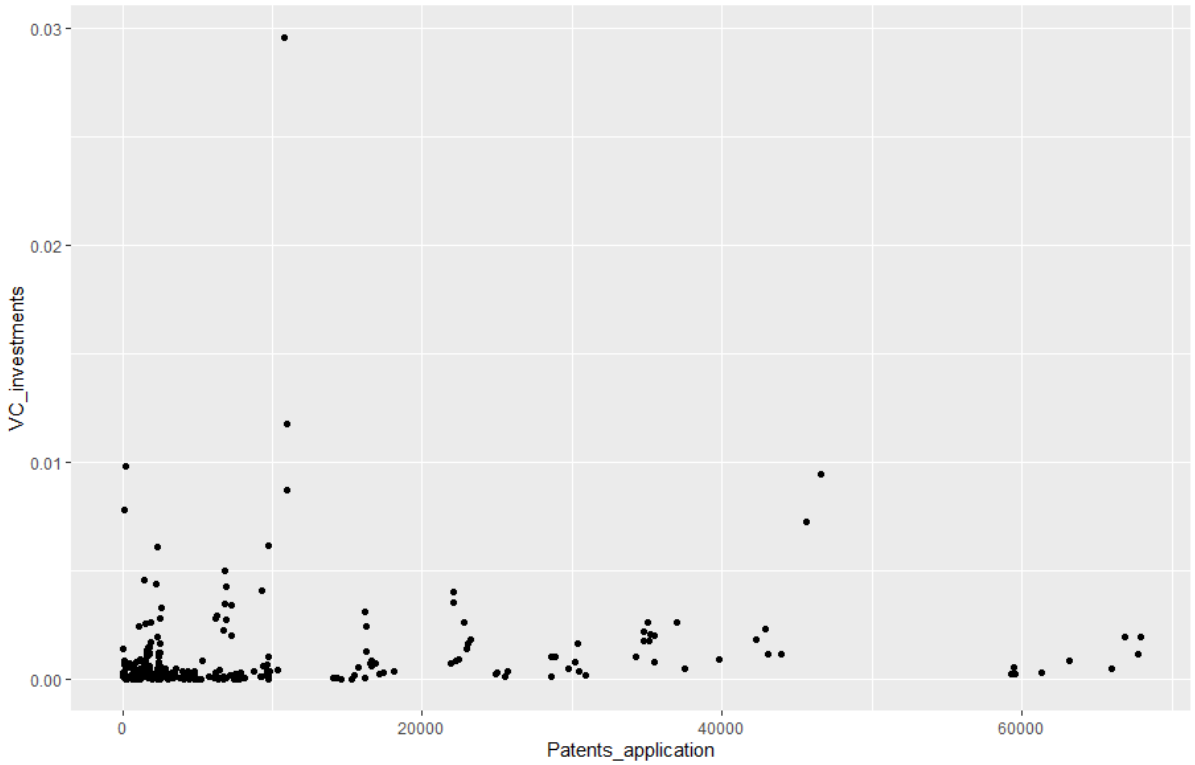



Source: Refinitv Eikon Database, TC360data (World Travel & Tourism Council).

### 3.1.3.10 Patents applications, resident and non-resident

This variable is representative of the total yearly number of patents applications filed through the Patent Cooperation Treaty or with a national patent office for exclusive rights for an invention, product or process that consist in a new way of doing something or provides new technical solutions to a problem. It is calculated by summing two minor indicators, the patent applications by residents and non-residents. As already pointed out by authors like Romain & Pottelsberghe (2004) and Namji (2019) a high number of patents in a country should correspond to higher level of innovation, and consequently start-ups, therefore boosting the demand of venture capital. Thus, I expect a positive correlation between this variable and the independent variable subject of study.

**Figure 17: Plotted graph, patents application vs VC investments.**



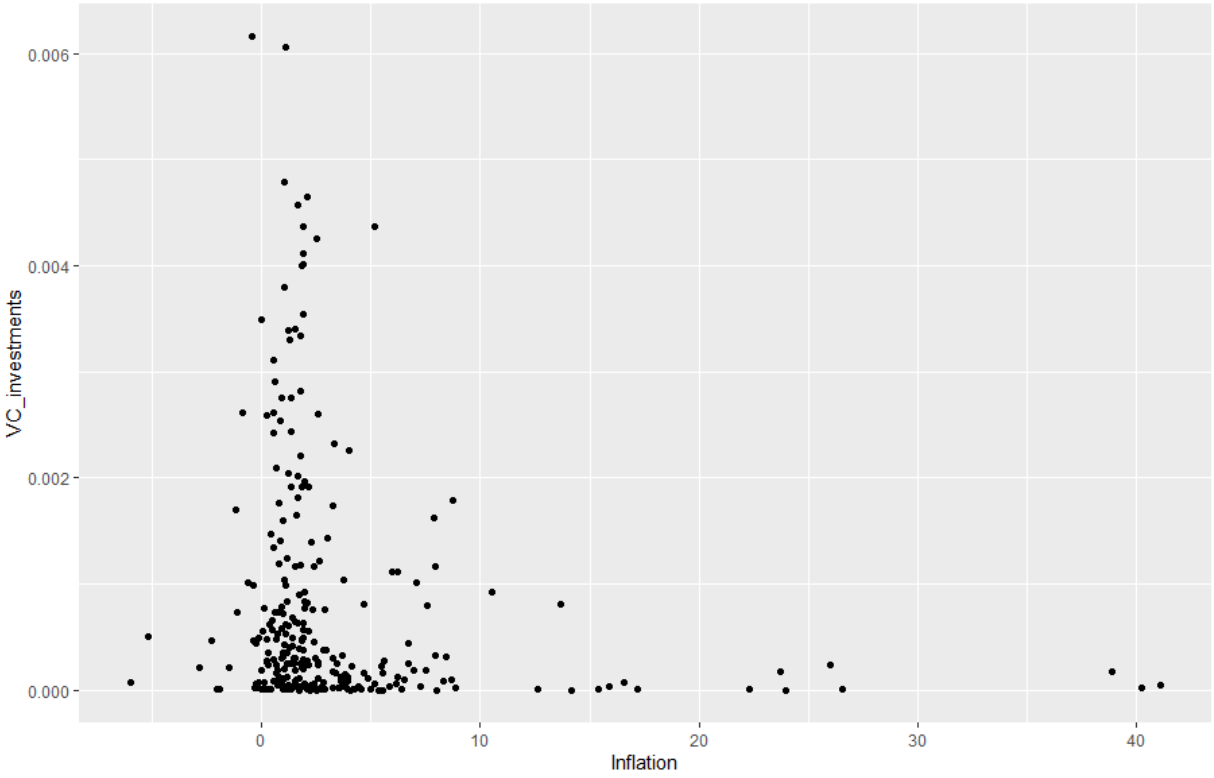

Source: Refinitv Eikon Database, World bank data (World Intellectual Property Organization).

### 3.1.3.11 Inflation rate

One last factor which effect we would like to assess, stand in the inflation rate. We were not able to find any evidence from previous studies that properly investigate the relation between inflation and venture capital and so we included it in our predictor list to extend this area of studies.

In our case the inflation variable correspond to the annual growth rate of the GDP implicit deflator which shows the rate of price change in the economy as a whole. The GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency.

**Figure 18: Plotted graph, inflation rate vs VC investments.**




Source: Refinitiv Eikon, worldwide government indicators.

## 3.2 METHODOLOGY

### *3.2.1 Structure of the analysis*

The underlying structure of the analysis is the same used by Jeng & Wells (2000). It consists in a linear specification for the supply and demand schedules of venture capital funds. In the incoming regression analysis we estimate the coefficients of the equilibrium specification between demand and supply of venture capital investments. As we explained in section 2.2 the level of venture capital investments is influenced by aspects, the demand and the supply of venture capital.

The equation used to describe venture capital investment will be the following:

$$Y_{it} = \alpha_{it} + \beta_{it} \times X_{it} + \varepsilon_{it}$$

where i = 1 …, N is the number of entities (in our case the number of countries) for one same period t=1….,T stands to the different time periods (in our case correspond to the years), Y is the dependent variable (in our case venture capital investments divided GDP) and X the dependent variables (GDP growth rate, inflation rate, quality of education index, etc.).

As already explained, changes in the volume of venture capital investments come from either changes in supply or demand of venture capital, an equation that truly describe level of venture capital investments in the market represents the equilibrium between the demand and supply. So, following the approach of Jeng & Well (2000), we firstly describe a linear equation of venture capital demand and then find the equilibrium specification. The equation that describes the venture capital supply is the following:

$$Venture\ capital\ Supply_{it} = \alpha_0 + \alpha_1 \text{return}_{it} + \alpha_2 \text{GDP\_growth}_{it} + \alpha_3 \text{S\&P\_global\_equity\_index}_{it} + \alpha_4 \text{Taxes\_on\_income\_profits\_capitalgain}_{it} + \alpha_5 \text{Infaltion}_{it}$$

The equation that describes the venture capital demand is the following one:

$$Venture\ capital\ Demand_{it} = \beta_0 + \beta_1 \text{return}_{it} + \beta_2 \text{GDP\_growth}_{it} + \beta_3 \text{S\&P\_global\_equity\_index}_{it} + \beta_4 \text{Patent\_applications}_{it} + \beta_5 \text{R\&D\_expenditure}_{it} + \beta_6 \text{Inefficient\_governement\_bourocracy}_{it} + \beta_7 \text{Quality\_of\_management\_schools}_{it} + \beta_8 \text{University\_industry\_collaboration\_R\&D}_{it} + \beta_9 \text{Quality\_education\_system}_{it} + \beta_{11} \text{Travel\_Tourism\_contribution}_{it}$$

To get the equilibrium equation (venture capital demand=venture capital supply=venture capital funds). We solve the supply equation with respect to the return variable and substitute it in the demand equation. Considering the equality between the quantities of funds supplied and demanded, we find the equilibrium amount of venture capital funds as a function of the explanatory variable:

$$Venture\ capital\ \text{Funds}_{it} = Y_0 + Y_1 \text{GDP\_growth}_{it} + Y_2 \text{S\&P\_global\_equity\_index}_{it} + Y_3 \text{Patent\_applications}_{it} + Y_4 \text{R\&D\_expenditure}_{it} + Y_5 \text{Inefficient\_governement\_bourocracy}_{it} + Y_6 \text{Quality\_of\_management\_schools}_{it} + Y_7 \text{University\_industry\_collaboration\_R\&D}_{it} + Y_8 \text{Quality\_education\_system}_{it} + Y_9 \text{Travel\_Tourism\_contribution}_{it} + Y_{10} \text{Inflation}_{it}$$

### *3.2.2 Regression model*

Given the nature of the analysis and the type of data collected (panel data), we decided to perform a regression analysis. The regression is performed with RStudio, an integrated

development environment for R, a programming language for statistical computing and graphics. For the code we used to run the regression please refer to figure 25, 26, 27 and 28 in the annex section.

There are many techniques through which we can perform a regression but the most basic and renown one is the *OLS regression*. OLS is a technique in inferential statistics to estimate coefficients of linear regression equations which value and sign allow us to interpret the relationship between one or more independent variable and a dependent variable. Anyway, in our case, the OLS model is very likely to be ineffective, the reason being Panel Data. To analyse the data we collected we need to use techniques of panel data analyses, which in our case can be three: Pooled OLS, fixed effect and random effect. Pooled OLS is a variant of normal OLS that can instead be used for panel data analysis and that will represent our starting point. Despite other techniques being usually more efficient, POLS is a good way to begin building and testing a statistical model, since, as we will see in section 3.3.3, to prove the effectiveness of the model it is needed to go through an assumption testing procedure.

A commonly considered superior technique to POLS is fixed effect (FE). This methodology takes in account the relationship between predictors and the outcome variable within the entity (countries in our case), assuming that something within the unit can bias the predictors or the outcome variable. FE remove the effect of those time-invariant characteristics and give us a way to correctly assess the net effect of the predictors on the outcome variable. Another direction that can be taken is panel analysis with random effect (RE). Unlike FE, RE assumes the variation across entities to be random and uncorrelated with the predictor or independent variables, it should be used If there are reasons to believe that differences across entities have some influence on your dependent variable. On the choice between RE and FE, Jeng & Wells (2000) explains that the within regression captures the difference in the dependent variable due to changes over time of the independent variables meanwhile the between regression captures the difference in venture capital investments between countries as a result of differences in characteristics across countries. Literature wise, both methodologies have been used, there are authors, like Jeng & Wells (2000) or Félix Et al. (2013), who used both, but there are also authors, like Marti & Balboa (2001) or Groh & Wallmeroth (2016), who used only random effects model believing, after the Hausmann test (3.3.3) it suited more the analyse.

One last method we take in consideration is the feasible general least squares (FGLS). This

technique can be estimated both with fixed or random effects and it's used to deal with problems out heteroskedasticity, auto-correlation and cross-sectional dependence (3.3.3). Namji (2019) used the FGLS with fixed effect to perform the analysis after finding problems of heteroskedasticity and collinearity in the data.

As you can see, the selection across the regression techniques vary from author to author and mostly depends on the results of assumption testing. In our case, we let the decision to be taken to the assumption testing results. You will see at the end of the assumption testing and model improvements section that the two analysis that suit best the data are identified with RE and FGLS with random effects. Why these methodologies have been used is showed in the next section, where we will present how we built the model, starting from a basic OLS pooling regression and concluding, after numerous model improvements, that the best methodologies to apply are the two selected.

### *3.2.3 Model building, improvements and tests*

Despite we already did a process of data cleaning at the very beginning by removing missing values (3.2.1), it is possible that the database still contains observations that are unusual and that might alter the results of the regression. To solve this problem, we used Cook's Distance[5] and removed from the database all the outliers, obtaining in this way a database of 260 observations. Still, we decided to perform the regression on both the cleaned database and the not cleaned one, in order to be able to evaluate the results on both databases[6].

After this first step we tested for homoscedasticity. This term refer to the characteristic of the variance of the residuals to be homogeneous across levels of the predicted values. If the condition is not respected we'll end up in a situation of heteroskedasticity, a condition that might alter the results of the analysis and deserve proper checking. We test this assumption with the Breusch-Pagan test. In our case, the test gives a p-value very close to zero, forcing us to reject the hypothesis of homoscedasticity and conclude we have heteroskedasticity in the data[7].

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[5] a commonly used estimate of the influence of a data point when performing a least-squares regression analysis.

[6] cleaned database can sometimes alters results.

[7] Heteroskedasticity will be controlled by applying the log function to the independent variable and the

Another test that we must run is the autocorrelation or independence one, which checks if errors associated with one observation are not correlated with the errors of another observation or, in other words, it checks for autocorrelation in the residuals. If autocorrelation is present, standard errors might be underestimated and therefore the hypothesis-testing[8] might not be reliable since it is based on standard errors. To assess this aspect of the database we conducted the Breusch-Godfrey/Wooldridge test for serial correlation and concluded that there is a problem of autocorrelation in the POLS and FE methodology but not in RE.

The next assumption to check is multicollinearity, a situation in which two or more variables are correlated with each other. This presence of redundancy alters the results of the regression which become not reliable. To check whether this is the case or not, we used the variance inflation factor (VIF) which measures how much the variance of a regression coefficient is inflated due to multicollinearity in the model. The VIF assumes value from 1 onwards and if it exceeds 5 it indicates a problem of multicollinearity and variable should be taken off from the model. In our case the VIF is lower than 5 in all the predictors, but for the university-industry collaboration in R&D index for which is slightly above 5. Since, its value is very close to 5 we can keep the variable in the model without any repercussion.

It can also happens that two variables that increase with time, even if independent from each other, might present a strong correlation. Time series to be included in a regression needs to be stationary in mean, or in other words, we need to avoid having trends in the data otherwise we might compromise the analysis. To check this we used the Dickey-Fuller test. This test gives a negative value with some related confidence levels, the more negative is the number the more we reject the hypothesis of the presence of a unit root in our data. In our case, some dependent variable, when tested, have a value not satisfying and consequently are non-stationary. Despite having some independent variables that present unit roots, the natural logarithm of the dependent variable looks to be stationary in the mean, allowing us to proceed with the assumption testing process. Regarding stationarity we also need to consider that, given the fact we are using Panel Data, the test

application of the Arellano method in RE. FGLS doesn't need any correction.

[8] Hypothesis testing is the process of evaluating p-values. If compromised we will not be able to assess the statistical significance of variables.

should be performed for each country time-series singularly to be fully reliable and testing it on the full dataset can give us just some useful information but cannot be fully reliable. Furthermore, with a number of years as low as ours (9), non-stationary problems in the independent variables shouldn't be a problem.

Lastly, we checked for cross sectional dependence and concluded that there is cross sectional problem in the data. Still, when using micro-panels[9] this should not create problems.

We than tested Pooled OLS vs RE, Pooled OLS vs FE and FE vs RE to evaluate the most suited to the regression. From the tests emerge the superiority of FE and RE with respect to POLS and, between FE and RE, the Hausmann test signal a preference for RE.

The conclusion we draw from the assumption testing and technique testing is that POLS should not be used and between FE and RE we should pick RE. Still, our data present heteroskedasticity, autocorrelation and cross-section dependence, giving us good reasons to perform the FGLS technique with random effects. In our case we'll perform both RE and FGLS, correcting for heteroskedasticity and autocorrelation in the first case.

### 3.3 RESULTS

This chapter contains the results of the regression analysis, using the dataset explained in section 3.2.1, the variables presented in 3.2.2 and 3.2.3 with the methodologies explained in 3.2.3.

As anticipated the regression has been performed on two different databases, one without and one with outliers, and with two different techniques, FGLS and Random Effect.

Results are shown in table 14 and table 15 in the annex section, where the different models account to for the database in use (cleaned or not cleaned) and the number of variable included. We decided in fact, to address the results by considering all the variable at first and then just those which are significant, reason being, excluding not relevant variables might sometimes changes results.

All the models showed in tables 14 and 15 have an adjusted R-Squared that varies from nearly 30% to around 45%. With very small differences, models with no outliers have higher R-Squared and models with more variables also, even if not significant variables are included. The adjusted R-Squared is a statistical measure that tell us how much of the

[9] High number of entities and low number of years.

movements of the independent variable we have been able to catch with our model, by looking at this measure we can evaluate the quality of a regression. We consider 30-45% to be a good value in our analysis but it could be incremented by adding new significant variables.

Before going into the deep interpretation of results for each variable, we need to do some other considerations. First of all, the majority of the coefficients in all the models have the expected sign, but in the case of universities-industry collaboration in R&D index. For the inflation rate instead, coefficients are not consistent in the models, and so deprive us the possibility to evaluate them. As for significance, interpreted by looking at P-Values, we can confirm that only GDP growth rate, R&D expenses, travel and tourism contribution to GDP and the quality of management index are relevant all over the studied models. The significance of the other variables looks to be not consistent across the regression, compromising in this way their evaluation and impact on the dependent one. As for the inefficient government bureaucracy index, P-values never cross the 0.05 confidence level, confirming that the factor is not relevant in our analysis. Despite the small changes of p-values, we can find similar results in both FGLS and Random effect models, which is a good sign when interpreting the quality of the overall regression.

The first variable we are going to address is GDP growth rate. GDP growth coefficients and p-values are very in line with our expectations. The variable is significant at a 5% confident level in all regressions and becomes more relevant in the FGLS ones, reaching confidence levels at 1% in the respective models 1,2,3 and 4 (table 14 and 15). The positive relation between venture capital investments and GDP growth is confirmed by the coefficients, which always maintain positive levels. As explained in section 3.2.3.1, an economy in expansion phase will provide more investments opportunity, consequently increasing the level of venture capital investments.

The S&P global equity index was included to catch the positive impact of a growing stock market, which our analysis failed to capture. The variable is not significant in all the models and the very low value of coefficients can't really let us evaluate them. To the limits of our research and our dataset, we cannot conclude that changes in the public national equity market affect the level of venture capital investments.

As for the taxes on income, profits and capital gain results do not have significant p-values but always have positive coefficients. The positive relation can be explained with what we stated in section 2.2.3, countries with higher levels of taxations are usually highly

developed country with solid venture capital industry, such as Germany or United Kingdom. Still the not significance of the variable in the regressions deprive us from stating with certainty the relation.

As expected, the variable research and development expenditure is strongly positively correlated with venture capital investments. The high value coefficients are also matched in all the regressions' models with significance levels at 0.1%, showing us that countries' effort in R&D are rewarded with a more dynamic entrepreneurial and start-ups environment which attract more venture capital investments.

Totally different is the situation around the bureaucracy governmental factor. Even if the coefficient sign are those expected the parameters show no significance to levels of venture capital investments.

The index representing collaboration levels in R&D between universities and industries is probably the only one that really surprised us. The predictor in the random effect analysis shows a negative sign in all four models, maintaining a good level of significance of 5% in models 1 and 2 but decreases in model 3 and 4 when we considered only relevant variables. The surprising thing is the coefficients are negative. We expected higher levels of venture capital investments with more participation in industrial R&D of universities given the strict relation venture capital has with innovation. The same predictor when analysed with the FGLS technique still shows a negative relation with the explained variable but lose relevance in the models with just relevant variables. A conclusion on how this variable impact the levels of venture capital investments cannot be deduct from this analysis, a better investigation on its true effect should be conducted.

We can now assess the predictor which express the quality of management schools in countries. We find a strong positive relationship in this case sustained with high levels of significance in all models; this is interesting but expected and show that the presence of good business management schools increase level of venture capital investments. We can find a clear example of this in America with the iconic Silicon Valley, from many considered to be the native location of venture capital, which has benefitted strongly from its nearness to Stanford Business School. This could be also a sign that the university network, not just business schools, is very important in creating innovative environments, from which eventually new start-up emerge and consequently the request of new venture capital increase.

A predictor like tourism and travel contribution to GDP aims to catch whether the

presence of high levels of tourism can somehow affect the venture capital world. Our regressions shows that the variable is negatively related to venture capital investments and significant in all cases. As presented in chapter 2.1, this could emerge from the fact that venture capital investments are mainly related to sectors like technology, healthcare, industrials and financials, the tourism sector, while it can still see innovative start-up spawn, it is generally less propense to receive venture capital funds.

The number of patents applications, residents and non-resident, is highly significant in all models but have very low positive coefficients. The positivity in the coefficients suggest the presence of a positive effect of this predictor on venture capital investments but its very low value means that the impact it's so low we cannot really trust the results.

The last variable we are going to address is inflation. Again, this variable appears to be not relevant in every model and with changing sign in coefficients. As far as our analysis goes, inflation looks to not have an impact on the level of venture investments.

### *3.3.1 Comparison with previous studies*

In the above chapters we replicated the analysis performed in previous academic studies on the subject of determinants of venture capital. Their methodologies have been applied to our dataset and got the results just presented; table 5 compare our outcome with these reference authors results.

**Table 5: Comparison of results.**

| Potential determinants | Our results | Gompers & Lerner (1998) | Jeng & Wells (2000) | Marti & Balboa (2001) | Romain & Pottelsberghe (2004) | Félix Et al. (2013) | Groh & Wallmeroth (2016) | Namji (2019) |
|---|---|---|---|---|---|---|---|---|
| **GDP growth** | + | + | NS | NS | + | + | | |
| **S&P global equity index** | NS | + | NS | | | + | | - |
| **Taxes on income, profits and capital gains** | + , NS | - | | | | | - | |
| **R&D expenditure** | + | + | | | + | - , NS | | - |
| **Inef. gov. Bourocracy** | NS | | - , 0 | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **University and industry collaboration in R&D** | - , NS | | | | | | | |
| **Quality of management schools** | **+** | | | | | | | |
| **Quality of education** | **NS** | | | | | | | |
| **Travel and tourism contribution to GDP** | **-** | | | | | | | |
| **Patents application** | + , 0 | | | | + | | | + , 0 |
| **Inflation rate** | **NS** | | | | | | | |

Note: NS stand for not significant. 0 stands for coefficients very close to 0. In yellow the four factors found to be always significant.

We decided to follow the methodology originally used by Jeng and Wells (2000), who worked with sectional and cross time observations and applied panel analysis technique such as random effect and fixed effect. In our case we applied only the random effect model, like Marti & Balboa (2001), and not the fixed effect one, but implemented also the FGLS method following the approach of Namji (2019).

The effect of GDP growth on venture capital has been widely studied by the literature which generally found positive results or not statistically significant. Gompers & Lerner (1999) found that higher GDP growth lead to greater venture capital activities, Jeng & Wells (2000) and Marti & Balboa (2001) found the variable not significant and Félix Et al. (2013) highlight once again the positive relation. These results, vastly reflect ours, especially those of Félix Et al. (2013) who show positive coefficients in all his models, in particular those with random effects (same happens in our random effects models).

As for the stock market opportunities impact, which we addressed by considering the changes in the SP global equity index and which came out not significant, we got similar results to Jeng & Wells (2000), who did not confirm the positive outcome of Gompers & Lerner (1999) or Félix Et al. (2013). On this we must say that previous studies do express different opinions, Namji (2019) results shows negative coefficients and justify the outcome with the alternative investment nature of stocks to venture capital: when market capital return is higher, the opportunity cost of investment for venture capital investor is

higher, consequently, the supply of venture capital will decrease.

Regarding the market capital return, the impact represents the expected signal and statistical significance. Since the market capital return is an opportunity cost of money for investor, the negative sign shows that the venture capital investment will be decreased when the capital market has more return.

Regarding taxes, we do not find support in previous studies. Capital gain tax is showed to be negatively related to venture capital by Gompers & Lerner (1999) and the same for corporate tax by Groh & Wallmeroth (2016). Still, as we said in the section 3.3 and 2.2.3, our outcome could be biased by the state of development of the countries included in the analysis.

The positive coefficients we found for R&D expense are sustained by both Romain & Pottelsberghe (2004) and Gompers &Lerner (1999) but are contrary to those of Félix Et al. (2013) and Namji (2019). Anyway, Félix Et al. (2013), explained that their R&D variable probably didn't measured innovation correctly and still sustained that the positive relation should exist.

Our governmental variable, found to be not significant, have a very small literature background. Namji (2019) studied a different government related variable, government subsidiary for R&D, which was not significant. Jeng & Wells (2000) and Romain & Pottelsberghe (2004) both found a negative relation with labour market rigidities, effect that we tried to catch with our index of inefficient government bureaucracy but failed in the intent.

As for our education's variables, only the one expressing the quality of management schools have been found positive and significant. We were not able to find any author that included in their regression a similar predictor, depriving us the possibility to do a proper comparison. Still, outside this specific field of research, we found authors like Megginson (2003) that argues that, in order to foster a growing risk capital industry, education with respect to schools, universities and research institutions plays an important role.

The same conclusion can be done for tourism related variables, which have included in the analysis only to extended further the group of studied factors by the literature. The only confirmation in this case stand in the focus of venture capitalists who, in time, showed to prefer sector more prone to technological development than tourism start-ups (see 2.1).

Again, inflation impact on the level of venture capital investments have no previous

studies to compare with and so we cannot confirm the not significance of our results.
Lastly, our patent's variable results find confirmation in Romain & Pottelsberghe (2004) and Namji (2019) who both found a positive and significant relation. In particular our outcome, strongly match that of Namji (2019) who included two different variables, the residential patent and cumulative of residential and foreign patent and obtained in both cases significance and positive signs but coefficients extremely close to zero.

## 3.4 THE ITALIAN VENTURE CAPITAL INDUSTRY

Chapter 2 and 3 focus on the global industry of venture capital. We describe the state and the drivers of it in chapter 2 and deepened our knowledge on some of the factors affecting venture capital investments in chapter 3. Now, with section 3.4, we want to analyse further, using the data and findings on previous chapters, the industry of one particular country: Italy.

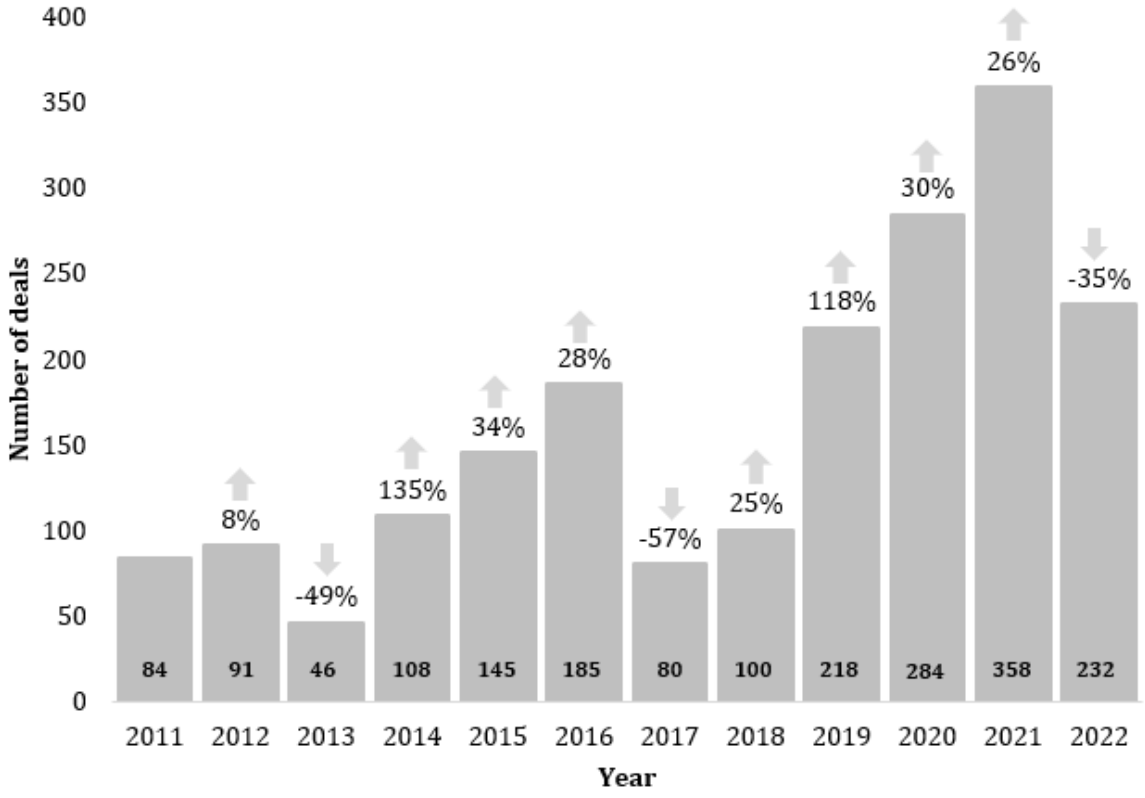
### *3.4.1 The state of venture capital in Italy*

The analysis starts by following the same methodology applied to the analysis of the global venture capital industry in section 2.1 but adding few more details and considering a slightly different period of time (2011-2022 YTD[10]). We therefore extrapolated all the venture capital deals that took place in 2011-2022 YTD and, by analysing their features, studied the state of the Italian venture capital in the last 10 years. To validate our findings we will also compare the results with the 2021 Venture Capital Monitor report by AIFI (Italian Association of Private Equity, Venture Capital and Private Debt).
So, according to Refinitiv Eikon database, from January 2011 to September 2022, the Italian country saw nearly 1950 investment deals in seed, early, expansion, and later stage. Just from looking to when these deals took place we can confirm that an incredible positive trend is present in Italy: 45% of all the recorded deals from 2011 occurred in the last three analysed years (2020, 2021 and 2022 YTD) . The industry, from the starting point of 84 deals in 2011, reached a total number of 358 deals in 2021 (386 investments accordingly to VeM (2021), an astonishing increase by more than 400% (see figure 22). If

[10] YTD stand for "year-to-date", an acronym used to indicate the case in which data do not cover the full year but only a part of it, more specifically to the most recent data available or, in this case, to the last possible update.

we instead take into account the yearly amount of money invested in venture capital deals we obtain an even more emphasized positive trend. From 2011 venture capitalists invested a total of 6500 million of $, with an initial yearly value of 206 million in 2011 and a final one of 1270 million in 2021 (1079 billion of € accordingly to the 2021 VEM report), an increase of more than 600%. The value becomes even greater in 2022 YTD where the industry saw 1340,6 billion of dollar invested (see figure 23). The yearly venture capital investments value can also give us some interesting implications on valuations. In 2022 YTD, an average of 5,8 million of dollars have been invested in each deal, a measure way higher than the average in the analysed years which stands only to 3,4 million, consequently suggesting that an increase in valuations might have caught on in the most recent years.

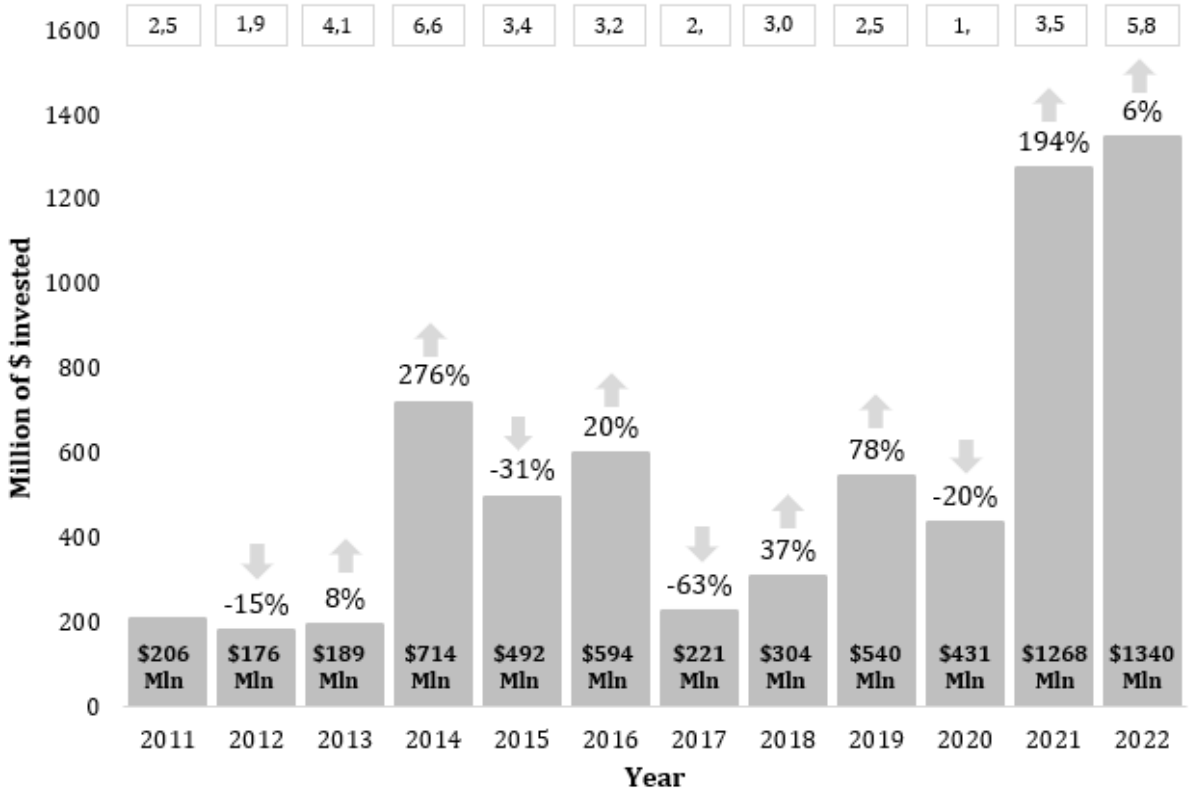
**Figure 19: Yearly number of deals in Italy with percentage changes, 2011-2022**




Source: Personal elaboration from Refintiv Eikon Database.

Note: 2022 only contains the deals occurred until 21/09/2022. The graph also highlight the yearly percentage increase (above each column) and the yearly number of deals recorded (inside each column).

**Figure 20: Yearly Million of $ invested and Yearly average Million of $ invested per deal, 2011-2022 YTD**




Source: Personal elaboration from Refintiv Eikon Database.

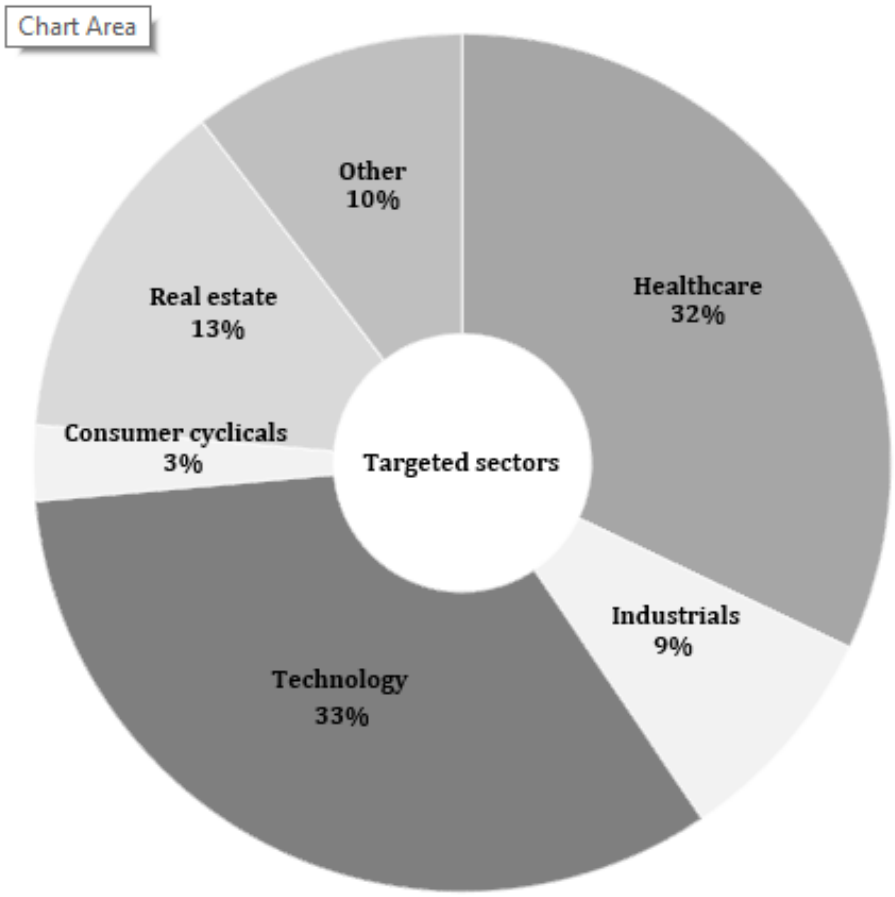
Note: 2022 only contains the deals occurred until 21/09/2022. The graph also highlight the yearly percentage increase (above each column), millions of dollars invested each year (inside each column) and yearly average of millions of dollars invested per deal (on the top of the graph).

Anyway, the yearly average invested dollars per deal is a metric affected by the single value of each deal that took place in a specific year and needs to be taken accordingly: a single big deal can excessively boost this metric but does not necessarily mean that the average valuation is increased.

As for the targeted sectors, in the analysed years venture capitalists invested in wide range of start-ups pertaining to multiples and different sectors but despite the heterogeneity and the constant change in the composition of the investee start-ups, clear preferences have been shown for the technology sector, to which pertain 47% of all the businesses that received venture capital funds in the last 12 years. Other than technology, investors seemed to also like industrial, consumer cyclicals and healthcare companies

which also received a good share of investments and maintained relevance through the years. Especially healthcare start-ups seems to have gained importance, especially in 2022 where they account for 32% of all the investee companies. A noticeable mention also goes also to businesses operating in the real estate sector, that slowly attracted venture capital investments reaching a share of 13% in 2022.

**Figure 21: Targeted sectors by Venture Capitalists, 2022**




Source: Personal elaboration from Refintiv Eikon Database.

Note: 2022 only contains the deals occurred until 21/09/2022. "Others" serve as cluster for minority shares sectors: financials (2%), energy (2%), basic materials (2%), academic and education (2%), consumer non-cyclicals (3%).

Of the 1950 analysed deals, the majority refers to early-stage investments (51%), a good share to the expansion phase (28%) and later stage (16%) and only 5% to seeds, composition built by taking into account all the deals happening from 2011 but that is also the one prevailing in most of the years. Still, we can observe slight changes and some light

trends, later stage investments lost significance, decreasing their share from 40% in 2011 to 27% in 2022; early-stage investments seem to be much more in vogue in recent years than in the past, from 26% to a 42%, peaking in 2014 with 85%.

Lastly, we wanted to address the provenience of these venture capital investments. From the collected data emerges that the majority of investors are Italian based, more precisely a 77,6% out of all the deals in 2011-2022 YTD. Still, we see that the share of Italian investors became slightly smaller in the years, signalling a bigger involvement of foreign investors in the territory, the main ones being United States, France, United Kingdom and Germany, to which pertain respectively 6.4%, 4.8%, 2.7% and 1.9% of all the investors.

### *3.4.2 Comparison between Italy and Western Europe*

To have a clear vision of the state of venture capital in Italy we cannot only look to the Italian country alone, we must compare it with other industries from other countries that serve as benchmarks. For this purpose, we use Western European countries and continue the analysis started in section 3.2 where we presented the average share of venture capital investments to GDP in the years 2009-2021. What we saw in section 3.2 is that out of all Western European countries Italy classifies as one of the states with less venture capital activity, with just 0.02% share of venture capital investments to GDP, situation also remain almost unchanged even in 2021, despite the increase to 0.056% (see table 6). The low attractiveness of the Italy under a venture capital point of view is confirmed by the Venture Capital & Private Equity country attractiveness index (Groh, Liechtenstein, Lieser, & Biesinger, 2021), an index built to measure the attractiveness of a country for investors in Venture Capital and Private Equity assets. Italy has been given a score of 71, which is below the European average, 74, and significantly lower the one obtained by top tier countries like UK, Germany and France (see table 7). This low attractiveness can be explained by looking at the drivers that strongly affects countries' venture capital and private equity industry and that consequently also determined their attractiveness for investors (see figure 25).

**Table 6: Western European countries by share of venture capital investments to GDP, 2021.**

| *Rank* | *Country* | *Share of VC investments* |
|---|---|---|
| **1** | United Kingdom | 0,63% |
| **2** | Sweden | 0,38% |

| | | |
|---|---|---|
| **3** | Denmark | 0,35% |
| **4** | Germany | 0,32% |
| **5** | Netherlands | 0,28% |
| **6** | Switzerland | 0,27% |
| **7** | France | 0,25% |
| **8** | Finland | 0,24% |
| **9** | Spain | 0,21% |
| **10** | Ireland | 0,16% |
| **11** | Norway | 0,15% |
| **12** | Belgium | 0,11% |
| **13** | Greece | 0,07% |
| **14** | ***Italy*** | 0,06% |
| **15** | Austria | 0,05% |
| **16** | Portugal | 0,05% |

Source: Personal elaboration from Refintiv Eikon Database.

Note: Smaller countries like Luxemburg, Monaco and Malta has not been taken in consideration because of their limited size.

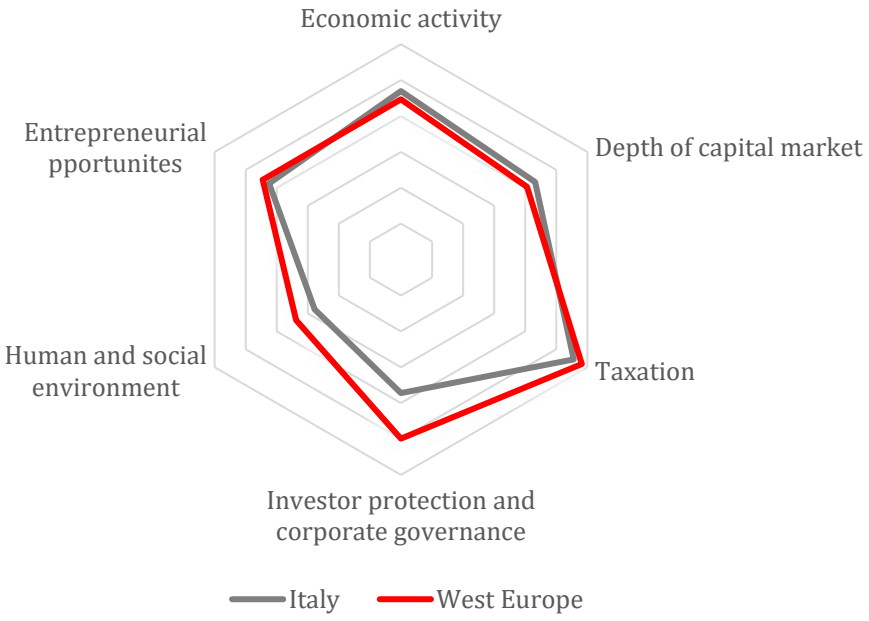
**Table 7: Western European countries VCPE index, 2021**

| *Rank* | *Country* | *VCPE Index* |
|---|---|---|
| **1** | United Kingdom | 90,3 |
| **2** | Germany | 87,3 |
| **3** | France | 83,6 |
| **4** | Netherlands | 81,7 |
| **5** | Sweden | 81,0 |
| **6** | Denmark | 80,8 |
| **7** | Switzerland | 79,5 |
| **8** | Finland | 78,9 |
| **9** | Norway | 78,1 |
| **10** | Spain | 76,1 |
| **11** | Belgium | 75,0 |
| **12** | Austria | 75,0 |
| **13** | Ireland | 73,9 |
| **14** | ***Italy*** | 70,8 |
| **15** | Portugal | 65,4 |
| **16** | Greece | 55,5 |

Source: Groh, Liechtenstein, Lieser, & Biesinger, 2021.

Note: Smaller countries like Luxemburg, Monaco and Malta has not been taken in consideration because of their limited size.

**Figure 22: Factors influencing VC and PE, Western Europe and Italy, 2021**




Source: https://blog.iese.edu/vcpeindex/

The drivers we are referring to are those that we already faced and studied in section 2.2, but, in the VCPE case, the categories in which they are regrouped are: the economic activity, entrepreneurial opportunities, investor protection and corporate governance, human and social environment, taxation and depth of capital market. In the year 2021, VCPE finds Italy to have a slightly better economic activity and depth of capital markets than the Western European average; a relatively good taxation system and decent entrepreneurial opportunities, just below the average; a human and social environment moderately lower and an investor protection and corporate governance systems significantly inferior. It is in fact, in these two last drivers' categories than we can find the real reason of a low VCPE index.

The regression analysis performed in chapter 3 can also give us another tool to evaluate the venture capital industry. By looking at the statistically significant factors[11] we can evaluate the industry and compare it with those of the rest of the Western European

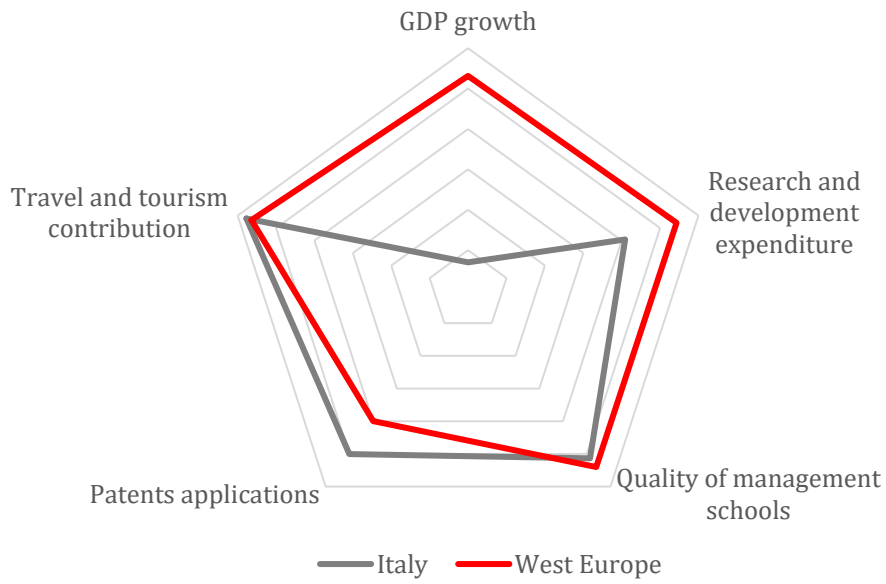
[11] GDP growth, travel and tourism contribution to GDP, R&D expenditure, patents application and quality of management schools

countries.

On these variables Italy has an average[12] of – 0.12 % GDP growth, 1.236% of R&D, a score of 4.96 in the quality of management index, 8000 patents application and a travel and tourism contribution to GDP, versus a Western Europe average of respectively 1.72%, 1.77, 5.282, 5991 and 12.0%.

Beside the patent's applications, which impact couldn't be fully understood in chapter 3, the country proves once more to be below the Western European average in all the factors that influence positively the level of venture capital investments (GDP growth, R&D expenditure, patents application and quality of management schools), and above in the only factor found to negatively affect the level of venture capital activities (travel and tourism contribution to GDP)

**Figure 23: Regression analysis factors, West Europe and Italy, 2011-2021 average**




Source: multiples, refers to table 11.

But, although the Italian venture capital industry has always been less significant in size than its European competitor, it is now slowly gaining importance. Last years, especially 2020 and 2021, showed a significant reduction of the gap that always stood between Italy

[12] Average calculate on the years 2011-2022, excluding 2019, year strongly biased by the pandemic.

and its comparable country in Europe, such as Spain, Germany and France . The Italian 5y CAGR in fact is one of the highest in Western Europe, a value that comfortably sits at 40%, way higher than other European countries like UK (23%), Germany (33%), France(21%) and Sweden (29%). This indicate that the Italian venture capital industry is growing at a faster rate than the European average (30%), a positive result confirmed also by the VEM report 2021.

**Table 8: Western European countries 5y CAGR**

| *Rank* | *Country* | *CAGR* |
|---|---|---|
| **1** | Norway | 0,64 |
| **2** | Denmark | 0,57 |
| **3** | Spain | 0,44 |
| **4** | Italy | 0,39 |
| **5** | Switzerland | 0,37 |
| **6** | Germany | 0,33 |
| **7** | Ireland | 0,31 |
| **8** | Sweden | 0,29 |
| **9** | Netherlands | 0,29 |
| **10** | Belgium | 0,26 |
| **11** | United Kingdom | 0,23 |
| **12** | France | 0,22 |
| **13** | Austria | 0,17 |
| **14** | Finland | 0,08 |
| **15** | Portugal | -0,03 |

Source: Personal elaboration from Refintiv Eikon Database.

These results are attributable also to the public participation which assumed relevant dimension in the last years . The most important Italian institution in this field is the CDP Venture Capital SGR, a national innovation fund that operates through direct and indirect investment funds, to support start-ups in all stages of their life cycle, with the aim of making the venture capital system a cornerstone of Italy's economic development and innovation. In 2021 CDP contributed strongly to the growth of the industry where it launched two technology transfer hubs, eight acceleration programs and a new fund with corporate focus. It is also important to highlight the strong commitment of institutions like the MISE, which allocated 2.55 billion of euros to the already collected 600 million of euros by new investors and the European investment fund, which singed a partnership agreement with CDP Venture Capital SGR to realize 260 million of euros in investments

towards highly technological projects.

Still, even if reduced, the gap between Italy and the other European countries still stand strong, signalling a situation of underdevelopment and necessity of growth. To achieve further growth, the industry needs to face and fix many of the market weaknesses. Firstly, efforts need to be redirected towards a larger and better structured supply with a higher number of domestic venture capital funds which in 2021 accounted only to 30, meanwhile the average for the main European countries in 2021 was 150 with also a significant higher volume of capitals under management. Other than this, it is present a remarkable difficulty in collecting capital from institutional investors, an overall corporate venture capital poorly developed, high difficulty in the disinvestment stage and more generally an economic system very much fragmented.

## Conclusion

This dissertation is intended to develop further and investigate deeper the determinants of venture capital by building an empirical model based on data pertaining to 36 different countries and a range of time of 9 years (chapter 3). More specifically the model pertain to the unbalanced panel category, with a number of entities (countries) of 36 and a time period (years) that varies from 3 to 9. The techniques of analysis put in place are two: random effect and FGLS. The literature showed us that the preferred technique in use are both fixed and random effects but we decided to follow the approach used by Marty and Balboa (2001) and use only random effect after the Hausmann Test indicated it as more appropriate (3.2.3). Still, after finding problems of heteroskedasticity and autocorrelation like Namji (2019), we decide to implement also the FGLS technique.

The model tests the impact of different predictors on one independent variable, that in our case, consists in venture capital investments normalized by GDP (3.1.2). The predictors instead pertain to two different groups: factors already confirmed by the literature, with the goal to confirm or not their impact, and not studied before, to find new relations and expand the field of research. To the first group pertain the GDP growth rate, R&D expenses, taxation, stock market growth and the number of patents applications. In the second one we included the quality of education, the quality of management schools, the contribution of tourism to GDP, the level of industrial and academical collaboration in R&D and inflation rate (3.1.3).

The results show that, out of the ten variables, the GDP growth rate, the quality of management schools, R&D expenses and the contribution of tourism to GDP are statistically significant to the level of venture capital investments (3.3). The positive correlation with GDP growth confirms the results of Jeng and Wells (2000), Marti and Balboa (2001) and Felix (2013), proving that an economy in expansion phase will provide more investments opportunity, consequently increasing the level of venture capital investments. According to our model also domestic research and development expenditure positively influence venture capital investments, proving once more that the innovation capacity and research output of a country contribute to create a more dynamic and entrepreneurial environment which means more opportunities and deals for venture capital funds. The positive relation is confirmed also by Gompers and Lerner (1999) and Romain and La Potterie (2004).

Another variable that has been found strongly significant in our model regards the quality of management schools. The predictor shows a positive coefficient and high statistical significance in all the models, proving that the presence of good business and management schools in a country increase venture capital investments. Being this one of the new variables tested we do not have a literature background that can confirm or contrast our result. Still, researches out of our specific field, like Megginson (2003), argues that universities, schools and research institutions play an important role in fostering a growing risk capital industry.

The last variable found to be significant is the contribution of tourism to GDP. In this case the relation is negative, showing that higher is the contribution of tourism to R&D the lower are investments in venture capital. This is probably because venture capital investments usually targets different sectors where innovation and start-ups birth rate is higher (2.1). With this we are not suggesting that innovation is not present in the tourism sector but instead that a country GDP sector composition is important when addressing the level of venture capital investments.

With regard to the other variables we concluded that the quality of education, the inefficiency in government bureaucracy and inflation rates are not significant, also presenting in the case of inflation rate different coefficients' sign in the FGLS model and the random effect one, depriving us completely the possibility to evaluate them. As for the stock market growth, the not relevance to venture capital investment is an outcome sustained by multiple authors (Gompers and Lerner (1998), Jeng and Wells (2000), Felix et All (2019)). Taxation, instead, apparently from our model not affecting the dependent variable, is found to be negatively related by Gompers and Lerner (1999) and Groh and Wallmeroth (2016), suggesting that our result could be not correct. Still, the relation between tax and venture capital might not be straightforward as one could think, developed countries usually have higher level of taxation but also higher levels of venture capital and the opposite is true for underdeveloped countries (VCPE, 2021). Considering that, we included both underdeveloped and developed country in our research, this could have biased the result of the taxation factor.

As for the number of patents applications, we found it to be relevant only in the FGLS model and with a coefficient very close to zero, an outcome very similar to the only obtained by Namji (2019) in the patents related variables and that doesn't let us evaluate properly its relationship with venture capital.

Lastly, we believed the collaboration between industry and universities in research and development a factor that was for sure going to impact positively the level of venture capital investments given the positive correlation of venture capital with R&D and the suspected one with the university network, but our result did not confirm it. This factor appears to be negatively related and also not significant in some cases, outcome that cannot let us evaluate it properly.

The obtained results also helped us to evaluate the state of venture capital in Italy (3.4). The industry shows a significant positive trend in the last year and despite being underdeveloped if confronted with other Western European countries it is growing at a higher rate (3.4.1). Still, in 2021, the industry is seen as less attractive to investors than other Western European countries (e.g. UK, France, Germany, Sweden), the reason being the a less favourable social and human environment and lower levels of investor protection and corporate governance (VCPE, 2021). The lower attractiveness of Italy with respect to the Western Europe average is also confirmed by the factors found to be significant in our regression analysis, less R&D expenditure, lower GDP growth rate, lower quality of management schools and higher level in the contribution of tourism to GDP (3.4.2).

## Bibliography


Associazione Italiana del Venture Captial (AIFI), *Venture Capital Monitor,* 2021.

Baughn, C. C., & Neupert, K. E., *Culture and National Conditions Facilitating Entrepreneurial Start-ups*, Journal of International Entrepreneurship, (2003).

Bruce, D., *Taxes and entrepreneurial endurance: evidence from the self-employed,* University of Chicago Press, 2002.

Cumming, D., Johan, S., & Zhang, M., *The Economic Impact of Entrepreneurship: Comparing International Datasets,* 2014.

Deutsche Bank Chief Investment Office, *CIO Special, Venture Capital Investing,* 2021.

Djankov, S., Lopez-de-Silanes, F., Shleifer, A., & Porta, R. L., *The law and economics of self-dealing,* Journal of finance economics, 2008.

Félix, E. G., Gulamhussen, M. A., & Pacheco, C., *The Determinants of Venture Capital in Europe - Evidence Across,* 2013.

Gage, D., *The Venture Capital Secret: 3 Out of 4 Start-Ups Fail*, The Wall Street Journal, 2012.

Gompers, P. A., & Lerner, J., *What drives Venture Capital fundraising?*, 1999.

Gornall, W., & Strebulaev, I. A., *The Economic Impact of Venture Capital: Evidence from Public Companies,* 2021.

Groh, A. P., & Wallmeroth, J., *Determinants of venture capital investments in emerging markets,* 2016.

Groh, A., Liechtenstein, H., Lieser, K., & Biesinger, M., *The Venture Capital and Private Equity Country Attractiveness Index 2021,* 2021.

Jeng, L. A., & Wells, P. C., *The determinants of venture capital funding: evidence across countries*, Journal of corporate finance, 2000.

KPMG, *Venture Capital Pulse Q2 2022,* 2022.

Marti, J., & Balboa, M., *Determinants of private equity fundraising in Western Europe,* 2001.

Megginson, W. L., *TOWARDS A GLOBAL MODEL OF VENTURE CAPITAL?*, Journal of applied corporate finance, 2001.

Najmi, A., *The Determinants of Venture Capital Funding in G7 countries,* 2019.

National Venture Capital Association (NVCA), *NVCA 2022 Yearbook,* 2022.

Nicholas, T., *Venture Capital: an American history,* 2019.

Refinitiv Eikon., *Venture Capital Screener*, 2022.

Romain, A., & Pottelsberghe, *The Determinants of Venture Capital: Additional Evidence,*

2004.

Statista Research Department, *Venture capital worldwide - statistics & facts*, Tratto da Statista.com:https://www-statista-com.skema.idm.oclc.org/topics/4724/venture-capital-worldwide/, (2022).

Tariq, T., *Start-Up Financing,* University of Twente, 2013.

Zider, B., *How Ventrue Capital Works*, Harvard Business Review, 1998.

## Sitography


Statista Research Department, *Venture capital worldwide - statistics & facts*, https://www-statista-com.skema.idm.oclc.org/topics/4724/venture-capital-worldwide/

The World Bank, *Retrieved from S&P Global Equity Indices (annual % change)*, https://data.worldbank.org/indicator/CM.MKT.INDX.ZG

The World Bank, *GDP growth (annual %)*, https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG

The World Bank, GovData360*, Quality of management schools, 1-7 (best)*, https://govdata360.worldbank.org/indicators/entrp.ed.mgmt.qual?country=BRA&indicator=3397&viz=line_chart&years=2012,2016

The World Bank, *Inflation, consumer prices (annual %)*, https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG

The World Bank, *Patent applications, nonresidents*, https://data.worldbank.org/indicator/IP.PAT.NRES

The World Bank, *Patent applications, residents*, https://data.worldbank.org/indicator/IP.PAT.RESD

The World Bank, *Quality of the education system*, TCdata360, https://tcdata360.worldbank.org/indicators/hc04cb276?country=QAT&indicator=568&countries=BRA&viz=line_chart&years=2007,2017

The World Bank, *Research and development expenditure (% of GDP)*, https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS

The World Bank, *Taxes on income, profits and capital gains (% of revenue)*, https://data.worldbank.org/indicator/GC.TAX.YPKG.RV.ZS

The World Bank, TCData360, *Inefficient Government Bureaucracy*, https://tcdata360.worldbank.org/indicators/mpf.gov.bur?country=BRA&indicator=3279&viz=line_chart&years=2008,2017

The World Bank, *Travel and Tourism total contribution to GDP*, TCdata360, https://tcdata360.worldbank.org/indicators/tnt.tot.contrib.gdp?country=BRA&indicator=24695&viz=line_chart&years=1995,2028

The World Bank, *University-industry collaboration in Research & Development*, TCdata360,

https://tcdata360.worldbank.org/indicators/h4247b4d7?country=BRA&indicator=604&viz=line_chart&years=2007,2017

## ANNEXES

### Table 9: Studied drivers of venture capital by author.

| *Factors included in the analysis* | **Gompers and Lerner (1998)** | **Jeng and Wells (2000)** | **Marty and Balboa (2001)** | **Romain and la Potterie (2004)** |
|---|---|---|---|---|
| | USA industry aggregated data | Panel data and cross section (21 countries) | Panel data and cross section (16 countries, focus on west Europe) | Panel data (16 countries) |
| ***Macroeconomics*** | | | | |
| GDP (growth rate or per capta) | x | x | x | x |
| One-year interest rate | x | | | x |
| Ten-years interest rate | | | | x |
| Spread between rates | | | | x |
| Exports levels | | | | |
| Unemployment rate | | | | |
| ***Capital market*** | | | | |
| IPO total market value | | x | | |
| Private pension (levels or growth rate) | x | x | | |
| Stock Market capitalization growth | x | x | | |
| Total market capitalization | | | | |
| Price to book ratio | | | | |
| M&A Investment volume | | | | |
| ***Taxation*** | | | | |
| Capital gain tax rate | x | | | x |
| Corporate income tax | | | | x |
| ***Legal structure / investor protection*** | | | | |
| Accounting standards | | x | | |
| IP Protection | | | | |
| Disclosure Index | | | | |
| Shareholder Suits Index | | | | |
| Legal Rights Index | | | | |
| Shareholder Suits Index | | | | |
| Ease of starting a business index | | | | |
| Labour market rigidities | | x | | x |
| ***Innovation output of the society*** | | | | |
| Number of patents | | | | x |
| R&D expenditure | x | | | x |
| Innovation Index | | | | |
| Gov. subsidiary for new technologies | | | | |
| R&D capital stocks | x | | | x |
| ***Cultural*** | | | | |
| TEA (total entrepreneurial activity) | | | | x |
| Bribery & Corruption Index | | | | |
| ***Specific to the VC industry*** | | | | |
| VCPE index | | | | |
| VC divestment | | | x | |
| VC investment | | | x | |

## Table 10: Studied drivers of venture capital by author (continuation).

| *Factors included in the analysis* | **Felix et all (2013)** | **Prohorovos and Pavlyuk (2013)** | **Groh and Wallmeroth (2016)** | **Najmi (2019)** |
|---|---|---|---|---|
| | Panel data, fixed and random effect (23 countries focus on Europe) | Cluster analysis (22 countries divided in 2 clusters) | Panel data, random effect (118 countries, focus on emerging markets) | Feasible generalized least squares (G7 countries) |
| ***Macroeconomics*** | | | | |
| GDP (growth rate or per capta) | x | x | | |
| One-year interest rate | | | | |
| Ten-years interest rate | x | | | x |
| Spread between rates | | | | |
| Exports levels | | | x | |
| Unemployment rate | x | | x | x |
| ***Capital market*** | | | | |
| IPO total market value | x | x | | |
| Private pension (levels or growth rate) | | | | |
| Stock Market capitalization growth | x | | | x |
| Total market capitalization | | | | x |
| Price to book ratio | x | | | |
| M&A Investment volume | | | x | |
| ***Taxation*** | | | | |
| Capital gain tax rate | | | | |
| Corporate income tax | | | x | |
| ***Legal structure / investor protection*** | | | | |
| Accounting standards | | | | |
| IP Protection | | | x | |
| Disclosure Index | | | x | |
| Shareholder Suits Index | | | x | |
| Legal Rights Index | | | x | |
| Shareholder Suits Index | | | | |
| Ease of starting a business index | | | | x |
| Labour market rigidities | | | | |
| ***Innovation output of the society*** | | | | |
| Number of patents | | | | x |
| R&D expenditure | x | | | x |
| Innovation Index | | | x | |
| Gov. subsidiary for new technologies | | | | x |
| R&D capital stocks | | | | |
| ***Cultural*** | | | | |
| TEA (total entrepreneurial activity) | x | | | |
| Bribery & Corruption Index | | | x | |
| ***Specific to the VC industry*** | | | | |
| VCPE index | | x | | |
| VC divestment | x | x | | |
| VC investment | x | x | x | |

## Table 11: Correlation Matrix

| | *VC_investments* | *GDP_growth* | *SP_global_equity_index* | *Taxes* | *RD_exp* | *Inef_gov_bourocracy* | *Quality_management_schools* | *University_industry_collab* | *Quality_education* | *Travel_Tourism_contribution* | *Patents_application* | *Inflation* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VC_investments | 1 | | | | | | | | | | | |
| GDP_growth | 0,166040553 | 1 | | | | | | | | | | |
| SP_global_equity_index | -0,029146628 | -0,131156984 | 1 | | | | | | | | | |
| Taxes_income_profits_capitalgains | 0,141164545 | 0,110778799 | 0,036936341 | 1 | | | | | | | | |
| RD_exp | 0,208374183 | -0,029467264 | 0,041243215 | 0,109899862 | 1 | | | | | | | |
| Gov_eff | 0,215665793 | 0,037986613 | 0,085624863 | 0,229647441 | 0,704527 | | | | | | | |
| Inef_gov_bourocracy | -0,202289208 | -0,08569348 | -0,098891695 | 0,174338876 | -0,01799 | 1 | | | | | | |
| Quality_management_schools | 0,244379139 | 0,080141584 | 0,148270402 | 0,408150936 | 0,494169 | -0,174301767 | 1 | | | | | |
| University_industry_collaboration_RD | 0,27404476 | 0,123470217 | 0,030172631 | 0,353431933 | 0,726877 | -0,193870596 | 0,716276034 | 1 | | | | |
| Quality_education | 0,250032859 | 0,074641945 | 0,099577971 | 0,254251057 | 0,610578 | -0,319518911 | 0,69289481 | 0,765224931 | 1 | | | |
| Travel_Tourism_contribution | -0,124493119 | -0,087995046 | -0,035566155 | 0,017039094 | -0,16704 | 0,128835961 | -0,115909919 | -0,210203125 | -0,17533358 | 1 | | |
| PPP | 0,005382921 | 0,140779278 | -0,010607799 | -0,014711937 | -0,24666 | -0,053690663 | -0,147256476 | -0,092032703 | -0,08081392 | -0,158617818 | | |
| Patents_application | 0,221987462 | 0,021365442 | 0,031844196 | 0,544928158 | 0,201002 | -0,032345497 | 0,196607213 | 0,276312134 | 0,107914918 | -0,078331403 | 1 | |
| Inflation | -0,08857838 | -0,109479497 | 0,012442815 | -0,252367797 | -0,34515 | -0,212185949 | -0,210783388 | -0,345019854 | -0,348308068 | -0,028905312 | -0,057994579 | 1 |

## Table 12: Descriptive statistics

| *VC_investments* | | *Taxes_income_profits_capitalgains* | | *Quality_management_schools* | | *SP_global_equity_index* | | *Travel_Tourism_contribution* | | *RD_exp* | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean | 0,00114797 | Mean | 45,74629245 | Mean | 5,005909544 | Mean | 8,599344777 | Mean | 9,379613172 | Mean | 1,724690971 |
| Standard Error | 0,000149896 | Standard Error | 1,004856717 | Standard Error | 0,040489998 | Standard Error | 1,60822421 | Standard Error | 0,215021099 | Standard Error | 0,060789883 |
| Median | 0,000338086 | Median | 46,23727613 | Median | 5,091578443 | Median | 9,138774491 | Median | 8,940445 | Median | 1,62904501 |
| Mode | #N/A | Mode | #N/A | Mode | #N/A | Mode | #N/A | Mode | #N/A | Mode | 2,178570032 |
| Standard Deviation | 0,002453906 | Standard Deviation | 16,45021344 | Standard Deviation | 0,662849842 | Standard Deviation | 26,327765 | Standard Deviation | 3,52004709 | Standard Deviation | 0,995173275 |
| Sample Variance | 6,02165E-06 | Sample Variance | 270,6095221 | Sample Variance | 0,439369913 | Sample Variance | 693,1512098 | Sample Variance | 12,39073151 | Sample Variance | 0,990369848 |
| Kurtosis | 69,13977931 | Kurtosis | 0,595440925 | Kurtosis | -0,893653241 | Kurtosis | 0,752249456 | Kurtosis | 0,562169119 | Kurtosis | -0,528225585 |
| Skewness | 6,859772645 | Skewness | 0,498847099 | Skewness | -0,271204419 | Skewness | 0,42252597 | Skewness | 0,936987409 | Skewness | 0,511605796 |
| Range | 0,029552221 | Range | 77,00145096 | Range | 2,969806866 | Range | 156,1843401 | Range | 17,1456 | Range | 4,572060212 |
| Minimum | 7,56252E-08 | Minimum | 15,32616004 | Minimum | 3,41709785 | Minimum | -58,34576427 | Minimum | 4,0415 | Minimum | 0,084700003 |
| Maximum | 0,029552297 | Maximum | 92,327611 | Maximum | 6,386904716 | Maximum | 97,83857585 | Maximum | 21,1871 | Maximum | 4,656760216 |
| Sum | 0,307655917 | Sum | 12260,00638 | Sum | 1341,583758 | Sum | 2304,6244 | Sum | 2513,73633 | Sum | 462,2171801 |
| Count | 268 | Count | 268 | Count | 268 | Count | 268 | Count | 268 | Count | 268 |
| *GDP_growth* | | *Inef_gov_bourocracy* | | *Patents_application* | | *University_industry_collaboration_RD* | | *Inflation* | | *Quality_education* | |
| Mean | 1,715603327 | Mean | 12,81119403 | Mean | 28687,25373 | Mean | 4,621793369 | Mean | 3,24619086 | Mean | 4,371958007 |
| Standard Error | 0,198402491 | Standard Error | 0,274413028 | Standard Error | 6034,288085 | Standard Error | 0,048194595 | Standard Error | 0,34716185 | Standard Error | 0,059080678 |
| Median | 2,078987826 | Median | 12,65 | Median | 4727 | Median | 4,692056768 | Median | 1,83184152 | Median | 4,468086029 |
| Mode | #N/A | Mode | 11,1 | Mode | 2060 | Mode | 5,665696273 | Mode | #N/A | Mode | #N/A |
| Standard Deviation | 3,247988753 | Standard Deviation | 4,492334886 | Standard Deviation | 98785,5534 | Standard Deviation | 0,788979522 | Standard Deviation | 5,683284426 | Standard Deviation | 0,967192385 |
| Sample Variance | 10,54943094 | Sample Variance | 20,18107273 | Sample Variance | 9758585561 | Sample Variance | 0,622488686 | Sample Variance | 32,29972187 | Sample Variance | 0,93546111 |
| Kurtosis | 4,703527196 | Kurtosis | 0,110882051 | Kurtosis | 25,10106164 | Kurtosis | -1,06743805 | Kurtosis | 21,65091103 | Kurtosis | -0,97371406 |
| Skewness | -1,147840034 | Skewness | 0,098331131 | Skewness | 5,107155206 | Skewness | -0,251478848 | Skewness | 4,196270876 | Skewness | -0,150281306 |
| Range | 29,65621762 | Range | 25,3 | Range | 606956 | Range | 3,110520588 | Range | 47,11158154 | Range | 4,102661791 |
| Minimum | -15,13646791 | Minimum | 1,9 | Minimum | 0 | Minimum | 2,857625479 | Minimum | -5,992201556 | Minimum | 2,133737535 |
| Maximum | 14,51974971 | Maximum | 27,2 | Maximum | 606956 | Maximum | 5,968146067 | Maximum | 41,11937999 | Maximum | 6,236399326 |
| Sum | 459,7816917 | Sum | 3433,4 | Sum | 7688184 | Sum | 1238,640623 | Sum | 869,9791505 | Sum | 1171,684746 |
| Count | 268 | Count | 268 | Count | 268 | Count | 268 | Count | 268 | Count | 268 |

## Table 13:Variables, sources and previous/expected results.

| ***Dependent variable*** | **Source** | **Unit** | **Previous literature studies** | **Expected relation** |
|---|---|---|---|---|
| *VC_investments* | Refinitive.com for the volume of venture capital investments, World Bank Data for GDP values | Millions of $ | | |
| ***Independent variables*** | | | | |
| *GDP_growth* | World Bank Data (World Bank national accounts data, and OECD National Accounts data files) | % change | ✓ | + |
| *SP_global_equity_index* | World bank Data (Standard & Poor's, Global Stock Markets Factbook and supplemental S&P data) | % change | ✓ | + |
| *Taxes_income_profits_capitalgains* | World bank data (International Monetary Fund, Government Finance Statistics Yearbook and data files) | % of total taxes | ✓ | - |
| *RD_exp* | World bank data (UNESCO Institute for Statistics) | % of GDP | ✓ | ++ |
| *Inef_gov_bourocracy* | Worldwide government indicators | 0-30 | ✓ | - |
| *Quality_management_schools* | TC360data (world economic forum) | Estimated value | x | + |
| *University_industry_collaboration_RD* | TC360data(World Economic Forum Global Competitiveness Index) | 1-7 | x | + |
| *Quality_education* | TC360data(World Economic Forum Global Competitiveness Index) | 1-7 | x | + |
| *Travel_Tourism_contribution* | TC360data(World Travel & Tourism Council) | % of GDP | x | - |
| *Inflation rate* | Worldwide government indicators | % | x | - |
| *Patents_application* | World bank data (World Intellectual Property Organization ( WIPO )) | Total number of applications, resident and non resident | ✓ | + |

Source: Personal elaboration.

**Table 14: Random effects regression results.**

| *Panel analysis with random effect* | | | | |
|---|---|---|---|---|
| | ***Model 1 ( full dataset, all variables )*** | ***Model 2 ( clean dataset, all variables )*** | ***Model 3 ( full dataset, significant variables )*** | ***Model 4 ( full dataset, all variables )*** |
| ***R-Squared*** | ***0,32*** | ***0,35*** | ***0,30*** | ***0,32*** |
| ***N° of Entities*** | ***36*** | ***36*** | ***36*** | ***36*** |
| ***N° of observations*** | ***268*** | ***260*** | ***268*** | ***260*** |
| ***N° of years*** | ***3 to 9*** | ***3 to 9*** | ***3 to 9*** | ***3 to 9*** |
| ***Variables*** | ***11*** | ***11*** | ***5*** | ***5*** |
| GDP_growth | **0,0699** | **0,0661** | **0,0676** | **0,0626** |
| | *0,0379* | *0,0409* | *0,0400* | *0,0474* |
| SP_global_equity_index | **0,0003** | **0,0010** | | |
| | *0,9377* | *0,7864* | | |
| Taxes_income_profits_capitalgains | **0,0185** | **0,0187** | | |
| | *0,1665* | *0,1327* | | |
| RD_exp | **0,8593** | **0,8935** | **0,8398** | **0,8782** |
| | *0,0004* | *0,0001* | *0,0002* | *0,0000* |
| Inef_gov_bourocracy | **-0,0188** | **-0,0023** | | |
| | *0,5767* | *0,9450* | | |
| University_industry_collaboration_RD | **-0,7439** | **-0,6350** | **-0,4099** | **-0,3792** |
| | *0,0362* | *0,0602* | *0,1983* | *0,2169* |
| Quality_management_schools | **0,8411** | **0,8096** | **1,1177** | **1,0756** |
| | *0,0105* | *0,0097* | *0,0002* | *0,0001* |
| Quality_education | **0,3323** | **0,2702** | | |
| | *0,2239* | *0,2896* | | |
| Travel_Tourism_contribution | **-0,1024** | **-0,1013** | **-0,1004** | **-0,0989** |
| | *0,0277* | *0,0181* | *0,0298* | *0,0218* |
| Patents_application | **0,0000** | **0,0000** | | |
| | *0,2509* | *0,2342* | | |
| Inflation | **0,0063** | **0,0108** | | |
| | *0,8132* | *0,6676* | | |

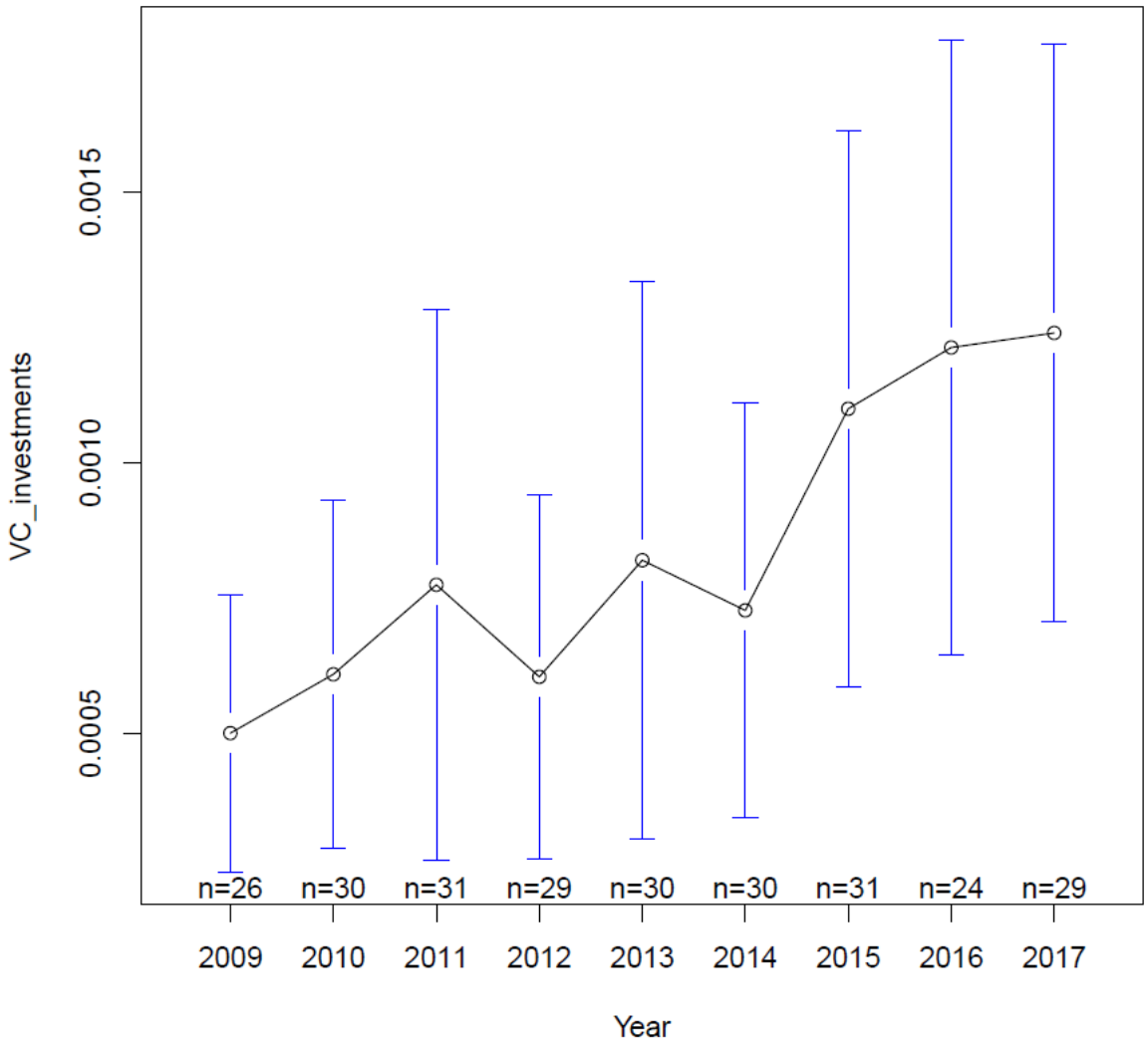
Source: Regression results, R studio.

**Table 15: FGLS regression results.**

| *Panel analysis with FGLS* | | | | |
|---|---|---|---|---|
| | ***Model 1 ( full dataset, all variables )*** | ***Model 2 ( clean dataset, all variables )*** | ***Model 3 ( full dataset, significant variables )*** | ***Model 4 ( full dataset, all variables )*** |
| ***R-Squared*** | ***0,43*** | ***0,45*** | ***0,41*** | ***0,31*** |
| ***N° of Entities*** | ***36*** | ***36*** | ***36*** | ***36*** |
| ***N° of observations*** | ***268*** | ***260*** | ***268*** | ***260*** |
| ***N° of years*** | ***3 to 9*** | ***3 to 9*** | ***3 to 9*** | ***3 to 9*** |
| ***Variables*** | ***11*** | ***11*** | ***6*** | ***5*** |
| GDP_growth | **0,0970** | **0,0731** | **0,1036** | **0,0738** |
| | *0,0032* | *0,0207* | *0,0014* | *0,0152* |
| SP_global_equity_index | **0,0004** | **0,0002** | | |
| | *0,9218* | *0,9597* | | |
| Taxes_income_profits_capitalgains | **0,0120** | **0,0133** | | |
| | *0,1880* | *0,1277* | | |
| RD_exp | **0,7381** | **0,7954** | **0,6984** | **0,6871** |
| | *0,0000* | *0,0000* | *0,0000* | *0,0000* |
| Inef_gov_bourocracy | **-0,0333** | **-0,0187** | | |
| | *0,2375* | *0,5027* | | |
| University_industry_collaboration_RD | **-0,4545** | **-0,6350** | **-0,1676** | |
| | *0,0928* | *0,0602* | *0,4902* | |
| Quality_management_schools | **0,8646** | **0,8755** | **1,0697** | **0,9496** |
| | *0,0005* | *0,0002* | *0,0000* | *0,0000* |
| Quality_education | **0,3323** | **0,1465** | | |
| | *0,2239* | *0,4281* | | |
| Travel_Tourism_contribution | **-0,1040** | **-0,1013** | **-0,1014** | **-0,0944** |
| | *0,0006* | *0,0005* | *0,0007* | *0,0008* |
| Patents_application | **0,0000** | **0,0000** | **0,0000** | **0,0000** |
| | *0,0619* | *0,0662* | *0,0039* | *0,0023* |
| Inflation | **-0,0180** | **-0,0124** | | |
| | *0,3969* | *0,5398* | | |

Source: Regression results, R studio.

**Figure 24: Unbalanced panels and independent variable yearly range.**




Source: Personal elaboration with R studio plotting tooling.

Notes: The graph shows the range in which the independent variable move each year. The graph also shows information about the number of entities every year.

**Figure 25: R programming code. Part 1.**

```
setwd("C:/Users/Asus/Desktop/Università-DESKTOP-VFVGGV9/magistrale/
      Tesi magistrale/DB")
library(readxl)
Final <- read_excel("Final.xlsx")
View(Final)
dev.off()

###First step i estimate OLS pooling
library(plm)
olspool <- plm(VC_investments~GDP_growth+SP_global_equity_index
               +Taxes_income_profits_capitalgains+RD_exp
               +Gov_eff+Inef_gov_bourocracy+Quality_management_schools
               +University_industry_collaboration_RD+Quality_education
               +Travel_Tourism_contribution
               +Patents_application+Inflation,
               data=Final,index=c("Country","Year"),model="pooling" )
summary(olspool)

###Start with the assumption testing to improve the model

#OULIARS REMOVAL
ols <- lm(VC_investments~GDP_growth+SP_global_equity_index
          +SP_global_equity_index
          +Taxes_income_profits_capitalgains+RD_exp+Gov_eff
          +Inef_gov_bourocracy+Quality_management_schools
          +University_industry_collaboration_RD+Quality_education
          +Travel_Tourism_contribution
          +Patents_application+Inflation,data=Final )
summary(ols)
plot(ols,which=4)
cooksd <- cooks.distance(ols)
outliers <- as.numeric(names(cooksd)[(cooksd>(4/269))])
View(outliers)
Clean<-Final[cooksd<4/269,]

###restimate OLS pooled

olspool2 <- plm(VC_investments~GDP_growth+SP_global_equity_index
                +SP_global_equity_index+Taxes_income_profits_capitalgains
                +RD_exp+Gov_eff+Inef_gov_bourocracy+Quality_management_schools
                +University_industry_collaboration_RD+Quality_education
                +Travel_Tourism_contribution+Patents_application+Inflation,
                data=Clean,index=c("Country","Year"),model="pooling" )
summary(olspool2)

View(Clean)
library(gplots)
pdf("rplot.pdf")
plotmeans(VC_investments~Year,mean="",data=Clean)
dev.off()


#HOMOSCEDASTICITY
library(lmtest)
bptest(VC_investments~GDP_growth+SP_global_equity_index
       +Taxes_income_profits_capitalgains+RD_exp+Gov_eff+Inef_gov_bourocracy
       +Quality_management_schools+University_industry_collaboration_RD
       +Quality_education+Travel_Tourism_contribution
       +Patents_application+Inflation,data=Clean, studentize=F)

###to reduce it i apply log function and re perform the model
```

**Figure 26: R programming code. Part 2.**

```
bptest(log(VC_investments)~GDP_growth+SP_global_equity_index
       +Taxes_income_profits_capitalgains+RD_exp+Gov_eff+Inef_gov_bourocracy
       +Quality_management_schools+University_industry_collaboration_RD
       +Quality_education+Travel_Tourism_contribution
       +Patents_application+Inflation,data=Clean, studentize=F)

olspool3 <- plm(log(VC_investments)~GDP_growth+SP_global_equity_index
                +Taxes_income_profits_capitalgains+RD_exp+Gov_eff
                +Inef_gov_bourocracy+Quality_management_schools
                +University_industry_collaboration_RD+Quality_education
                +Travel_Tourism_contribution+
                  Patents_application+Inflation,
                data=Clean,index=c("Country","Year"),model="pooling" )
summary(olspool3)

#multicollinearity
library ("car")
vif(olspool3)

###remove Gov_eff and recalculate VIF

olspool4 <- plm(log(VC_investments)~GDP_growth+SP_global_equity_index
                +Taxes_income_profits_capitalgains+RD_exp+Inef_gov_bourocracy
                +Quality_management_schools
                +University_industry_collaboration_RD
                +Quality_education+Travel_Tourism_contribution
                +Patents_application+Inflation,
                data=Clean,index=c("Country","Year"),model="pooling" )
summary(olspool4)
vif(olspool4)

#STATIONARITY
library(urca)
summary(ur.df(log(Clean$VC_investments)))
plot(log(Clean$VC_investments))

###Some variables are not stationary but not the independent one

#INDIPENDENCE or AUTOCORRELATION
library(plm)
pbgtest(olspool4)
###There are problem of serial correlation

#cross-sectional test
pcdtest(olspool4,test=c("lm"))
pcdtest(olspool4,test=c("cd"))

###there is cross sectional dependence
###Now i test with FE and RE
FE <- plm(log(VC_investments)~GDP_growth+SP_global_equity_index
          +Taxes_income_profits_capitalgains+RD_exp+Inef_gov_bourocracy
          +Quality_management_schools+University_industry_collaboration_RD
          +Quality_education+Travel_Tourism_contribution
          +Patents_application+Inflation,
          data=Clean,index=c("Country","Year"),model="within" )
summary(FE)
```

**Figure 27: R programming code. Part 3.**

```
RE <- plm(log(VC_investments)~GDP_growth+SP_global_equity_index
          +Taxes_income_profits_capitalgains+RD_exp+Inef_gov_bourocracy
          +Quality_management_schools+University_industry_collaboration_RD
          +Quality_education+Travel_Tourism_contribution+Patents_application
          +Inflation,data=Clean,index=c("Country","Year"),model="random" )
summary(RE)
###re-perform the tests to see if assumption are respected

pFtest(FE,olspool4)
###FE way better than OLS

library(plm)
plmtest(olspool4, type=c ("bp"))
###random way better than OLS

phtest(FE,RE)
#RE better, still we have problem of stationarity/heteroskedasticity, use FGLS


#FGLS
library(plm)
fgls <- plm(log(VC_investments)~GDP_growth+SP_global_equity_index
            +Taxes_income_profits_capitalgains+RD_exp+Inef_gov_bourocracy
            +Quality_management_schools+University_industry_collaboration_RD
            +Quality_education+Travel_Tourism_contribution
            +Patents_application+Inflation,
            data=Clean,index=c("Country","Year"),model="pooling")
summary(fgls)

#FINALS MODELS
summary(fgls)
summary(RE)

###all finals models
#RE
#1
RE <- plm(log(VC_investments)~GDP_growth+SP_global_equity_index
          +Taxes_income_profits_capitalgains+RD_exp+Inef_gov_bourocracy
          +Quality_management_schools+University_industry_collaboration_RD
          +Quality_education+Travel_Tourism_contribution
          +Patents_application+Inflation,
          data=Final,index=c("Country","Year"),model="random" )
summary(RE)
#2
RE_only <- plm(log(VC_investments)~GDP_growth+RD_exp+Quality_management_schools
               +University_industry_collaboration_RD+
                 Travel_Tourism_contribution,
               data=Final,index=c("Country","Year"),model="random" )
summary(RE_only)

#3
RE_clean <- plm(log(VC_investments)~GDP_growth+SP_global_equity_index
                +Taxes_income_profits_capitalgains+RD_exp+Inef_gov_bourocracy
                +Quality_management_schools
                +University_industry_collaboration_RD
                +Quality_education+Travel_Tourism_contribution+
            Patents_application+Inflation,
            data=Clean,index=c("Country","Year"),model="random" )
summary(RE_clean)
```

**Figure 28: R programming code. Part 4.**

```
#4
RE_clean_only <- plm(log(VC_investments)~GDP_growth+RD_exp+
                  Quality_management_schools
                  +University_industry_collaboration_RD
                  +Travel_Tourism_contribution,
                  data=Clean,index=c("Country","Year"),model="random" )
summary(RE_clean_only)

#corrections to solve heteroskedascitity and autocorrelation problems
coeftest(RE,vcovHC(RE,method="arellano"))
coeftest(RE_only,vcovHC(RE_only,method="arellano"))
coeftest(RE_clean,vcovHC(RE_clean,method="arellano"))
coeftest(RE_clean_only,vcovHC(RE_clean_only,method="arellano"))

#FGLS
library(plm)
#1
fgls <- plm(log(VC_investments)~GDP_growth+SP_global_equity_index
            +Taxes_income_profits_capitalgains+RD_exp+Inef_gov_bourocracy
            +Quality_management_schools+University_industry_collaboration_RD
            +Quality_education+Travel_Tourism_contribution+
              Patents_application+Inflation,
            data=Final,index=c("Country","Year"),model="pooling")
summary(fgls)
#2
fgls_only <- plm(log(VC_investments)~GDP_growth+RD_exp+
               Quality_management_schools+University_industry_collaboration_RD
               +Travel_Tourism_contribution+Patents_application,
               data=Final,index=c("Country","Year"),model="pooling")
summary(fgls_only)
#3
fgls_clean <- plm(log(VC_investments)~GDP_growth+SP_global_equity_index
                  +Taxes_income_profits_capitalgains+RD_exp+Inef_gov_bourocracy
                  +Quality_management_schools
                  +University_industry_collaboration_RD
                  +Quality_education+Travel_Tourism_contribution
                  +Patents_application+Inflation,
                  data=Clean,index=c("Country","Year"),model="pooling")
summary(fgls_clean)
#4
fgls_clean_only <- plm(log(VC_investments)~GDP_growth+RD_exp+
                    Quality_management_schools+Travel_Tourism_contribution+
                    Patents_application,
                    data=Clean,index=c("Country","Year"),model="pooling")
summary(fgls_clean_only)

#graphs
library(ggplot2)
library(readxl)
Final <- read_excel("Final.xlsx")
ggplot(data=Clean, aes(x=Gov_eff, y=VC_investments))+geom_point()
ggplot(data=Clean, aes(x=University_industry_collaboration_RD,
                       y=VC_investments))+geom_point()
```