



The impact of COVID-19 on Venture Capital's level of investments

Tiago de Almeida

Dissertation written under the supervision of professor Eva Schliephake.

Dissertation submitted in partial fulfilment of requirements for the MSc in Finance, at the Universidade Católica Portuguesa, 6th of January 2021.

Abstract

Title: The impact of COVID-19 on Venture Capital's level of investments

Student: Tiago Sardinha de Almeida

This investigation analyzes the impact of the COVID-19 pandemic on venture capitals' investment levels, including American and European venture capital firms. By employing regression analysis, it is found that venture capitals lowered their investment levels by 2.5% due to the macroeconomic shock and the uncertainty caused by the pandemic. When comparing regions, the virus's impact is more severe in the European countries, accounting for a 4% decrease in the raised amount, while American deals did not present a significant change. These drops, however, can only be seen in the seed funding rounds, being early and later stages not significantly affected by the pandemic. We argue that the entrepreneurial activity is being affected by the fear and uncertainty about the future and that venture capitals are focusing more on existing funds than looking for new investments, leading to a lower seed investment level. Lastly, it is studied the impact of the pandemic on two industries - Healthcare and Technology. Results yielded an increase of 6% in the raised amounts relative to healthcare companies, while technology companies received 5% less funding since the COVID-19 outbreak. As an explanation, it is argued that healthcare represented a growing need for everyone under lockdown.

Keywords: venture capital; COVID-19; coronavirus; crisis; investment levels; seed stage of investments; early stage of investments; later stage of investments

Sumário

Titúlo: The impact of COVID-19 on Venture Capital's level of investments

Aluno: Tiago Sardinha de Almeida

Esta tese analisa o impacto da pandemia COVID-19 nos níveis de investimento das sociedades de capitais de risco, em empresas americanas e europeias. Através de regressões lineares, verifica-se que as sociedades de capitais de risco reduziram os níveis de investimento em 2.5% devido ao choque macroeconômico e à incerteza causada pela pandemia. Na comparação das regiões, o impacto do vírus é mais acentuado nos países europeus, correspondendo a uma redução de 4% no valor arrecadado, enquanto que os negócios americanos não apresentam variação significativa. Estas quedas, no entanto, só podem ser verificadas nas rondas de financiamento inicial, sendo os estágios intermédios e posteriores não significativamente afetados pela pandemia. Argumentamos que o empreendedorismo está a ser afetado pelo medo e incerteza sobre o futuro, e ainda que as sociedades estão-se a concentrar mais nos fundos existentes do que na pesquisa de novos investimentos, levando a um menor nível de investimento inicial. Por fim, é estudado o impacto da pandemia em duas indústrias - Saúde e Tecnologia. Os resultados apresentam um aumento de 6% nos valores relativos às empresas de saúde, enquanto as empresas de tecnologia receberam 5% a menos de financiamento desde o aparecimento da COVID-19. Como explicação, argumenta-se que a saúde representava uma necessidade crescente para todos os que estavam sujeitos Ao confinamento.

Palavras-Chave: sociedade de capital de risco; COVID-19; coronavirus; crise; níveis de investimento; ronda de financiamento inicial; ronda de financiamento intermédia; ronda de financiamento posterior

Acknowledgements

To professor Eva Schliephake, for the crucial advice and guidance provided during the last months. It would not have been possible without her help on tackling every problem along the way, and for that, I am grateful.

I would also like to mention the Católica University's community's support – Teachers, Master Affairs, I.T. services team, and others – who, even at a distance, provided great assistance when needed.

Lastly, a thank you note to my closest friends and family without whom nothing would be rewarded enough to achieve. Special thanks to my parents and brother, who always pushed me to do my best.

1. Introduction

Venture Capital is a business model that acts as an alternative form of financing for new high growth companies that carry high levels of risk along with them. This type of business was first documented in the 1920s through several forms of what it has become today (Felizardo, 2016). With this business concept's evolution, the first official venture capital firm came to be established in America in 1946 – American Research & Development Corporation (Bygrave & Timmons, 1992). In the following decades, numerous venture capitals were established, and the number of investments experienced a significant increase. Until 1978, pension funds had to invest following the "prudent person rule", as provided by the Employee Retirement Income Security Act (ERISA). With the industry prospering, the increasing demand for capital also required an increase in the capital supply. By this time, many managers would not invest in venture capitals as this could be seen as "imprudent". In 1979, the U.S Department of Labor announced that pension fund managers were allowed to invest in high risk assets, including venture capitals. The statement was made as a clarification of the ERISA rule, to explain that investing in venture capital funds was not "imprudent". This event had a meaningful impact on the industry, reflected in the fact that 8 years after the announcement venture capitals had more than \$4 billion invested, and more than half of these investments came from pension funds' contributions (Gompers & Lerner, *The Venture Capital Revolution*, 2001). Over these decades, the venture capital industry was subject to some shifts on the contribution to the companies in which they invested. Venture capital was not a simple monetary form of financing companies, but it could also be a means of providing intellectual and technical expertise. In the late 1990s, venture capitals experienced another boom, with investments topping up at \$89.8 billion in 2000 (Sohl & Rosenberg, 2003). Despite its ups and downs, venture capitals have been expanding their presence in the world's economy to the point that in 2018 they held roughly \$803 billion of assets under management (McKinsey & Company, 2019).

A favourable startup environment is normally rewarded with positive impacts on economic growth. The development of new businesses leads to a wealthier economy and improves society's situation (Szarek & Piecuch, 2018). Despite their importance, startups struggle with receiving capital to develop their innovative ideas and new technologies (Zider, 1998). The relationship between investors and startups is characterized by high risk, uncertainty and asymmetric information. By the time a firm invests in a startup, the risk is shared between enterprises, creating other agency problems like moral hazard and adverse selection (Tykvová,

2000). The factors pointed out above are the main reason for the lack of an adequate capital supply. Nevertheless, there are still business angels and venture capitals that are willing to take riskier investments. Other financial entities like banks are less frequent in these types of businesses because of their high risk and the poor amount of tangible assets that can be used as collateral (Bottazzi & Da Rin, 2002). Filling this gap is what makes venture capitalism such an essential activity for a country's economic growth and for stimulating innovation (Gompers & Lerner, *The Venture Capital Revolution*, 2001).

This relationship between the economy and venture capital's activity also works the other way around. One can guess that the state of the economy should also have a great impact on the supply side of venture capitals. Through periods of crisis, financial institutions are harmed in numerous ways, and that consequently affects ventures. The global financial crisis of 2008 proved that pension funds, insurance companies and banks are the entities that can take a huge loss in crisis periods (Impavido & Tower, 2009). Considering that the investors in venture capital funds are mostly pension funds, financial firms and insurance companies (Zider, 1998), once the economy enters into depression, it is expected that the injections of capital for the venture capital's investments fail to keep its normal pace, leading to a breakdown in the industry.

The unforeseen crisis caused by the COVID-19 pandemic is taking a huge hit on the world's economy, and this paper deals with the effects of this event on the venture capital's activity. It all started in late 2019 in Wuhan, when an unknown virus quickly began to contaminate the entire population. The main issue of this new disease was that many carriers did not have obvious symptoms, consequently allowing the virus to spread even faster. By the end of February 2020, a total of 79,300 cases were confirmed, and 2,835 fatalities in China (Thomala, 2020). As we live in a highly globalized world, it didn't take long until the problem started to hit every country. By early March 2020, Italy and Spain's cases spiked to the point that not even China had ever reached before. At the end of this month, one-third of humanity was under lockdown (Neilson & Woodward, 2020). Studies on the impacts of a lockdown explain the tremendous economic damage of such an event. The costs include more than 400 million jobs and an estimated \$11 billion loss for a one-month lockdown. With human's health under threat, the uncertainty in our lives rose to a level not seen in a long time. Unsurprisingly, the Volatility Index (VIX) has reflected the induced uncertainty of the financial volatility peak that was recorded in March 2020, and is the highest in recent history, including the global financial crisis

(Caggiano, Castelnovo, & Kima, 2020). Huge implications could derive from these effects, as the stock market is directly linked to one of the biggest exit markets for venture capital's investments, the IPO market (Rajan & Servaes, 2002). Another major repercussion from the lockdowns is the GDP growth, which is expected to decrease by 9% in 2020 in the world's biggest economy, the United States (Baker, Bloom, & Terry, 2020). In Europe, the damage is expected to be uneven as some countries were more affected by the crisis than others. Nevertheless, Clark (2020) estimates a contraction of 7.4 percent in the European Union's GDP growth.

The venture capital industry is already characterized by a huge amount of uncertainty and risk. Adding to that, the economic environment imposed by the number of deaths going up every day even aggravates, and now it is important to explore how these firms are reacting to this drama. Companies must adapt their procedures to meet social distancing requirements, which in many cases means working remotely. As Chandna (2020) pointed out, this crisis does not have the same impact on every industry. While some industries are struggling to survive or face tremendous structural transformations, others have thrived or even accelerated through this crisis. The ability to work on a remote basis does not apply to all sectors, and with the lockdowns, many businesses had to close for a while. This is where the motivation for this paper comes from. Given that venture capitals invest in innovative technologies and some industries are not being affected by the crisis, venture capitals might have been keeping its investments levels in the successful industries to offset the other industries where they might have been losing some money.

With the economy almost coming to a halt, the effect on venture capital deals and the reaction in response to the new COVID-19 reality are questions that are still unanswered. This paper aims to answer these questions by building several research models. First, the aim is to understand how the environment of fear and uncertainty caused by the COVID-19 pandemic affects the venture capital investment levels. According to what has been said, the macroeconomic shock is also inherent to this environment under study. Results show that this environment negatively impacts venture capital investments. Second, we explore the impact of this pandemic on a regional level. Two regions are used for this purpose – Europe and the United States of America. Not only the reaction to the COVID-19 outbreak was very different in these two regions, but both strongly diverge in terms of economic and social patterns of society and economy. For the data collected in this paper, evidence suggests that European

firms downgraded their investment levels more than American firms. Third, a microanalysis is carried out, and the deals are separated into the different stages of investments. Here, the seed stage level of investments is negatively affected by the pandemic, on a significant level. Even though not significant, the early stage of investments also reports a negative impact, but later stages have increased their investments during the coronavirus period. Fourth, an industry study is carried out. In line with the previous analysis, data is grouped into different categories, but this time by industry. With all the recent events, venture capitals may have had to adjust the allocation of the investment funds even by resorting more to industries that were thriving at the time of this pandemic. This latter study aims to track any shifts that ventures might have suffered to adjust to the new reality. Results indicate that investments in the healthcare industry increased during the pandemic. Contrariwise, the technology industry saw a decrease in the volume of investment received from venture capitals.

The remainder of this paper is organized as follows: Section 2 presents the literature review that is relevant for the resolution of this study, Section 3 explains the hypothesis formulated to complete the research, Section 4 describes the data set, Section 5 presents the empirical methods and results which are then discussed in Section 6. Finally, Section 7 concludes the study and section 8 delivers an outlook for future research along with the limitations for the execution of this paper.

2. Literature Review

Private equities have been increasing their impact on the global economy for the last three decades. Along with its importance, the literature related to this industry has been expanding. To begin with, this paper requires knowledge of the determinants that impact such businesses. Venture capital investments are influenced by numerous factors, which can either be endogenous or exogenous. Also, literature that relates past crisis periods with venture capitals should provide useful insight into possible outcomes from this study.

2.1 Macroeconomic determinants

Gompers and Lerner (1999) issued a working paper where they examine the determinants of venture capital fundraising in the U.S., from 1972 to 1994. The analysis covers macroeconomic, regulatory and performance factors. Results show that shifts in demand for venture capitals play

a critical role in their activity – higher GDP growth and R&D expenses have a positive impact on venture capital's level of investments. The authors also reach the conclusion that with lower tax rates on capital gains there is a greater quantity of venture capital raised. Reputation and fund performance are also highlighted as determinants that positively affect the fundraising. Results for regulation factors show that ERISA clarifications also had a meaningful positive impact on the industry.

Jeng and Wells (2000) used a sample of 21 countries, from all around the world, to study the impact of some macroeconomic indicators on the venture capital activity. Data for this research covers the years 1986-1995. The studied determinants included initial public offerings (IPO), GDP, market capitalization growth, labour market rigidities, accounting standards, private pension funds and government programs. Results indicate that IPOs are the strongest driver of the industry. While GDP and market capitalization growth were not found to be significant, private pension fund levels were a significant determinant over time. Government policies can also have a great strong impact on the venture capital activity.

Following the same analysis, Schertler (2003) published a paper that identifies the forces of venture capital activity in Western Europe countries from 1988 to 1998. The author separately examines early and later stages of investments. Evidence from this research shows that liquidity of stock markets, human capital endowment and labour market rigidities do not affect later stages of investments. On the other hand, early stage of investments is found to be positively affected by liquidity of stock markets, human capital endowment and labour market rigidities.

One year later, Romain and La Potterie (2004) studied the economic impact of venture capital. The data collected is composed of 16 OECD countries from 1990 to 2001, and it is used to study both the demand and supply of venture activity. The authors concluded that venture capital activity contributes significantly to growth, mainly through two channels. First, they are responsible for the introduction of new products and processes on the market. Second, these firms develop an improved absorptive capacity of the knowledge created by private and public research institutions. Empirical results also show that investment levels are positively affected by interest rates, R&D expenditures, GDP growth and the level of entrepreneurial activity. Labour market rigidities are found to be negatively correlated with venture capital investments – contradicting Schertler's (2003) results. As different countries and time series were used in both papers, this might have been the reason why these studies yielded different results.

Moreover, Kelly (2012) studied the drivers of private equity activity in 17 European countries. The author selected the period from 2003 to 2008, and separated the research into two different types of investors – venture capital and buyout investors. Furthermore, the determinants were grouped into two classes as well – structural and cyclical factors. On a combined level, both venture capitals and buyout investors are affected by market capitalization (positive relation), unemployment (negative relation), summary innovation index (positive relation) and tax and legal environment (negative relation). When the two types of funds are separated, the only significant venture capital determinants were unemployment and summary innovation index. Also, it is argued that market capitalization is not significant for venture capital activity because firms might not use IPO as a means of exit or, if they do, they follow the U.S. market. To conclude, both cyclical and structural factors affect venture capital activity.

More recently, Félix, Pires and Gulamhussen (2013) analyzed the determinants of the European venture capital market, expanding on the model by Jeng and Wells (2000). This time, the authors built a data set of 23 European countries for the period from 1992 to 2003. In addition to the determinants tested by Jeng and Wells (2000), the following were added: unemployment rate, trade sale divestment, and the price/book ratio. Empirical results confirm that two of the new determinants were significant in the European venture capital market – unemployment rate (negative relation) and trade sale divestments (positive relation). When explaining the trade sale divestment relation, it is suggested that this is the best exit option for European venture capital investments. As regards the macroeconomic determinants, evidence from this paper shows that GDP growth, R&D expenditures, IPO and interest rates have a positive impact on venture capital activity.

From the literature covered, there are several factors that can be related to venture capital activity as drivers that positively affect the activity – GDP growth, R&D expenditures, private pension funds, IPO, interest rates, and stock market capitalization. On the other hand, there are also drivers that are negatively correlated with the venture capital activity – unemployment, tax rates and labour market rigidities.

Given that the object of this study is a crisis period, macroeconomic indicators are highly influenced by measures taken by governments to mitigate the impacts of the COVID-19 outbreak. As a result of this relationship, the crisis variable would also analyze the effects of this macroeconomic shock on the venture capital investment amounts. Thus it would not make

sense to control for macroeconomic factors while analyzing a macroeconomic shock. The macroeconomic shock will be absorbed by the pandemic measures introduced in the models, which are furtherly explained.

2.2 Micro determinants

Micro determinants are made of firm, industry, and venture capital specific characteristics. As an example, Block and Sandner (2009) constructed the following control variables: first vs second or later round, investment consortium (more than one venture capital investing on the same round), strategic investor in investment consortium, business angel in investment consortium, firm age and industry dummies. Following the same approach, Breukers (2013) controls for venture capital experience, venture capital age, startup company age, round number, round amount, and seed/early/later stages of investment.

The Cumming et al. (2008) research supports the assumption that venture capitals adjust their investment decisions according to liquidity conditions of an IPO exit market. When comparing Europe to the United States, Giot and Schwenbacher (2007) indicate a difference in the exit market between regions. They argue that in Europe, the IPO market is less liquid than in the United States, leading to a better venture capital investment environment for the US-based firms. As Levine (2002) mentioned, the United States is a more market-based economy, while Europe countries are more bank-based, with the exception of the United Kingdom. Lavender, Moore and Smith (2020) reported that European venture capital firms were investing with a tremendous amount of caution by the end of the second quarter of 2020. Instead of being focused on investing more, the authors argue that European venture capitals are taking more time to conduct due diligence and commit to existing funds, lowering the level of investments. Rövenich (2020) published an article comparing venture capital activity among regions. Evidence shows that in early 2020 the United States was responsible for 41% of the ventures' investments against 27% accounted for in Europe. Having considered this, a variable concerning regions will be used to control for the discrepancies between Europe and the United States.

Other variables chosen for this study will be presented further, including a more detailed explanation of how they have been constructed.

2.3 Impact of the global financial crisis in venture capital's activity

The COVID-19 pandemic generated a major crisis in the world economy as it spread all over the world locking down countries and businesses. The last crisis with an impact of this scale on the economy was the 2008-2009 global financial crisis. While both crises have completely different causes, it is still important to understand similarities regarding financial and economic deterioration. Gunay (2020) studied the differences between both crises in foreign exchange markets and found that the turmoil generated by COVID-19 in April was not as bad as the global financial crisis period. Nevertheless, this pandemic is still ongoing, and updated data could produce different results. Roland Berger (2020) for example, provides an overview of both crises at an industry level, concluding that the pandemic is generating a more radical and abrupt effect, hitting many industries harder than the 2008 financial crisis.

Following this reasoning, for the sake of this research, it is important to highlight the existing literature on the impacts of the global financial crisis of 2008-2009 on private equities and venture capital activity. Block and Sandner (2009) measured the impact of the global financial crisis on the venture capital market through a dataset that comprises venture capital investments in U.S. Internet firms. Results indicate a 20% decrease in the average amount of funds raised per funding round. However, this decline is found to be significant only for later stages of investments. Block and Sandner (2009) argue that this reduction affects funding rounds at a later stage because firms in this stage could not avoid the reduction in the capital they needed to survive, whilst earlier stage firms could postpone their initial funding and expansion. Felizardo (2016), who did the same research for 20 European countries, also found that later stage investments were the most affected. While later stage funding rounds yielded a significant and negative reaction to the crisis, seed and early stage of investments did not show any significance for the period under analysis.

Bernstein et al. (2017) show how private equities envision crisis periods as an opportunity for growth. During the 2008/2009 crisis, private equity backed companies increased investments compared to their peers, along with equity and debt inflows. Consequently, after matching private equity backed companies with a control group of non-private equity backed companies, the authors show that private equity backed companies experienced higher asset growth and increased market share during the crisis. This research considers every private equity firm based in the United Kingdom, and the time period ranges from 2004 to 2011.

2.4 COVID-19's relevant measures and implications on venture capitals

Taking this literature into account, if the COVID-19 crisis proves to be in some way similar to the financial crisis of 2008, only later stages of investments are expected to show a negative impact. Nevertheless, as mentioned before, the crisis that we are experiencing is more abrupt from an industry perspective. Back in 2008, the major problem of fast-growing companies was that banks and other financial institutions could not raise capital, whilst venture capitals, with more resources, were apt to feed their investments (Bernstein et al., 2017). Today the U.S. government rapidly responded with a massive corporate credit market intervention raising a huge amount of debt, authorizing \$3.8 trillion in bailouts (Elenev et al., 2020). Moreover, the ECB announced the pandemic emergency purchase programme (PEPP). This plan consists of a €750 billion purchase programme, ensuring that this supportive financing would reach every sector of the economy (ECB, 2020) - companies without private equity support might have been able to accompany private equity backed firms. With this, it will be interesting to see how the attractiveness of investing during crisis changed for venture capitals. Mason (2020) argues that the coronavirus crisis will result in an immediate reduction in venture capital investments. The author highlighted China's situation, where venture capital deals dropped 50-57 percentage points in the first two months of 2020 compared to the rest of the world. His expectations for the rest of the world rely on a very similar picture of China's huge decrease in venture capital activity. Moreover, Gompers et al. (2020) surveyed over 1,000 venture capital firms to see how the COVID-19 pandemic impacted their decisions and investments. Results show that venture capitals have slowed their investment pace by 29% and reported a 1.6% decrease in the internal rate of return. The paper concludes that the venture capital industry has been more resilient to the pandemic than other sectors of the economy, and has had a smaller reduction in its activity than in previous crises.

Within all the consequences of the arrival of the virus, we must not forget to mention uncertainty and fear factors. Barrios and van der Wielen (2020) created a model that estimates the economic anxiety within the European Union (E.U.) countries based on the intensity of Google searches on remote working, recession unemployment, and unemployment benefit. Results show that the intensity of online searches spiked with the announcement of the first positive case. Even though people reacted to the first positive case, the peak of searches was witnessed 6 weeks after. In most cases, the peak is linked with the beginning of confinement, which made people worry about their jobs. Lyócsa et al. (2020) constructed a very similar

model for the United States. This time, the American society only began to intensify the COVID-19 related searches in March, accompanied by the peak that was reported on market uncertainty (VIX) and the crash of the S&P 500 (Lyócsa et al. 2020). Despite the late reaction, Americans relate to Europeans as the peak emerges with the lockdowns (see appendix A and B).

For the purpose of this paper, investments will be studied on an industry level as well. The COVID-19 crisis affects industries in different ways, with some thriving or even accelerating, while others faced damaging hits. Chandna (2020) explains that some industries – e-commerce, media and gaming, video conferencing, public cloud, cybersecurity and health tech – are enjoying growth revenues, against others – live events, restaurants, physical retail, travel and hospitality, real estate, I.T. services.

3. Hypotheses

Considering the literature presented above, several hypotheses are formulated. This research is based on a database that provides data for all country deals. We will study the coronavirus pandemic's impact on both European countries and the United States, which is by itself the most influential country in the venture capital industry. That being said, the first hypothesis is drawn:

Hypothesis 1: The COVID-19 pandemic negatively affects Venture Capital's Activity.

The main goal of the 1st hypothesis is to test, for all European countries and the USA, if the investment level of venture capitals has a negative relationship with the economic environment emerging from the coronavirus pandemic.

European countries and the United States had a very different reaction to the onset of the COVID-19 pandemic. Moreover, evidence from the literature covered shows that the United States has a stronger venture capital market, which could also prevent firms from suffering from the crisis. This leads us to believe that the impact of the coronavirus is potentially different between regions. Thus the 2nd hypothesis is formulated:

Hypothesis 2: The COVID-19 pandemic affects the venture capital's activity more in Europe than in the United States

With this hypothesis, the goal is to test if the assumption – Europe's venture capital market is weaker than the United States – holds for the venture capital's activity. Expectations for this test are built on this assumption. American firms are expected to have more resources, shielding them from lowering their investments as much as European firms.

After studying the impact of the coronavirus crisis on a broader scale, a more investment-specific question arises. Is the impact of the COVID-19 pandemic equally strong for different stages of investments? Previous research, mentioned in the literature review, covered this proposition and earlier results showed that each stage of investment reacts differently to an economic crisis. Therefore, we formulate the 3rd hypothesis, in an attempt to track any different effects among each type of investment stages i.e. seed, early and later.

Hypothesis 3: The COVID-19 pandemic affects the venture capital's activity more in the later stage than in the early and seed stage of investments.

Given the researched literature, we can predict that later stages of investments would be more affected by the coronavirus crisis than the seed and early stages. Nevertheless, this crisis has a different nature and there might be some different outcomes from the previous research. The expectations for this hypothesis are that the later stage of investment is affected in a higher magnitude than the others, and it can also be the case where even the signal differs.

The economic environment brought about by the coronavirus pandemic is affecting industries in a very exogenous way. While some industries are enjoying huge growth in revenues, others are suffering because they are not even allowed to keep working. In short, the recent events changed the whole perspective of some industries. As venture capitals invest in emerging businesses, it is important to see to what extent these firms are reacting to this new reality. In an attempt to answer some of these open questions, the 4th hypothesis is formulated:

Hypothesis 4: The COVID-19 pandemic increases venture capital's investment levels on the healthcare industry and decreases in the technology industry.

With all the work that has been done remotely, the hurdles that emerged are countless and many startups were created to tackle those problems (More, 2020). The main goal of building this fourth and last hypothesis is to capture any of these possible shifts of interest from venture

capital investors to adjust to the new trends. Expectations for this study are in line with the articles presented before and, for the sake of effectiveness, the main industries of interest have been chosen conditional on investment amounts.

4. Data

4.1. Data Description

As mentioned before, the focus of this research is to study the impact of the coronavirus pandemic environment on the venture capital industry. To test the hypotheses, we require a wide range of data on deals and firm characteristics. In this section, all the data for the execution of this paper will be described.

Regarding the hypotheses described in the last section, the dependent variable for the models further constructed will reflect the volume of venture capital's activity. In line with previous literature, the dependent variable used for the regressions is the equity invested by $Firm_t$ at $time_i$, retrieved from Thomson Reuters Eikon – Deal Screener. The unit of analysis for the models applied is the deal established by each venture capital firm – $Firm_{t,i}$. It is possible that different firms invest in the same company during the same funding round (investment consortium). The data was extracted in October 2020 and it comprises every venture capital deal from January 2019 to September of 2020, with the dolar as the currency for every deal. The deals from firms based on the following 36 countries were matched: Austria, Belgium, Bulgaria, Channel Islands, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Gibraltar, Greece, Hungary, Iceland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, Netherlands, Norway, Poland, Portugal, Republic of Ireland, Romania, Russian Federation, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States of America. For the purpose of this study, all European countries are treated as the same region (Europe), and the United States as a different region. The entire dataset amounts to 13,912 deals, relating to 10,625 funding rounds. From the entire list of deals, 8,573 concern venture capital firms based in the United States and 5,339 relate to venture capitals from the European countries listed above. Finally, the Kurtosis of the variable *Equity invested by $Firm_{t,i}$* would be 701, which indicates a strong non-normal distribution. Also, the sample presented critical outliers that could negatively bias the results. To prevent these

distortions, the variable used in the entire research is the logarithm of base 10 from the amount of equity invested by $Firm_{t,i}$. The logarithm function has the effect of making larger values from the sample less extreme (Principals of Econometrics, 2011, p. 152). Thus, not only do the outliers become less significant, but it also turns the variable closer to a normal distribution.

Furthermore, to test the third hypothesis, the dependent variable is filtered to the required segments. As the different stages of investment are included within the scope of study, the dependent variable for each regression will be as follows:

- Seed: Equity invested by $Firm_{t,i}$ in companies at the first funding round
- Early: Equity invested by $Firm_{t,i}$ in companies at the second or third funding round
- Later: Equity invested by $Firm_{t,i}$ in companies at fourth funding round or later

The same method was applied to the fourth hypothesis, but this time subject to the industries to which the investment companies belong.

Secondly, an explanatory variable had to be created. The main goal of this study is to understand how the economic environment resulting from the virus is affecting venture capital's investments. The pandemic forced many countries to lockdown, freezing the economy for a while. With the confinement, there was a drop of consumption and labour supply, increasing unemployment. Consequently, production intensity slows down and the growth of the economy is negatively affected. All these factors together generate a macroeconomic shock, which is strongly correlated with the time of the lockdowns¹. When accounting for the fear and uncertainty, the peak is also registered at the start of the lockdown period. Accordingly, the criteria for the construction of the explanatory variable will be the beginning of confinement in each country². The sample is split into two groups, and the COVID-19 variable signals if the deal took place before or after the beginning of the confinement:

- The COVID-19 variable is a dummy, which takes the value of 1 for every deal that took place after the first lockdown of its respective region, and 0 otherwise.

Finally, this leads us to independent variables other than the COVID-19 crisis, added to control for influences on the dependent variable. The control variables are: region, round number, first round dummy, number of firms investing in funding round, age of company receiving venture capital funding, age of venture capital firm, and industry dummies (Table 1).

¹ Appendix C and D show the GDP and unemployment shock, recorded on the 2nd quarter of 2020

² Appendix E displays the considered dates for each country

Table 1: Variable description

Variables	Description
Dependent Variables:	
Equity invested	The Log10 of the total Equity amount invested by $Firm_{t,i}$
Independent Variables:	
COVID-19	Dummy variable indicating whether the investment takes place before the COVID-19 pandemic environment (0) or after (1)
COVID-19*Region	Interaction variable, multiplication between COVID-19 and region dummy variables
Control Variables:	
Region Dummy	Dummy variable indicating whether the venture capital is from Europe (0) or from the United States (1)
Round Number	The number of times the company has received venture capital funds, at funding date
First Round	Dummy variable indicating whether the deal is relative to a first funding round
Number Firms	Number of firms participating in the same funding round, for the same company
Company Age	The log10 of the age from the company receiving venture capital funding
VC Age	The log10 of the age from the venture capital firm involved in the deal
Industry Dummy	Dummy variable indicating to which of the 10 industry categories the company belongs

'Region' is a dummy variable that takes the value 1 for investments when the venture capital firm is American and 0 for European venture capital firms. 'Round number' is the number of the funding round, and ranges from 1 to 35. A dummy was created to control for the first funding round, given the significance of this specific round. It takes the value of 1 for deals made on the first funding round, and 0 otherwise. As mentioned before, several firms can participate in the same funding round, taking the name of the respective investment consortium. To control for this effect that knowingly influences the amount invested by firms, a variable is added with the number of firms participating in the same investment round of the same company. The variables 'Age of company receiving venture capital' and 'Age of venture capital firm' were normalized. For both variables reporting ages, the logarithm of their respective value is applied. The industry dummies control for the industry of the company invested by the venture capital firm. There are 10 industry dummies that are determined by the Thomson Reuter Business Classification (TRBC) – Business Sector³. Table 1 summarizes the variables described above.

³ The following link describes the 10 business sectors of TRBC - https://en.wikipedia.org/wiki/The_Refinitiv_Business_Classification

4.2. Descriptive Statistics

A first look at the statistics in Table 2 – Panel A shows us that the mean investment level for deals before the beginning of confinement is slightly higher than the deals managed thereafter. Given the fact that we are looking at the logarithm of the equity invested, even a small difference could be proven significant. When looking at regions alone (Panel B and C), Europe also shows a decrease in the average investment amount, while the deals from the United States do not present any changes throughout the period of analysis. In line with the literature presented, the average amount invested in a deal managed by American firms is higher than the deals from European firms. Moreover, American deals have a higher standard deviation, meaning that the investment amounts are more dispersed than in Europe.

The first conclusion that we can reach from the control variables is that both regions present comparable firm characteristics, meaning that firms are similar among regions. Nevertheless, it is still worth mentioning that in Europe the mean of round number is lower than in America. The difference is not explained by the intensity of seed stage investments, as both regions have around 40% of the investments related to the first funding rounds. The explanation might be found in the fact that American venture capital firms go further in the investment stages than European firms. As for the number of firms, European firms show a higher syndication level than the American ones. Besides this, European firms decreased the investments related to first funding rounds by 6pp after the pandemic. Manigart et al. (2002) argue that the syndicate size among the European venture capital industry is driven by financial motives, contrasting with the American industry, which implies risk reduction or other strategic reasons. The time period captures a crisis, so it is possible that European firms resorted more to syndication than the American ones, resulting in a higher average number of firms participating in a deal.

Table 2: Descriptive statistics – 'Mean Before' stands for the mean of every deal that took place before the 'COVID-19' variable turns 1 and 'Mean After' stands for every deal that took place after the variable turns 1. Every statistic reported as a percentage is relative to the total number of deals.

Panel A - All					
Variables	Obs	Mean	StDev	Mean Before	Mean After
Dependent Variables:					
Equity invested (log10)	13912	6.68	0.70	6.69	6.67
Control Variables:					
Region Dummy (in %)	13912	61.62	49.00	63.21	58.08
Round Number	13912	2.76	2.50	2.75	2.78
First Round (in %)	13912	39.23	48.83	39.84	37.86
Number Firms	13912	3.38	2.47	3.30	3.58
Company Age	13912	1.77	0.20	1.77	1.77
VC Age	13912	3.63	0.57	3.63	3.62
Industries:					
Basic Materials (in %)	13912	1.00	10.00	1.03	1.11
Consumer Cyclicals (in %)	13912	5.00	22.00	5.48	4.02
Consumer Non-Cyclicals (in %)	13912	7.00	25.00	6.56	6.75
Energy (in %)	13912	0.50	6.00	0.46	0.28
Financials (in %)	13912	5.00	22.00	5.33	4.81
Healthcare (in %)	13912	17.00	37.00	16.25	17.83
Industrials (in %)	13912	9.00	29.00	9.15	9.17
Technology (in %)	13912	55.00	50.00	54.80	54.90
Telecommunications Services (in %)	13912	0.40	7.00	0.46	0.44
Utilities (in %)	13912	0.20	5.00	0.31	0.16
Panel B - Europe					
Variables	Obs	Mean	StDev	Mean Before	Mean After
Dependent Variables:					
Equity invested (log10)	5339	6.54	0.60	6.55	6.52
Control Variables:					
Round Number	5339	2.56	2.14	2.52	2.64
First Round (in %)	5339	40.00	49.00	41.32	35.83
Number Firms	5339	3.83	2.56	3.74	4.00
Company Age	5339	1.76	0.29	1.76	1.76
VC Age	5339	3.60	0.53	3.62	3.59
Panel C - United States of America					
Variables	Obs	Mean	StDev	Mean Before	Mean After
Dependent Variables:					
Equity invested (log10)	8573	6.77	0.74	6.77	6.77
Control Variables:					
Round Number	8573	2.88	2.69	2.89	2.87
First Round (in %)	8573	39.00	49.00	38.97	39.33
Number Firms	8573	3.11	2.37	3.04	3.27
Company Age	8573	1.77	0.12	1.78	1.77
VC Age	8573	3.64	0.59	3.64	3.64

Supporting this idea, we can see that both regions increased the average number of firms involved in a deal after the beginning of the lockdowns. Finally, data on industries is consistent with the expectations, with technology (55%) and healthcare (17%) being the ones in which venture capitals invest more. If we look at the values within periods, there were more investments in the healthcare industry after the coronavirus event than before, as both regions present a 2pp increase. The technology industry also received more investments by European firms, but American firms invested less in technology companies after the COVID-19. A complete version of panel B and C from table 2 is presented in the appendixes⁴.

Finally, Table 3 presents a summary of the correlation matrix from the variables included in the models. The complete version of this table is on the appendix. From the first column we can see that the COVID-19 variable negatively correlates with the dependent variable (-0.02). The rest of the variables, excluding the first round, have a positive correlation with the equity invested by firm. Judging by these values, it is fair to say that first investment rounds tend to involve less equity invested, and that this amount is expected to increase as the round increases. Concerning the correlations between control variables, there are some variables that show high correlation. To prevent multicollinearity, variance inflation factors (VIF) are calculated for all variables. Results for VIF are displayed in table 3. James et al. (2017) argue that the maximum value of a VIF should not be higher than “5”, being “1” the lowest. The low values of VIF suggest that multicollinearity should not be an issue in this investigation.

Table 3: Correlations and VIF's – This table presents the correlations between each variable and the dependent variable in the second column. The third column regards the variable's correlations with the explanatory variable. The last column displays the variance inflation factors (VIF) for each independent variable.

	Equity invested (log10)	COVID-19	VIF
Equity invested (log10)	1		
COVID-19	-0.02	1	1
Region Dummy	0.16	-0.14	1.03
Round Number	0.23	0.01	1.51
First Round	-0.28	-0.03	1.52
Number Firms	0.24	0.06	1.09
Company Age	0.14	0.02	1.07
VC Age	0.15	-0.01	1.06

⁴ Industry's statistics relative to European and American firms are described in appendix F and G (respectively)

5. Empirical Methods and Results

To test the validity of the hypotheses presented before, several models are tested. In this section, the models applied will be explained along with the results for each hypothesis. All models presented below are reported as robust standard errors to prevent a possible presence of heteroskedasticity (Principles of Econometrics, 2011, p. 318). Concerning multicollinearity, VIF tests were run through all models to make sure results are robust.

First Hypothesis: *The COVID-19 pandemic negatively affects the venture capital's activity.*

The following base regression is built with the dependent variable being the amount invested by the venture capital firm and the variable of interest being COVID-19, described above.

$$Equity.Inv_{i,t} = \alpha + \beta_{1,t}COVID_19 + \varepsilon$$

The dependent variable was modified to the log10 of its original value to be treated as normally distributed and to diminish the outliers' significance. After building this base regression, control variables are added on the model to see if the results are robust. 'Region Dummy' is only introduced on a second model to make sure this variable was not absorbing other country specific factors and creating a bias on the results.

$$Equity.Inv_{i,t} = \alpha + \beta_{1,t}COVID_19 + \beta_{2,t}RoundNumber + \beta_{3,t}FirstRound + \beta_{4,t}NumberFirms + \beta_{5,t}CompanyAge + \beta_{6,t}VC.Age + \beta_{7,t}IndustryDummies + \varepsilon$$

$$Equity.Inv_{i,t} = \alpha + \beta_{1,t}COVID_19 + \beta_{2,t}RegionDummy + \beta_{3,t}RoundNumber + \beta_{4,t}FirstRound + \beta_{5,t}NumberFirms + \beta_{6,t}CompanyAge + \beta_{7,t}VC.Age + \beta_{8,t}IndustryDummies + \varepsilon$$

Table 4: COVID-19 and the total level of investments in venture capitals – For all models presented in this table, standard errors are robust and clustered by firms. The dependent variable for Model I and II is the log10 of the Equity invested. The p-values are presented in parenthesis: * $p \leq 0.10$; ** $p \leq 0.05$; *** $p \leq 0.01$; two-sided tests employed.

Variables	Model I (OLS)			Model II (OLS)		
	Log10(Equity invested)			Log10(Equity invested)		
	β (p-value)			β (p-value)		
COVID-19	-0.0241	(0.038)	**	-0.0248	(0.029)	**
Region dummy				0.2633	(0.000)	***
Round number	0.0223	(0.000)	***	0.0177	(0.000)	***
First round	-0.2470	(0.000)	***	-0.2541	(0.000)	***
Number firms	0.0512	(0.000)	***	0.0594	(0.000)	***
Company age	0.2924	(0.000)	***	0.2865	(0.000)	***
VC age	0.0804	(0.000)	***	0.0697	(0.000)	***
Industry dummies	YES			YES		
Constant	5.7001	(0.000)	***	5.573	(0.000)	***
Observations	13912			13912		
F-test	$p < 0.001$			$p < 0.001$		
R ²	0.1413			0.173		
Skewness (Kurtosis)	-0.32 (3.91)			-0.32 (3.91)		

Judging by the models I and II, the variable COVID-19 has a negative effect on the venture capital activity (at a 5% significance level). Looking only at coefficients, we can say that, on average, the venture capital investment level experienced a decrease of around 2.5 percent due to the macroeconomic shock plus the fear and uncertainty generated by the coronavirus pandemic. Results are consistent with or without the region fixed effects.

For the control variables, results show a powerful relationship with the dependent variable. 'Region dummy' is controlling for country fixed effects. To make sure results were robust, this variable was not introduced in the first model. When introduced in model II, it shows a positive relationship at a 1% significance level, which is consistent with the summary statistics, where we can see that deals involving American venture capital firms are, on average, of a larger amount than in Europe. The coefficient of this variable is huge, and the interpretation that we can take from it is that, on average, the investment amount of an American firm deal is 26.33% higher than a European one. Furthermore, the variables 'Round number' and 'First round' show that investments tend to be of a higher amount as the funding round increases. The 'Number of firms' show a positive relationship in the dependent variable as well, meaning that as the number of firms involved in a deal increases, the amount invested by each firm is also expected to be higher. A possible explanation for this might be the share of risk, which reduces individual risk

and might allow firms to invest a higher amount. Interpreting the coefficient, as the number of firms in a deal increases by 1, the amount invested by each firm would increase by 5.94% (Model II), at the 1% significance level. Lastly, both variables addressing the ages of the entities participating on a deal are proven to positively affect the dependent variable, at the 1% significance level. Therefore, the control variables are all significant and with the expected signs.

In short, the COVID-19 variable shows a negative relationship with the amount invested by venture capitals, and coefficients are significant at a 5% level – the coronavirus crisis seems to have a significant negative impact at the level of venture capital investments. We can therefore accept the first hypothesis.

Second Hypothesis: *The COVID-19 pandemic affects the venture capital's activity more in Europe than in the United States*

Now we want to test the relationship between the COVID-19 variable and the investment amount of venture capital deals within regions. To test this hypothesis, three models are constructed. The sample is split into European deals and American deals. This will lead us to the first and the second model, where an OLS regression is run for each region. Lastly, the third model is constructed with the entire data from the European and American deals, but the variable COVID-19*Region is introduced. In the third model, β_3 will be the term we are interested in. It will determine how much the treatment group (American deals) changes compared to how much the control group (European deals) changes after the treatment event (COVID-19). The equations for the regressions of the three models are presented below.

$$Equity.Inv_{i,t} (only Europe) = \alpha + \beta_{1,t}COVID_19 + \beta_{3,t}RoundNumber + \beta_{4,t}FirstRound + \beta_{5,t}NumberFirms + \beta_{6,t}CompanyAge + \beta_{7,t}VCAge + \beta_{8,t}IndustryDummies + \epsilon$$

$$Equity.Inv_{i,t}(only America) = \alpha + \beta_{1,t}COVID_19 + \beta_{2,t}RoundNumber + \beta_{3,t}FirstRound + \beta_{4,t}NumberFirms + \beta_{5,t}CompanyAge + \beta_{6,t}VC.Age + \beta_{7,t}IndustryDummies + \epsilon$$

$$Equity.Inv_{i,t} (All) = \alpha + \beta_{1,t}COVID_19 + \beta_{2,t}RegionDummy + \beta_{3,t}Region * COVID_19 \\ + \beta_{4,t}RoundNumber + \beta_{5,t}FirstRound + \beta_{6,t}NumberFirms + \beta_{7,t}CompanyAge + \\ \beta_{8,t}VC.Age + \beta_{9,t}IndustryDummies + \epsilon$$

Table 5: COVID-19 and the level of investments in Europe and America separately - For all models presented in this table standard errors are robust and clustered by firms. The dependent variable in Model I is the log10 of the equity invested by European firms, in Model II is the log10 of the equity invested by American firms, and in Model III is the log10 of the equity invested by both European and American firms. The p-values are presented in parenthesis: * $p \leq 0.10$; ** $p \leq 0.05$; *** $p \leq 0.01$; two-sided tests employed.

	Model I (OLS)		Model II (OLS)		Model III (OLS)	
	Sample I: European Deals		Sample II: American Deals		Sample III: All deals	
	Log10(Equity invested)		Log10(Equity invested)		Log10(Equity invested)	
Variables	β (p-value)		β (p-value)		β (p-value)	
COVID-19	-0.0370	(0.022)**	-0.0170	(0.269)	-0.0514	(0.002)***
Region Dummy					0.2489	(0.000)***
Region*COVID-19					0.0431	(0.055)*
Round Number	0.0390	(0.000)***	0.0138	(0.000)***	0.0177	(0.000)***
First Round	-0.2460	(0.000)***	-0.2581	(0.000)***	-0.2548	(0.000)***
Number Firms	-0.0019	(0.559)	0.1005	(0.000)***	0.0594	(0.000)***
Company Age	0.2231	(0.000)***	0.3706	(0.000)***	0.2859	(0.000)***
VC Age	0.0754	(0.000)***	0.0719	(0.000)***	0.0695	(0.000)***
Industry Dummies	YES		YES		YES	
Constant	5.8748	(0.000)***	5.5613	(0.000)***	5.5881	(0.000)***
Observations	5339		8573		13912	
F-test	p<0.001		p<0.001		p<0.001	
R ²	0.154		0.195		0.174	
Skewness (Kurtosis)	-0.27 (5.01)		-0.46 (3.67)		-0.32 (3.91)	

Starting the analysis by looking at model I, the COVID-19 variable seems to affect European firms' level of investments. The amount invested in deals made throughout the coronavirus period is expected to be 3.70% lower than before the virus, on average, at a 5% significance level. The control variables show a strong relationship with the dependent variable and the expected signs, except for the 'Number of firms'. Interestingly, this variable does not seem to significantly impact the amount invested by European venture capitals. The reason might be that European firms do not take the number of firms investing in the same funding round as

criteria for the amount being invested (e.g. European firms might have a set value independently of the number of firms investing).

When looking at Model II, the explanatory variable is also negative but loses significance. American venture capitals did not reduce the amount invested due to the macroeconomic shock and the uncertainty induced by the pandemic, at a significant level. Nevertheless, it is important to mention that the variable addressing the number of firms is significant this time. On average, as the number of firms participating in a funding round increases by 1, the amount invested by an American firm would increase by 10.05%, at the 1% significance level.

Finally, Model III presents a Difference-in-Difference (DiD) approach, implemented through OLS regression. Results for this model show what was suggested by Models I and II. The impact of the pandemic on the investment levels is higher in Europe than in America. The DiD estimator shows that European firm deals are more negatively affected by the pandemic than American firm deals. The impact is 4.31% stronger in Europe, at the 10% significance level.

To wrap up, the influence of the factors absorbed by the COVID-19 pandemic on the investment amounts seems to be higher in European firms than in American firms. With the results in line with what was expected, the second hypothesis is accepted.

Third Hypothesis: *The COVID-19 pandemic affects the venture capital's activity more in the later stage than early stage of investments.*

The third hypothesis is intended to study the impact of the variable COVID-19 crisis at the different stage levels. To make this possible, three separate equations are constructed where the dependent variables are: Equity Invested by Firm on a Seeding round (1st round); Equity Invested by Firm on an Early round (2nd or 3rd round); and Equity Invested by Firm in a later round (later than 3rd round). The following equations present the base regressions constructed for this hypothesis.

$$Equity.Inv.Early_{i,t} = \alpha + \beta_{1,t}COVID_19 + \varepsilon$$

$$Equity.Inv.Seed_{i,t} = \alpha + \beta_{1,t}COVID_19 + \varepsilon$$

$$Equity.Inv.Later_{i,t} = \alpha + \beta_{1,t}COVID_19 + \varepsilon$$

The dependent variables of the three regressions are normalized by the log10 function, as explained before. The first hypothesis approach is applied here, except for the control variables addressing the funding rounds – Number Round and First Round. The final equations for the third hypothesis are presented below.

$$Equity.Inv.Seed_{i,t} = \alpha + \beta_{1,t}COVID_19 + \beta_{2,t}RegionDummy + \beta_{3,t}NumberFirms + \beta_{4,t}CompanyAge + \beta_{5,t}VC.Age + \beta_{6,t}IndustryDummies + \varepsilon$$

$$Equity.Inv.Early_{i,t} = \alpha + \beta_{1,t}COVID_19 + \beta_{2,t}RegionDummy + \beta_{3,t}NumberFirms + \beta_{4,t}CompanyAge + \beta_{5,t}VC.Age + \beta_{6,t}IndustryDummies + \varepsilon$$

$$Equity.Inv.Later_{t,i} = \alpha + \beta_{1,t}COVID_19 + \beta_{2,t}RegionDummy + \beta_{3,t}NumberFirms + \beta_{4,t}CompanyAge + \beta_{5,t}VC.Age + \beta_{6,t}IndustryDummies + \varepsilon$$

Table 6: COVID-19 and the level of investments on different stages of funding rounds - For all models presented in this table standard errors are robust and clustered by firms. The dependent variable in Model I is the log10 of the equity invested in seed funding rounds, in Model II is the log10 of the equity invested in early funding rounds, and in Model III is the log10 of the equity invested in later funding rounds. The p-values are presented in parenthesis: * $p \leq 0.10$; ** $p \leq 0.05$; *** $p \leq 0.01$; two-sided tests employed.

	Model I (OLS) Sample I: Seed Rounds Log10(Equity invested) β (p-value)		Model II (OLS) Sample II: Early Rounds Log10(Equity invested) β (p-value)		Model III (OLS) Sample III: later Rounds Log10(Equity invested) β (p-value)	
COVID-19	-0.0523	(0.003)***	-0.0108	(0.548)	0.0028	(0.911)
Region Dummy	0.2084	(0.000)***	0.2678	(0.000)***	0.3459	(0.000)***
Number Firms	0.0353	(0.000)***	0.0595	(0.000)***	0.0783	(0.000)***
Company Age	0.2634	(0.000)***	0.3573	(0.000)***	0.1962	(0.011)**
VC Age	0.0668	(0.000)***	0.1063	(0.000)***	0.0416	(0.144)
Industry Dummies	YES		YES		YES	
Constant	5.4693	(0.000)***	5.6667	(0.000)***	5.3376	(0.000)***
Observations	5457		4959		3496	
F-test	$p < 0.001$		$p < 0.001$		$p < 0.001$	
R ²	0.100		0.105		0.130	
Skewness (Kurtosis)	-0.19 (4.31)		-0.50 (4.57)		-0.75 (4.50)	

Starting the analysis on the seed stage of investments (Model I), the results show that the impact of the COVID-19 variable is significant at the 1% confidence level. This variable's impact is negative, meaning that the amount invested in the first rounds decreased by 5.23% due to the environment brought by the pandemic. When looking at Models II and III, the pandemic period does not seem to impact the investment levels at the early and later stages of investments, at a significant level. The coefficient is positive for later stages of investments (Model III), but nothing can be implied based on these results because they are statistically insignificant.

'Region dummy' shows a strong relationship with the dependent variable again, and the coefficient does not differ a lot from the results provided in table 4, even though when analyzing later stages of investments (Model III) we can see that the coefficient for 'Region dummy' is higher than in any other model. The interpretation is that, when looking only at later funding rounds, the investment amount of an American firm deal is 34.59 % higher than a European one. This result is consistent with what has been discussed in the summary statistics, where it is stated that American venture capital firms go further in the investment stages than European firms. If we look at the three models simultaneously (I, II, and III), the variable 'Number of firms' also provides some interesting results. The sign is again positive, as expected, and it is significant at the 1% significance level. Also, a trend can be seen regarding this variable, as it increases with funding stages. From the results provided, we could say that for later stages of investment, the influence from the number of firms on the investment amount is expected to be higher (increasing coefficient). Furthermore, results on the variable addressing the age of venture capitals show that this factor's importance is not significant for later stages of investments. When investing in a later funding round, venture capital age does not appear to impact the firm's amount invested. Still, both coefficients addressing ages are higher at the early stages of investment, meaning that the age factor is more determinant on deals relating to 2nd or 3rd funding rounds.

To conclude, the testing of the third hypothesis yielded different results for each stage of investment. The seed stage is negatively affected by the COVID-19 crisis (at a 1% level), while early and later stages are not. Therefore, we reject the hypothesis that the impact of COVID-19 is higher on later stages of investment.

Fourth hypothesis: *The COVID-19 pandemic increases venture capital investment levels in the healthcare industry and decreases in the technology industry.*

To develop the fourth and last hypothesis of this paper, the first step is to isolate the deals by industry category. After obtaining the data for each industry under study, the log10 function is applied to the investment amounts, just as before. For the sake of brevity, the only industries that are going to be presented in this section are technology and healthcare. The selection criterion was the impact on the venture capital industry, and these are the industries where venture capital firms allocate the majority of the investment funds (72% overall). The base regressions for this hypothesis require two separate models, being the dependent variable the amount invested by a firm in a company from the technology industry (model I) and the healthcare industry (model II).

$$Equity.Inv.Technology_{i,t} = \alpha + \beta_{1,t}COVID_19 + \epsilon$$

$$Equity.Inv.Healthcare_{i,t} = \alpha + \beta_{1,t}COVID_19 + \epsilon$$

The control variables are added further on to control for the factors that are known to influence the dependent variable, leading to the final equations:

$$Equity.Inv.Technology_{i,t} = \alpha + \beta_{1,t}COVID_19 + \beta_{2,t}RegionDummy + \beta_{3,t}Round.Number + \beta_{4,t}First.Round + \beta_{5,t}NumberFirms + \beta_{6,t}CompanyAge + \beta_{7,t}VC.Age + \epsilon$$

$$Equity.Inv.Healthcare_{i,t} = \alpha + \beta_{1,t}COVID_19 + \beta_{2,t}RegionDummy + \beta_{3,t}Round.Number + \beta_{4,t}First.Round + \beta_{5,t}NumberFirms + \beta_{6,t}CompanyAge + \beta_{7,t}VC.Age + \epsilon$$

Table 7: COVID-19 and the total level of investments by industries - For all models presented in this table standard errors are robust and clustered by firms. The dependent variable in Model I is the log10 of the equity invested in the technology industry, and in Model II is the log10 of the equity invested in the healthcare industry. The p-values are presented in parenthesis: * $p \leq 0.10$; ** $p \leq 0.05$; *** $p \leq 0.01$; two-sided tests employed.

Variables	Model I (OLS)			Model II (OLS)		
	Sample I: Technology Log10(Equity invested)			Sample II: Healthcare Log10(Equity invested)		
	β (p-value)			β (p-value)		
COVID-19	-0.0477	(0.001)	***	0.0564	(0.034)	**
Region dummy	0.2731	(0.000)	***	0.3111	(0.000)	***
Round number	0.0315	(0.000)	***	-0.0083	(0.120)	
First round	-0.2664	(0.000)	***	-0.0742	(0.023)	**
Number firms	0.0608	(0.000)	***	0.0851	(0.000)	***
Company age	0.4175	(0.000)	***	-0.0174	(0.777)	
VC age	0.0913	(0.000)	***	0.0491	(0.050)	**
Constant	5.2342	(0.000)	***	6.1563	(0.000)	***
Observations	7625			2329		
F-test	$p < 0.001$			$p < 0.001$		
R ²	0.208			0.166		
Skewness (Kurtosis)	-0.28 (3.79)			-0.68 (3.97)		

Table 7 shows us that the variable COVID-19 has a negative relationship with the amount invested in technology companies (Model I). The coefficient is significant at a 1% level, and the interpretation is that, when investing in technology companies, venture capitals reduced the amount invested by 4.77%, on average. Results are consistent with the literature presented. Just as for the last hypotheses, control variables show a very strong impact on the dependent variable for the 1st model applied in table 7. The signs of these variables are as expected and consistent with previous results. All coefficients are significant at a 1% level.

Lastly, model II indicates that the variable COVID-19 has a positive impact on the amount invested by venture capital firms in the healthcare industry. Looking at the explanatory variable, the coefficient is significant at a 5% level, explaining a 5.64% increase in the amount invested in the healthcare industry during the pandemic period. The variables' Region dummy', 'First round', 'Number firms' and 'VC age' show the expected signs and are almost all significant at a 1% level. As for the variable 'Round number', results contradict what was seen in previous results. This time, the coefficient is negative, meaning that a lower amount of investment is expected at later stages of investment. The reason behind this change is possibly due to industry-specific effects; nevertheless, it is statistically insignificant. The same applies to

'Company age', where the coefficient is the opposite as for other hypotheses, though it is also insignificant.

To sum up, the effect of the COVID-19 variable is successfully tested on the dependent variable, at an industry level. The main takeaway from this hypothesis is that the variable of interest can impact the venture capital industry in different ways and magnitudes when selecting different industries. As such, the fourth hypothesis is accepted – the COVID-19 pandemic increases the healthcare industry's investment amounts and decreases in the technology industry.

6. Discussion of results

Starting with the explanatory variable, results show that COVID-19 variable has a negative impact on the overall venture capital level of investments. Considering early literature on the global financial crisis, venture capitals should not significantly decrease the raised amounts. Still, just as Chandna (2020) pointed out, this crisis has a more abrupt impact on some industries, which could be the reason for these results. Concerning the control variables, the first hypothesis's results show that its relationship with the dependent variable is strong and significant. The sign of the coefficients is also in line with what was expected – American firms invest higher amounts; as the round number increases, so does the amount invested; as the number of firms participating in a deal increases, so does the amount invested; and that the older the companies involved, the higher the amount invested.

While the negative impact holds significant for European countries, American firms do not present a significant negative impact on the amounts raised throughout the pandemic. Supporting this outcome, the DiD model also suggests that European firms decreased their investments at a higher level than American firms, and results were significant. Concerning this hypothesis, results are in line with our expectations, which were built on the assumption that the American venture capital market is stronger than the European one. This business model was crafted in the United States and, since then, it has been the region with the most influence on the industry. A more developed market might have helped American ventures to hold more resources and keep the investment levels, even throughout the pandemic. All the determinants affecting investments held significant except for the 'Number of firms' in the European market. In Europe, syndication among venture capitals is driven by financial motives (Manigart et al.,

2002). Therefore, it is fair to expect that the amount invested by European firms would not increase with an investment consortium. Also, it is still worth mentioning that financial constraints are even more significant, given the fact that we are analyzing a crisis period.

When looking at different stages of investments, results contradict the literature on the global financial crisis. This time, the seed stage of investments was the most affected. This hypothesis's expectations were formulated based on previous works, but this analysis' outcomes can have a possible justification. First, if we consider the supply of venture capital, firms are investing with greater precaution than ever, and this might have pushed them away from investing huge amounts in new businesses, which should be riskier (Lavender et al., 2020). Secondly, when looking at the demand for venture capital, some interesting conclusions might come up. Bendell et al. (2020) argue that the entrepreneur's mood highly influences entrepreneurship activity. The times we live in suggest that the fear of failure is very likely to occur. Considering this, individuals might have been frightened by the pandemic and stepped back from creating a company. Regarding the characteristics of the firms and deals, results present the expected outcomes, which align with the first hypothesis.

Finally, the fourth hypothesis also presents fascinating results. The root of the crisis we are living lies in is a disease, and many health issues came up with the onset of this new virus. With people under lockdown, healthcare technology represented a growing need for everyone. With this new reality, many companies devoted their time to tackle these needs that surged throughout the pandemic. Therefore, results are in line with the expectations, and the COVID-19 variable shows a positive impact on the amount invested by venture capitals in the healthcare industry. Regarding the technology industry, results yielded a negative impact on investment levels. Deloitte (2020) issued a paper that explains why the technology industry is having a hard time because of the pandemic. The supply of raw materials, the disruption to the electronics value chain and the inflationary risk on products are the leading causes pointed out. Looking at the control variables' results in this last hypothesis, technology industry investment levels are strongly influenced by all the determinants used. Nevertheless, the healthcare industry amounts do not seem to be driven by the round number and by the company age.

7. Conclusion

The research conducted in this paper aimed to understand the impact of the coronavirus pandemic on the level of investments handled by venture capitals. The study developed allows us to make conclusions at four different levels: venture capital industry as a whole, venture capital in Europe and America, venture capital per stage of investments, and venture capital's industries of preference.

Using data from both European and American firms, our study proved that indeed COVID-19 affected the amounts raised. The level of investments suffered a 2.5% drop due to the macroeconomic shock and uncertainty recorded since the beginning of the lockdowns. When we separated the data into regions, we concluded that the pandemic affected more European venture capital firms than American ones. While Europe deals suffered a decrease of almost 4% on the average level of investments, American deals did not prove to have a significant drop. This leads us to identify the following implications for startups that are seeking capital:

- There was a decrease in the overall level of investments, meaning that firms willing to raise capital should weight the tradeoff between asking now or postponing their funding. With the reduction of capital supply, competitiveness amongst startups increases and it can be more challenging to be the chosen one;
- If there is a huge need to raise capital or a brilliant idea to be implemented as soon as possible, it should probably be best to seek American venture capital firms. They did not lower their level of investments as much as European firms;

When comparing the different stages of investment, seed stage proved to be the most affected by the pandemic. Considering European and American ventures, there was a 5% drop on the amounts raised concerning the first rounds of investments. As regards the early and later stages of investments, it was not found a significant decrease. Startups that did not receive initial funding yet should include a discount of around 5% in their business planning due to the pandemic. If the company is looking for a second or later funding round, it should be more concerned about the increased competitiveness among potential investment recipients, as the amounts raised did not suffer from the pandemic.

Taking the fourth hypotheses into account, there are some interesting conclusions that we can take from it. The technology industry has always been the main focus of venture capital's funding. Even though the crisis we are living raised some different needs for the moment. In this paper, we conclude that while the technology industry's investment levels decreased, the healthcare industry experienced an increase in the raised amounts. Relating these results with the stages of investments, we have to consider that only 37% of the healthcare industry deals are relative to a first funding round. Besides the fear of investing in new-born businesses, it can also be the case where the seed stage of investments has been hurt by this shift of industry focus, given that the healthcare industry performs poorly on this stage of investments.

8. Limitations and Further Research

During this research, several factors have been identified with the potential to limit the analysis. To start with, the time period can be considered too short to detect any relevant changes. Many deals that have been recorded through the pandemic were already closed before the virus came to life. This paper only studies the effects of coronavirus until September of 2020, and the pandemic is still ongoing by the end of this year. Nevertheless, the literature on this late topic is still scarce, so this paper should constitute a valuable tool on venture capital's reaction to the recent events.

When matching the deals by regions, the European countries did not present an even amount of deals. European deals came mainly from the United Kingdom, Germany, and France. This discrepancy can also create some "bias" on the results. To make this analysis more complete, we should account for the economic environment within European countries. Also, the COVID-19 pandemic affected all countries included in this research, but not in the same way. Some countries got more impacted by the virus than others (i.e. the impact of COVID-19 in Spain and Italy against Germany and France). The models used in this research do not consider these factors.

To the best of our knowledge, this is the first study to empirically document and analyze the effects of the COVID-19 pandemic on the venture capital raised amounts, comparing Europe and America. Nevertheless, some improvements can be made to this research. First, it would be interesting to see if the results reached in this analysis hold by expanding the time period until when the virus is gone, which should be soon. Also, a post-COVID-19 analysis could be

done - will there be permanent damages or shifts in the industry? Second, once the macroeconomic determinants of the year 2020 are available, it will be possible to scale the raised amounts to the country's size. This way, we can control for the different economic environment across the European countries. As such, there are many questions left unanswered:

- Does the impact of COVID-19 on startups differ when a venture capital does not back the company?
- Is there any different selection effect than before, when choosing the companies? If so, which are the key factors that will allow a startup to get funding?
- Over a more extended period, did the importance of venture capital funding for startups increase or decrease due to the pandemic?

References

- Baker, S. R., Bloom, N., & Terry, S. J. (2020). *Using Disasters to Estimate the Impact of Uncertainty*. National Bureau of Economic Research, No. 27167.
- Baker, S., & Bloom, N. (2013). *Does Uncertainty Reduce Growth? Using Disasters as Natural Experiments*. NBER Working Paper No. 19475.
- Barrios, S., & van der Wielen, W. (2020). *Fear and Employment During the COVID Pandemic: Evidence from Search Behaviour in the EU*. Joint Research Centre (JRC), the European Commission's science and knowledge service.
- Bendell, B., Sullivan, D., & Ornstein, S. (2020). *How Fear of "Looming Megacatastrophes" Alters Entrepreneurial Activity Rates through Psychological Distance*. Academy of Management Perspectives Vol. 34, No 4.
- Berger, R. (2020, April 24). Retrieved from Roland Berger:
<https://www.rolandberger.com/en/Insights/Publications/This-crisis-is-different-Comparing-the-coronavirus-crisis-with-the-financial.html>
- Bernstein, S., Lerner, J., & Mezzanotti, F. (2017). *Private Equity and Financial Fragility During the Crisis*. Review of Financial Studies 32(4), 1309-1373.
- Block, J., & Sandner, P. (2009). *What is the Effect of the Current Financial Crisis on Venture Capital Financing? Empirical Evidence from US Internet Start-ups*. MPRA Paper No. 14727. Available at: <http://mpa.ub.uni-muenchen.de/14727/>.
- Bottazzi, L., & Da Rin, M. (2002). *Venture Capital in Europe and the Financing of Innovative Companies*. Economic Policy : A European Forum 17(34): 231-69.
- Breukers, M. (2013). *Venture capital and the financial crisis*. Financial Economics. Retrieved from <http://hdl.handle.net/2105/13601>.
- Bygrave, W. D., & Timmons, J. (1992). *Venture Capital at the Crossroads*. University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship.
- Caggiano, G., Castelnuovo, E., & Kima, R. (2020). *The global effects of Covid-19-induced uncertainty*. Economics Letters, Volume 194.
- Chandna, A. (2020, July 22). Retrieved from Forbes:
<https://www.forbes.com/sites/asheemchandna/2020/07/22/greylock-covid-19-impact-on-start-ups-assessing-the-first-few-months/?sh=157a1f9f1c8f>
- Clark, D. (2020, November 6). Retrieved from Statista:
<https://www.statista.com/statistics/1070317/eu-gdp-growth-rate/>

- Cumming, D., Fleming, G., & Schwienbacher, A. (2008). *Liquidity Risk and Venture Capital Finance*. Available at: <https://doi.org/10.1111/j.1755-053X.2005.tb00119.x>.
- Delloitte. (2020, March 25). *Understanding COVID-19's impact on the technology sector*. Retrieved from <https://www2.deloitte.com/global/en/pages/about-deloitte/articles/covid-19/understanding-covid-19-s-impact-on-the-technology-sector-.html>
- ECB. (2020, March 18). Retrieved from https://www.ecb.europa.eu/press/pr/date/2020/html/ecb.pr200318_1~3949d6f266.en.html
- Elenev, V., Landvoigt, T., & Van Nieuwerburgh, S. (2020). *Can the Covid Bailouts Save the Economy?* National Bureau of Economic Research (NBER), No. 27207.
- Eurostat. (2021, November 13). *News Release Euro Indicators*. Retrieved from [ec.europa.eu: https://ec.europa.eu/eurostat/documents/2995521/10662173/2-13112020-AP-EN.pdf/0ac3f053-f601-091d-ea21-db1ecaca7e8c](https://ec.europa.eu/eurostat/documents/2995521/10662173/2-13112020-AP-EN.pdf/0ac3f053-f601-091d-ea21-db1ecaca7e8c)
- Félix, E., Pires, C., & Gulamhussen, M. (2013). *The Determinants of Venture Capital in Europe—Evidence Across Countries*. *Journal of Financial Services Research*, 259–279.
- Felizardo, M. (2016). *How do Economic Crises impact Venture Capital activity in European countries? – An Empirical Analysis*.
- Giot, P., & Schwienbacher, A. (2007). *IPOs, trade sales and liquidations: Modelling venture capital exits using survival analysis*. *Journal of Banking & Finance*, 2007, vol. 31, issue 3, 679-702.
- Gompers, P. A., Kaplan, S. N., & Mukharlyamov, V. (2020). *Private Equity and COVID-19*. National Bureau of Economic Research, No. 27889.
- Gompers, P., & Lerner, J. (1999). *What Drives Venture Capital Fundraising?* National Bureau of Economic Research, No. 6906.
- Gompers, P., & Lerner, J. (2001). *The Venture Capital Revolution*. *Journal of Economic Perspectives*, Vol. 15 No. 2 Spring 2001.
- Gunay, S. (2020). *COVID-19 Pandemic Versus Global Financial Crisis: Evidence from Currency Market*. Available at SSRN: <https://ssrn.com/abstract=3584249>.
- Impavido, G., & Tower, I. (2009). *How the Financial Crisis Affects Pensions and Insurance and Why the Impacts Matter*. IMF Working Paper.
- James, G., Witten, D., Hastie, T., & Tibshirani, R. (2017). *An Introduction to Statistical Learning With applications in R*. Springer Texts in Statistics.
- Jeng, L. A., & Wells, P. C. (2000). *The determinants of venture capital funding: evidence across countries*. *Journal of Corporate Finance* Volume 6, Issue 3, 1 September 2000, Pages 241-289.

- Kelly, R. (2012). *Drivers of private equity investment activity: are buyout and venture*. Venture Capital, 14, 309-330.
- la Potterie, B., & Romain, A. (2016). *The Economic Impact of Venture Capital*. Bundesbank Series 1 Discussion Paper No. 2004,18.
- Lavender, J., Moore, C., & Smith, K. (2020). *Venture Pulse Q2 2020 Europe - Global analysis of venture funding*. KPMG Private Enterprise. Available at: <https://assets.kpmg/content/dam/kpmg/xx/pdf/2020/07/venture-pulse-q2-2020-europe.pdf>.
- Levine, R. (2002). *Bank-Based or Market-Based Financial Systems: Which is Better?* NBER Working Paper No. 9138.
- Log-Linear Models. (2011). In R. Hill, W. E. Griffiths, & G. C. Lim, *Principles of Econometrics, Fourth Edition* (p. 152). John Wiley & Sons, Inc.
- Lyócsa, Š., Baumohl, E., Výrost, T., & Molnár, P. (2020). *Fear of the coronavirus and the stock markets*. Finance Research Letters. 36. 101735. 10.1016/j.frl.2020.101735.
- Manigart, S., Lockett, A., Meuleman, M., Landstrom, H., Bruining, H., Desbrières, P., & Hommel, U. (2006). *Venture Capitalists' Decision to Syndicate*. Entrepreneurship Theory and Practice. 30. 10.1111/j.1540-6520.2006.00115.x.
- Mason, C. (2020). *THE CORONAVIRUS ECONOMIC CRISIS: ITS IMPACT ON VENTURE CAPITAL AND HIGH GROWTH ENTERPRISES*. Joint Research Centre (JRC), the European Commission's science and knowledge service.
- McKinsey & Company. (2019). *Private markets come of age: McKinsey Global Private Markets Review 2019*. <https://www.mckinsey.com/~/media/mckinsey/industries/private%20equity%20and%20principal%20investors/our%20insights/private%20markets%20come%20of%20age/private-markets-come-of-age-mckinsey-global-private-markets-review-2019-vf.ashx>.
- Moore, C. (2020). *Venture Capital's response to COVID-19*. KPMG Blog.
- Neilson, S., & Woodward, A. (2020, December). Retrieved from Business Insider: <https://www.businessinsider.com/coronavirus-pandemic-timeline-history-major-events-2020-3>
- Rajan, R., & Servaes, H. (2002). *The effect of market conditions on initial public offerings*. Working paper, University of Chicago.
- Rövenich, K. (2020). *How COVID-19 has impacted Q1 2020 venture capital activity in payments*. Available at: https://www.ey.com/en_fi/banking-capital-markets/how-covid-19-has-impacted-q1-2020-venture-capital-activity-in-payments.
- Schertler, A. (2003). *Driving Forces of Venture Capital Investments in Europe: A Dynamic Panel Data Analysis*. Kiel Working Papers, No. 1172.

Sohl, J., & Rosenberg, W. (2003). *The US Angel and Venture Capital Market: Recent Trends and Developments*.

Szarek, J., & Piecuch, J. (2018). *The importance of startups for construction of innovative economies*. *International Entrepreneurship Review*, 4(2), 69-78.

Thomala, L. L. (2020, December 21). Retrieved from Statistica:
<https://www.statista.com/statistics/1092918/china-wuhan-coronavirus-2019ncov-confirmed-and-deceased-number/>

Tyková, T. (2000). *What do economists tell us about venture capital contracts?* Mannheim: ZEW Discussion Papers, No. 00-62.

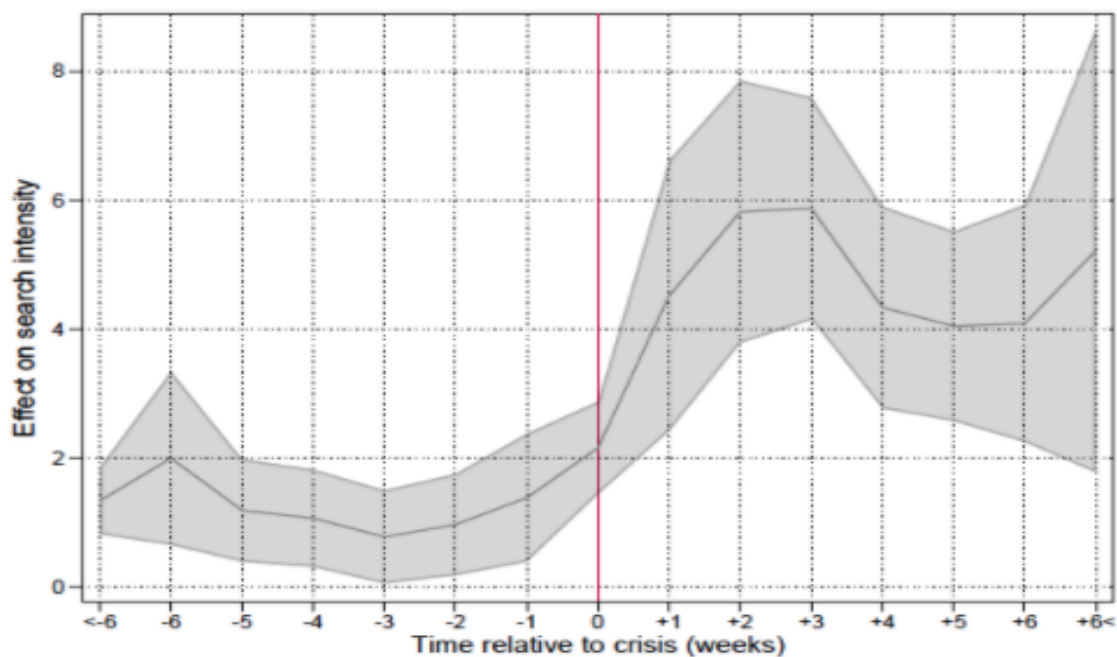
Using Robust Standard Errors. (2011). In R. Hill, W. E. Griffiths, & G. C. Lim, *Principals of Econometrics, Forth Edition* (p. 318). John Wiley & Sons, Inc.

Zider, B. (1998). *How Venture Capital Works*. *Harvard Business Review*, 135-139.

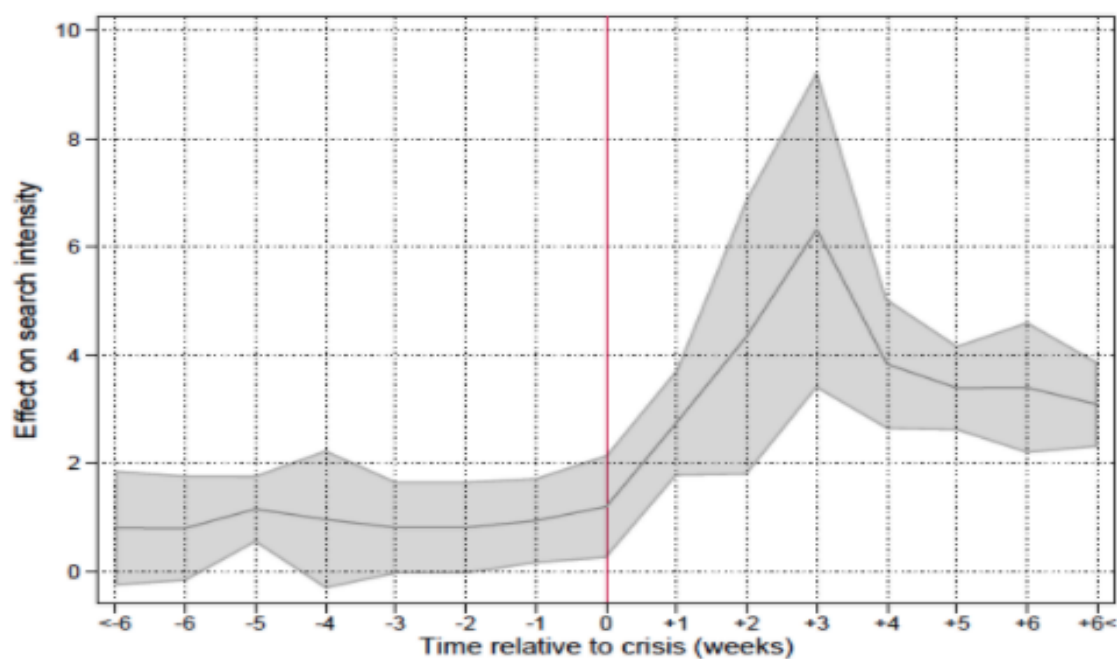
Appendix A: Recession and Unemployment search volume intensity. Source: (Barrios and van der Wielen, 2020).

This figure's upper panel plots the DiD estimates in the search's intensity for recession in the European countries. The time '0' is accounted for as the announcement of the first positive coronavirus case. The peak is recorder 6 weeks after the announcement of the first positive case (March). The lower panel applies the same model but for unemployment related searches. Here, the peak is registered 3 weeks after the announcement of the first positive case.

(a) Recession

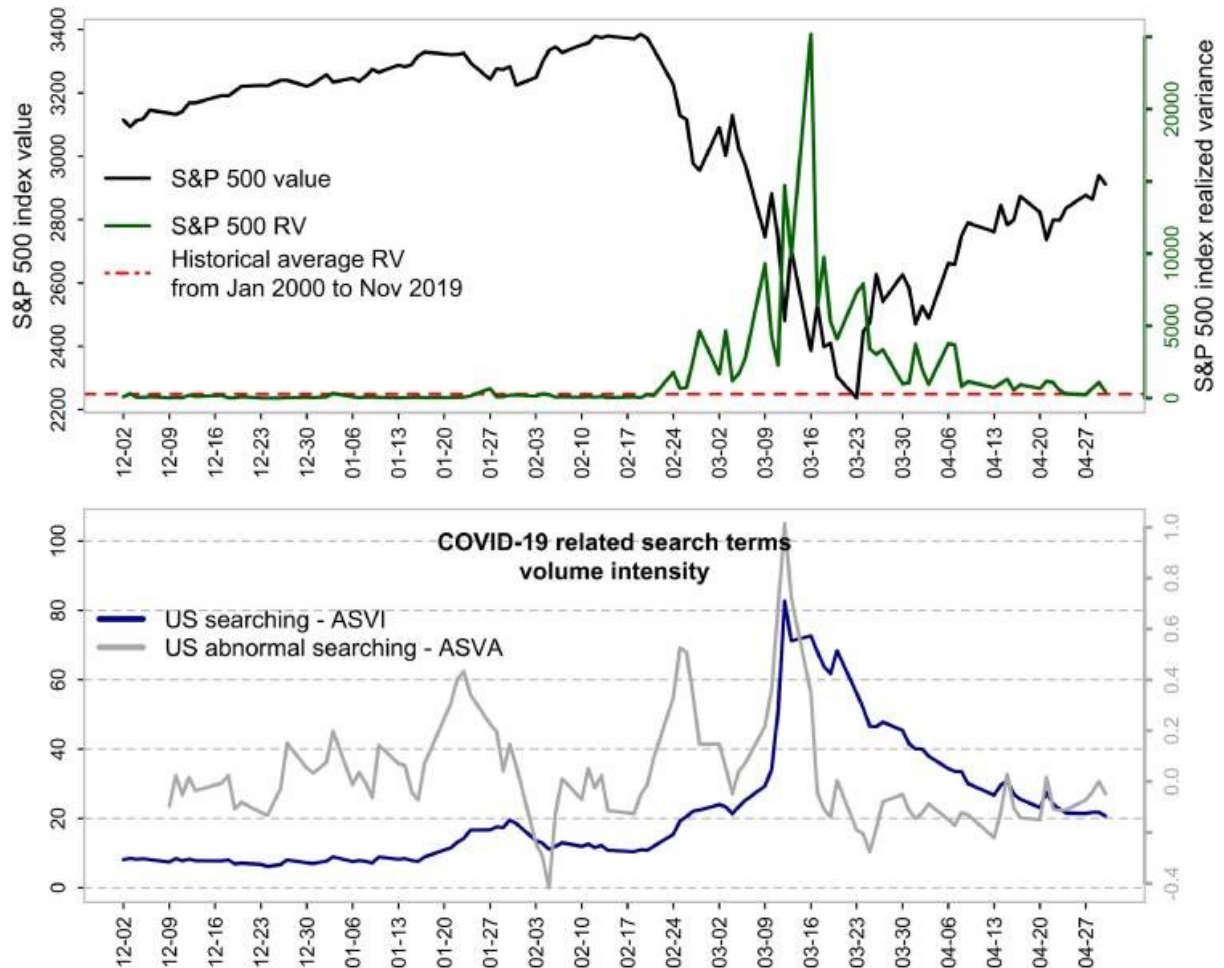


(b) Unemployment



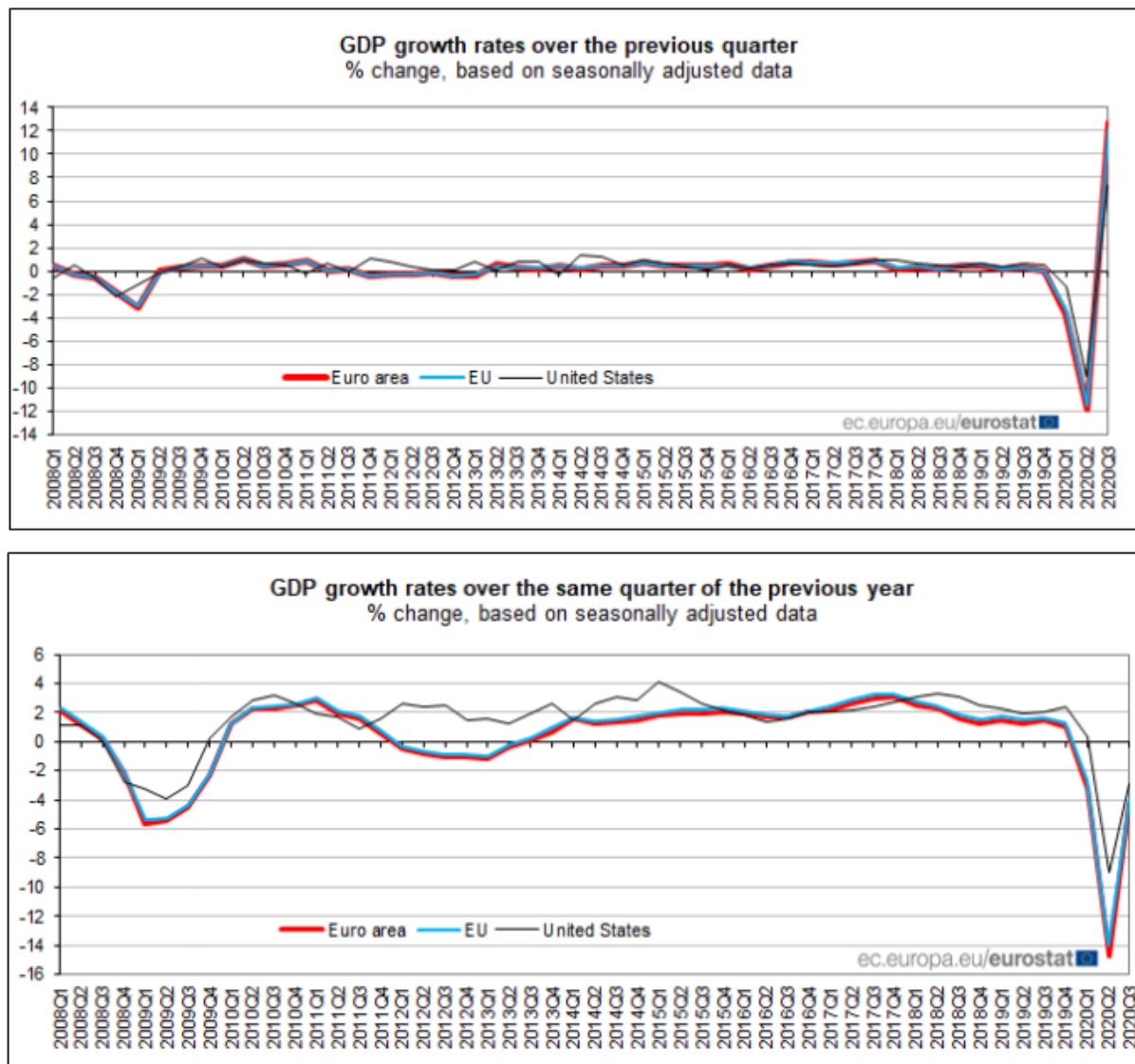
Appendix B: Market uncertainty and search volume intensity. Source: (Lyócsa et al. 2020).

This figure's upper panel shows the value and the realized variance of the S&P 500 index over the period from December 2019 to April 2020. The lower panel plots the search intensity and the abnormal searching volume activity relative to the COVID-19. The search's intensity's peak is accompanied by the crash of the index's value, which happens in March 2020.



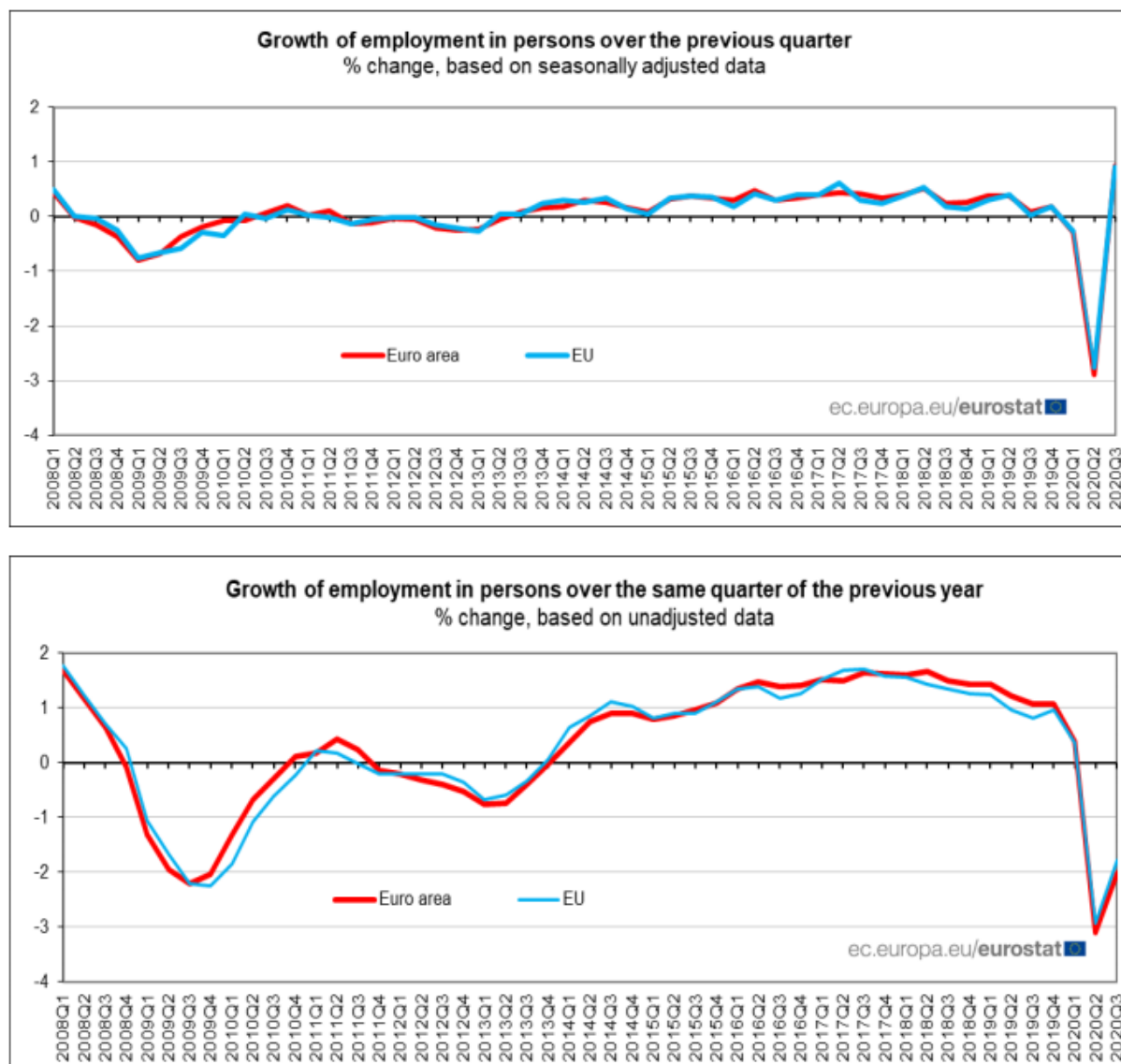
Appendix C: GDP growth rates in Europe and America. Source: (Eurostat, 2020).

This figure's upper panel shows the GDP growth rates over the previous quarter for both European countries and America, and the lower panel shows the GDP growth rates over the same quarter of the previous year. The shock of the GDP growth occurred in the second quarter of 2020.



Appendix D: Growth of employment rates in Europe. Source: (Eurostat, 2021).

This figure's upper panel shows the employment growth rates over the previous quarter for European countries and the lower panel shows the employment growth rates over the same quarter of the previous year. The shock of the employment growth occurred in the second quarter of 2020.



Appendix E: Dates of country's lockdowns.

This table displays the dates considered for the construction of the COVID-19 variable. As not all countries adopted the lockdown as a precautionary measure for the stop of the contagion, a summary of the governments' measures on the dates listed below is described in the 'Type of Measure' column.

Country	Date	Type of Measure
Austria	16/03/2020	National lockdown
Belgium	18/03/2020	National lockdown
Bulgaria	01/03/2020	National lockdown
Channel Islands	25/03/2020	National lockdown
Cyprus	15/03/2020	Closed all borders and recommended social confinement
Czech Republic	16/03/2020	National lockdown
Denmark	12/03/2020	National lockdown
Estonia	17/03/2020	Closed all borders and recommended social confinement
Finland	16/03/2020	Closed all borders, schools, and recommended social confinement
France	17/03/2020	National lockdown
Germany	23/03/2020	National lockdown
Gibraltar	24/03/2020	Closed all borders and recommended social confinement
Greece	23/03/2020	National lockdown
Hungary	28/03/2020	National lockdown
Iceland	16/03/2020	Closed all borders, schools, and recommended social confinement
Italy	09/03/2020	National lockdown
Latvia	29/03/2020	National lockdown
Liechtenstein	17/03/2020	Closed all borders and recommended social confinement
Lithuania	16/03/2020	National lockdown
Luxembourg	19/03/2020	National lockdown
Malta	07/04/2020	National lockdown
Monaco	17/03/2020	National lockdown
Netherlands	12/03/2020	National lockdown
Norway	12/03/2020	National lockdown
Poland	13/03/2020	National lockdown
Portugal	19/03/2020	National lockdown
Republic of Ireland	12/03/2020	National lockdown
Romania	24/03/2020	National lockdown
Russian Federation	28/03/2020	National lockdown
Slovak Republic	12/03/2020	Closed all borders and recommended social confinement
Spain	14/03/2020	National lockdown
Sweden	18/03/2020	Banned gatherings and travel restrictions - Government against lockdown
Switzerland	17/03/2020	National lockdown
Turkey	23/03/2020	National lockdown
United Kingdom	23/03/2020	National lockdown
United States of America	19/03/2020	1 st USA State's lockdown - California

Appendix F: Complete version of ‘table 2’ Panel B (Europe) including the industries’ statistics

'Mean Before' stands for the mean of every deal that took place before the 'COVID-19' variable turns 1 and 'Mean After' stands for every deal that took place after the variable turns 1. Every statistic reported as a percentage is relative to the total number of deals.

Panel B - Europe					
Variables	Obs	Mean	StDev	Mean Before	Mean After
Dependent Variables:					
Equity invested (log10)	5339	6.54	0.6	6.55	6.52
Control Variables:					
Round Number	5339	2.56	2.14	2.52	2.64
First Round (in %)	5339	40.00	49.00	41.32	35.83
Number Firms	5339	3.83	2.56	3.74	4.00
Company Age	5339	1.76	0.29	1.76	1.76
VC Age	5339	3.60	0.53	3.62	3.59
Industries:					
Basic Materials (in %)	5339	1.00	11.00	1.13	1.16
Consumer Cyclicals (in %)	5339	5.00	22.00	5.86	3.99
Consumer Non-Cyclicals (in %)	5339	7.00	25.00	6.85	6.31
Energy (in %)	5339	1.00	8.00	0.76	0.39
Financials (in %)	5339	6.00	23.00	6.45	4.60
Healthcare (in %)	5339	16.00	37.00	15.60	17.33
Industrials (in %)	5339	10.00	30.00	10.10	10.30
Technology (in %)	5339	53.00	50.00	52.17	54.54
Telecommunications Services (in %)	5339	1.00	7.00	0.54	0.61
Utilities (in %)	5339	0.00	5.00	0.42	0.06

Appendix G: Complete version of ‘table 2’ Panel C (United States of America) including the industries’ statistics

'Mean Before' stands for the mean of every deal that took place before the 'COVID-19' variable turns 1 and 'Mean After' stands for every deal that took place after the variable turns 1. Every statistic reported as a percentage is relative to the total number of deals.

Panel C - United States of America					
Variables	Obs	Mean	StDev	Mean Before	Mean After
Dependent Variables:					
Equity invested by Firm (log10)	8573	6.77	0.74	6.77	6.77
Control Variables:					
Round Number	8573	2.88	2.69	2.89	2.87
First Round (in %)	8573	39.00	49.00	38.97	39.33
Number Firms	8573	3.11	2.37	3.04	3.27
Company Age	8573	1.77	0.12	1.78	1.77
VC Age	8573	3.64	0.59	3.64	3.64
Industries:					
Basic Materials (in %)	8573	1.00	10.00	0.97	1.08
Consumer Cyclicals (in %)	8573	5.00	22.00	5.25	4.04
Consumer Non-Cyclicals (in %)	8573	7.00	25.00	6.39	7.07
Energy (in %)	8573	0.00	5.00	0.28	0.20
Financials (in %)	8573	5.00	21.00	4.68	4.96
Healthcare (in %)	8573	17.00	38.00	16.64	18.19
Industrials (in %)	8573	9.00	28.00	8.60	8.35
Technology (in %)	8573	56.00	50.00	56.27	55.20
Telecommunications Services (in %)	8573	0.00	6.00	0.41	0.32
Utilities (in %)	8573	0.00	5.00	0.25	0.24

Appendix H: Complete version of ‘table 3’ - Correlations and VIF's

This table presents a correlations matrix for all the variables used in this research. The correlations between each variable and the dependent variable are displayed in the second column. The following columns present the correlations among every variable used in the models applied. The last column displays the variance inflation factors (VIF) for each independent variable.

	Equity invested by Firm	COVID- 19	Region Dummy	Round Number	First Round	Number Firms	Company Age	VC Age	VIF
Equity invested (log 10)	1								
COVID-19	-0,02	1							1
Region Dummy	0,16	-0,14	1						1,03
Round Number	0,23	0,01	0,06	1					1,51
First Round	-0,28	-0,03	0,00	-0,57	1				1,52
Number Firms	0,24	0,06	-0,14	0,12	-0,19	1			1,09
Company Age	0,14	0,02	0,03	0,24	-0,19	0,00	1		1,07
VC Age	0,15	-0,01	0,03	0,15	-0,16	0,18	0,05	1	1,06