UNIVERSIDADE CATÓLICA PORTUGUESA

Market uncertainty and the European stock market

Analysis of Covid-19 pandemic impact on the European stock market

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Analysis of Covid-19 pandemic impact on the European stock market

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Abstract

This dissertation explores the impact of the Covid-19 pandemic on the Euro STOXX 50 index, a key benchmark for the eurozone financial market. The study utilizes daily infections and fatalities related to Covid-19 to investigate its influence on the index's volatility and returns.

Using data from Yahoo Finance for the Euro STOXX 50 index and the World Health Organization for the daily infections and Covid-19 related fatalities, the study focuses on the period between January 2nd, 2020 and December 31st, 2020.

This study employs the GARCH(1,1) model with a skewed student distribution to analyse the impact of the pandemic on the Euro STOXX 50 index. This model uses 257 observations from the daily log returns from 2020. allows for the variance of the error term to be time-dependent, making it suitable for analysing data with heteroscedasticity.

The study finds that the pandemic's arrival in Europe led to a significant decline in prices from late February to early March. However, prices stabilized from June, only to be significantly affected again in November. These findings suggest that reacted heavily to the both lockdowns due to decreases in economic activity, suggesting that even though the increase in cases and deaths did have a significant impact the the index volatility, it was the decrease in economic activity and the speculation regarding the consequences from the in how economy would react to the policies taken that actually had a heavy impacte on the financial market.

Keywords: Covid-19; European financial market; Economic instability

Resumo

Esta dissertação explora o impacto da pandemia Covid-19 no índice Euro STOXX 50, uma referência chave para o mercado financeiro da zona euro. O estudo utiliza infecções diárias e fatalidades relacionadas ao Covid-19 para investigar o seu impacto na volatilidade e retornos do índice.

Usando dados do Terminal Yahoo Finance para o índice Euro STOXX 50 e da Organização Mundial da Saúde (OMS) para infecções diárias e mortes relacionadas ao Covid-19, o estudo é referente ao período entre 2 de janeiro de 2020 e 31 de dezembro de 2020.

Este estudo utiliza o modelo GARCH(1,1) com uma distribuição t-student assimétrica para analisar o impacto da pandemia no índice Euro STOXX 50. Este modelo usa retornos de log diários de 2020, permitindo que a variância do termo de erro seja dependente do tempo, tornando-o adequado para analisar dados com heterocedasticidade.

O estudo revela que a chegada da pandemia na Europa levou a uma queda significativa nos preços no final do mês fevereiro e durante março. No entanto, os preços estabilizaram-se a partir de junho, sendo novamente significativamente afetados no mês de novembro. Estas descobertas sugerem que o mercado financeiro Europeu reagiu fortemente à pandemia, devido à diminuição da atividade económica, sugerindo que, embora o aumento de casos e mortes tenha tido um impacto significativo na volatilidade do índice, foi a queda na atividade económica e a especulação relativa ao comportamento da economia e das consequências das políticas tomadas que mais impactaram o mercado financeiro.

Palavras-chave: Covid-19; Mercado financeiro Europeu; Instablididade economica

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List of Abbreviations

BDZ – Börsen-Daten-Zentrale GmbH (data centre of the Frankfurt stock exchange)

CDC - Centers for Disease Control and Prevention, the National Public Health Agency of the United States of America

GDP – Gross Domestic Product

WHO – Worlds Health Organization

UNAID – Joint United Nations Programme on HIV/AIDS

1. Introduction

The world has experienced several recessions in the last century, with the most recent being the global pandemic caused by the SARS-CoV-2 virus. The outbreak began in Wuhan, China in 2019 and quickly spread worldwide due to globalization. As nations struggled to address the sanitary, economic, and financial impacts of the virus, stock markets around the world reacted accordingly. The economic and financial effects of the pandemic have been felt globally, with businesses shutting down, unemployment rates rising, and governments having to implement economic stimulus measures.

Previous literature has established a correlation between market uncertainty and economic recessions and stock market crashes. In light of this, the aim of this dissertation is to analyse the impact of the Covid-19 pandemic on the European financial market. Specifically, this study will examine the relationship between the evolution of daily new cases and deaths caused by Covid-19 and the Euro STOXX 50 index, which serves as the benchmark for the European financial market. Understanding the impact of the pandemic on the European financial market is crucial as it has a significant effect on the global economy and the lives of millions of people.

The importance of this study lies in its potential to provide insight into how pandemics can impact financial markets and economies. The findings of this research might add to the current literature on this subject and help to inform future policy decisions and mitigate the negative effects of future pandemics on the financial market. Additionally, the study will provide valuable information on how the pandemic has affected the most developed economic region in the

world and serve as a benchmark for future research on the impact of pandemics on the financial market.

The dissertation is divided into six sections. Section 1 will provide an introduction and explanation of the research question. Section 2 will review relevant literature on the subject. Section 3 will give an overview of the data used in the study. Section 4 will explain the methodology used for data analysis. Section 5 will present and discuss the results. Finally, section 6 will provide conclusions and recommendations.

In summary, this dissertation aims to analyse the impact of the Covid-19 pandemic on the European financial market and its importance lies in providing insight into how pandemics can impact financial markets and economies.

For this reason, we will first start by looking at the background of this pandemic and some of the actions by governments across the European Union (EU), given that it is established that government decisions do have a social, economic and financial impact. Understanding the nature of this virus and the reactions taken by EU members will provide the necessary context for the analysis of the impact that Covid-19 virus had on the European financial market.

1.1– Coronavirus pandemic

The Coronavirus (Covid-19) is a highly contagious disease caused by the SARS-CoV-2 virus, which first emerged in Wuhan, China in December 2019. The virus quickly spread throughout Europe, with the first case being detected in Bordeaux, France on January 24th, 2020. The World Health Organization declared Covid-19 a public health emergency of international importance on January 30th, 2020, and a pandemic on March 11th, 2020.

Despite the freedom of movement within the EU and the Schengen area, many governments were slow to prioritize the pandemic response due to the ongoing Brexit negotiations. From March 13th to May 22nd, 2020, and again in late 2021, WHO declared Europe as the epicentre of the pandemic. Italy was the first European country to experience a widespread outbreak, leading to the implementation of the world's first country-wide lockdown.

Symptoms of the disease can vary depending on the type of virus variant, but three common types of cluster symptoms have been identified as respiratory, digestive and musculoskeletal. The rapid spread of the virus and the varying symptoms of the disease highlights the need for ongoing research and monitoring of the virus to effectively combat the pandemic. The Covid-19 pandemic brought to light the significance of studying the potential impact of pandemics on the current era of freedom of movement and global interconnectedness

1.2– EU response to Covid-19 pandemic

The Covid-19 pandemic has brought unprecedented challenges to the EU, both in terms of public health and economic stability. Initially, member states approached the crisis with disparate regulatory measures, which proved ineffective in slowing the spread of the virus. As infections increased, countries began to converge towards more restrictive policies, such as mandatory quarantines and lockdowns, which came at a significant economic and social cost. In a second phase, EU leaders recognized the need to take a coordinated approach in order to mitigate the effects of the crisis. In order to achieve this, they agreed to tackle four priority areas: limiting the spread of the virus, ensuring the provision of Personal Protective Equipment (PPE), promoting treatment and vaccine development, and supporting the economy (jobs, businesses, and education).

To achieve these goals, the EU took a number of measures. Firstly, the European Commission activated the EU Civil Protection Mechanism to coordinate the supply and distribution of PPE and other medical equipment across member states. Many countries such as Italy and Spain were particularly affected in the first wave of the pandemic and were in dire need of medical supplies.

Additionally, in Northern European countries such as Germany and Denmark, the government's response was effective in controlling the spread of the virus. Secondly, the EU set up a Coordination Group for the Development of Vaccines, which aimed to accelerate the development and rollout of vaccines. This was particularly important for countries such as France and Italy which had one of the lowest vaccination rates in the EU. Thirdly, to support the economy,

the EU established the €100 billion SURE instrument, which provided financial assistance to member states to help them protect jobs and incomes.

On 21 July 2020, EU leaders also agreed on a €750 billion recovery package, which aimed to support the economic recovery and the transition to a more sustainable and resilient economy. Moreover, in 2021, the EU launched the Recovery and Resilience Facility (RRF) instrument, which provided €672.5 billion to help member states address social and economic issues derived from the pandemic. Countries such as Greece, Portugal and Italy were some of the most affected by the pandemic and received significant funding from the RRF. The EU also approved the €1074 billion long-term EU budget for 2021-2027, with a focus on investment in technology and green energy transition.

Taking into account the previous measures taken by E.U. goverments and the social effects that the pandemic had in Europe, this dissertation will support similar literature in acquiring more information regarding the financial markets behaviour, consequently helping with decision making. For this purpose, it will consider the number of Covid-19 related deaths and cases and research its impact on the European financial market by seeing its impact on the index returns volatility. Research found that there were two different periods where Returns were significantly volatily, around June and November, periods that coincide with the first and second wave peaks of the Covid-19 pandemic.

2. Literature Review

2.1- What is uncertainty?

Unlike Risk, uncertainty is not quantifiable. Even though we cannot predict when a situation will happen, it is possible to compute every situation's outcome probability, that is, it is still unpredictable whether a certain situation will happen, however, it is possible to know its outcome, as Knight (1921) explains, uncertainty applies to every situation where it is impossible to know the necessary information needed to accurately predict the impact of a given situation and he defines it as a situation, that decision makers are exposed to, that affect the stock market in unpredictable ways.

This definition of uncertainty by Knight (1921) has been widely recognized and accepted by many economists and has been further studied in relation to stock market performance. For example, Gourio and Sala (2012) found that a higher level of uncertainty, as measured by the Knightian uncertainty index, is associated with a decrease in stock market returns. Similarly, Baker and Wurgler (2007) found that firms with higher levels of uncertainty, as measured by the volatility of their sales growth, have lower stock returns.

Furthermore, it has been shown that uncertainty can have a negative impact on investment and economic growth. Bloom (2009) found that uncertainty shocks lead to a decrease in investment and GDP growth. Similarly, Baker and Bloom (2016) found that high levels of economic policy uncertainty, as measured

by newspaper articles containing words such as "uncertain" or "uncertainty," are associated with slower GDP growth and investment.

In light of these findings, it is crucial to understand the impact of uncertainty on the stock market performance, as well as its potential effects on investment and economic growth. This is why it is important to define risk uncertainty for the purpose of this dissertation, as it allows for a more in-depth analysis of the relationship between uncertainty and stock market performance.

For this reason, it is impossible to predict when such an occurrence will happen, and consequently, the expected impact it might have on the market. However, we cannot undermine that such occurrences can influence market performance in various dimensions. Therefore, it can be helpful to identify if, independently of the market uncertainty cause, it is possible to identify patterns, so that we know what exactly might happen to firms from different industries when such a situation occurs.

Since there is no exact measure for uncertainty, it will be measured by firms stock performance, using stock price volatility as a proxy. This volatility is strongly correlated to other measures of uncertainty like firm earnings, productivity growth and firm profit. This correlation has been used in Bloom (2009) that shows, using the S&P500 index as a benchmark, that it was possible to get evidence that during unstable periods, the stock market was more volatile and that it was highly correlated with firm profitability and growth. This proxy has also been previously used by Leahy and Whited (1996) and Bloom, Bond and Van Reenen (2007). Creating a precedent as a proxy for uncertainty.

2.2-Pandemics and Global Recessions

According to the Association for Professionals in Infection Control and Disease, a pandemic is a global disease outbreak that causes a larger number of cases and deaths and leads to social disruption and economic and financial losses.

As the world becomes increasingly interconnected, with trade representing a larger percentage of global GDP, with global trading as a percent of the GDP representing 20% of worlds GDP in 1950 and growing to around 40% in 2000 and almost 60% in 2022, as demonstrated by Graph 1, a pandemic can create uncertainty in international markets, leading to a contraction in global real GDP and a decline in other measures of global activity.

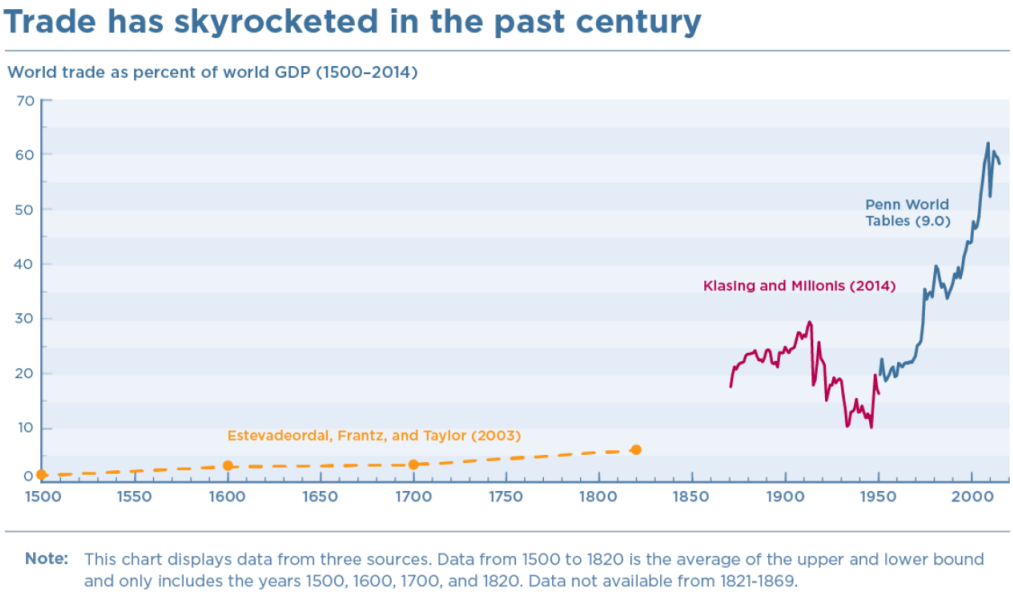


Figure 1- Graphic with world trade as percentage of world GDP.
Source: Adaptation from Peterson Institute for International Economics (https://www.piie.com/microsites/globalization/what-is-globalization)

Research has shown that pandemics have been a major contributor to past global recessions. For example, the 1918 influenza pandemic is believed to have contributed to the severity of the 1920-1921 global recession (Friedman and Schwartz, 1963). The 2002-2003 SARS outbreak and the 2008-2009 H1N1 influenza pandemic also had a negative impact on global economic growth (Kose et al., 2020).

So, what exactly is a global recession? Currently, the concept of a global recession is not widely defined. Unlike local national recessions, relying on the evidence of two consecutive quarters of decreased output as a means to determine a global recession is not a reliable method. This is due to the lack of current and comprehensive up to date data on global output and the rarity of actual contraction in global output during a global recession.

This statement is supported by the International Monetary Fund (IMF) which suggests that using GDP alone is too narrow of a measurement of economic activity and that multiple indicators should be used to provide a better view of the world's economic and financial condition.

For this reason, we will use the definition used by Kose et al. (2020), in their Global Recessions working paper, where they defined it as a contraction in global real GDP (synchronized recessions across many countries' economies), accompanied by a decline in other measures of global activity.

Therefore, the significance of considering the Covid-19 pandemic as a period of global recession cannot be overstated. The complexity of events resulting from the pandemic, including decreased production and widespread lockdowns and travel restrictions, have had a profound impact on the global economy and financial sectors. By taking Covid-19 pandemic as a global recession, it becomes possible to not only compare its effects with previous pandemics, but also to better understand the nature and extent of its impact on the financial markets.

2.3-Historical Context of the Euro Stoxx 50 index

The EURO STOXX 50 is a blue-chip index that represents the fifty largest companies in Eurozone countries among 19 Industries, by free-float market capitalization. It is a widely followed benchmark to track equity market performance and development in the Eurozone and it is also usually used as an underlying for financial products that thanks to flexible exit rules, ensures that the index accurately represents the performance of the largest and most liquid companies from various sectors across the euro area.

Has of July 2022, the index had a free-float market capitalization of €2,772.3 billion (index total market capitalization available for public trading). The majority of currently listed companies belong to France and Germany (16), Followed by the Netherlands (6), Italy and Spain (4) and lastly by Ireland (2), Belgium and Finland (1). The predominant industries, as seen in Figure 2 below, are the technology sector, represented by four companies, together represent 15% of the index, the consumer production and services sector, where five companies constitute almost 14% of the index and the industrial goods and services sector that represents around 13% of the index with six companies.

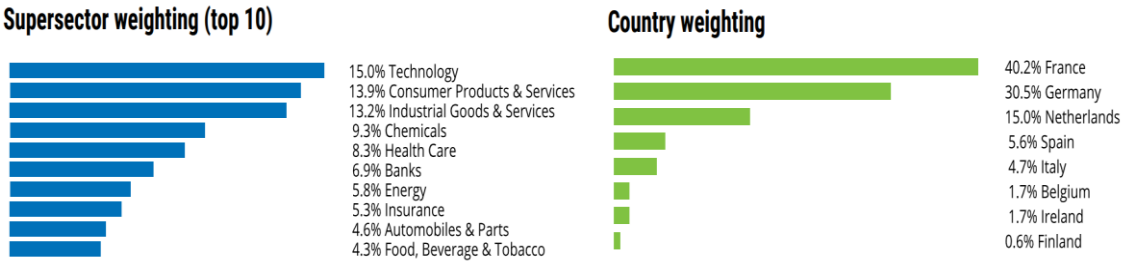


Figure 2 - Euro STOXX 50 index structure, all data as July 29, 2022.Source: Euro STOXX 50 report

Since its origin, the index has been considerably volatile, as seen in Figure 3. It reached its peak in the year 2000 with a closing price of €5,450.22, however the early 2000´s brought a decline in economic activity. The technological era generated a lot of speculation around tech companies and as consequence overvalued investments. Once interest rates increased and with the speculation of a Japanese recession, investors opt to invest in safer assets, such as bonds. For these reasons, and later, the 2001 terrorist attacks and a series of large accounting scandals, many firms lost their value, leaving the stock market vulnerable. In Europe Union, the introduction of a new currency, on January 1st, 1999, the euro, enhanced the economic recession, since its value immediately plummeted, and the Eurozone got affected by inflation.

Figure 3 - Euro STOXX 50 closing prices (1998-2022).
Source: Google Finance.
(https://www.google.com/finance/quote/SX5E:INDEXSTOXX?sa=X&ved=2ahUKEwiKxrfk9P5AhVE_YUKHaBoBsEQ3ecFegQIQxAg&window=MAX&comparison=)

Even though the index never got to the same level again, the European market quickly recovered. However, in 2007 another recession took place, in form of a banking crisis, since numerous banks invested in high-risk mortgage

securities that defaulted due to the burst of the housing market bubble in the United States of America. Financial institutions such as Lehman Brothers, Bear Stearns and Citibank, just to name a few, filed for bankruptcy in 2008, leading to a stock market crash. Although the crisis started in the United States housing market, its financial impact was felt in stock markets across the world.

Most markets reached lows during this period when stock prices fell more than 50% in most markets from October 2007 until March 2009, when majority of markets bottomed out. On 6 March 2009, S&P500 reached for the first since June 1996, a minimum value of €683.38, Dow Jones reached €7,062.93 on March 2020, its lower point since 1997. Euro STOXX, as observed on Figure 3 above, reached its minimum value of €1,817.24 in March 2009. The economy only actually recovered from 2011 onwards.

2.4-Expected market performance during a pandemic

Over the last century, there have been several major pandemics that affected global economies and financial markets, including the Spanish Flu (1918-1920), Hong Kong Flu (1968-1969), Influenza Pandemic (1957-1958), Ebola (1976-present), HIV/AIDS (1981-present), SARS (2002-2004), and currently and still ongoing Covid-19 pandemic (2020-present). The impact of pandemics on financial markets has been studied by various authors, including Burdekin (2020), McKibbin and Sidorenko (2006), and Barro, Ursua, and Weng (2021).

The 20th century saw three major outbreaks of influenza pandemics, with the first one occurring in 1918, known as the Spanish flu, despite its origin in the United States. The virus that caused the pandemic was of avian origin and is considered one of the deadliest in recorded history. According to the Centers for Disease Control and Prevention (CDC) and the National Public Health Agency of the United States, the virus infected around 500 million people, roughly one-third of the world population at the time, and is estimated to have caused 50-100 million deaths globally (Morens & Fauci, 2007). On average, the average country's GDP declined by approximately 6% and its private consumption by 8% (Barro et al., 2021). The National Bureau of Economic Research, estimated that countries with a death rate of at least 2%, experienced a 26% drop in stock return, however these results might have been influenced by the end of World War I, which lasted from July 1914 to November 1918.

The second outbreak of the influenza virus, known as the Asian Flu, was first identified in Singapore in February 1957 and later in Hong Kong in April. It was named the Asian Flu given its eastern Asian origin. Measuring the exact implications of influenza is challenging today because the symptoms are similar

to other diseases (National Institute of Allergy and Diseases, 2017) and secondly because some symptoms are only diagnosed after the virus infection has been cleared. The modern approach is to calculate the excess mortality during influenza seasons, excess mortality is the difference between deaths during a flu season and the expected deaths without influenza influence during the same period (Lone Simonsen, 1999). The Asian Flu lasted from 1957 to 1958 and is estimated to have caused 1.1 million excess deaths worldwide. With advances in technology, a vaccine was quickly identified and created, reducing the social and financial impact of the pandemic. According to Fidelity International Limited, the S&P 500 continued to grow from 1957 to 1958, even though the growth rate decreased by 24% to 2.9%, respectively. The UK equity market, which fell by 5.8% in 1957, rose 40% in 1958, showing that measures taken were effective in mitigating the impact of the Asian Flu and made possible for faster market recovery.

The third influenza pandemic, known as the Hong Kong Flu, started in July 1968 and lasted until 1970. This virus strain was notorious for being highly contagious, reaching 500,000 infections two weeks after initially being reported, and spreading globally by the end of that year. However, improvements in medical care and its availability to the general population, as well as the probable immunity created by the Asian Flu pandemic, resulted in a low mortality rate, one of the lowest of the 20th-century pandemics, with a case fatality rate of approximately 0.2%, meaning that for each a thousand people infected, on average, there will be two expected deaths. Despite this, the Hong Kong flu is estimated to take the lives of one to four million people, according to WHO.

Jinjarak et al. (2021) concluded that the average mortality rate was linked to a 2.4% decrease in output and a decrease in productivity by 1.9%, mainly due to its impacts on work force health, skill acquisition and capital investment,

which dropped by 1.2%, resulting in a 2.4% decline in output over the pandemic lifespan. The study also revealed that consumption declined by 1.9%, displaying the impact that pandemics can have on the world economy.

The Human Immunodeficiency Virus (HIV) is a virus that attacks the immune system and was first detected in West-central Africa in 1959 and later in the United States of America in the early 1980s (WHO, 2021). While there is currently no cure for HIV infection, with appropriate treatment, it is possible to manage the disease and prevent its progression to acquired immunodeficiency syndrome (AIDS) (WHO, 2021). The HIV/AIDS pandemic has had a significant impact on global health, with 84.2 million people estimated to have been infected and 40.2 million people dying from the virus since its inception (UNAID/WHO, 2021). In 2021 alone, 38.4 million people were living with the virus and 1.5 million were newly infected, while 650,000 people died from HIV virus related causes (UNAIDS/WHO, 2021).

The impact of HIV/AIDS is particularly exhibited in Africa, where the disease still poses a significant challenge. Cuddington & Hancock (1994) estimated that from 1985 to 2010, the average GDP growth in Malawi would be 0.2% to 0.3% lower, or in a more extreme case scenario, 1.5% to 1.8% lower when compares to a scenario without AIDS. This would result in a reduction of real GDP from 5.03 billion kwacha to 4.81 to 4.77 in the medium scenario, or 3.80 to 3.46 billion Kwacha in the extreme scenario (Cuddington and Hancock, 1994). In 2005 a study on the economic impact of HIV was conducted, also found that the impact of HIV could reduce a country's GDP growth by 0.5% to 2.6% when

affected by the virus, mainly due to the destruction of human resources and reduced investment in education (Veenstra & Whiteside, 2005).[1]

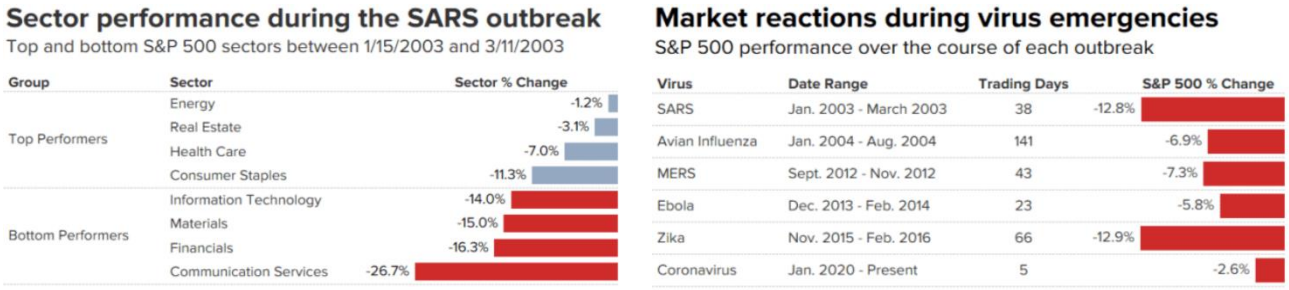
Severe Acute Respiratory Syndrome (SARS) emerged as a global health threat in the early 21st century, starting with its first reported case in Foshan, China in late 2002. Despite only infecting a limited number of people, approximately 8500, and causing around 900 deaths, the virus was able to spread across 29 countries until 2004.

Despite the low social impact, the outbreak managed to cause significant economic consequences, costing the global economy around $40 million and a drop in GDP by 0.1%, and significatively affect the stock market, as seen by the drop of the S&P500 by 12.8%. All 11 sectors composing the index suffered losses, with Communication Services, Financials and Materials sectors taking particularly heavy hits of 27%, 16% and 14% respectively (Figure 4).

In this section, we aim to provide a quick analysis of the impact of pandemics on financial markets worldwide. Pandemics can have far-reaching effects that go beyond just health problems and can impact society as a whole, including consumption and production restrictions. These restrictions are accompanied by increasing health problems, resulting in a decrease in productivity that significantly affects economic growth as well as causes major financial impacts as depicted in Graph 6, which showcases the market reaction to several pandemics in the 21st century using the S&P500 index as a proxy for market performance. resulting. Some notable pandemics that had a profound impact on the financial market include the previously mentioned 2003 SARS

[1] Please see also Bloom & Mahal (1997) and Arndt and Lewis (2001).

outbreak and the 2015-2016 Zika outbreak, which resulted in a 12.8% and 12.9% loss of the S&P500 index, respectively.



Sector performance during the SARS outbreak

Top and bottom S&P 500 sectors between 1/15/2003 and 3/11/2003

Group	Sector	Sector % Change
Top Performers	Energy	-1.2%
	Real Estate	-3.1%
	Health Care	-7.0%
	Consumer Staples	-11.3%
Bottom Performers	Information Technology	-14.0%
	Materials	-15.0%
	Financials	-16.3%
	Communication Services	-26.7%

Market reactions during virus emergencies

S&P 500 performance over the course of each outbreak

Virus	Date Range	Trading Days	S&P 500 % Change
SARS	Jan. 2003 - March 2003	38	-12.8%
Avian Influenza	Jan. 2004 - Aug. 2004	141	-6.9%
MERS	Sept. 2012 - Nov. 2012	43	-7.3%
Ebola	Dec. 2013 - Feb. 2014	23	-5.8%
Zika	Nov. 2015 - Feb. 2016	66	-12.9%
Coronavirus	Jan. 2020 - Present	5	-2.6%

Figure 4 - S&P500 performance, by sector, during 2003 SARS outbreak and performance during 21st century pandemics (data until January 28th, 2020)
Source: Adaptation from Citi Research (https://www.cnbc.com/2020/01/28/market-reactions-to-major-virus-scares-show-stocks-have-more-to-lose.html)

2.4.1-Covid-19 outbreak impact on global economic and financial Markets

As previously mentioned, the world was abruptly disrupted in 2020 by a new pandemic caused by the SARS-CoV-2 virus. The virus rapidly spread across the globe, infecting more than 755 million people and causing approximately 6,8 million fatalities as of February 2023.

In light of previous literature on the impact of pandemics on the global financial markets, it was only natural for researchers to promptly assess the influence of the Covid-19 outbreak on markets and economies worldwide. For instance, Landier & Thesmar (2020) studied, at the beginning of the pandemic, the potential impact on future corporate earnings during Covid-19 crisis. Results predict a long-lasting effect of the pandemic on the economy.

Schoenfeld (2020) used hand-collected financial data from the S&P500 at the firm level to analyse the impact of pandemics on financial markets. Results show that most public firms lost value, even though the majority of firms stated that they had little to no exposure to pandemics.

The study found that the S&P 500 stocks decreased by 28.6% at the peak of the pandemic, resulting in a total loss of $9 trillion, or approximately $18 billion per firm on average. The transportation, leisure and energy industries sectors were found to have suffered the most during this period. Additionally, the S&P500 commodity index decreased by 39.2%, with crude oil losing 60% of its value and other commodities such as natural gas, corn and wheat also experiencing declines.

In line with expectations during uncertain times, the value of gold increased, while the value of the U.S. dollar decreased compared with Euro, GBP and Japanese Yen (Schoenfeld, 2020). These findings provide valuable insights into the impact of pandemics on financial markets and demonstrate the need for firms to consider pandemic risk in their financial planning and risk management strategies.

According to Mazur et al. (2021)), the dramatic responses of the U.S. government and the crash caused by the Covid-19 pandemic had a significant impact on the U.S. economy. The authors reported that U.S. GDP fell by 4.8% in the first quarter of 2020 and the unemployment rate surpassed 20%. In addition, the authors also pointed out that the Dow Jones Industrial Average index fell by 26% in the first four trading days of March 2020.

Salisu & Vo (2020) examined the effect of health news on the predictability of stock returns, using data from the 20 most affected countries by the Covid-19 pandemic. The data consisted of official daily information on reported cases and deaths. The results showed that health news had a significant negative impact on the stock returns of those countries, confirming, confirming that uncertainty does have a negative influence on stock performance and, therefore, on investors' decision making. As the authors stated, "…*rational investors seeking to maximize returns may need to evaluate the extent of uncertainty associated with infectious diseases before taking any investment decision*…"

Smales (2021) also highlighted the importance that investor attention plays in shaping financial market outcomes, particularly in times of pandemics. By examining the relationship between investor attention and the Covid-19 pandemic, the author provides valuable insights into the behaviour of retail investors during times of crisis.

The author used Google Search Volume (GSV) for the word "coronavirus" as a proxy for retail investors' attention to Covid-19 related health news. The results revealed that GSV is, indeed, an appropriate proxy for investors' attention and that its influence on global stock market returns have economically and statistically relevance.

These findings highlight the importance of considering the role of investor attention in shaping financial market outcomes during pandemics. They also demonstrate the need for investors to be informed and attentive to health news related to pandemics, as it can have a significant impact on their investment decisions.

2.4.2-Global financial Markets reaction to Covid-19 cases/deaths

Al-Awadhi et al. (2020) examined the effects of Covid-19 related deaths and infections on the Chinese stock market returns. The findings revealed a strong correlation between the progression of the pandemic, as measured by the daily increase in confirmed cases and fatalities, and the performance of the Chinese stock market. It was noticed that stocks held by foreign investors experienced a greater decline in value compared to locally held stocks and that larger market capitalization stocks faced the most significant drops in return. Additionally, the researchers concluded that sectors such as medicine, manufacturing and information technology outperformed the market, while the beverages and transportation industries performed significantly worse.

Rocha (2021) conducted a similar study, focusing on the U.K. stock market and utilizing 2020 data from the Financial Times Stock Exchange All-share index and Covid-19 related total daily deaths and cases. This time results did not demonstrate a substantial association between the daily index returns and the total number of Covid-19 total related cases and fatalities. However, it was observed that there were positive and negative impacts on specific periods.

Onali (2020) investigated the impact of Covid-19 related cases and deaths on the U.S. stock market. The study utilized a combination of data from the S&P500 and Dow Jones indices, covering the period from 8 April 2019 to 9 April 2020. The cases and deaths data were obtained from seven countries, including the U.S, that were significantly affected by the pandemic. The results indicated that changes in the number of cases and deaths in the first three months of 2020 did not have a substantial effect on the U.S. stock market, with certain exceptions. Specifically, the number of reported cases in China (when logged) and the

number of deaths reported in France and Italy (as per the VAR models) had a significant negative impact on the returns of the Dow Jones Index.

As previously discussed, it is established that pandemics have a significant impact on social, economic and financial well-being. With the information presented above, the focus of this dissertation will be specifically on the impact of Covid-19 pandemic on the European financial markets. The methodology of this study will be drawn from related literature in the field.

3. Data

As previously mentioned, the primary objective of this dissertation is to assess the impact of Covid-19 pandemic related daily total infections and fatalities on the behaviour of the European financial market. This study is an adaptation of similar research conducted by Onali (2020), Rocha (2021) and Al-Awadhi et al. (2020) but focused on the European market.

The data used consists of the daily prices and volume from the index Euro STOXX 50 (graph 5), obtained from Yahoo Finance and the new total daily number of infections and fatalities, obtained from the World Health Organization. This data covers every business day from January 2nd, 2020 to December 31st, 2020.

The Euro STOXX 50 is widely considered to be a good benchmark for studying the financial market in the eurozone, as it is highly transparent and well respected. Being widely followed by investors, economists and market analysts, it is used as a reference for a range of financial products, including exchange-traded funds and financial derivatives. This widespread use makes it a useful tool to track the eurozone financial market performance.

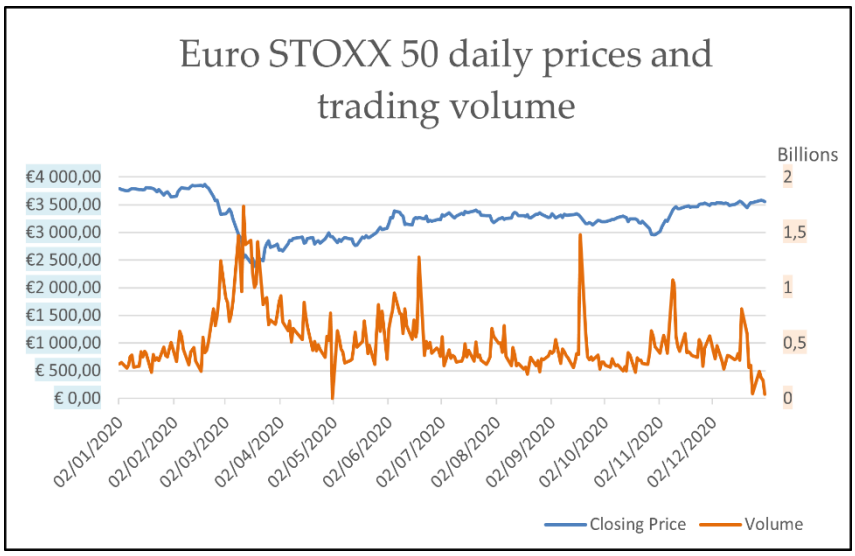


Figure 5 - Daily prices and trading volume for the Euro STOXX 50 index (from 2 January 2020 to 31 December 2020) *Source: Yahoo Finance*

Based on the analysis of Figure 5, it can be observed that the Euro STOXX 50 price experienced a sharp decline from late February to early March, which could potentially be attributed to the arrival of Covid-19 in most European countries and the subsequent declaration of the pandemic by the WHO. This was also around the time when many European countries implemented restrictions on circulation and lockdowns.

While the previous price value was never regained, prices stabilized at around the €3,000 to €3,500 mark, from June onwards, with a drop below this value only occurring in late October. Nonetheless, the Index still managed to end the year 2020 slightly above the €3,500 price mark.

During the period when daily closing prices dropped in February/March, the Euro STOXX 50 also experienced a significant increase in trading volume from February to April, although trading volume was less consistent and suffered several peaks throughout the year. Apart from March, the months of June, September and November were also notable.

Furthermore, data on the daily and total number of Covid-19 cases and deaths for each European were collected from the World Health Organization

over the same period. A descriptive statistical analysis was then made, presented in Table 1, showing the mean, median, maximum a minimum values as well as the standard deviation.

Table 1 - Descriptive statistics of new daily cases, deaths and Euro STOXX 50 log daily returns

Variables	Mean	Median	Maximum	Minimum	Standard Deviation	Skewness	Kurtosis
Daily Cases	45,633.65	13,876	244,284	0	64,283.15		
Daily Deaths	1,141.30	307	4,679	0	1,465.056		
Log Daily Returns	-0.0001	0.0002	0.0924	-0.1240	0.0201	-0.902	8.023

Table 2 presents the average number of Covid 19 cases and related deaths from 1st January to 31st December 2020, which were 45,634 and 1,141 people, respectively. The maximum values reached 244,284 cases and 4,679 deaths. Data also includes negative new daily number of Covid-19 cases, with minimum values never surpassing negative 2, usually due to data entry mistakes, technical issues with the reporting system or errors in processing the data. Nevertheless, these observations will still be considered since from the market perspective that was considered to be the real number and it would react accordingly to it.

Figure 6 demonstrates Europe's Covid-19 evolution for 2020. It shows a first wave of Covid-19 from March to April with cases never surpassing the 5,000 mark. During the studied period, reported infections never exceeded the 30,000 mark. As summer approached, reported infections dropped to considerably low values. However, from September, cases quickly rose, reaching its peak on November 6th, 2020, with 244,284 daily infections. From there, daily cases

remained relatively high, with infections reaching the 10,000 to 20,000 mark. By December 31st, 2020, the total number of Covid-19 infections in Europe was approximately 12 million people.

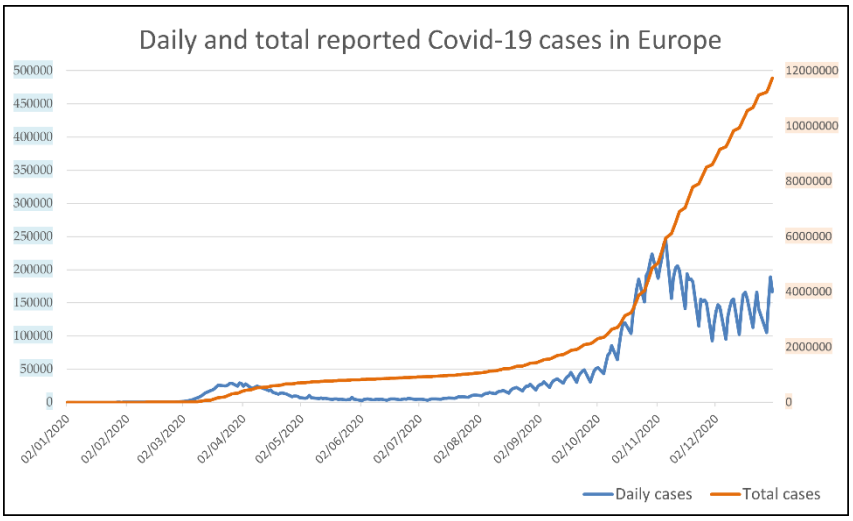


Figure 6- Daily and total Covid-19 Reported cases in Europe (from 2 January 2020 to 31 December 2020)
Source: Data from World Health Organization

In terms of daily reported Covid-19 related deaths, the first case was reported on 13 February, but it wasn't until mid-March that fatalities began to surge, with about 4,500 reported deaths. Throughout March to mid-May, fatalities remained high, with over 500 deaths daily across Europe. Approaching summer, deaths declined, but then began to rise again in late September and remained high until the end of the year, with daily fatalities ranging from 3,000 to 4,500, as evidenced by Figure 7.

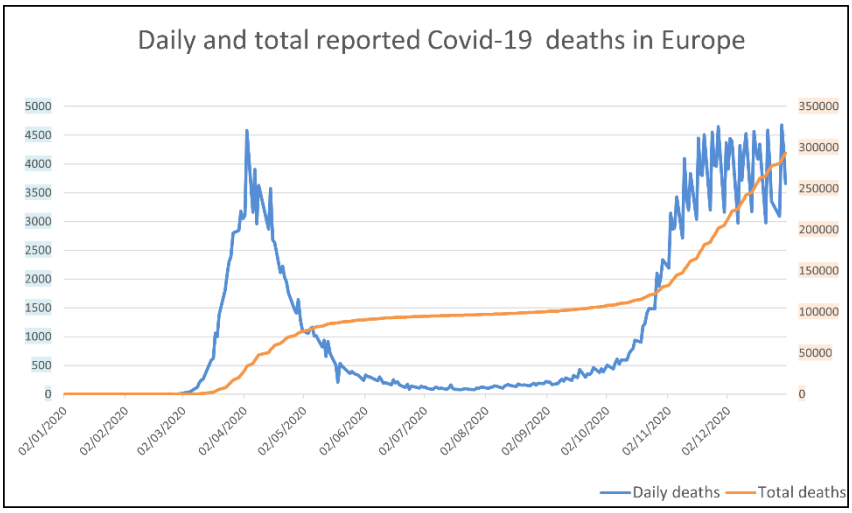


Figure 7 - Daily and total Covid-19 Reported deaths in Europe (from 2 January 2020 to 31 December 2020)
Source: Data from World Health Organization

4. Methodology

The analysis of stock returns will take into consideration their heteroskedastic nature, implying that not all samples will have the same error variance throughout time. This can potentially lead to biased or skewed results (Morgan, 1976), due to the volatility of stock returns tending to be time-varying, with periods of high volatility followed by periods of low volatility. To account for this, a more appropriate model is the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model.

The GARCH model allows for the variance of the error term to be time-dependent, making it a suitable model for analysing data with heteroscedasticity. By allowing for time-varying volatility, the GARCH model can provide more accurate estimates of the parameters and better capture the underlying patterns in the data.

Therefore, to address this issue, the data will be analysed using a GARCH model, which has been shown in literature to be effective in modelling heteroskedastic data by allowing for time-varying volatility to capture underlying patterns in the data. The model utilizes past squared observations and past variances to model current variances (Lamoureux & Lastrapes, 1990). This model has proved itself to be extremely useful in the field of finance due to its effectiveness in modelling asset returns and inflation (Engle, 1982).

Using this model, data will be analysed to answer the following hypotheses:

H1: Did Covid-19 have a significant impact on the European stock markets in 2020, what was the impact?

H2: Did Covid-19 have, throughout 2020, specific periods where it impacted the European stock market, what was the impact?

H3: Did the number of daily fatalities and cases impact the European stock market?

4.1-Models Specification

We used a quantitative approach to analyse the impact of Covid-19 pandemic on the European stock market. To analyse the data, we employed the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model, which is commonly used in financial econometrics to model volatility. The analysis was performed using the R script language, following R libraries used in the finance analysis: quantmod, dplyr, tidyverse, tseries, rugarch, xts, and PerformanceAnalytics.

For the first hypothesis we will investigate whether there were any specific periods, during the 2020 year, where the pandemic influenced the European market. For this hypothesis, we will use the 2020 data of the Euro STOXX 50 index adjusted closing prices (Figure 5) to calculate the log daily returns. From this information we are able to calculate the daily returns volatility. Using a rolling basis method, using the prior 10 business days cumulative daily returns volatility, we are able to evaluate if there were any specific days throughout the year where the index returns were significantly affected.

To achieve this, the following model is proposed:

$$\mathbf{H0:}\ Y_t = b_0 + \sum_1^{248} b_1 F_{x,\,t} + \varepsilon_t = b_0 + \varepsilon_t$$

$$\mathbf{H1:}\ Y_t = b_0 + \sum_1^{248} b_1 F_{x,\,t} + \varepsilon t \neq b_0 + \varepsilon_t$$

This proposition will answer the first research question, with a daily analysis of the cumulative daily returns after January 16th, since 10 business days are needed to collect data to use the rolling basis method. However, this method

will allow us to see the market reaction to the information from the past two weeks while also taking more precise conclusions by emphasizing the impact of the daily return's volatility. This is enabled by the timespan chosen, instead of considering the combined data from 2020 to analyse.

To reject the null hypothesis, at least one of the days must record significantly different cumulative daily returns volatility.

For the second and third research questions, the aim will be to analyse the relationship between the number of daily new cases and the daily new deaths on the daily returns volatility of the Euro STOXX 50 index. For this hypothesis we will use 2020 data from the World Health Organization daily number of cases and casualties (Figure 6 & 7) and the Euro STOXX 50 daily volatility (Figure 10) as independent variables.

To achieve this, the following models will be estimated:

$$H_0: F_t = b_0 + b_1 X_t + \varepsilon_t = b_0 + \varepsilon_t$$

$$H_1: F_t = b_0 + b_1 X_t + \varepsilon_t \neq b_0 + \varepsilon_t$$

&

$$H_0: F_t = b_0 + b_1 Z_t + \varepsilon_t = b_0 + \varepsilon_t$$

$$H_0: F_t = b_0 + b_1 Z_t + \varepsilon_t = b_0 + \varepsilon_t$$

For this propositions to be true, and rejecting the null hypothesis, either b1 has to be different than 0, meaning that the independent variable significantly affects the dependent variable (Y_t).

4.2-Variables

To analyse the data, the following variables will be used:

- Y_t represents the logarithm of adjusted daily returns of the Euro STOXX 50 index calculated as follows: $Y_t = Ln(\frac{Pt}{Pt-1})$; where P_t is the adjusted closing value for the Euro STOXX 50 index on day t and P_{t-1} is the Euro STOXX 50 adjusted closing price on the day t – 1.
- X_t defines the daily number of Covid-19 infections in Europe;
- Z_t defines the daily number of Covid-19 related deaths in Europe;
- $F_{x\,t}$ is a dummy variable, where x = 1,…,247 (where x = 1 represents the cumulative daily return volatility of the first 10 business days of 2020,…, x = 248 represents the cumulative daily return volatility of the last 10 business days of 2020).
- $\boldsymbol{\varepsilon}_t$, is the error term.

5. Results and Discussion

For each research question the respective variables coefficients will be analysed, checking whether there is statistically significance while providing a financial analysis of the results.

To start answering the first research question, we first analyse the descriptive statistics for the Euro STOXX 50 daily returns (Table 1).

Considering 257 observations from the Euro Stoxx 50 index closing prices, the log daily return mean of the index, during 2020, was -0.0001, suggesting that on average, even though slightly negative, there was little change in the index's value throughout the year. However, the median log daily return was slightly higher than the mean at 0.0002, indicating that there were some days with larger positive returns that pushed up the median value. The maximum log daily return was 0.0924, while the minimum log daily return was -0.1240, indicating that the index experienced both large negative and positive returns on some days.

The standard deviation of the log daily returns was 0.0201, suggesting that there was some volatility in the index over the year. However, the standard deviation was relatively low compared to the mean and median, indicating that there were not many extreme values. The negatively skewed distribution of log daily returns with a skewness of -0.9019 suggests that there were more days with small positive returns than with small negative returns. On the other hand, the leptokurtic distribution with a kurtosis of 8.0229 indicates that there were more extreme values (both positive and negative) than would be expected in a normal distribution, suggesting that there were some days with very large positive or negative returns.

Overall, these findings suggest that the Euro Stoxx 50 index experienced some volatility in 2020, but on average, there was little change in the index's value throughout the year.

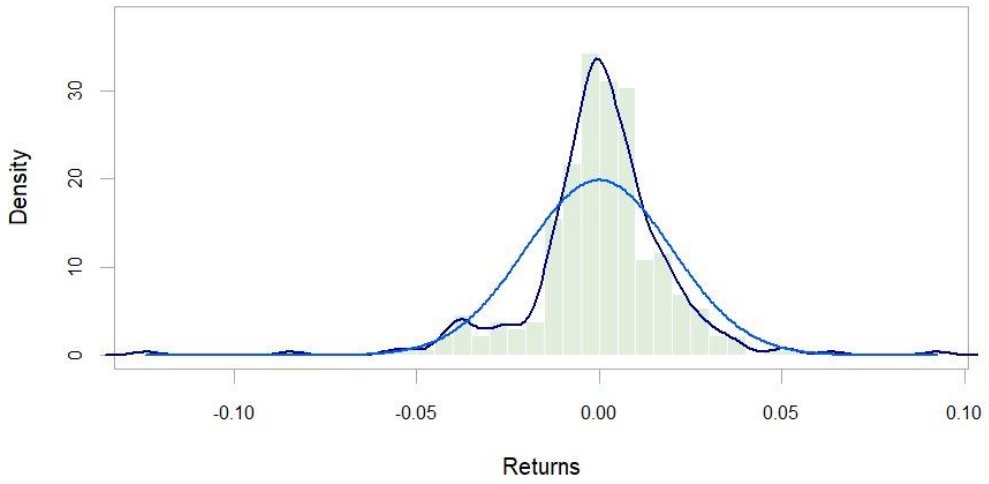


Figure 8 - Histogram of daily returns in 2020 (257 observations)

The histogram (Figure 8) of the Euro STOXX 50 daily returns in 2020 suggests that the distribution of returns is more skewed than normal, which can also be observed in the daily returns time series (Graph 9). Nevertheless, it is visible that around March and November daily returns were significantly higher and lower, indicating a possible consequence of the Covid-19 pandemic on the index.

Based on this analysis, it can be concluded that a normal distribution is not a suitable method for analysing this data, as the data refers to stock returns, it is important to account for heteroskedasticity in the modelling process (Rocha, 2021), making it so that a normal distribution is an inappropriate model as it assumes symmetrical distributions.

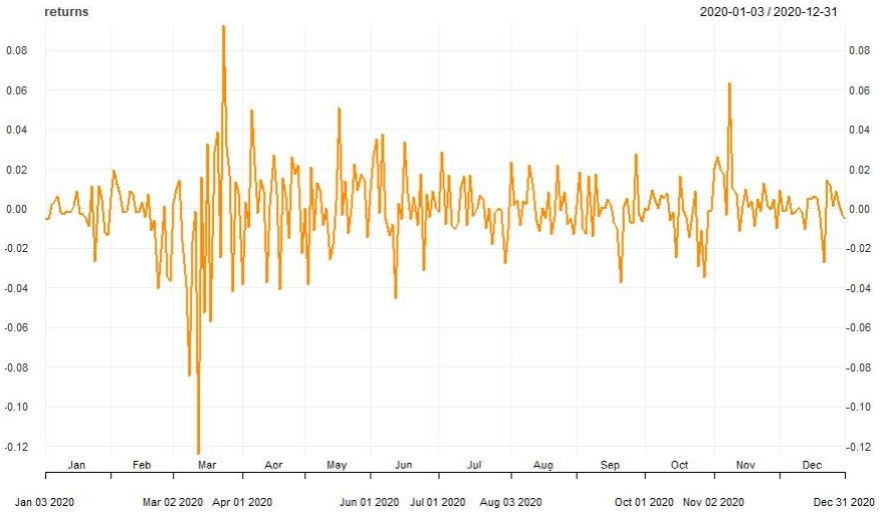


Figure 9- Time series of the Euro STOXX 50 daily returns

Based on this information, we will use a GARCH model, more specifically GARCH (1,1) model with Skewed student distribution. This model includes one lag for the autoregressive (AR) and moving average (MA) terms, usually used in this field of study as it captures some key financial data. This specification will consider that volatility generates volatility, therefore changes in volatility today imply changes in volatility in the future (Bollerslev, 1986), the model also understands that past shocks have lasting effects on volatility, meaning that it is able to capture the idea that large events have a significant impact on future volatility (Taylor, 1986).

To further explore weather 2020 European stock market was impacted by the pandemic (First research question), the volatility of the daily returns was calculated using the programming language R, on a ten-day rolling window basis.

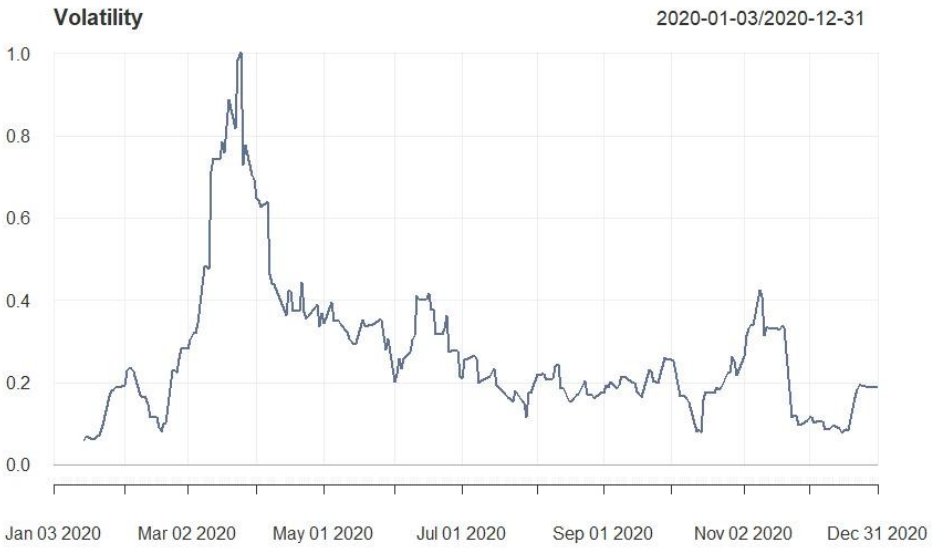


Figure 10 –Euro STOXX 50 Daily Returns Volatility (Computed on a 10 day rolling window basis)

The analysis of Figure 10 highlights the presence of three distinct time intervals characterized by increased volatility of the Index. These peaks occurred during the months of March and November, which align with the first and second waves of the pandemic, respectively. Additionally, another time interval in the month of June was identified with significant volatility.

These findings provide insight into a potential relationship between the financial market's response and the impact of the pandemic on the economy.

In order to be possible to take any conclusions from the previous figure, this analysis will be supported by Table 2, which contains the daily volatility coefficients for each 10-day rolling window returns.

Table 2 - Daily output of variable volatility

Variable	Coefficients
14/02/2020	0.041332115**
17/02/2020	0.049950010**
27/02/2020	0.068106455*
28/02/2020	0.032881017**
02/03/2020	0.032173829**
03/03/2020	0.064370920*
04/03/2020	0.089982235*
05/03/2020	0.078353746*
06/03/2020	0.044169653**
09/03/2020	0.060618336*
10/03/2020	0.065216516*
11/03/2020	0.060387253*
12/03/2020	0.067421025*
16/03/2020	0.074884300*
18/03/2020	0.047517224**
19/03/2020	0.098925886*
28/05/2020	0.063586518*
02/06/2020	0.079408940*
03/06/2020	0.064183083*
04/06/2020	0.032135809**
05/06/2020	0.013942447**
08/06/2020	0.043625092**
28/10/2020	0.093392490*
30/10/2020	0.063597080*
11/11/2020	0.030106124**
12/11/2020	0.049315581**
13/11/2020	0.046062202**
16/11/2020	0.059830470*

*Notes: ***,**,* denotes significance at 1%, 5% and 10%, respectively.*

Table 2 provides insights into the impact of the COVID-19 pandemic on Euro STOXX 50 returns volatility. The table presents daily volatility coefficients for each 10-day rolling window returns, denoting significance at the 1%, 5%, and 10% levels. Significance at these levels implies that the null hypothesis of the independent variable not affecting the dependent variable can be rejected, indicating a significant impact on the returns.

The analysis reveals that during the period from February 14, 2020, to March 19, 2020, most coefficients were significant at the five or ten percent level of significance, highlighting a significant increase in returns volatility. This period coincided with the onset of the pandemic in Europe, considered the first wave.

Further examination of Table 3 reveals that the majority of coefficients for May 28, 2020, to June 8, 2020, and from October 28, 2020, to November 16, 2020, were also below either the five or the ten percent level of significance. This indicates a significant increase in the volatility of the return during these periods, signifying a lasting impact of the pandemic on the Euro STOXX 50 index.

This analysis shows that there were three distinct time periods where the volatility of the Euro STOXX 50 returns was significantly higher than normal. The first period coincides with the start of the pandemic in Europe, which is considered to have been the first wave. The second period occurred during the early stages of the pandemic recovery, with governments beginning to lift lockdown restrictions and economies starting to open. The last period coincides with the second wave of the Covid-19 pandemic in Europe, which resulted in many governments imposing stricter measures to control the virus spread.

Therefore, we can conclude that the null hypothesis, is rejected and consequently say that the European financial market was in fact impacted by the pandemic, alongside other events, more specifically during those three periods.

To answer the second and third research questions, we will we will take a look at Figure 11, which displays the logarithmic daily returns of the 2020 Euro STOXX 50 and the logarithm of the two independent variables, daily cases and daily deaths. The purpose is to do a pre-analysis of the potential relationship

between Covid-19 pandemic, measured by the daily new cases and deaths, and the stock market performance, measured by the index volatility.

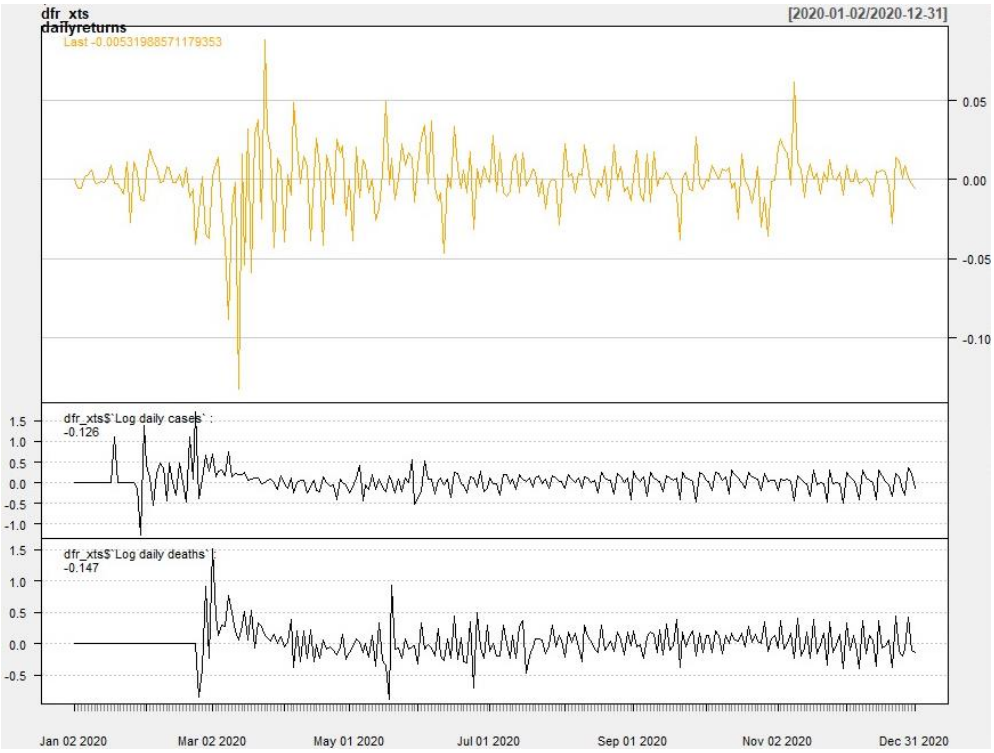


Figure 11 – Daily Euro STOXX 50 returns volatility and daily new covid-19 related cases and deaths

The Figure indicates that there is a correlation between the index volatility and the daily number of cases/deaths. This effect was particularly evident during the months of February/March, May/June and October/November. When significant changes in volatility occurred.

Daily cases were found to have some statistical significance during the early part of the year until March and then again in June but less notably. They do not appear to have an apparent impact for the remainder of the year.

On the other hand, daily deaths appear to be strongly correlated with return volatility, mainly around the months of March and again in May/June.

They also appear to have some persisting effect for the rest of the year, although to a lesser degree.

In addition, it is worth mentioning that the time periods in which both variables appear to have a significant impact on the independent variable coincide with the time periods when this independent variable exhibits significant changes in behaviour.

These findings suggest a potential correlation between Covid-19 cases and deaths and the stock market volatility during these time periods.

The impact of the COVID-19 pandemic on Euro STOXX 50 returns volatility was analysed in order to study the second and third research questions. The variables Cases and deaths, calculated on a 10-day rolling window basis, were examined to determine if there were any specific periods where these variables had a significant impact on the returns. Additionally, the periods were checked to see if they matched the periods where the index volatility was significantly altered.

Table 4 provides insights into the impact of the COVID-19 pandemic on Euro STOXX 50 returns volatility. The table presents daily cases and covid-19 related death coefficients for each 10-day rolling window returns, denoting significance at the 1%, 5%, and 10% levels. Significance at these levels implies that the null hypothesis of the independent variables having no effect on the dependent variable can be rejected, indicating a significant impact on the volatility of the returns.

The Table 4 analysis reveals that during the period from March 3, 2020, to March 27, 2020, all coefficients were significant at the five level of significance, with the majority amount even being significant at the 1% level. Similarly to the

cases, the death coefficients also present significant values, from March 10, 2020, to April 3, 2020. This indicates a strong correlation between both variables and the Returns volatility, meaning that the index behaviour can be explained by the evolution of the pandemic.

In comparison to the significant volatility coefficients, it can be concluded that the European Covid-19 cases actually had a more significant impact on the financial market, since in these initial moments, there are more matches between the significant index volatility changes and the daily number of cases, more specifically for the period of March 3 to March 19, 2020. It is also possible to realize that the index was significantly more volatile before either variable had a significant effect on the returns. This can be explained by the European market being linked to other markets and starting to feel the effects that this pandemic had worldwide.

Additional analysis shows that the death coefficients also present a significant period from October 19 to November 3, 2020. This indicates that after an initial phase the market stopped reacting to the number of cases and, instead, started to pay more attention to the daily number of deaths.

In conclusion, it is visible that both variables have a positive and statistical significance for the respective dates, meaning that not only they did in fact impact the Euro STOXX 50 index returns, but as they have a positive relationship, as the cases/deaths increase, so does the volatility of the returns.

In earlier dates the P-values are significantly low, indicating a higher degree of confidence in the statistical significance of the coefficients, this is a result of the goverments implemented lockdowns with the objective of stopping the spread of the virus, there was also uncertainty surrounding the goverments policies that heightened this consequences.

However, as time progresses the P-values increase, turning the relationship less significant. In general, we can see that at first, the financial market had a strong relationship with both variables, even though the number of cases impacted the index the most. In a later period, the cases did not have as strong of a relation, however, during this period, the daily number of deaths started to affect the market performance. This could also be the response to the many stimulus measures to stabilize the market in the short term, that created uncertainty in the long term about the implications and risks of such measures.

Table 3 - Daily cases and daily deaths impact in volatility by date

Variable (deaths)	Coefficients	Variable (cases)	Coefficients
10/03/2020	0.039847514**	03/03/2020	0.098687209*
11/03/2020	0.011419446**	04/03/2020	0.037325673**
12/03/2020	0.026173263**	05/03/2020	0.058119481*
13/03/2020	0.008293432***	06/03/2020	0.052414284*
16/03/2020	0.000490181***	09/03/2020	0.023636649**
17/03/2020	0.001752500***	10/03/2020	0.001994462***
18/03/2020	0.000798349***	11/03/2020	0.001100636***
19/03/2020	0.003930450***	12/03/2020	0.001592002***
20/03/2020	0.003606050***	13/03/2020	0.002079746***
23/03/2020	0.002440181***	16/03/2020	0.001418590***
24/03/2020	0.003915912***	17/03/2020	0.002239073***
25/03/2020	0.005939147***	18/03/2020	0.004114259***
26/03/2020	0.006517607***	19/03/2020	0.007050415***
27/03/2020	0.009019072***	20/03/2020	0.009042034***
30/03/2020	0.018741138**	23/03/2020	0.000697641***
31/03/2020	0.014886128**	24/03/2020	0.002795359***
01/04/2020	0.024860577**	25/03/2020	0.004446380***
02/04/2020	0.012508331**	26/03/2020	0.005963664***
03/04/2020	0.016634585**	27/03/2020	0.014192312**
27/04/2020	0.094896483*	27/04/2020	0.068546791**
29/04/2020	0.091124020*		
30/04/2020	0.090962004*		
01/05/2020	0.053764546*		
04/05/2020	0.085141807*		
13/05/2020	0.093256449*		
19/10/2020	0.074864913*		
20/10/2020	0.074415803*		
22/10/2020	0.008981488***		
23/10/2020	0.013908678**		
26/10/2020	0.014845801**		
27/10/2020	0.022104082**		
28/10/2020	0.076376806*		
29/10/2020	0.065241715*		
30/10/2020	0.070357193*		
02/11/2020	0.081730929*		
03/11/2020	0.082124861*		

*Notes: ***,**,* denotes significance at 1%, 5% and 10%, respectively.*

6. Conclusion

This dissertation purpose is to provide an overview of the financial market behaviour during uncertain periods by analysing the European financial market during the first year of the Covid-19 pandemic.The Covid-19 pandemic had a significant impact on the global economy, leading to a sharp decline in economic activity and an increase on the financial markets volatility.In a society with increasing interdependency, with ever more liberal economic and capital markets, it is of great importance to understand the consequences that unstable times might provoque on the economic system.

In 2020, Covid-19 pandemic struck, and with it serious consequences emerged, from country wide lockdowns that lead to abrupt decrease in economic activity, to stimulus checks to slow down economic recession and other economic and social policies implemented by the government that affected the market.

Using a Garch model with a t-student skewness, we constructed a dataset of the number of Covid-19 related deaths and cases on a 10 day rolling window and them paired with the daily returns of the Euro STOXX 50 for 2020. We analyse if there were significant volatility of the index for that year, and pin-point in which dates that happened, afterwards, we analysed the impact that daily cases and deaths had on the index volatility. This made possible to compare and see if pandemic was responsible for any abnormal index volatility.

Results conclude that there were two separate periods where the market reacted to the pandemic. First around the first European lockdown phase, where the market highly responded to the number of cases and secondly around the

second wave in November where the market reacted more to the fatalities numbers.

However, there are some limitation to this work as it was not possible to isolate the possible effects of Covid-19 from every other event that could affect financial markets, such as Brexit, Black lives matter world social movement and the United States elections.

This theis contributes to the current literature by providing more insight into the behaviour of financial markets during periods of stress. Is can help governments and companies with decision making by considering the market reaction to this types of events.

Note that there is space for further investigation on this topic, since it was considered a Index that was not present in every European country and even by checking the reaction of the market by industries, as it is know that some industries have a reverse reaction to the market, for example the pharmaceutical and the communications industries.

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