FACULTEIT ECONOMIE EN BEDRIJFSKUNDE

# THE IMPACT OF COVID-19 ON STOCK MARKET PERFORMANCE WORLDWIDE

Aantal woorden: 20.032

Nathan Christiaens
Stamnummer : 01508061

Jeroen Macharis
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Promotor: Prof. Dr. Koen Inghelbrecht

Masterproef voorgedragen tot het bekomen van de graad van:

Master in de bedrijfseconomie: bedrijfseconomie

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# SUMMARY

The purpose of this thesis is to investigate the impact of Covid-19 on the stock market performance worldwide. Therefore, this paper takes into account the number of Covid-19 cases, the number of deaths due to Covid-19, the government measures and the financial stimulus packages. Concerning the financial stimuli, two different types of support are taken into account: the provided income support and the debt and contract relief. Since both types of financial support are related to households, the demand side of the stock market is investigated. The MSCI index of each country, which represents up to 85% of the free float market capitalization, is used to determine the stock market returns.

Most existing literature only focuses on one of the four previously mentioned factors, or only focuses on a limited number of countries. That's why this master dissertation handles all four items for a larger number of countries spread around the globe. Furthermore, while most papers only take into account the first few months of the pandemic, this dissertation takes into account a longer period of approximately 10 months: from the 1st of January 2020 until the 3rd of November 2020.

Next to the main research, a data description is executed to make a comparison between countries in terms of how hard each one was hit by the virus and how they have handled the pandemic.

The results show that the number of cases do not have an impact on the stock market returns during the investigated period of approximately 10 months. Same results are found for the number of deaths due to Covid-19. Looking at the impact of government measures to stop the spread of the virus, only a part of the investigated countries shows a link between the measures and the returns. However, if there is a relation between these two, the results always show that government measures have a small, positive impact on the stock market. Concerning financial stimulus packages, both income support and debt and contract relief mostly show a direct link with the stock market returns. Both stimuli can lead to three different types of reactions on the stock market: the support creates a positive sentiment and thus leads to a positive impact on the returns, the support creates a negative sentiment and therefore has a negative impact on the returns, or the stimulus packages have no impact.

A difference in reaction on both types of stimulus packages within a country itself is possible, which could be explained by the prospect theory or the fact that both financial stimuli solve different types of problems. The inconsistent policy regarding both financial stimuli could also be a possible explanation for the different reactions.

# ACKNOWLEDGEMENT

Completing this paper on a relatively new subject would not have been possible without the support of many people. Therefore, we would like to express a word of gratitude for some people that helped us during this period of hard work.

First of all we would like to thank Professor Koen Inghelbrecht from Ghent University. As the promotor of our thesis, he was always there to provide solutions for many complicated problems we ran into. He helped us to get on the right track and was always there for us when advice was needed. His help, assistance and motivation made sure we reached our best results.

Secondly, we would like to thank all the people in our surroundings that supported us while writing this thesis: parents, family, friends… Their encouragement brought the best out of us, which had a positive impact on the outcome of this dissertation.

Lastly, we also want to express our gratitude to the University of Oxford and the Blavatnik School of Government for the use of their collected data and the quick and helpful response regarding questions about their database.

# TABLE OF CONTENTS

# LIST OF ABBREVIATIONS

| | |
|---|---|
| ADF test | Augmented Dickey-Fuller test |
| BLUE | Best Linear Unbiased Estimator |
| EMH | Efficient Market Hypothesis |
| EU ODP | European Union Open Data Portal |
| GDP | Gross Domestic Product |
| OLS regression | Ordinary Least Squares regression |
| OWID | Our World In Data |
| EPU index | Economic Policy Uncertainty index |
| PHEIC | Public Health Emergency of International Concern |
| SARS | Severe Acute Respiratory Syndrome |
| TEU index | Twitter-based Economic Uncertainty index |
| VIF | Variance Inflation Factor |
| VIX | Volatility Index |
| WHO | World Health Organization |
| YTM | Yield To Maturity |

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# 1. INTRODUCTION

There is no doubt that the Covid-19 pandemic is one of the most far-reaching events of the last decades. In a certain way, every country is impacted by the outbreak of the virus. It is clear that the virus has an impact on many aspects of people's life, but what is its impact on the stock market? Some previous virus outbreaks did not have an impact on the stock markets (Baker et al., 2020), but with such a global pandemic, the results may be different this time. Also, some countries or even continents are hit more severe by the virus than others, but does this mean their stock markets are also hit harder?

The main goal of this thesis is to prove whether or not the pandemic had an impact on the stock markets worldwide. This is done by analyzing data from 28 different countries spread around the world. As a start, the data itself is analyzed to form a global image about the impact in the investigated countries. Next, the main research is executed which first focuses on the impact of the number of cases and deaths per country. Afterwards, the effect of the stringency of the government measures (to limit the spread of the virus) is investigated. Finally, this thesis examines the impact of two types of financial support: the income support and the debt and contract relief.

This paper forms an important addition to the existing literature because of the observation of a longer period of time in multiple countries. It also adds important results to the domain of the financial stimuli, which until now has not been extensively studied.

The structure of this thesis consists of the following sections: the first section is the literature review, where the existing information on this subject is combined. The second section describes the research design and the research questions that this paper will answer. The third section handles the collected and used data, including the descriptive statistics. The fourth section shows the research and the results of the investigation. Section five describes the limitations of this investigation and the possible expansions, while section six contains the final conclusion.

# 2. LITERATURE REVIEW

## 2.1. The corona pandemic

On the 31st of December 2019, the first infection with the new coronavirus SARS-CoV-2 was identified in the city Of Wuhan, the capital of the Hubei Province in China. This specific strain of coronaviruses had never been diagnosed in humans before. Up to today, it is still unknown how the virus ended up infecting a human being, since it had mostly been diagnosed in animals.

The virus can cause the illness Covid-19, for which no vaccine was available for the public until the end of December 2020. The coronavirus mostly spreads through small droplets, which are released during coughing, sneezing and even talking or breathing. This is the reason why many countries around the globe obliged people to keep a safe distance and to wear a mouth mask (Rijksinstituut voor Volksgezondheid en Milieu, 2020).

The illness typically causes infected people to have a fever, a cough or extreme tiredness. Other symptoms that are observed are headaches, sore muscles, loss of taste and smell, shortness of breath… (Mayo Clinic, 2020). The illness causes a severe danger for elderly people (+70 years old), people with underlying conditions (such as pulmonary problems) and people with obesity. These groups have a higher risk of ending up in the hospital, intensive care or even dying from the infection (Rijksinstituut voor Volksgezondheid en Milieu, 2020).

After the first case, that was reported in Wuhan, the virus spread at a very high pace. Logically, it first spread outside Wuhan and the amount of cases in China rose to huge numbers every day. It did not take long before cases were reported in other Asian countries, and soon also in other continents. The first confirmed case in Europe took place on the 24th of January and was located in France. At the end of January, already more than 10.000 people were infected with the virus, most of them still in Hubei and the rest of China. Belgium noted their first case on the 3th of February. During the months February and March, more and more countries had to deal with infections and the rising number of hospital patients quickly followed. On the 11th of March, the World Health Organization (WHO) declared in an announcement that Covid-19 is considered a pandemic. (World Health Organization, 2020).

Because of the rising numbers of cases, hospitalizations and deaths, many countries decided to implement measures to try to limit the further spread of corona. Most of them chose for a temporary ‘lockdown’, with the definition of a lockdown differing from country to country. Some governments still let people have a form of freedom (for example in Sweden), but measures had an impact in every country and on everyone’s life. Some big events during the Covid-19 pandemic are shown in Figure 1.

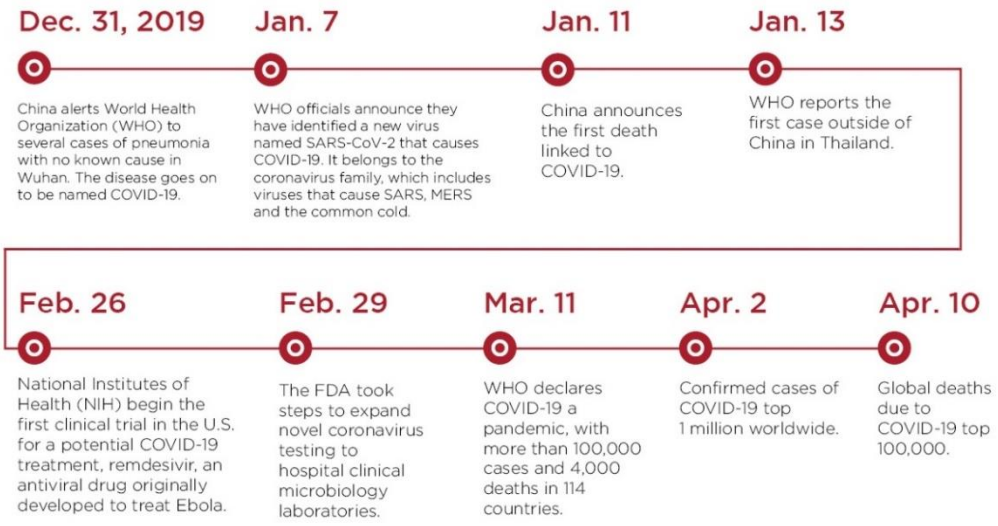



*Figure 1: Big events during the Covid-19 pandemic (American Society for Microbiology, 2020)*

All of the events above have an enormous impact: socially, economically, financially,… It is no secret that this crisis also has an impact on the stock markets' returns and volatility. Fear and uncertainty are elements that play a key role in this unusual time for the stock markets. Until a vaccine is provided to most of the population and the world has gone 'back to normal', this uncertainty and unexpected events will keep having an impact.

## 2.2. Impact of previous virus outbreaks

In the previous years, some serious virus outbreaks have already been witnessed: SARS, Ebola, the Zika virus, polio etc. However, a virus outbreak with such an impact as the Covid-19 pandemic has not occurred in recent decades. What can be learned from the previous outbreaks and are there any similarities with the current crisis?

Since 2005, whenever there is a serious disease outbreak that needs an internationally coordinated approach, the WHO can declare a Public Health Emergency of International Concern (PHEIC). This has taken place six times for the following diseases: H1N1 influenza, polio, Ebola (in 2014 and 2019), the Zika virus and the novel coronavirus.

Previous papers have studied the differences and similarities of stock market reactions on the PHEIC announcements by the WHO. Albeit these PHEIC announcements can be seen as similar events, there were no unambiguous patterns observed in the stock market reactions (Schell, Mei Wang, &Luu Duc Huynh, 2020). Of all virus outbreaks that were investigated in this research, only Covid-19 turned out to have a significant negative impact on the stock market prices for at least 30 days. Only the PHEIC announcement of the Ebola outbreak in 2014 led to semi-similar results compared to Covid-19, this in terms of the number of countries that experienced negative abnormal returns. However, these

countries were not negatively impacted in the long run. The impact of the other viruses on the stock markets was only minimal and temporary.

Baker et al. (2020) found that no other disease in history caused equally drastic and frequent swings in the daily stock market prices as did Covid-19. In other words, the novel coronavirus has a much bigger impact on the stock market volatility than any similar previous disease. Especially the policy responses and the measures to prevent the spread of the virus are the main reason for the big impact on the stock market.

Scientists found out that the Severe Acute Respiratory Syndrome (SARS) and COVID-19 belong to the same family of viruses. For this reason, a closer look could be taken at the impact of SARS on the stock market. Despite the fact that a lot of articles argued that SARS would have a big negative impact, Nippani and Washer (2004) concluded that there is no evidence that SARS negatively influenced the affected nations' stock markets. This indicates that the markets were able to react correctly to the limited impact of SARS. This was confirmed by Keogh-Brown and Smith (2008), who found that the economic impact of SARS was minimal and only temporary.

After all, SARS 'only' affected 23 countries, while the coronavirus is already detected in more than 150 countries. This is one of the reasons why the impact of Covid-19 on the stock markets is much bigger than the impact of SARS. Other reasons could be detected as well, such as the social-media driven news cycle, the expensive stock market at the end of 2019 and the beginning of 2020, and the global interconnected supply chains (DeCambre, 2020).

Also, on sectoral level something can be learned from previous virus outbreaks. It is clear that some sectors are positively affected during pandemics, while others are negatively impacted. Chen, Jang and Kim (2007) have shown that the tourism industry is the most fragile sector during epidemics. At this moment, there are also disasters taking place in this sector. Besides this, also retail, wholesale and entertainment are vulnerable sectors. On the other hand there are some industries that thrive during pandemics, such as the biotechnology sector (Chen, Chen, Tang, &Huang, 2009). These findings are confirmed by Donadelli, Kizys and Riedel (2017), who found that the WHO alerts and disease-related news influence the investor's mood and lead to significant positive effects on biotechnology and pharmaceutical stocks in the US.

## 2.3. The reaction of the stock markets

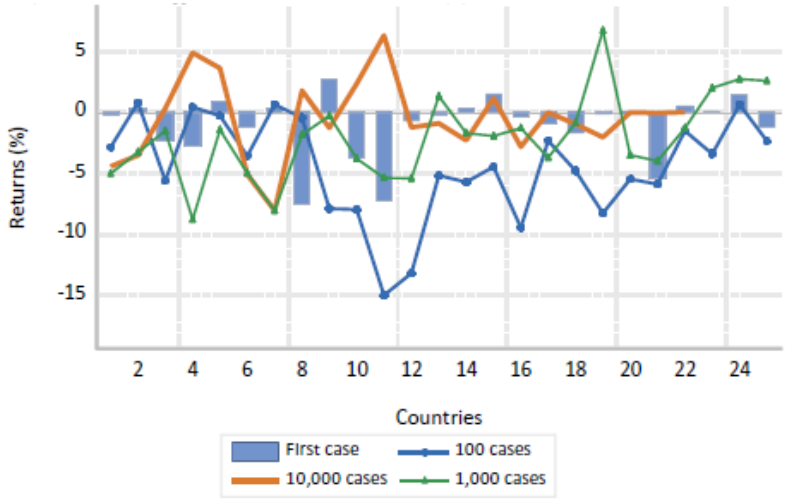
To gain a comprehensive view about the ongoing Covid-19 situation, the current literature is studied. The conclusion can be drawn that there are four important factors influencing the stock market returns

and volatility: the number of confirmed cases, the number of fatalities, the government measures and the financial stimulus packages of local authorities. Unfortunately, research on the latter is limited.

### 2.3.1. Cases and fatalities

#### Stock market returns

Phan and Paresh (2020) gave a commentary on how the stock prices reacted to the different stages of the pandemic. Their main hypothesis states that the markets typically overreact in the early stages of the virus outbreak, but that they will correct themselves after government measurements are taken, more information becomes available and people start understanding the real situation. This overreaction followed by the correction can be seen in Graph 1, which shows the stock market returns of 25 countries at the moment of the 1st, 100th, 1000th and 10.000th Covid-19 case in that particular country. As visible in the graph, the returns generally increase over the different stages of the virus. This study is just a commentary, so the results still have to be proven by hard numbers, which is done in the following.




*Graph 1: Stock market returns for the different stages of the outbreak (Phan & Narayan, 2020)*

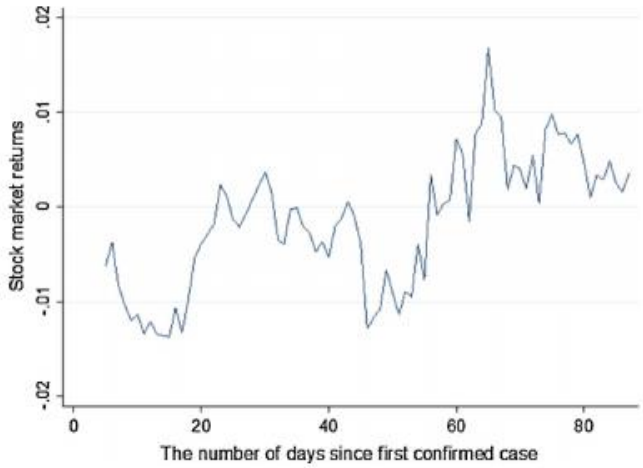
Al-Awadhi, Alsaifi, Al-Awadhi and Alhammadi (2020) investigated whether the coronavirus had an impact on the stock markets of the Hang Seng Index and the Shanghai Stock Exchange Composite Index. The results show that both the daily growth in total confirmed cases and total number of deaths due to Covid-19 had significant negative effects on the stock returns of all companies included in these indices. They also proved that B-shares (which are designed for foreign investors) clearly experienced more negative effects than A-shares. In other words, foreign investors were more pessimistic about the situation than the native citizens. Afterwards, Schell et al. (2020) acknowledged these discoveries with their own research.

For the UK, very similar results can be found. Both the number of confirmed cases as the number of deaths due to Covid-19 show a direct and negative link with the daily stock returns (Tahat & Ahmed, 2020). The same conclusion can be drawn for the United States (Onali, 2020).

The above mentioned studies focused on single countries' indices, which can be extended by looking at multiple stock markets at the same time. This provides a very interesting insight. Namely, Ashraf (2020) learned in a study covering 64 countries that stock markets only react negatively to an increase in the amount of confirmed cases, and not the number of deaths. This can be explained by the fact that dying from the virus is a result of getting infected. Markets have already reacted to the increase in confirmed cases, whilst fatalities have less of an impact afterwards.

Khan et al. (2020) also found a statistically significant relationship between the growth rate of weekly new cases of the coronavirus and the stock markets. Their OLS regression model showed that both parameters are correlated negatively for most of the important countries in America, Asia and Europe. Liu et al. (2020) confirmed the adverse effect of the number of cases on the stock returns using an event study method.

It is also important to look at the timing of market plunges. The timing of market decreases mostly occur in different stages. On average, the market first shows a remarkable decline at the day of the first confirmed case. After some days, the market starts recovering as government measures are taken and as a counter-action to the exaggerated first reaction. After some time the virus results in a severe outbreak and a second downfall occurs (Ashraf, 2020; Khan et al., 2020). This sequence can be seen in Graph 2.

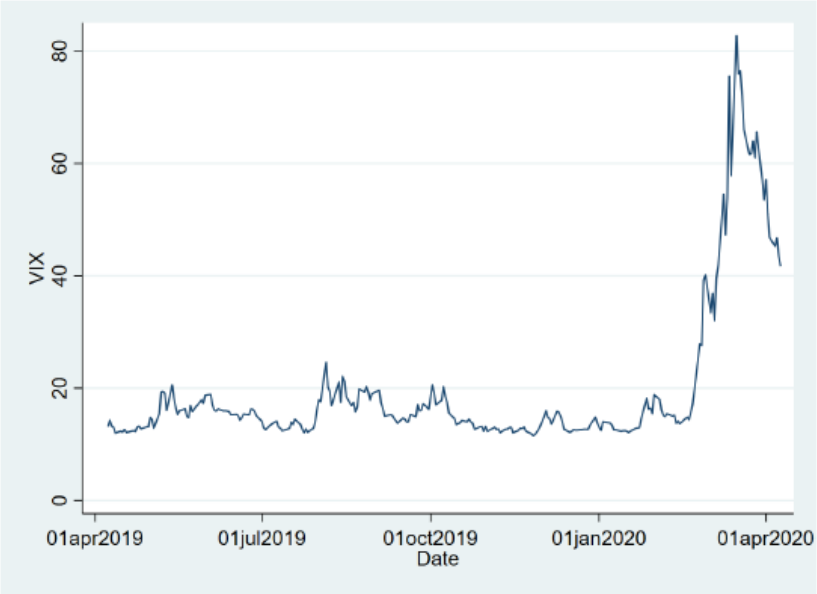



*Graph 2: Daily stock market returns in function of the days since the first confirmed case (Ashraf, 2020)*

## Volatility

The Covid-19 pandemic did not only negatively impact the mean of the stock market returns, but also increased the volatility. The volatility is measured using the standard deviation of the returns.

Looking at the Volatility Index (VIX), which reflects the volatility of the S&P500, it is obvious that the volatility in the United States increased significantly since the outbreak of the coronavirus. The values of the VIX, often called the "fear index", are shown in Graph 3. A significant relationship between the number of confirmed cases and deaths due to the coronavirus and the VIX is found. Both parameters are positively correlated (Baig, Butt, Haroon, &Rizvi, 2020; Onali, 2020). Other research discovered even more detailed links between the official announcements regarding new cases and deaths and the VIX. First of all, it is proven that only new cases reported in other countries than China have a significant impact on the VIX. Furthermore, the announcements of deaths in all countries have a significant influence on the VIX, but this effect is stronger for deaths reported outside of China. At last, the spread of Covid-19, measured by the number of affected countries, is positively correlated with the financial volatility in the United States (Albulescu, 2020).




*Graph 3: VIX values during one year (Onali , 2020)*

Ahmed (2020) showed in his study that there is a positive relationship between the human costs in terms of deaths and cases and the volatility of the FTSE 100. In other words, the volatility of the stock market in the United Kingdom increased as well since the outbreak of Covid-19.

The above stated conclusions can be extended for countries all over the world. Liu et al. (2020) concluded, using an event study method, that the volatility of the 21 most important stock market indices in the world increased due to the outbreak of the coronavirus. This is in accordance with prior

strands of literature that link restrictive government policies (Zaremba et al., 2020) and distress and anxiety causing news (Mehra and Sah, 2002; Donadelli et al., 2017) with the volatility of stock markets.

The increase of the stock market volatility can be related to higher levels of risk and a rising uncertainty. How long will this situation last, how will the number of cases evolve over time, will there be a vaccine,…? Besides this, also the enormous negative impact of the virus on the economy boosts the volatility of the stock market (Ahmed, 2020).

Onali (2020) detected a negative relationship between stock market returns and volatility. This is in line with previous literature that studied the correlation between the VIX index and US stock market returns (Mollick & Assefa (2013), Fernandes et al. (2014)).

### 2.3.2. Government measures

Following the quick increase of cases and deaths around the world, many governments chose to issue measures to limit the further spread of the virus. These differed between the large number of nations who were hit with Covid-19: some imposed a real lockdown, where inhabitants were forced to stay in their house during a certain period of time and schools, pubs, restaurants,… were forced to close. Some countries chose for a smaller intervention, for example the Swedish government never imposed a real lockdown. Big events, however, were cancelled worldwide.

Actions taken by local governments have an impact in many forms: financially, economically, socially… The impact on stock market returns and volatility cannot be overlooked. But nonetheless, lockdowns and other measures have certainly had a positive impact as well.

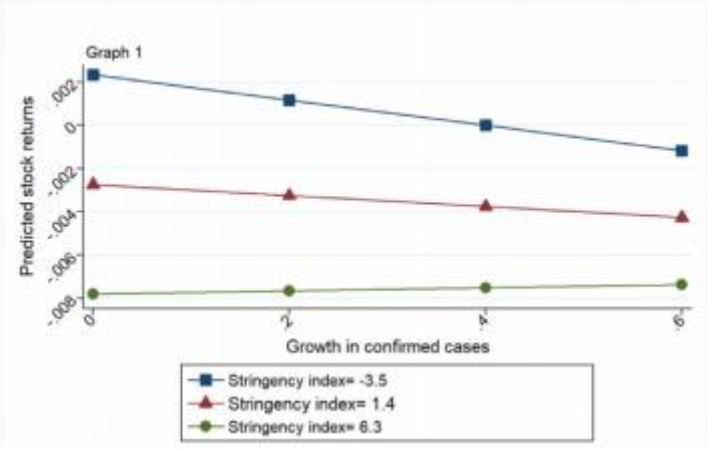
Oxford University has developed the Coronavirus Government Response Tracker, a tool that shows how the government from a specific country has taken action to contain the spread of Covid-19. To obtain this tracker, 19 indicators are created that take into account information of containment and closure, economic policies and health system policies (University of Oxford & Blavatnik School of Government, 2020).

Studies concerning the US and the S&P500 show that government restrictions have caused a negative impact on the stock market. By using the stringency index of Oxford University, Baig, Butt, Haroon and Rizvi (2020) show that the implementation of government restrictions, such as limited mobility due to lockdowns, social distancing, closure of workplaces… contributes to the illiquidity and instability of the markets.

Other studies also show a negative impact on stock market volatility, and this in many countries around the world. Using the stringency index of Oxford University and panel regression for 67 countries, results show that the interventions of the government lead to higher stock market volatility: increase in

stringency of measures has an increase of volatility as a result (Zaremba, Kizys, Aharon, &Demir, 2020). Furthermore, these scientists found that two types of policy responses show most of the impact on the volatility. First, the government information campaigns have a major influence on investors and the composition of their portfolio. Second, the cancellation of public events also has a more significant impact on the volatility, compared to other measures (for example the closing of schools or closing of public transport). The reason for this is that the cancellation of these public events are mostly one of the first measures taken, which forms a first negative signal for investors. Therefore, this intervention gives people the first chance to react and change their portfolio.

As mentioned before, next to the negative impact of government regulations, the advantage of such measures exist as well. Ashraf (2020) studied the impact of social distancing, containment and health response and income support packages on stock markets. This by using the government response index and stock market information from 80 different countries. For social distancing, the results show that this measure has a direct negative impact on stock market returns. After all, economic activity is affected by this measure. However, social distancing also saves lives: it reduces the number of infections. This leads to the fact that socials distancing also has an indirect positive impact on stock market returns. As shown in Graph 4, more stringent actions clearly lead to lower expected returns. However, the indirect effect can be seen through the slope of the lines, with very strict rules even having a positive effect on returns when growth in confirmed cases rises.

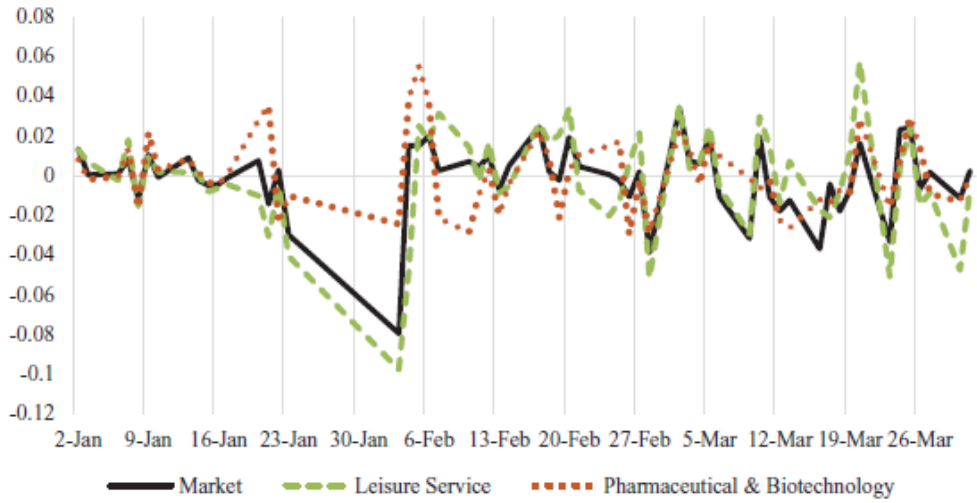



*Graph 4: Relationship between the growth in confirmed cases and predicted stock returns, depending on stringency of government measures (Ashraf, 2020)*

The positive effect of containment and health response also has a positive impact on the stock market returns. People have trust in this approach of the government and the investors regain their confidence. Adding to this, the healthcare leads to a decrease in number of cases and deaths, which in itself has an extra positive effect on the returns. Growth in number of cases still has a negative impact on expected returns. Lastly, the distribution of income support packages leads to a positive effect on returns,

because they counter the negative effects of social distancing and lockdowns (Ashraf, 2020). The effect of stimulus packages is described more extensively later on.

The impact of the government's reaction hits differently regarding the various industry sectors. In China, at the moment of the Covid-19 outbreak, the leisure industry was hit the hardest while pharmaceutical and biotechnology mostly benefitted. However, reversals can be observed with some sectors as well. Looking at the post-event window, 19 of the 22 industries with negative cumulative abnormal returns have recovered within a month. Six industries with positive cumulative abnormal returns during the event window, faced a downfall in the post-event window. This can be seen in Graph 5, which shows the raw returns over time for the whole A-share market and two industries. Some industries, such as the computer industry, show positive cumulative abnormal returns in both the event window and post-event window (Huo & Qiu, 2020).




*Graph 5: Impact on leisure and pharmaceutical and biotechnology industry (Huo & Qiu, 2020)*

### 2.3.3. Financial stimulus packages by local authorities

Unfortunately, the impact of financial stimulus packages provided by the local authorities on the stock markets is not yet examined extensively. That is why the research of this dissertation will take a closer look at this matter.

Considering the countries of the G7, it turned out that those financial stimulus packages had a positive effect on all the countries' stock markets (Phan & Narayan, 2020).

Onali (2020) confirmed this statement, particularly for the United States. The VIX reached its peak on March 27$^{th}$ after which it recovered at high pace. This suggests that the announcement of the federal reserve on March 24$^{th}$, to provide financial stimulus packages, helped decreasing the VIX. Cox, Greenwald and Ludvigson (2020) discovered more detailed insights related to these stimulus packages.

Conventional monetary policy announcements (such as lowering the federal funds rate, extensive asset purchasing, …) did not impact the markets, at least initially. In contrast to this, unconventional monetary policy announcements (special Covid-19 lending facilities to support the economy) effectively play a role in the recovery of markets.

However, a remark should be made here. Weeks after announcing the help measures by the federal reserve, only a small fraction of the promised credits have been extended. This reinforces the assumption that the market movements during the coronavirus pandemic are much more a reflection of sentiment than substance. This way, the market recovery could be attributed to the response to important pieces of good news rather than to the financial support itself.

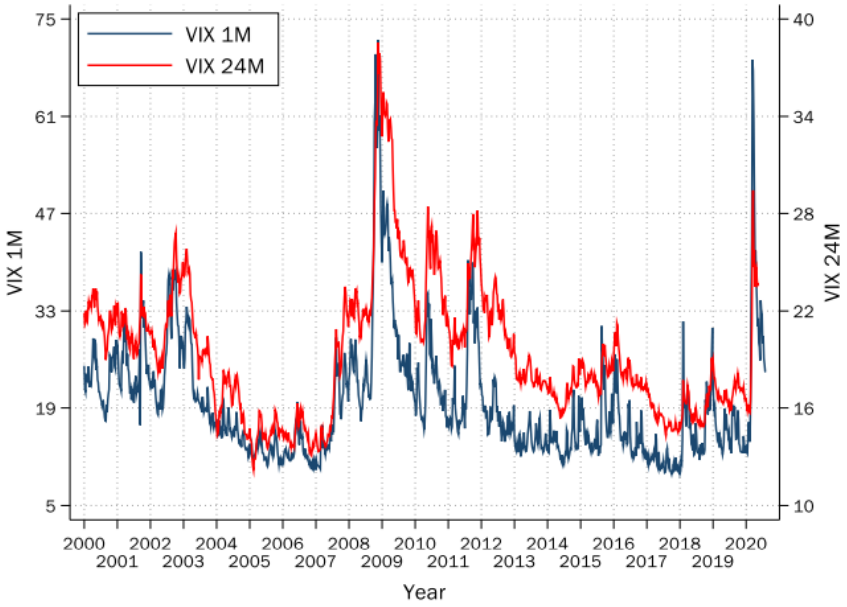
## 2.4. Investors' sentiment during Covid-19 pandemic

### 2.4.1. Anxiety, fear and uncertainty

Because of the spread of Covid-19 around the world, anxiety and fear started to take the upper hand over people. News about the pandemic reached investors at a high pace and risk aversion started to emerge because of the negative mood. Reaction to this risk can lead to a collapse of the stock prices and financial distress because the worries of the investors about the pandemic disease affect their future expectations of the financial markets (Cerqueti & Ficcadenti, 2020). Up to now, many questions about the virus have yet to be answered. For example, nobody has an idea about how quickly the economy will recover from this pandemic (Altig et al., 2020).

#### United States

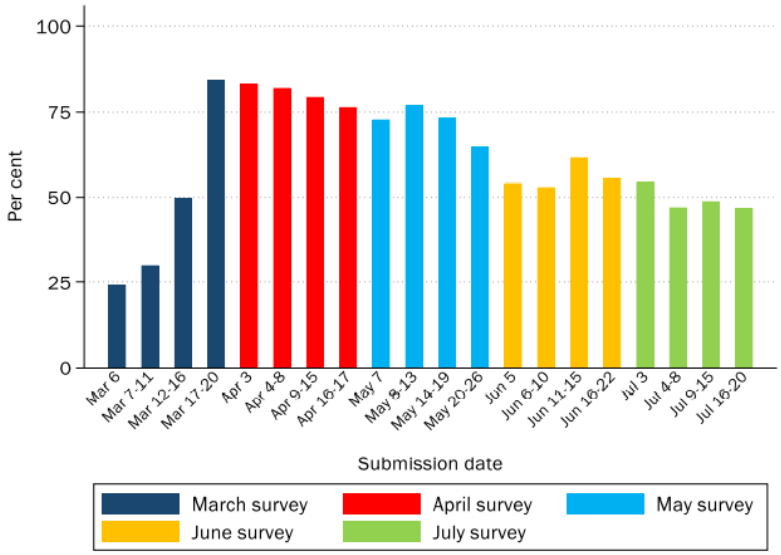
No argument can deny that a huge economic crisis is being faced. For example in the US, unemployment is rising and Gross Domestic Product (GDP) is falling. The stock market volatility in the United States can be presented using the VIX, this is the option-implied volatility of returns on the S&P 500 index. The 1-month and 24-month VIX reached high numbers, almost comparable to the 2008 crisis, as can be seen in Graph 6 (Altig et al., 2020).




*Graph 6: The 1-month and 24-month VIX-index (Altig et al., 2020)*

## United Kingdom

By performing a survey and using the UK Decision Maker Panel, its becomes clear that Covid-19 has become the most important factor of uncertainty for almost every business in the UK. It rose from a 'small' 25% in the beginning of March to a whopping 80-90% in the beginning of April, as seen in Graph 7. The Brexit suddenly became a much less important factor for businesses in the United Kingdom (Altig et al., 2020).




*Graph 7: % firms reporting Covid-19 as their top source of uncertainty (Altig et al., 2020)*

Same results are found by Ahmed and Tahat (2020) concerning uncertainty and risk in the UK: risk levels and uncertainty have increased. Next to that, this uncertainty and economic impact have caused volatility to increase as well.

### Globally

Instead of investigating the anxiety in one country individually, Zhang, Hu and Ji (2020) tried to show the rise of uncertainty and the consequences for stock markets by looking at the standard deviation of daily returns from 12 majorly affected countries by the pandemic (see Table 1). The standard deviation, which is also the volatility, of (almost) every country has risen when numbers are compared between the months of February and March. Only China shows a drop in standard deviation and therefore risk, which is a consequence of China being the first country to be hit by the virus, taking place mostly before the month of March.

*Table 1: the number of confirmed cases and standard deviations for the months of February and March (Zhang et al., 2020)*

| Country | Confirmed cases on Feb/29/20 | Confirmed cases on Mar/27/20 | Std_Feburary | Std_March | Rank 01 | Rank 02 |
|---|---|---|---|---|---|---|
| US | 68 | 101657 | 0.0069 | 0.0268 | 7 | 1 |
| Italy | 1128 | 86498 | 0.0083 | 0.0258 | 2 | 2 |
| China Mainland | 79261 | 81378 | 0.0098 | 0.0084 | 1 | 12 |
| Spain | 45 | 65719 | 0.0074 | 0.0234 | 4 | 3 |
| Germany | 79 | 50871 | 0.0073 | 0.0212 | 5 | 5 |
| France | 100 | 32964 | 0.0069 | 0.0221 | 8 | 4 |
| United Kingdom | 23 | 14543 | 0.0064 | 0.0198 | 11 | 6 |
| Switzerland | 18 | 12928 | 0.0067 | 0.0172 | 9 | 9 |
| Korea, South | 3150 | 9332 | 0.0069 | 0.0189 | 6 | 8 |
| Netherlands | 6 | 8603 | 0.0074 | 0.0192 | 3 | 7 |
| Japan | 241 | 1468 | 0.0065 | 0.0164 | 10 | 10 |
| Singapore | 102 | 732 | 0.0050 | 0.0159 | 12 | 11 |
| Total confirmed | 84221 | 466693 | | | | |
| Average Std. | | | 0.0071 | 0.0196 | | |

In total, the average risk has gone up from 0,0071 to 0,0196. It can be noted as well that the standard deviation ranking in March is mostly consistent with the number of confirmed cases (Zhang et al., 2020).

By constructing a global fear index, depending on the number of cases and deaths, Salisu and Akanni (2020) tried to show the relation between trends in stock prices and fear of investors. The results clearly show a trend of decrease in stock market returns when the global fear index rises. The other way around, if the global fear index decreases, the stock returns improve.

## 2.4.2. News

Globalization and improved information channels have caused news to spread quickly and very detailed. This news has a massive impact on investors sentiment and behavior, which makes them take action and react on the newly received information about the pandemic.

Using a coronavirus panic index, a coronavirus media index and a sentiment index, it has been proven that macroeconomic news, as well as the enormous amount of information sources, explain a significant portion of volatility in financial markets. This volatility also increased most in heavily affected industries by Covid-19 (Haroon & Rizvi, 2020). Parallel to these findings, research of Liu, Manzoor, Wang, Zhang and Manzoor (2020) shows that short-term views of investors result in an overreaction on the market and this overreaction started to increase massively because of media information feeding the pessimistic feeling caused by news regarding Covid-19.

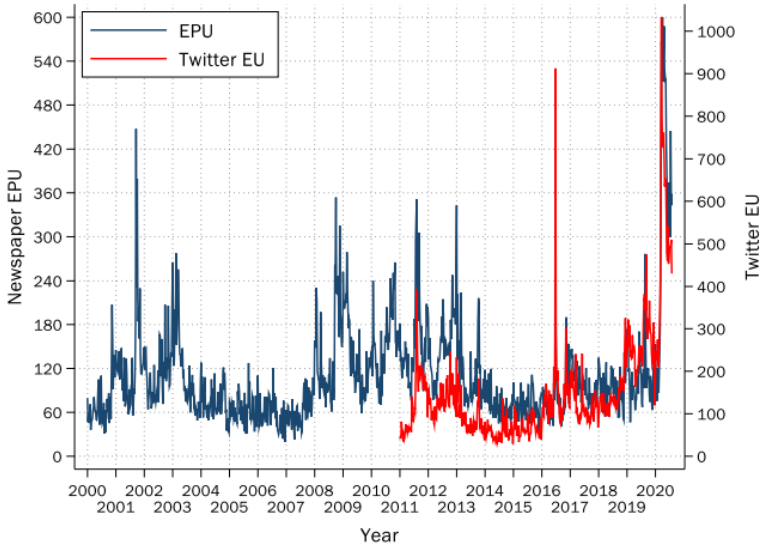
Finally, in addition to what has been written about the news and its impact on stock markets, Cepoi (2020) states that the stock markets have asymmetric dependencies related to COVID-19 information such as fake news, media coverage or contagion. This is why they suggest that there is need for more intensive use of proper communication channels in order to milder the Covid-19 related financial turmoil.

### 2.4.3. Internet and social media

For the last couple of years, social media and search engine data can be used to investigate the reaction and anxiety of investors and others to released news and information. Cerqueti and Ficcadenti (2020) did research on the relationship between the Google searches for "coronavirus" and the trust in the stock market. Results for countries with a high human development show specific degrees of optimism and pessimism. In some countries the emergence had been underestimated in the beginning, while in other countries the anxiety boosted from the beginning (Iceland, Malaysia, Malta…). Cerqueti and Ficcadenti (2020) also show a general trend of pessimism around the middle of March, the moment when a lot of countries imposed a lockdown.

A similar study with panel data was executed to find the relationship between the Google trend synthetic index (which gives information about how many times a term is 'Googled') and the stock market volatility. Same results emerge: high attention of investors, which is displayed by the Google search index, comes along with an increase of the implied volatility and a decrease in stock prices. The other way around, shocks from the stock market increase investors' attention. The relationship between Google Trend and implied volatility is also more noticeable in Europe compared to Asia (Papadamou, Fassas, Kenourgios, &Dimitriou, 2020).

There are also other ways to investigate uncertainty with internet and social media data. The Economic Policy Uncertainty (EPU) index shows how many times the words "economics", "policy" and "uncertainty" are used in the U.S. newspapers. The Twitter-based Economic Uncertainty (TEU) index uses all tweets that contain both the words "economic" and "uncertainty". Both graphs, as visible in Graph 8, reach their peak during the crisis (Altig et al., 2020).

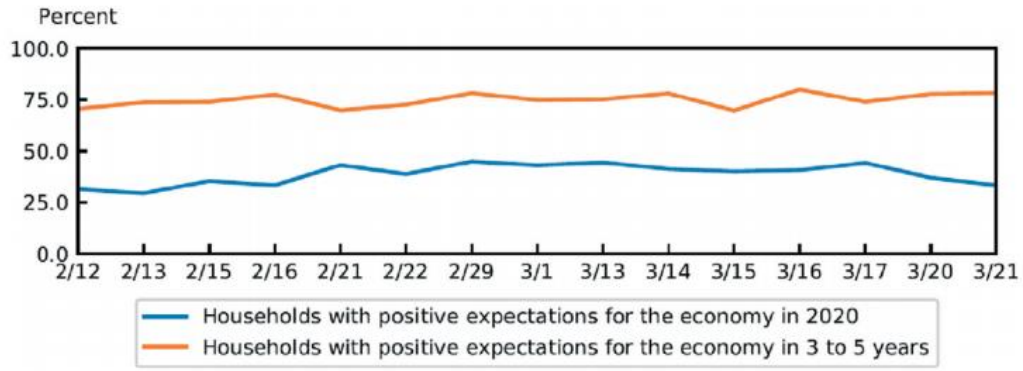



*Graph 8: The EPU and the Twitter EU (Altig et al., 2020)*

The platform StockTwits can be used by investors to post messages about investment subjects. They can label their message or post with a sentiment, going from bullish, to neutral, to bearish. Studying these posts, it becomes clear that the sentiment had a major decrease during the period of the pandemic. However, not all sectors get the same sentiment during this crisis. Following from the results, financial sectors are the most pessimistic, while the healthcare sector is the most optimistic (Fallahgoul, 2020).

### 2.4.4. Portfolio reaction and future expectations of investors

As a result of the uncertainty, investors react by changing the composition of their portfolio. A study was executed to make the comparison between the United States and China in terms of changes to their portfolio. When looking at the financial decisions of the Chinese households, 19,97% changed their investment portfolio. In comparison to the US: 61% of Americans changed their portfolio, which is clearly way higher than in China. Next to that, 8,74% of Chinese households decreased their total investment amounts. In the short-run, many Chinese citizens had a negative view on the future economy, as is the case in many other countries. However, as shown in Graph 9, expectations in the long-run seem to be more positive, showing that Chinese people expect a recovery after a certain amount of years (Yue, Korkmaz, &Zhou, 2020).

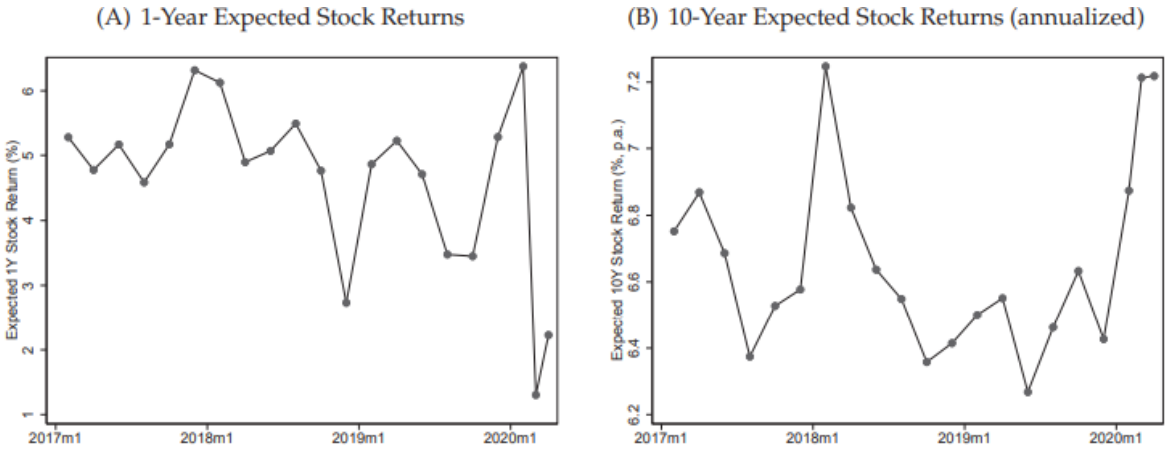



*Graph 9: Short-term and long-term expectations for the Economy in China (Yue et al., 2020)*

Giglio, Maggiori, Stroebel and Utkus (2020) studied investor behavior and reaction before, during and after the crash of the US stock market, more specifically the S&P500. A survey is executed at three different, important points in time:

- 11th of February 2020: almost all time high of the US stock market.
- 11th of March 2020: after the dramatic plunge of the market.
- 16th of April 2020: revival of the stock market by 25% but still way below its highest point.

The survey shows that the expectation of investors of the 1-year stock return became lower than in previous years, falling from 3%-6% to 1%-2%. This is shown in Graph 10. The expected returns in the long-run (10 years) however, have increased (Giglio et al. 2020).




*Graph 10: 1-year and 10-year expected stock returns (Giglio et al., 2020)*

Looking at the economic growth, investors expect the real GDP growth to decrease from 2,8% to 2,2% in the next 3 years. Same as seen with the expected stock market returns, the view in the long-run is different: the 10-year expected real GDP increases. The survey also uncovers that the expectations of a possible short-run stock market disaster and a possible short-run GDP disaster increase. The disagreement between investors took a massive leap as well. When looking at the composition of the portfolios, the optimists (who have on average the most equity in their portfolio), sell more of their

equity in comparison to the neutrals and the pessimists. Pessimists show less change in the equity share of their portfolio (Giglio et al. 2020).

# 3. RESEARCH DESIGN

In this section the research design with its corresponding research question will be discussed. The main research question can be split up into four sub-questions. Besides this, the added value of this thesis will also be clarified.

## 3.1. Research questions

What is the impact of Covid-19 on the stock market performance worldwide? This is, beside the title of this master dissertation, the main research question that will be handled.

This main research question is split into the four following sub-questions:

- What is the impact of the number of Covid-19 cases on the stock market returns?
- What is the impact of the number of Covid-19 deaths on the stock market returns?
- What is the impact of the government measures to prevent the spread of the virus on the stock market returns?
- What is the impact of financial stimulus packages on the stock market returns?

All these questions will be examined hereafter using Ordinary Least Squares (OLS) regressions. The results of the regressions will make it possible to look for analogies and/or contradictions with the literature review.

In the existing literature, the researchers focused either on the number of confirmed cases, the number of deaths or on the government measures, and this for a limited group of countries. Also, the research about the impact of financial stimulus packages is very limited. The purpose of this thesis is to give a broad and comprehensive view on the impact of Covid-19 on the stock market performance worldwide.

Moreover, almost all the literature that was reviewed, focused on the first wave of the pandemic. This is, roughly taken, the period from the beginning of March until the end of May. This thesis will cover a much larger time window, in which the impact of the virus on the stock market in later stages is also taken into account.

# 4. DATA DESCRIPTION

In this paragraph the data collection will be described, accompanied by an extensive description of these data. The corrective actions that had to be taken to make the dataset usable are also clarified in this section.

## 4.1. Data

In order to get a comprehensive understanding of the impact of Covid-19 on the stock market performance worldwide, data from 28 countries, spread around the world, are collected. The dataset consists of 14 European countries spread over the north, south, east and west of the continent. Besides this, the data of three North American, three South American, three African, three Asian and two Oceanic countries are gathered as well. The investigated countries are marked with a red dot in Figure 2.

*Figure 2: Map of the world with the red dots marking the investigated countries*

As stated above, not only the first wave of the pandemic is researched. The time window of this research goes from the first of January 2020 until the third of November 2020.

In order to be able to execute the required OLS regressions for the investigation, data about returns, Covid-19 cases and deaths, government measures and financial stimulus packages are collected. The government measures are expressed in the stringency index and the financial stimuli are covered in income support and debt and contract relief. As the income support and debt and contract relief refer to households, in particular the demand side for stocks is investigated and not the supply side.

An important remark has to be made concerning the collected data. Since the data about the cases and deaths are available on a daily basis and the stock market returns only on trading days, the weekend

data (and data on stock market closing days) are omitted in order to match our data. Afterwards (in model 3 and 4), the effect of the numbers of cases and deaths in the weekend on the stock market returns on Mondays will be examined to test the weekend effect. Sometimes data was missing, particularly in the beginning of the time window. This was solved by filling in the missing data by zero or by the same value as the previous day. If data for a specific country were missing before it reported any numbers, the missing data were given a value of zero. If, however, numbers were already being reported and at some specific days data were missing, the gaps were filled by taking numbers equal to the previous day.

All the data are combined in an Excel-file. In total there are 220 observations for each of the 28 different countries. Stata is used for the statistical data processing.

### 4.1.1. Returns

To examine the stock market returns of each country, the MSCI equity indices of the countries are used. These indices cover approximately 85% of the free float market capitalization of the corresponding country. The indices are retrieved from Refinitiv Datastream. By retrieving the return index (MSRI) of the particular countries, a price including dividends is obtained. To get the daily stock market return for each country, the daily change of the return indices is taken and expressed in percentages.

### 4.1.2. Cases and fatalities

For the number of confirmed Covid-19 cases and deaths, the data of the University of Oxford are used. The university made a complete data platform available called Our World In Data (OWID), where they devote an entire section on numbers and statistics about the coronavirus.

The data provided by the university of Oxford corresponds in very large extents to the data available on the European Union Open Data Portal (EU ODP), which confirms the correctness of the data.

### 4.1.3. Stringency of government measures

The strictness of the government measures is expressed by the stringency index, which can be found on the OWID-website. The exhaustive calculation of the index is documented in a BSG working paper (Hale et al., 2020). Intuitively explained, the index is calculated by taking the mean score of nine metrics (Ritchie et al., 2020):

- School closures
- Workplace closures
- Cancellation of public events
- Restrictions on public gatherings
- Closures of public transport

- Stay-at-home requirements
- Public information campaigns
- Restrictions on internal movements
- International travel controls

The index has a value between 0 and 100: the higher the score, the stricter the government response. It is important to notice that the stringency and the effectiveness of the measures are not necessarily linked with each other.

### 4.1.4. Stimulus packages

#### Income support

To get an insight into the financial stimulus packages provided by the government, first of all the income support is considered. This metric captures whether the government is providing direct cash payments, universal basic income, or similar, or is covering the salaries of people who lose their jobs or cannot work (Hale et al., 2020). These data are available on the OWID-website as well.

This parameter can take three different values:

- 0: no income support
- 1: the government covers less than 50% of lost salary
- 2: the government covers 50% or more of lost salary

#### Debt and contract relief

Debt and contract relief is, just like the income support, a parameter to get insight in the financial stimulus packages provided by the government and can also be found on the OWID-website. The metric records if the government is freezing financial obligations (for example stopping loan repayments, banning evictions,…) (Hale et al., 2020).

This parameter can also take three different values:

- 0: no debt relief
- 1: narrow relief, specific to one kind of contract
- 2: broad debt/contract relief

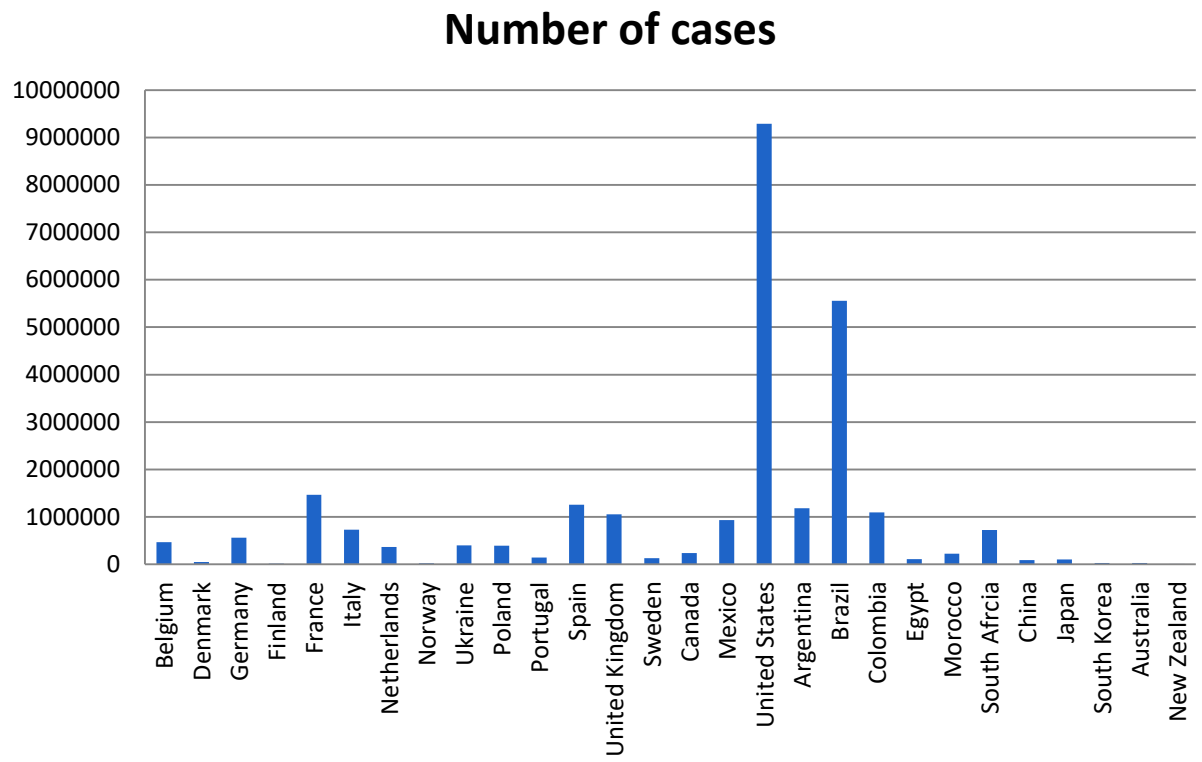
## 4.2. Descriptive statistics

Using the collected data, a global image can be created about how badly the investigated countries were affected in terms of cases, deaths, government measures and returns. Next to that, a conclusion can be drawn about how governments supported their people during the crisis following the outbreak

of the pandemic. This section will give an idea about the effect of Covid-19 in these 28 countries. The table with all data can be found in Appendix 1.

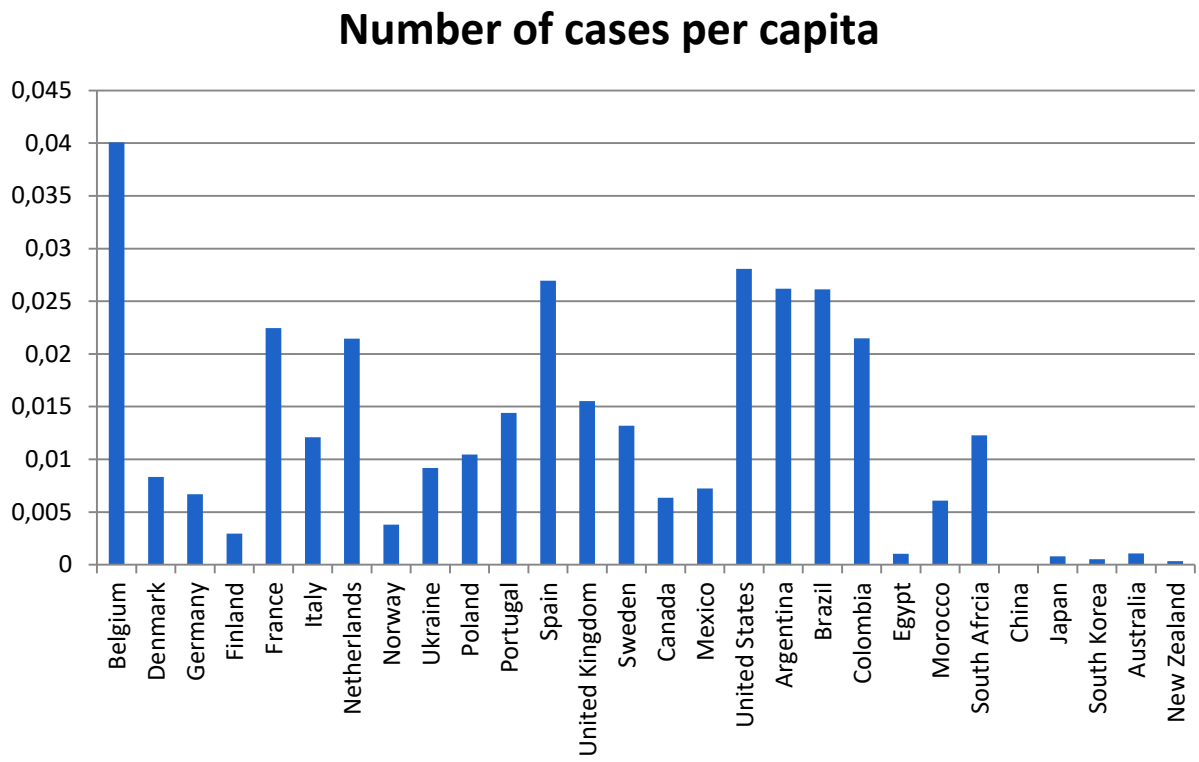
### 4.2.1. Cases

Graph 11 shows the confirmed cases per country. It becomes clear that some countries have a lot more confirmed cases than others. During the period of the 1st of January 2020 until the 3rd of November 2020, the United States were hit hardest with a total of 9.291.245 cases. In 2nd place, Brazil is found with 5.554.206 confirmed cases: a high number but still leaving a big gap between Brazil and the United States. France is the most severe hit country in Europe, with the third most cases overall. New Zealand only recorded 1612 cases, which makes it the best performing country.




*Graph 11:The number of cases per country*

The absolute number of cases, however, is not the best way to compare the impact Covid-19 has had in nations spread around the globe. It is logical that a country with a high number of inhabitants has more chances of a high number of cases. It is better to take the total confirmed cases and to divide it by the total population of the country. This way a comparison can be made between nations in terms of cases per capita. Graph 12 displays this, and immediately shows a different view compared to the total number of cases.




*Graph 12:The number of cases per capita per country*

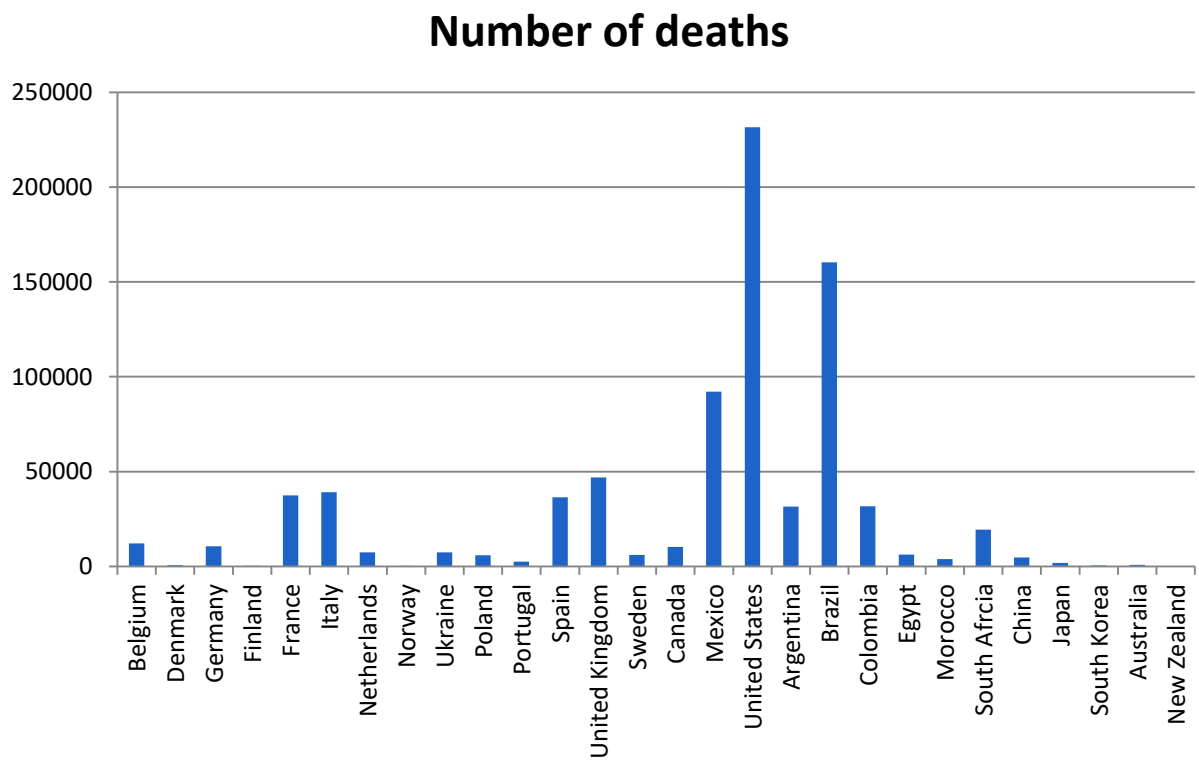
Belgium, one of the smaller countries taken into account, reaches a number of 0,04 cases per capita. With these statistic, it leaves the other nations far behind, with the United States following in second place with 'only' 0,028 cases per capita. High numbers are also found for Spain, Argentina and Brazil. Making a comparison between continents, the graph shows that Europe, North America and South America were affected more than Asia and Oceania.

A clear difference can also be found looking at Europe itself. Northern Europe (Norway, Sweden and Finland) is clearly less struck by Covid-19 in comparison to Southern Europe (Spain, Portugal and Italy) when it comes to cases per capita. As already mentioned, Belgium shows the worst statistics in Western Europe. Ukraine and Poland, which we can locate in Eastern Europe, perform better compared to Western Europe.

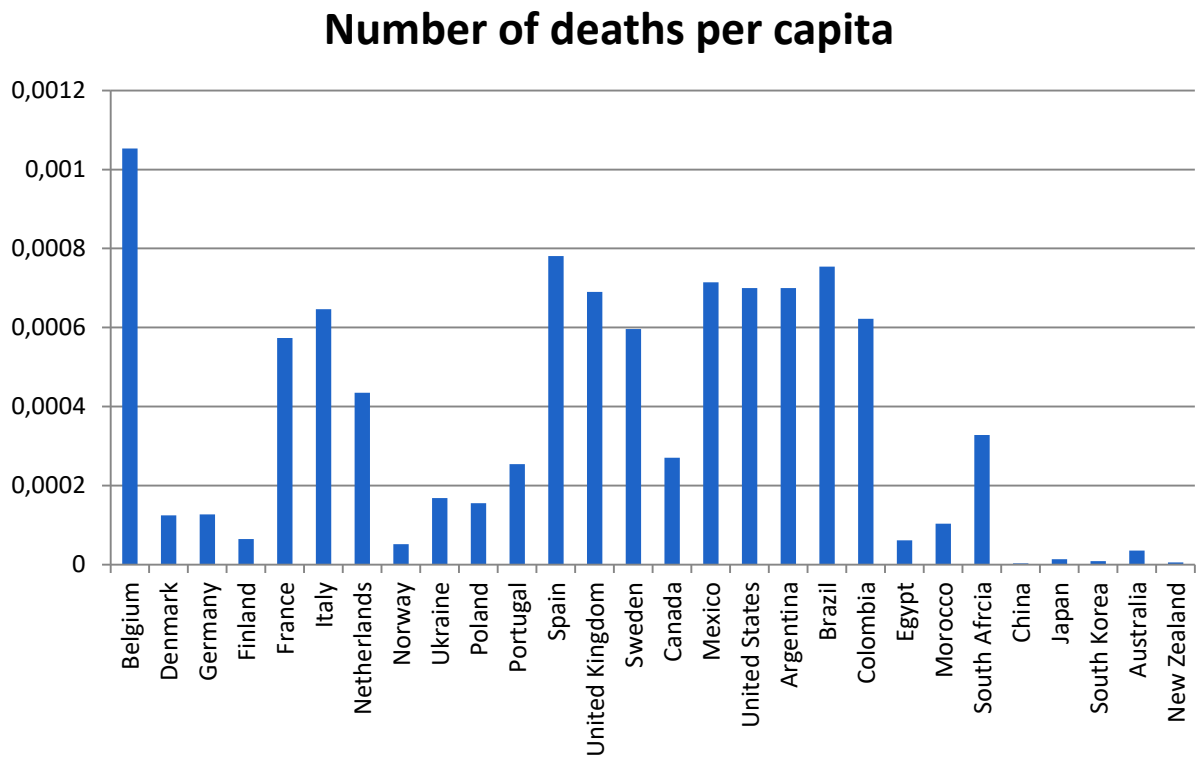
The difference between countries and continents can be caused by many different factors. First of all, the population and population density have an impact. As mentioned before, more inhabitants automatically increase the chance of a higher number of cases. Next to that, population density is also important: the more people that live in a smaller area, the higher the chance that the virus spreads. This could for example be a reason for why there is a difference between Northern and Southern Europe. Lastly, also the testing strategy and capacity can play a role when it comes to the reported numbers concerning the pandemic. Countries with a more profound testing strategy might discover more infections and thus present worse numbers.

### 4.2.2. Fatalities

Just like the number of cases, a graph can be made showing the number of deaths per country, as seen in Graph 13. In absolute numbers, the same two countries that lead in terms of cases, show very high statistics as well when it comes to fatalities: the United States (231.551 deaths) and Brazil (160.253 deaths). Mexico comes in third, which is different compared to the number of cases (where France came in third). However, as mentioned before, absolute numbers are not useful to compare countries with a different population, which is why the deaths per capita is calculated. This is shown in Graph 14.




*Graph 13:The number of deaths per country*



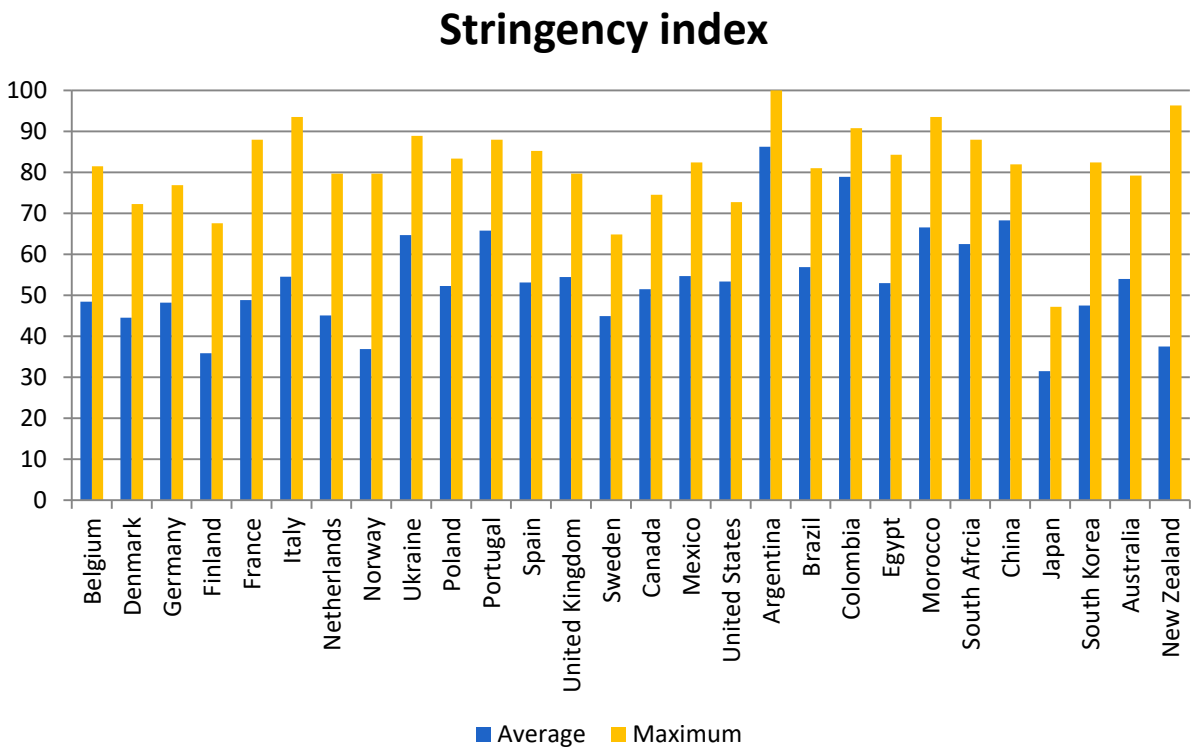

*Graph 14: The number of deaths per capita per country*

Similar to the number of cases, Belgium can be found as the worst performer when it comes to deaths per capita. Both cases and fatalities show the critical situation in which Belgium has found itself during the pandemic. The next European country is Spain, but clearly with significant lower numbers than Belgium. In terms of death per capita, the United States and the South American countries perform badly as well.

The number of deaths per capita are also influenced by government measures, population/population density and testing strategy/capacity, just like the number of cases were affected by these criteria. However, healthcare plays an important role as well: good healthcare can drastically reduce the amount of fatalities. But also the way of counting the Covid-19 deaths can have an impact. Belgium, for example, counted the number of fatalities that were infected with the virus and not the necessarily the number of deaths due to the virus, which automatically increases the numbers.

### 4.2.3. Stringency of government measures

As mentioned in the data section, the stringency index by Oxford University is used to investigate the measures taken by governments as a reaction to the outbreak of Covid-19. This stringency index contains many factors such as workplace closures, stay-at-home requirements, international travel controls… By taking into account all these factors, a global image of government actions can be formed. To compare the stringency index between countries, Graph 15 shows the average stringency index and the maximal stringency index for countries from 01/01/2020 until 03/11/2020.




*Graph 15: The average and maximal stringency index per country*

Overall, Argentina took the most stringent actions to contain the spread of the virus. With an average stringency index of 86,25 and even a maximum of 100 for a certain period, it is clear that the government took enormous actions. Only Colombia comes close to these numbers, with an average stringency index of 78,88. Note that these are two South American countries.

Focusing on Europe, Portugal and Ukraine score highest in terms of average stringency index, respectively 65,74 and 64,69. However, at a certain time Italy was the European country with the most stringent actions with a maximal index of 93,52. Comparing north and south, the graph shows that Southern Europe on average took more stringent actions than Northern Europe, with Finland taking the least government actions (on average).

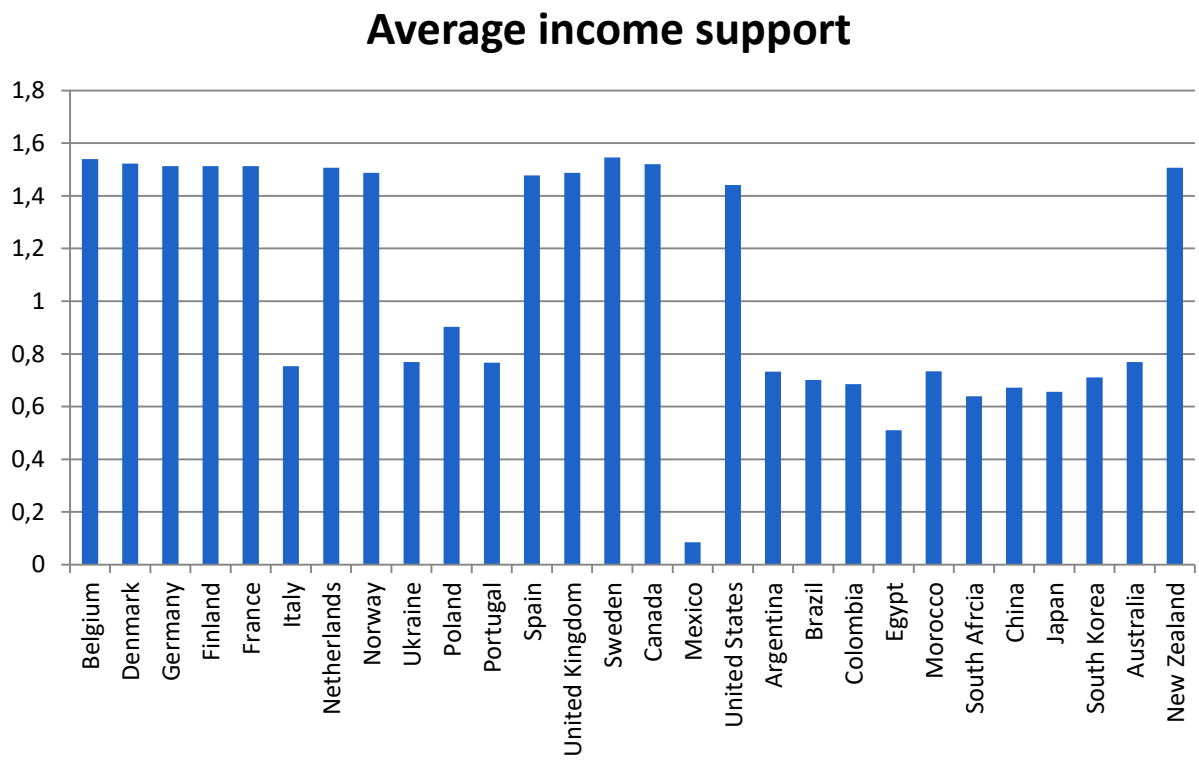
The nations of North America have quite comparable stringency indexes. This is also the case in Africa. Japan clearly shows less stringent actions in comparison to the other Asian countries (China and South Korea). New Zealand has the lowest average stringency index from all the countries, but it is noticeable that if it takes actions, it imposes very strict rules: the average stringency index is 'only' 37,51 while the maximum is 96,30.

In general, it is clear that the government measures vary over time. If the number of cases or deaths increase or decrease, the government measures respectively can become more or less strict.

### 4.2.4. Stimulus packages

#### Income support

Governments can support households by providing income support. As mentioned in the previous section about the used data, the income support index from Oxford University was used to investigate this stimulus package (0, 1 or 2). To compare the data between countries, Graph 16 shows the average income support for the investigated period.




*Graph 16: The average income support per country*

From all the European countries, most of them provide a high income support for their people for a long period of time. Ten of the fourteen countries have an average income support between 1,4 and 1,6. Only Italy, Ukraine, Poland and Portugal have an average income support of less than 1. It is noticeable that the two East European countries handled in this paper, have a lower income support than most of the rest of Europe.

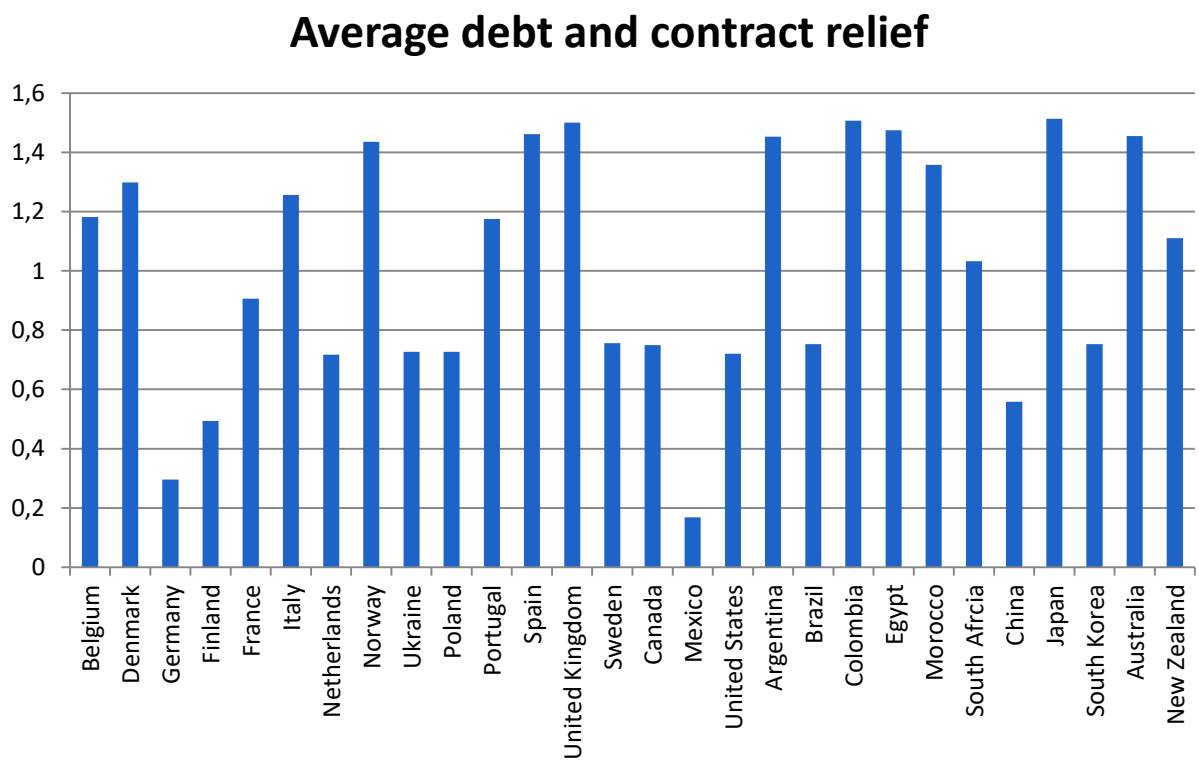
The continents of Africa, South America and Asia, clearly show a smaller average income support in comparison to Europe. New Zealand provides a high income support compared to its neighbour Australia and Mexico has almost no income support.

#### Debt and contract relief

Although there was a noteworthy link between countries and continents in terms of income support, there is no clear link when it comes to debt and contract relief. This is shown in Graph 17. In Europe,

some countries provide a high average debt and contract relief (such as the United Kingdom, Spain and Norway) while others have almost no debt and contract relief (Germany and Finland).

Also in other continents, there is no clear link between the countries: Mexico has a lower average relief than the United States and Canada while Japan is the only Asian country with an average relief of more than 1.



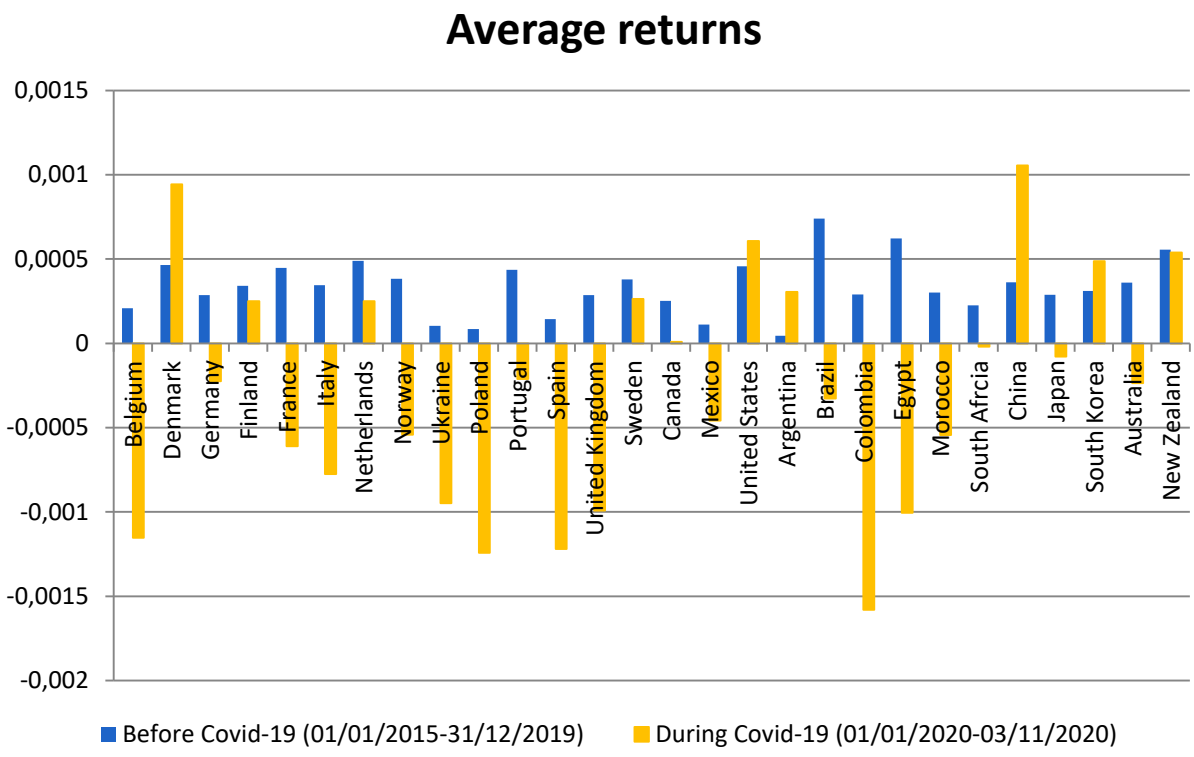

*Graph 17: The average debt and contract relief per country*

It is also important to notice that there is no link between income support and debt and contract relief: some countries act in both areas, some choose one and some give no support. For example, Germany has a high average income support, while their debt and contract relief is almost negligible.

### 4.2.5. Returns

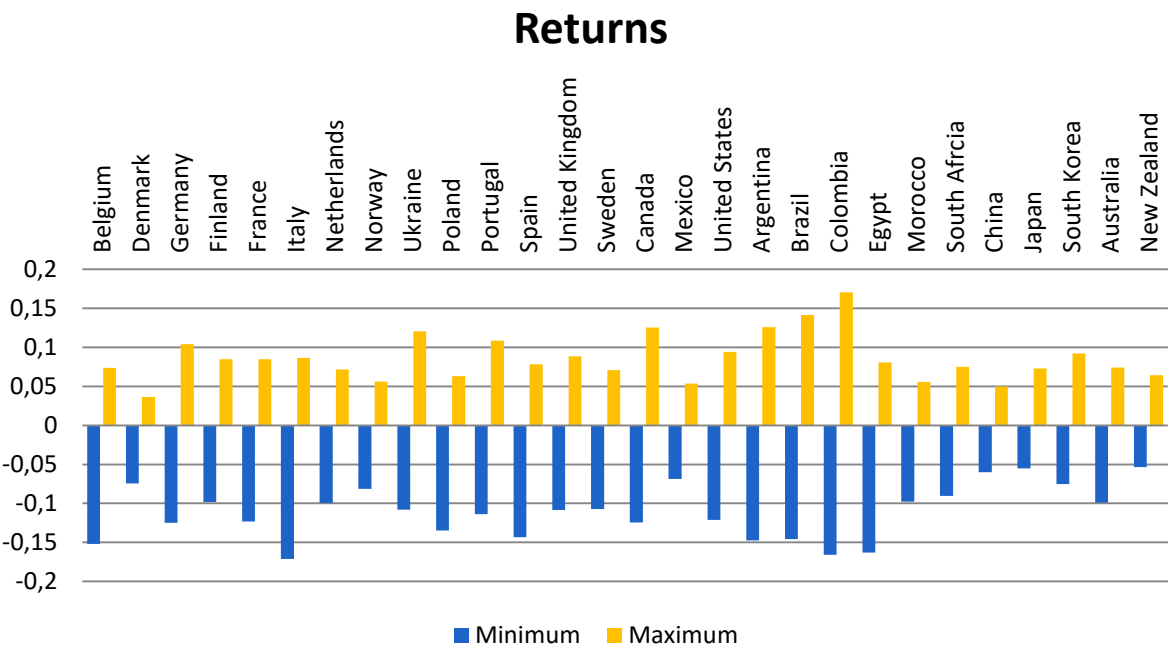
As previously mentioned, the MSCI index from the 28 different countries was used to determine the returns for each day. Graph 18 shows the average daily return for all investigated countries during the period of the 1st of January 2020 until the 3rd of November 2020.

Looking at the average daily returns, it is clear that some countries have a positive average return during the investigated period, while others have a negative average return. Most of the European countries (10 out of 14) have a negative daily average, which means the MSCI index at the end of the investigated period (3/11/2020) is lower than at the beginning (01/01/2020).




*Graph 18: The average daily returns before and during the outbreak of Covid-19*

Overall, there is no clear link between countries and continents about how the MSCI index fluctuated. Studying the graph, we could state that only 10 of the 28 countries have already recovered from the crisis. However, this doesn't mean they were not affected. This is visible in Graph 19, where the maximal and minimal returns during the outbreak of Covid-19 are shown.




*Graph 19:The maximal and minimal daily returns during the outbreak of Covid-19*

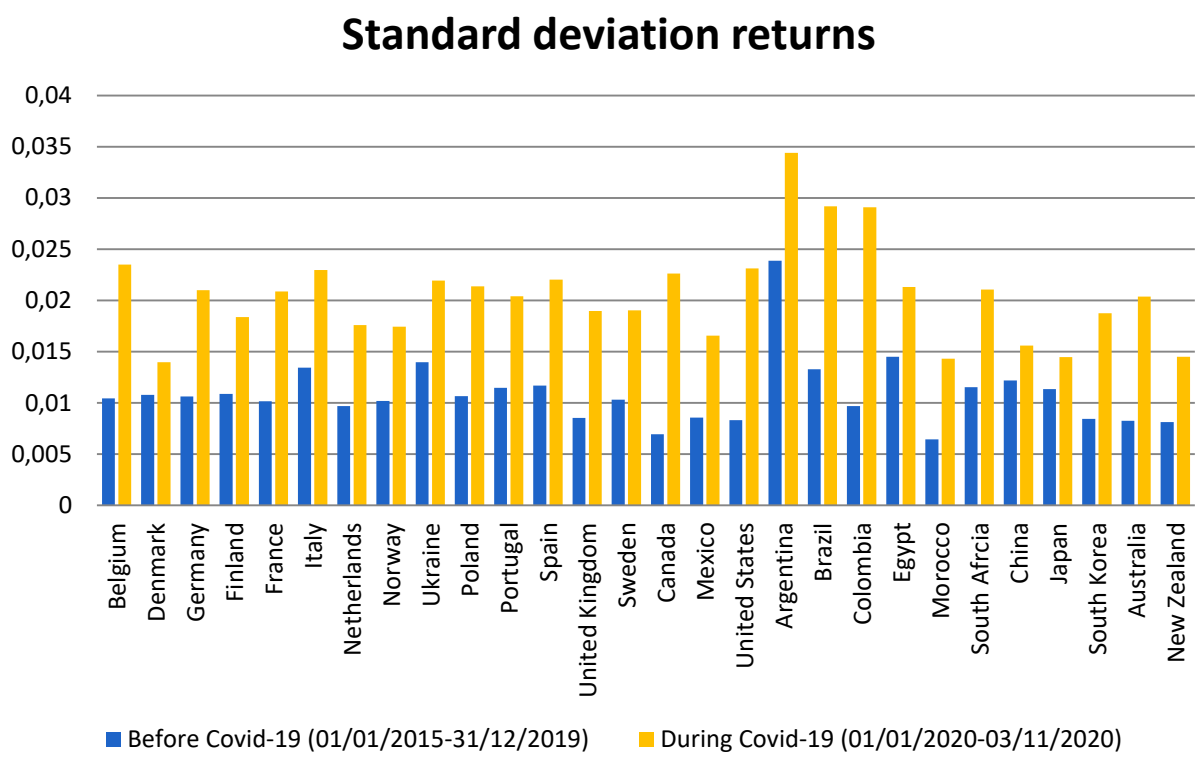
Graph 19 clearly shows that all markets were hit by the outbreak of the virus, looking at the lowest daily return per country during the pandemic. However, some high maximal daily returns are also visible. Some of these took place before the outbreak of Covid-19, while others were noted during the recovery of the first wave.

Italy endures the worst day of all countries, with a return of -17,13%, on the 12th of March. This is around the time that the coronavirus started to cause serious damage in Europe. Many other European countries also had their worst numbers around this period. Colombia had the best return on a single day compared to the others, however this was not a 'recovering day': the 17,06% return took place on the 25th of March, before the virus severely struck Colombia.

To make a comparison between the time of the pandemic and the time before the outbreak, the daily returns are also calculated (using the MSCI index) for a period of 5 years before the pandemic: from the 1st of January 2015 until the 31st of December 2019. These data, shown in blue in Graph 18, clearly show that all countries had a positive average daily return over these 5 years before Covid-19 struck the world. Because of the negative average daily returns for most countries during the pandemic, the conclusion should be drawn that most countries have been negatively impacted during the pandemic. Three of the 28 countries show a higher average return during the pandemic in comparison to the five years before: Denmark, the United States and China.

Lastly, the standard deviation of the daily returns during the period of the 1st of January 2020 until the 3rd of November 2020, is shown in Graph 20. The standard deviation of the returns can be considered as the volatility of stocks and is thus an indicator of fear. On average, most countries note a standard deviation between 0,015 and 0,025 during the investigated period. However, the three South American countries clearly have a higher standard deviation in comparison to the rest of the world.

To compare the volatility of the stock market during the pandemic with the volatility during previous years, the standard deviation of the daily returns was also calculated for a period of 5 years before the coronavirus: from the 1st of January 2015 until the 31st of December 2019. This is also visible in Graph 20. It is clear that volatility rose in all countries at the moment of the outbreak of the virus. This shows that investors' fear and the uncertainty started to rise because of the unpredictable future that the coronavirus puts forward. These results also confirm the outcome of the literature by Zhang, Hu and Ji (2020).




*Graph 20:The standard deviation of the returns, before and during the outbreak of Covid-19*

### 4.2.6. Industries

Looking at the returns in Graph 18, it becomes clear that some countries have a negative average daily return, some have a positive average daily return, and some countries even have an average daily return that is higher than the time before Covid-19. A reason for this could be the distribution of the amount of activity in each industry: not every sector is hit by Covid-19 in the same way. Some industries have to endure a very hard and uncertain time, while others thrive during the crisis. For example, Mazur, Dang and Vega (2020) mention that the healthcare and the software industry perform best, while the real estate and entertainment sector perform worst. Theoretically, it could be expected that a country with a lot of activity in the real estate sector, is hit harder by the pandemic. This would mean that the industries that dominate each country can determine whether the countries' performance is better or worse than others. To create a general view on this matter, the 28 countries are individually divided into eleven different industries. In Appendix 2, the percentages that each country is active in each industry can be found (according to the MSCI fact sheet of the considered country).

As shown in Graph 18, three countries perform better during the pandemic in comparison to 5 years before that: Denmark, the United States and China. Looking at the industry composition, Denmark is very active in the healthcare sector, while the United States and China are well-known for their activities in the IT industry and the communication services. These mentioned industries are expected to be impacted in a positive way by Covid-19.

Although some countries show a connection between industry activity and average returns, no direct link can be found between every country and its amount of positively/negatively impacted sectors. This could be explained by many factors. First of all, this study focuses on a longer period of approximately 10 months. After the first wave, some industries already had the chance to recover from their losses and closures, and therefore show no direct relation. This conclusion is also mentioned in the studied literature (Huo & Qiu, 2020). Secondly, the industry composition is only one of the many factors that determines how hard the stock market of a country is hit: healthcare, stringency of the government measures, financial support, other macroeconomic news… play an important role as well.

# 5. RESEARCH AND RESULTS

## 5.1. Research setup

In this section, the methodology and the models will be explained as well as the findings. In order to investigate the research questions, the program Stata is used to perform various OLS regressions.

In general, the research is divided into two main models. One model focusses on the relation between the stock market returns and the confirmed cases of Covid-19, the other model focusses on the relation between the stock market returns and the fatalities due to Covid-19. This distinction is made because these two independent variables are too highly correlated to put in one and the same model. Afterwards, these two basic models are expanded with additional parameters in order to fine-tune them. Each model is estimated separately per country. Table 2 provides a summary of all the variables that are used in the regression models.

*Table 2: Parameters used in the regression models*

| Variable name | Description |
|---|---|
| $R_i$ | The return of stock market i expressed in percentages. |
| $CASES$ | The number of confirmed Covid-19 cases expressed in absolute numbers. |
| $DEATHS$ | The number of Covid-19 deaths expressed in absolute numbers. |
| $STRING$ | The stringency index with a value between 0 and 100. |
| $D^{IS\_1}$ | Dummy variable that equals 1 if the income support changes to value a value of 1 (the government covers less than 50% of lost salary). |
| $D^{IS\_2}$ | Dummy variable that equals 1 if the income support changes to a value of 2 (the government covers 50% or more of lost salary). |
| $D^{DCR\_1}$ | Dummy variable that equals 1 if the debt and contract relief changes to a value of 1 (narrow relief, specific to one kind of contract). |
| $D^{DCR\_2}$ | Dummy variable that equals 1 if the debt and contract relief changes to a value of 2 (broad debt/contract relief). |
| $(D^{MON} * CASES)$<br>$(D^{MON} * DEATHS)$ | Interaction term to check the weekend effect, where $D^{MON}$ is a dummy variable that equals 1 if the observed day is a Monday. |
| $YTM_i$ | The yield to maturity of the government bond of country i expressed in percentages (control variable). |

## 5.2. Methodology

### 5.2.1. The classical OLS assumptions

Before using Ordinary Least Squares (OLS) regressions, it is necessary to check whether it is justified to use this method or not. This can be done by verifying the classical OLS assumptions. If these six (or seven, depending on the literature) assumptions hold true, then the OLS regression is the best method to use according to the Gauss-Markov Theorem (Glen, 2018). In other words, the OLS estimator will be the Best Linear Unbiased Estimator, which is often referred to as 'BLUE' in literature.

It is very important to note that all these assumptions are rarely perfectly fulfilled in practice. However, it is useful to check the assumptions because they indicate what the optimal conditions would be, which makes it possible to detect potential issues of the model.

Many of these assumptions are about characteristics of the residuals. In Figure 3, the observed values are indicated by the blue dots and the fitted value is represented by the red line. The difference between both is called the residual.

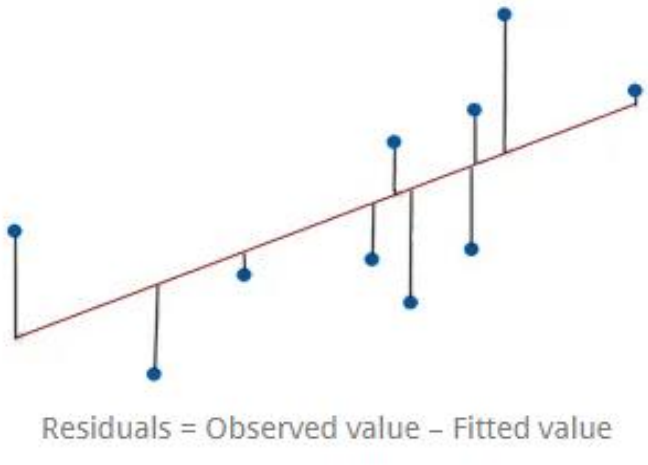



*Figure 3: The residual formed by the observed values and the fitted values (Frost, 2018)*

#### Linearity

The first assumption states that the regression model is linear in the coefficients as well as in the error term. A regression model is linear when all terms are either a constant or an independent variable multiplied by a coefficient. This assumption is automatically fulfilled since the function 'regress' is used in Stata. This is the command to execute a linear regression.

#### Exogeneity

The second assumption states that the independent variables are not correlated with the error term, this is called 'exogeneity of the regressors'. If they are correlated, which is called endogeneity, the error

term can be predicted by the independent variables, which means information is missing that should be incorporated in the model.

Violation of this measure can be attributed to the fact that there is simultaneity between the dependent and independent variables. This means that not only the independent variables have an impact on the dependent variable, but also the other way around. This is not a problem regarding the stringency, the confirmed cases or the number of deaths due to Covid-19 because the returns will never impact these terms. When it comes to the income support and debt and contract relief, this could be a problem. If the returns are good (or bad), the financial stimuli could be decreased (or increased). This issue is checked by using a time lag of one day in the model for the income support and the debt and contract relief. By doing this, there is a certainty that the causality is correct because the returns can never influence the financial stimuli of the day before. Applying this verification technique, the outcome of the regressions did not change: there is exogeneity.

### Homoscedasticity

The third assumption states that the variance of the error term is consistent for all observations. If this is the case, there is homoscedasticity. If the variance changes systematically over the range of measured observations, there is heteroscedasticity. Figure 4 plots the residuals against the fitted values and gives an illustration of what is described above.

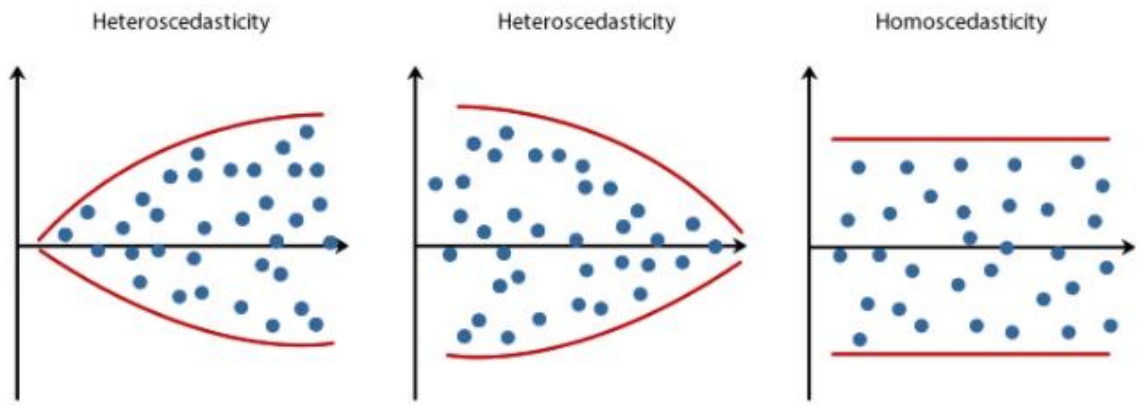



*Figure 4: Two forms of heteroscedasticity and one of homoscedasticity as a visual example (Key assumptions of OLS: Econometrics review, 2020)*

There are different ways to test whether there is homoscedasticity or heteroscedasticity, like the Breusch-Pagan or White test. Also looking at the residual plot, like Figure 4, can give an indication of the situation. In the following models of this research, the problem of heteroscedasticity is fixed by using Newey-West standard errors (lag of 5 time units).

#### No residual autocorrelation

Assumption four states that there is no autocorrelation between the observations of the error terms. If there is a correlation between the error terms, it is possible to predict the following error term with a meaningful significance. This also means that there is information missing that should be incorporated in the model (Frost, 2017).

To assess the presence of residual autocorrelation, the Durbin-Watson test can be used. This condition is also fulfilled in the following models by using Newey-West standard errors (lag of 5 time units).

#### No multicollinearity

The fifth assumption states that there is no multicollinearity between two or more independent variables. If multicollinearity is observed, there is a high correlation between multiple independent variables and one predictor variable can be linearly predicted from the others.

The easiest way to detect multicollinearity in a regression model is by calculating the Variance Inflation Factor (VIF) which considers a regression model of an independent variable as a function of all the other independent variables. The VIF can be calculated by the following formula:

$$\mathrm{VIF} = \frac{1}{1 - \mathrm{R}^2}$$

Arbitrarily chosen values determine whether the multicollinearity is too high or not. In this research, Stata automatically omits the independent variables if the multicollinearity is too high.

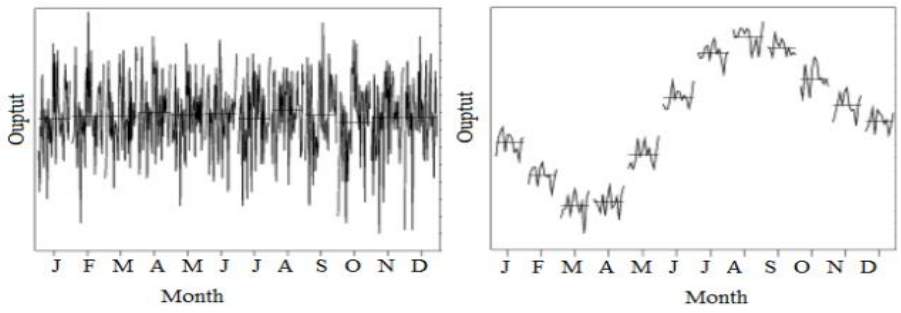
It is also due to this multicollinearity between confirmed cases and deaths that two different regression models are created: one for cases (model 1), one for deaths (model 2).

#### The error term has a population mean of zero

The sixth assumption states that the error term has a population mean of zero. If this is not the case, the regression model systematically impacts the output in a negative way. Since the constant term is included in the regression models, this assumption raises no concerns for these models. The constant term forces the mean of the residuals to equal zero.

### 5.2.2. Pitfall using time series: stationarity

Because of the use of time series data in the regression models, stationarity should be tested in order to be able to use OLS regressions. Stationarity means that a shift in time does not cause a change in the statistical properties of the time series (such as the mean, the variance and the covariance). Graph 21 shows the difference between stationary and non-stationary data. In general, non-stationary data cannot be modeled.




The plot on the left is stationary with no obvious trend while the plot on the right shows seasonality and is non-stationary.

*Graph 21: Difference between stationary and non-stationary data (Glen, 2017)*

The return is the dependent variable in the regression models, which is, in general, stationary. This conclusion is confirmed after checking for a unit root in the data using the Augmented Dickey-Fuller (ADF) test.

### 5.2.3. Influential Points

Two main categories can be distinguished regarding influential points:

- Outliers: these are data points of which the y-value is extreme and does not follow the general trend of the data. In other words, these are data points with exceptionally big residuals.
- High leverage points: these are data points with extreme x-values, either low or high.

Influential data points can unduly influence the model coefficients and are thus undesired. The Cook's Distance can be used to check for influential points, but in the following models the impact of influential points is simply not taken into account since they are negligible.

## 5.3. Model 1: Cases

As stated above, a distinction is made between two main models because of the high multicollinearity between the cases and fatalities due to Covid-19. The purpose of these models is to find an answer on the research questions and to create an insight in the impact of Covid-19 on the stock market performance worldwide.

The first model handles the confirmed cases due to the coronavirus and the equation is:

$$R_{i,t} = \alpha + \beta_1 CASES_t + \beta_2 STRING_t + \beta_3 D_t^{IS\_1} + \beta_4 D_t^{IS\_2} + \beta_5 D_t^{DCR\_1} + \beta_6 D_t^{DCR\_2} + \varepsilon_t$$

Where:

- $R_{i,t}$: the return of stock market i at day t expressed in percentages.
- α: the constant term of the regression.
- $CASES_t$: the number of confirmed Covid-19 cases at day t expressed in absolute numbers.
- $STRING_t$: the stringency index at day t with a value between 0 and 100.
- $D_t^{IS\_1}$: dummy variable that equals 1 if the income support changes to a value of 1 (the government covers less than 50% of lost salary).
- $D_t^{IS\_2}$: dummy variable that equals 1 if the income support changes to a value of 2 (the government covers 50% or more of lost salary).
- $D_t^{DCR\_1}$: dummy variable that equals 1 if the debt and contract relief changes to a value of 1 (narrow relief, specific to one kind of contract).
- $D_t^{DCR\_2}$: dummy variable that equals 1 if the debt and contract relief changes to a value of 2 (broad debt/contract relief).
- $\varepsilon_t$: the error term at time t.

The different β's represent the regression coefficients.

Important to notice is the fact that the dummy variables concerning the income support and the debt and contract relief only equal 1 at the date of the announcement of the financial stimulus. This is important regarding the Efficient Market Hypothesis (EMH). This hypothesis states that all the available information is entirely reflected in the market prices, which implies that markets only react on new information (Fama, 1991).

### 5.3.1. Results model 1

The results of model 1 are shown in Table 3.

*Table 3: The results of the first regression model*

| | $\alpha$ | CASES | STRING | $D^{IS\_1}$ | $D^{IS\_2}$ | $D^{DCR\_1}$ | $D^{DCR\_2}$ |
|---|---|---|---|---|---|---|---|
| Belgium | -0,0084012 (0,051)* | -0,00000039 (0,118) | 0,0001518 (0,027)** | 0,0059882 (0,000)*** | -0,0240567 (0,005)*** | 0,0023977 (0,739) | 0,0394336 (0,000)*** |
| Denmark | -0,0015505 (0,530) | -0,00000123 (0,678) | 0,0000634 (0,157) | 0,0208387 (0,000)*** | -0,0322191 (0,009)*** | 0 (omitted) | 0,0110791 (0,000)*** |
| Finland | -0,0045903 (0,118) | -0,00000147 (0,937) | 0,0001413 (0,047)** | 0 (omitted) | -0,0519313 (0,000)*** | 0,014085 (0,000)*** | 0 (omitted) |
| France | -0,0049941 (0,064)* | 5,17E-09 (0,970) | 0,0000939 (0,066)* | 0 (omitted) | -0,0619283 (0,000)*** | 0,0134529 (0,000)*** | 0 (omitted) |
| Germany | -0,0063943 (0,094)* | -0,000000216 (0,677) | 0,0001441 (0,023)** | 0 (omitted) | -0,0519496 (0,000)*** | -0,039024 (0,000)*** | 0 (omitted) |
| Italy | 0,0018682 (0,461) | 0,000000164 (0,653) | -0,0000599 (0,416) | 0,0295831 (0,000)*** | 0 (omitted) | 0 (omitted) | 0,0255283 (0,000)*** |
| Netherlands | -0,0040389 (0,146) | -0,00000029 (0,463) | 0,0000979 (0,040)** | 0 (omitted) | 0,0177427 (0,000)*** | 0,0251151 (0,000)*** | 0 (omitted) |
| Norway | -0,0048059 (0,047)** | -0,00000832 (0,282) | 0,0001289 (0,013)** | 0 (omitted) | -0,0118728 (0,000)*** | 0 (omitted) | 0,0340108 (0,000)*** |
| Poland | -0,0058616 (0,042)** | -0,000000213 (0,686) | 0,0001169 (0,009)*** | -0,017326 (0,000)*** | -0,0072685 0,001)*** | 0,0348814 (0,000)*** | 0 (omitted) |
| Portugal | -0,0001375 (0,958) | -0,00000148 (0,312) | 0,0000745 (0,233) | 0,0187778 (0,000)*** | 0 (omitted) | -0,017821 (0,000)*** | 0,0002778 0,000)*** |
| Spain | -0,0047487 (0,178) | 3,61E-08 (0,829) | 0,0000626 (0,233) | -0,034718 (0,000)*** | -0,0258923 (0,000)*** | 0,0708654 (0,000)*** | 0,0160255 0,000)*** |
| Sweden | -0,0034331 (0,273) | -0,00000164 (0,491) | 0,0001007 (0,072)* | 0 (omitted) | -0,0119001 0,000)*** | -0,033323 (0,000)*** | 0 (omitted) |
| Ukraine | -0,0046382 (0,067) | -0,000000215 (0,603) | 0,0000836 (0,049)** | -0,107571 (0,000)*** | 0 (omitted) | 0,0463093 (0,000)*** | 0 (omitted) |
| United Kingdom | -0,0080437 (0,050)** | -0,000000106 (0,457) | 0,0001306 (0,034)** | 0 (omitted) | 0,0087916 (0,000)*** | 0,0337158 (0,000)*** | 0,0190807 (0,000)*** |
| Canada | -0,0037338 (0,262) | -0,000000568 (0,594) | 0,0000968 (0,069)* | 0 (omitted) | -0,1009661 (0,000)*** | -0,075436 (0,000)*** | 0 (omitted) |
| Mexico | -0,0038358 (0,134) | -0,000000431 (0,284) | 0,0000862 (0,054)* | 0,0015566 (0,116) | 0 (omitted) | 0 (omitted) | 0 (omitted) |

| | α | CASES | STRING | $D^{IS\_1}$ | $D^{IS\_2}$ | $D^{DCR\_1}$ | $D^{DCR\_2}$ |
|---|---|---|---|---|---|---|---|
| United States | -0,0037405 (0,208) | 0,000000746 (0,935) | 0,0000802 (0,263) | 0 (omitted) | -0,0355679 (0,000)*** | 0 (omitted) | 0 (omitted) |
| Argentina | -0,0077052 (0,103) | 0,000000416 (0,194) | 0,0001382 (0,007)*** | -0,02623 (0,000)*** | 0 (omitted) | 0 (omitted) | 0,0446156 (0,000)*** |
| Brazil | -0,008086 (0,079)* | -0,000000057 (0,565) | 0,0001476 (0,028)** | 0,0178841 (0,000)*** | 0 (omitted) | 0,0502905 (0,000)*** | 0 (omitted) |
| Colombia | -0,0091423 (0,075)* | -0,000000059 (0,927) | 0,0001256 (0,085)* | 0,0032615 (0,547) | 0 (omitted) | 0 (omitted) | -0,013003 (0,003)*** |
| Egypt | -0,0050593 (0,102) | 0,000000192 (0,946) | 0,0000681 (0,201) | -0,0013 (0,645) | 0 (omitted) | 0 (omitted) | 0,0831658 (0,000)*** |
| Morocco | -0,0034634 (0,175) | 0,00000048 (0,491) | 0,0000433 (0,155) | 0,0390422 (0,000)*** | 0 (omitted) | -0,01528 (0,000)*** | -0,013914(0,000)*** |
| South Africa | -0,0045562 (0,136) | -0,000000338 (0,295) | 0,0001003 (0,014)** | -0,022435 (0,000)*** | 0 (omitted) | 0 (omitted) | -0,030459 (0,000)*** |
| China | 0,00183 (0,512) | -1,65E-09 (0,997) | -0,00000913 (0,839) | 0,0014307 (0,181) | 0 (omitted) | -0,016978 (0,000)*** | 0 (omitted) |
| Japan | -0,0010902 (0,490) | 0,00000155 (0,563) | 0,0000218 (0,789) | -0,013823 (0,000)*** | 0 (omitted) | 0 (omitted) | -0,021985 (0,000)*** |
| South Korea | -0,0021119 (0,447) | -0,0000219 (0,060)* | 0,0000966 (0,138) | -0,007297 (0,004)*** | 0 (omitted) | 0 (omitted) | -0,028545 (0,000)*** |
| Australia | -0,0009622 (0,668) | -0,00000482 (0,453) | 0,0000402 (0,318) | -0,053334 (0,000)*** | 0 (omitted) | 0 (omitted) | -0,000871 (0,777) |
| New Zealand | -0,0013941 (0,401) | -0,0000182 (0,799) | 0,0000476 (0,163) | 0 (omitted) | -0,0080502 (0,000)*** | 0,0622099 (0,000)*** | -0,001799 |

The coefficients of the independent variables and the constant are summarized in the table above. The p-value is reported between brackets and the level of significance, 10%, 5% and 1%, is indicated by *, ** and *** respectively. Whenever 'omitted' is indicated, it means the independent variable is omitted because of collinearity.

After executing the regression model as described above, the model is expanded with a control variable: the Yield To Maturity (YTM) of the countries' government bond. This yield to maturity is a measure of

the macroeconomic situation of the given country. Although a small change of the coefficients takes place, the outcomes and findings/results of model 1 do not change after adding this control variable.

### 5.3.2. Findings model 1

The findings following from Table 3 concerning model 1 are outlined below. Every parameter will be discussed extensively. All findings are based on a significance level of 5% or, in other words, a p-value below 0,05.

#### Cases

No significant link is found between the number of confirmed Covid-19 cases and the stock market returns. In none of the examined countries the stock market is influenced by the absolute number of cases, which is clearly in conflict with the conclusions found in the literature review.

This can be justified by the fact that most of the investigated literature focused on the first wave of the pandemic, which can roughly be situated from March until June (except for China, where this event took place earlier). The time window of this master dissertation extends from the 1st of January 2020 until the 3rd of November 2020, thus covering a much larger time span. During the first wave, the shocking effect of the reported number of cases in the news was much bigger than it was after the initial period. That could be the reason why the significant link between confirmed cases and the stock market returns has become insignificant.

Next to that, the relationship is investigated between the absolute numbers of cases and the stock market returns, which can also be a possible declaration. The absolute numbers change gradually over time and do not show major fluctuations on a daily basis, therefore the shocking effect is only limited.

The fact that people react differently to the number of reported cases in later stages compared to the first wave, became clear in the month of November. While almost all of Europe was hit by a second wave, the stock markets saw a historically good November rally. This was also boosted by, for example, the elections in the United States (Smith, Hodgson, &Lockett, 2020) and the good news regarding the effectiveness of Covid-19 vaccines (Jack, 2020).

#### Stringency of government measures

Looking at Table 3, it becomes clear that there is a significant link between the stringency index and the stock market returns in 11 different countries. In the other 17 countries, the stringency index does not impact the stock markets.

Although there are significant links, it is impossible to see a tendency in which countries or continents the stock markets are impacted in the same way by the stringency of the government measures. There is no coherence of geographical groups of countries that all react in a similar way to the stringency

index. This can be explained by the fact that every government takes their own government measures and there is no 'global coordination' to tackle the virus. Also, the fact that the number of investigated countries per continent is limited, except for Europe, makes it harder to detect geographical links.

A striking fact is that when a countries' stock market is affected by the stringency index, the coefficient is always slightly positive. This is in line with the outcomes of the literature review that claims that government measures have a twofold effect. On the one hand, government measures have a direct negative impact (on the short term) on the stock market returns because the economy is directly hit. On the other hand, these measures have an indirect positive impact (longer term) on the stock market returns because the number of cases and deaths will decrease and the sentiment is positive thanks to the believe in a better future (Ashraf, 2020). These two effects partially cancel each other out, so the actual impact is limited. Nevertheless, the indirect positive effect slightly dominates, which indicates a positive long-term sentiment of investors. This confirms the positive long-term sentiment that was also visible in the results of Giglio et al. (2020) and Yue, Korkmaz and Zhou (2020).

### Income support

The results indicate that income support has an impact on the stock market returns in most of the countries that are taken into account. As mentioned above, no coherence can be found between the different countries and this because of the same reasons.

The reaction on provided income support is different, depending on which country is considered. Three major groups[1] can be distinguished:

1. The countries where income support is associated with the severity of the pandemic. This is the case for 18 of the 28 countries: Belgium, Denmark, Germany, Finland, France, Norway, Poland, Spain, Sweden, Ukraine, Canada, the United States, Argentina, South Africa, Japan, South Korea, Australia and New Zealand.

   When income support is provided by the government, the financial stimulus indicates that the situation is not good at all and that the economy obviously needs support. This results in a negative sentiment and thus a negative impact on the stock market returns.

   Additional explanation for some countries can clarify the situation. In Belgium and Denmark, the support immediately goes from no income support (the government covers no lost salary) to an income support of category 2 (the government covers 50% or more of lost salary), which causes a negative sentiment and therefore a negative impact on the stock market returns. When the

[1] When there are significant coefficients with opposite sign for the income support in a country, extra explanation is given to clarify the situation.

income support is lowered to category 1 (the government covers less than 50% of lost salary), it is perceived as an improving situation. This results in a positive sentiment and a positive impact on the stock market returns. When an increase of the income support to category 2 takes place, the sentiment becomes negative once again and so is the impact on the stock market returns.

2. The countries where income support provides peace of mind and where there is great confidence in the government to deal with problems related to the income. This is the fact in 7 countries: Italy, the Netherlands, Portugal, the United Kingdom, Mexico, Brazil and Morocco.

   When income support is provided by the government, people have faith in a better future and they trust that the government takes the right decisions to counter the crisis. This results in a positive sentiment and thus a positive impact on the stock market returns.

3. The countries where the income support does not have an impact on the stock market returns. In 3 countries, there is no significant relation found between income support and the returns: Colombia, Egypt and China.

This is fully in line with the findings of the literature. Cox, Greenwald and Ludvigson (2020) proved that especially the psychological effect (the sentiment) of the financial stimuli is important, rather than effectively distributing them. Following Phan and Narayan (2020), markets are in function of the government. Therefore, as the government reacts, markets will also react. The combination of these two conclusions supports the outcomes of the regression models.

### Debt and contract relief

The outcome of model 1 reveals that the debt and contract relief mostly has an impact on the stock market returns of the investigated countries.

Three different reactions on debt and contract relief can be detected, similar to the reactions on income support:

1. Countries where debt and contract relief is associated with the severity of the pandemic and therefore causes a negative sentiment and a negative impact on the stock market returns. This is the fact for 9 countries: Germany, Sweden, Canada, Colombia, Morocco, South Africa, China, Japan and South Korea.

2. Countries where debt and contract relief provides peace of mind and where great confidence in the government can be found to deal with the problems regarding debt and contracts. Therefore, a positive sentiment and a positive impact on the stock market returns are the result. This is the case for the following 14 countries: Belgium, Denmark, Finland, France, Italy, the Netherlands, Norway, Poland, Spain, the United Kingdom, Ukraine, Argentina, Brazil and Egypt.

3. Countries where debt and contract relief does not have an impact on the stock market returns. There are 4 countries of this type: Portugal, the United States, Mexico, Australia.

New Zealand is a special case and cannot be classified in either of the three categories. In the earlier stages of the pandemic, it started with debt and contract relief of category 1 (narrow relief, specific to one kind of contract). This was well received which resulted in a good sentiment and positive impact on the stock market returns. Later on, it reinforced the debt and contract relief to category 2 (broad debt/contract relief). In the eyes of the households, this was not a good signal. Either the pandemic situation got a lot worse or the first decisions that were made were not sound. The sentiment went down, followed by a negative impact on the stock market returns.

In contrast to the results of the stringency index and the income support, some geographical links can be found between countries when it comes to the debt and contract relief. All the investigated Asian countries reacted negatively to the measures about debt and contract relief (for what this is worth, only 3 Asian countries taken into account). On the other hand, almost all European countries (11 out of 14) reacted positively to these measures. This may be explained by the fact that more similar measures were taken in these areas or that there is more dialogue on this matter.

These conclusions are also in line with the findings of the literature. This can be explained in the same way as in the case of income support.

## 5.4. Model 2: Fatalities

After looking at the impact of the confirmed Covid-19 cases on the stock market returns, the impact of the deaths due to the coronavirus is investigated as well. Both models are very similar and consistent outcomes are expected for the independent variables that are the same compared to model 1.

The second model handles about the fatalities due to the coronavirus and its equitation is given below:

$$R_{i,t} = \alpha + \beta_1 DEATHS_t + \beta_2 STRING_t + \beta_3 D_t^{IS\_1} + \beta_4 D_t^{IS\_2} + \beta_5 D_t^{DCR\_1} + \beta_6 D_t^{DCR\_2} + \varepsilon_t$$

Where:

- $R_{i,t}$: the return of stock market i at day t expressed in percentages.
- α: the constant term of the regression.
- $DEATHS_t$: the number of deaths due to Covid-19 at day t expressed in absolute numbers.
- $STRING_t$: the stringency index at day t with a value between 0 and 100.
- $D_t^{IS\_1}$: dummy variable that equals 1 if the income support changes to a value of 1 (the government covers less than 50% of lost salary).
- $D_t^{IS\_2}$: dummy variable that equals 1 if the income support changes to a value of 2 (the government covers 50% or more of lost salary).
- $D_t^{DCR\_1}$: dummy variable that equals 1 if the debt and contract relief changes to a value of 1 (narrow relief, specific to one kind of contract).
- $D_t^{DCR\_2}$: dummy variable that equals 1 if the debt and contract relief changes to a value of 2 (broad debt/contract relief).
- $\varepsilon_t$: the error term at time t.

The different β's represent the regression coefficients.

The dummy variables income support and debt and contract relief only equal 1 at the moment the support changes, just like in model 1. The reason for this is stated previously.

### 5.4.1. Results model 2

The results of model 2 are shown in Table 4.

*Table 4: The results of the second regression model*

| | α | FATALITIES | STRING | $D^{IS\_1}$ | $D^{IS\_2}$ | $D^{DCR\_1}$ | $D^{DCR\_2}$ |
|---|---|---|---|---|---|---|---|
| Belgium | -0,0091549 (0,043)** | -0,0000124 (0,576) | 0,0001716 (0,044)** | 0,005523 (0,002)*** | -0,02747 (0,000)*** | 0,004416 (0,395) | 0,038581 (0,000)*** |
| Denmark | -0,0011253 (0,640) | 0,0004066 (0,098)* | 0,00000286 (0,538) | 0,020634 (0,000)*** | -0,03228 (0,006)*** | 0 (omitted) | 0,009206 (0,000)*** |
| Finland | -0,0043296 (0,151) | 0,0001707 (0,660) | 0,0001259 (0,111) | 0 (omitted) | -0,05128 (0,000)*** | 0,014334 (0,000)*** | 0 (omitted) |
| France | -0,0055676 (0,048)** | -0,00000445 (0,510) | 0,0001171 (0,082)* | 0 (omitted) | -0,06257 (0,000)*** | 0,012643 (0,000)*** | 0 (omitted) |
| Germany | -0,0061766 (0,109) | 0,00000516 (0,767) | 0,0001277 (0,080)* | 0 (omitted) | -0,05172 (0,000)*** | -0,03993 (0,000)*** | 0 (omitted) |
| Italy | 0,0042422 (0,168) | 0,0000141 (0,181) | -0,0001286 (0,165) | 0,028813 (0,000)*** | 0 (omitted) | 0 (omitted) | 0,02595 (0,000)*** |
| Netherlands | -0),0043185 (0,133 | -0,0000146 (0,664) | 0,000104 (0,072)* | 0 (omitted) | 0,017624 (0,000)*** | 0,02645 (0,000)*** | 0 (omitted) |
| Norway | -0,0053268 (0,036)** | -0,0003065 (0,447) | 0,0001351 (0,028)** | 0 (omitted) | -0,01189 (0,000)*** | 0 (omitted) | 0,033489 (0,000)*** |
| Poland | -0,005635 (0,051)* | -0,0000388 (0,201) | 0,0001221 (0,005)*** | -0,01782 (0,000)*** | -0,00715 (0,000)*** | 0,034483 (0,000)*** | 0 (omitted) |
| Portugal | -0,0033316 (0,338) | 0,0000884 (0,514) | 0,0000477 (0,410) | 0,019605 (0,000)*** | 0 (omitted) | -0,01775 (0,590) | 0,001738 (0,773) |
| Spain | -0,0049398 (0,157) | -0,00000235 (0,660) | 0,0000757 (0,156) | -0,0352 (0,000)*** | -0,02628 (0,000)*** | 0,070256 (0,000)*** | 0,017301 (0,000)*** |
| Sweden | -0,0032984 (0,293) | 0,0000214 (0,493) | 0,0000741 (0,183) | 0 (omitted) | -0,01191 (0,000)*** | -0,03288 (0,000)*** | 0 (omitted) |
| Ukraine | -0,0047582 (0,060)* | -0,00000241 (0,926) | 0,0000818 (0,056)* | -0,10736 (0,000)*** | 0 (omitted) | 0,046593 (0,000)*** | 0 (omitted) |
| United Kingdom | -0,0080555 (0,053)* | -0,000000699 (0,869) | 0,000126 (0,053)* | 0 (omitted) | 0,0088995 (0,000)*** | 0,0337981 (0,000)*** | 0,0191792 (0,000)*** |
| Canada | -0,0037512 (0,260) | -5,83E-08 (0,998) | 0,0000882 (0,113) | 0 (omitted) | -0,10061 (0,000)*** | -0,07498 (0,000)*** | 0 (omitted) |
| Mexico | -0,0038194 (0,136) | -0,00000517 (0,123) | 0,0000878 (0,035)** | 0,0148882 (0,090)* | 0 (omitted) | 0 (omitted) | 0 (omitted) |
| United States | -0,0037092 (0,209) | 0,000000291 (0,908) | 0,0000796 (0,216) | 0 (omitted) | -0,0355028 (0,000)*** | 0 (omitted) | 0 (omitted) |
| Argentina | -0,0078094 (0,095)* | -0,00000559 (0,161) | 0,0001255 (0,014)** | -0,0248736 (0,000)*** | 0 (omitted) | 0 (omitted) | 0,0459369 (0,000)*** |
| Brazil | -0,0081425 (0,074)* | -0,00000173 (0,712) | 0,0001469 (0,052)* | 0,0179933 (0,000)*** | 0 (omitted) | 0,0503816 (0,000)*** | 0 (omitted) |

| | α | FATALITIES | STRING | $D^{IS\_1}$ | $D^{IS\_2}$ | $D^{DCR\_1}$ | $D^{DCR\_2}$ |
|---|---|---|---|---|---|---|---|
| Colombia | -0,0091117 (0,074)* | -0,00000737 (0,755) | 0,0001339 (0,076)* | 0,0025806 (0,635) | 0 (omitted) | 0 (omitted) | -0,0134543 (0,002)*** |
| Egypt | -0,0050035 ((0,109) | -0,0000125 (0,780) | 0,0000731 (0,158) | -0,0009073 (0,581) | 0 (omitted) | 0 (omitted) | 0,082932 (0,000)*** |
| Morocco | -0,0034291 (0,178) | 0,000226 (0,573) | 0,0000437 (0,152) | 0,0389573 ((0,000)*** | 0 (omitted) | -0,0153778 (0,000)*** | -0,0139266 (0,000)*** |
| South Africa | -0,0044116 (0,158) | -0,00001 (0,430) | 0,0000956 (0,015)** | -0,0221733 (0,000)*** | 0 (omitted) | 0 (omitted) | -0,0304519 (0,000)*** |
| China | 0,0018343 (0,511) | -2,965E-07 (0,952) | -9,12E-06 (0,836) | 0,0014266 (0,180) | 0 (omitted) | -0,01698 (0,000)*** | 0 (omitted) |
| Japan | -0,0007419 (0,675) | 0,0000754 (0,449) | 0,0000129 (0,885) | -0,014281 (0,000)*** | 0 (omitted) | 0 (omitted) | -0,0220664 (0,000)*** |
| South Korea | -0,001792 (0,521) | 0,0003406 (0,740) | 0,00004 (0,548) | -0,007071 (0,143) | 0 (omitted) | 0 (omitted) | -0,0296036 (0,000)*** |
| Australia | -0,0015391 (0,503) | -0,0003352 (0,045)** | 0,0000613 (0,118) | -0,0532331 (0,000)*** | 0 (omitted) | 0 (omitted) | -0,0042933 (0,000)*** |
| New Zealand | -0,0010313 (0,521) | 0,0026731 (0,267) | 0,0000298 (0,321) | 0 (omitted) | -0,0078787 (0,000)*** | 0,062671 (0,000)*** | -0,0018023 (0,112) |

The coefficients of the independent variables and the constant are summarized in Table 4. The p-value is reported between brackets and the level of significance, 10%, 5% and 1%, is indicated by *, ** and *** respectively. Whenever 'omitted' is indicated, it means the independent variable is omitted because of collinearity.

After executing model 2, this model is also expanded with the control variable YTM of the countries' government bond, just like model 1. Again, despite some small changes in coefficients, the findings on this model did not change.

### 5.4.2. Findings model 2

The things that can be learned from the executed regressions on model 2 are handled in the following. All these findings are based on a significance level of 5%, or in other words, a p-value below 0,05.

#### Fatalities

In general, it is justified to conclude that there is no significant link between the number of Covid-19 deaths and the stock market returns. Only in Australia did the stock markets react negatively on deaths due to the coronavirus.

The fact that no significant link is found between the number of fatalities and the stock market returns, like in the case of confirmed cases, can be attributed to the larger time window and the use of absolute numbers.

Cox, Greenwald and Ludvigson (2020) and Al-Awadhi et al. (2020) stated that the number of corona deaths do have an impact on the stock market returns, while Ashraf (2020) stated they have no impact. The findings of model 2 concur with the second strand of the literature.

The reason that the Australian stock market is affected by the number of Covid-19 deaths can possibly be ascribed to the fact that there were only very few deaths due to the virus. When a fatality is reported, this is exceptional and shocking news and therefore it can negatively impact the stock markets.

### Stringency of government measures

Regarding model 2, there is a significant link between the stringency index and the stock market returns in 6 countries. The other 22 countries showed no significant link. This does not entirely stroke with the outcome of model 1. However, it is remarkable that when the significance of the stringency index in model 1 changes to non-significant in model 2, or vice versa, the p-value was always at the edge of 5 percent in model 1. Furthermore, the same conclusion regarding the geographical coherence between countries can be drawn.

Model 2 also shows that the significant correlations between the stringency index and the stock market returns are always slightly positive, which confirms the conclusion about the positive long-term sentiment of the investors.

### Income support

As expected, the stock market reactions on income support were exactly the same as in model 1. This confirms what was found above. Only in South Korea did the impact of income support become insignificant, whereas it was significant in model 1.

### Debt and contract relief

The outcome of model 2 confirms the findings of model 1. The only difference that can be detected between model 1 and model 2 concerning this financial stimulus is that the debt and contract relief became significant in model 2 for Australia, whereas it was not in model 1. The coefficient is negative and this way Australia joins the group of countries where debt and contract relief is associated with the severity of the pandemic, meaning a negative sentiment and a negative impact on the stock market returns is created.

## 5.5. Difference between the reaction on income support and debt and contract relief

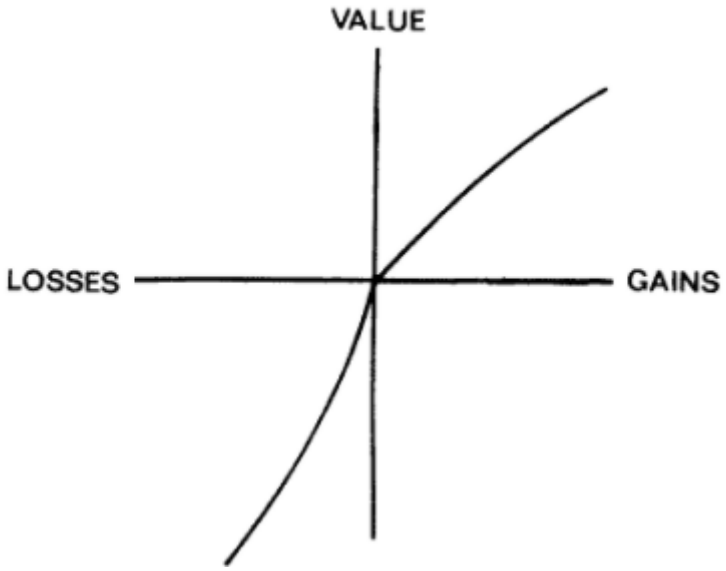
If a look is taken at the reactions of the different countries in terms of income support and debt and contract relief, it becomes clear that the reaction on the two different measures can differ even within one country. This is somewhat surprising because it could be expected that people would react in the same way on both types of financial stimuli.

First of all, this could be explained by the fact that the income support and debt and contract relief are totally unrelated to each other. That one policy is completely independent from the other can be seen in the descriptive statistics (Graph 16 and Graph 17). In Germany for example, the income support is high, while the debt and contract relief is low.

Next to that, both types of financial stimuli solve different problems. While income support helps to solve liquidity problems on the one hand, debt and contract relief helps to avoid solvability problems. As the income support and debt and contract relief are related to households, the demand site of the stock markets is investigated. As a consequence of this, the psychological part becomes quite important.

The fact that the reactions on both types of financial stimuli are different, is also supported by the prospect theory which focusses on the psychological aspect of making decisions. The main idea of this theory states that gains and losses are valued differently by people (Chen, 2020). If the amount of money lost is equal to the amount of money won, the negative value of the loss is bigger than the positive value of the gain, see Graph 22. This could also be a possible way to explain the difference between the reactions on income support and debt and contract relief. Income support is associated with a loss because it compensates a wage loss. On the other hand, debt and contract relief is associated with a gain because certain obligations disappear (paying taxes, energy bills,…).

Income support had negative impact on the stock market returns in 18 of the investigated countries, while debt and contract relief had positive impact on the stock market returns in only 14 countries. This is in line with the prospect theory that states that the negative value of losses outweighs the positive value of gains (Kahneman & Tversky, 1979). Of course, more research is recommended to verify this statement.




*Graph 22: A hypothetical value function (Kahnema &Tversky, 1979)*

## 5.6. Model 3 and 4: Weekend effect

Since the data about the cases and deaths are available on a daily basis and the stock market returns only on trading days, the weekend data (and data on stock market closing days) were omitted in model 1 and 2 in order to match the data. To check whether the number of reported cases and deaths during the weekend have an impact on the stock market returns on Monday, two additional models are tested.

An interaction term is generated by the multiplication of the dummy variable Monday, that only equals 1 when the considered day is a Monday, and the independent variable cases (or deaths). If the coefficient of this interaction term is significant, the extent of the impact of the weekend data on the stock market returns is known. If the coefficient is not significant, the weekend data have no additional impact on the stock market returns on Monday.

The equitation of model 3 is an extension of model 1 and is given below:

$$R_{i,t} = \alpha + \beta_1 CASES_t + \beta_2 STRING_t + \beta_3 D_t^{IS\_1} + \beta_4 D_t^{IS\_2} + \beta_5 D_t^{DCR\_1} + \beta_6 D_t^{DCR\_2} + \beta_7 (D_t^{MON} * CASES_t) + \varepsilon_t$$

Where:

- $R_{i,t}$: the return of stock market i at day t expressed in percentages.
- α: the constant term of the regression.
- $CASES_t$: the number of confirmed Covid-19 cases at day t expressed in absolute numbers.
- $STRING_t$: the stringency index at day t with a value between 0 and 100.
- $D_t^{IS\_1}$: dummy variable that equals 1 if the income support changes to a value of 1 (the government covers less than 50% of lost salary).

- $D_t^{IS\_2}$: dummy variable that equals 1 if the income support changes to a value of 2 (the government covers 50% or more of lost salary).
- $D_t^{DCR\_1}$: dummy variable that equals 1 if the debt and contract relief changes to a value of 1 (narrow relief, specific to one kind of contract).
- $D_t^{DCR\_2}$: dummy variable that equals 1 if the debt and contract relief changes to a value of 2 (broad debt/contract relief).
- $(D_t^{MON} * \mathrm{CASES_t})$: interaction term to check the weekend effect where $\mathrm{D_t^{MON}}$ is a dummy variable that equals 1 if day t is a Monday.
- $\varepsilon_t$: the error term at time t.

The equitation of model 4, which is an extension of model 2, is similar to that of model 3 and is given below:

$$\mathrm{R_{i,t}} = \alpha + \beta_1 \mathrm{DEATHS_t} + \beta_2 \mathrm{STRING_t} + \beta_3 \mathrm{D_t^{IS_1}} + \beta_4 \mathrm{D_t^{IS_2}} + \beta_5 \mathrm{D_t^{DCR_1}} + \beta_6 \mathrm{D_t^{DCR_2}} + \beta_7 (D_t^{MON} * \mathrm{DEATHS_t}) + \varepsilon_t$$

Where:

- $DEATHS_t$: the number of deaths due to Covid-19 at day t expressed in absolute numbers.
- $(D_t^{MON} * \mathrm{DEATHS_t})$: interaction term to check the weekend effect where $\mathrm{D_t^{MON}}$ is a dummy variable that equals 1 if day t is a Monday.

Based on the results of model 1 and 2, which showed that there is no significant link between cases/fatalities and stock market returns, it would a priori be expected that there is no significant link between the stock market returns on Monday and the reported number of cases and deaths in the weekend. This assumption is confirmed by the execution of both model 3 and model 4.

# 6. LIMITATIONS AND POSSIBLE EXPANSIONS

This section addresses the limitations of the executed investigation and possible expansions for future research.

Since it was the purpose to investigate the impact of Covid-19 on the stock market performance worldwide, already a high amount of regressions had to be executed. Including more countries in the research was thus very difficult. This made it somehow difficult to find relationships between countries, regions, political areas… In order to be able to find these relationships, future studies can concentrate on specific countries or groups of countries.

In this thesis, the income support and debt and contract relief are used to get an insight in the financial stimulus packages provided by the government. As both are related to households, the demand side of the stock markets is investigated. Future research could focus on the supply side of the stock markets by looking at the financial stimulus packages the government provides to support companies.

The time window in this master dissertation stretches from the first of January until the third of November. This means that the data stops at the beginning of an interesting next big wave of cases in many different countries. It could be interesting for researchers to examine this second wave and make a comparison with the first one.

In order to optimize the models, the yield to maturity of the government bonds was added as a control variable to correct for the macroeconomic situation. The models could be further optimized with additional control variables such as the unemployment rate of a country, the returns of the MSCI world index, the countries' budget deficit, the GDP/capita of a country… After all, the outbreak of Covid-19 is only one of the many factors that influences the stock market returns (Brexit, the elections in the United States,…). Future research could try to take into account more influencing factors at the same time.

Finally, this thesis focused on the relationship between the absolute numbers of cases/fatalities and the stock market returns. These numbers change gradually over time and do not show major fluctuations on a daily basis, which is why the shocking effect on investors is only limited. Therefore, it could be interesting to look for a relationship between the daily percentage change of cases/fatalities and stock market returns.

# 7. CONCLUSION

With the Covid-19 pandemic having such a global impact, many researches started to pile up at a high pace in the last months. Some of this literature handled the impact on the stock market returns. The existing literature however focused on a short period, on some specific variables or on a certain group of countries. This called for an investigation with a broader, longer and more global approach. With financial stimuli barely handled and some literature resulting in contradictory conclusions, this approach could clarify many things.

Therefore this thesis investigated the impact of the number of cases, the number of deaths, the government measures and the financial stimulus packages on the stock markets. This research was executed for 28 different countries, with 14 located in Europe and the other 14 spread over the other continents. Using the MSCI index as a measure for the stock market performance of that country, a comparison could be made between the 28 chosen countries.

Next to the main research, an overall image of the impact of the pandemic in these countries was created by an extensive data description. This analysis showed that the United States and Brazil were hit hardest in terms of absolute numbers of cases and deaths, while Belgium showed the worst numbers per capita. Some countries took way more stringent measures than others, with Argentina leading as the most stringent one. Europe provided on average more income support in comparison to the other continents. There is no coherence between the government's decisions regarding the provision of income support and debt and contract relief.

When it comes to the stock market returns, most countries show a negative average daily return over the investigated period. Next to that, a clear decrease in average returns is visible in comparison to five years before the outbreak of Covid-19. However, higher average returns were noted for Denmark, the United States and China in comparison to these five years, which could be explained by their activity in positively impacted industries. Lastly, all 28 countries showed a rise in volatility during the outbreak of Covid-19 in comparison to the five years before the spread of the virus, which implies that fear and uncertainty increased due to the pandemic.

The main research started by studying the link between the number of Covid-19 cases and the stock market returns. The results show that there is no significant relation between these two variables. This is in contrast with the literature that was published before this research. The reason for these different results is the fact that this thesis handles a longer period of time (from the 1$^{st}$ of January until the 3$^{rd}$ of November 2020). This was not the case in the existing literature, which focused mostly on the 'first wave' and in which the reaction of investors was different. Besides this, the absolute number of cases is

considered, which changes gradually over time and does not show major fluctuations on a daily basis. This could also limit the shock effect on investors.

The same results are found looking at the number of fatalities and the returns. This confirms the results of some the literature, which stated that there is no link between deaths and returns. However, some literature stated that there is a relation between the two. Again, the reason that no significant relationship is found could come down to the longer investigated period and the use of absolute numbers.

In terms of the stringency of the government measures, not all countries show a significant relation between the stock market returns and its measures to contain the spread of the virus. However, looking at the countries that do, the government measures always have a slightly positive impact on the returns of the stock market. This confirms the literature that states that the impact of the measures is twofold: a direct, negative impact (due to the impact on the economy) and an indirect, positive effect (due to the decrease in cases and fatalities and the confidence in the government's policy). The findings of this thesis indicate that the indirect, positive impact slightly dominates the direct, negative impact of the measures. This implies that there is a positive sentiment among investors on the longer term.

With the financial stimulus packages hardly covered in existing literature, this thesis handles two important stimuli: the income support and the debt and contract relief. These data are about households, which means the data are used to reach a conclusion on the demand side of the stock market. Most of the time, both types of support show a relation with the stock market returns, but the relationship is not always unambiguous. First of all, some countries impose financial support, which calms down the inhabitants and creates a positive sentiment, with people knowing that everything will be all right and having confidence in the government's policy. This leads to a positive impact on the stock market returns. In some countries however, people see the financial support as a measure of the severity of the pandemic. The financial stimulus indicates that the situation is not good at all and that the economy obviously needs support. This results in a negative sentiment and thus a negative impact on the stock market returns. Lastly, there is a (smaller) group of countries that shows no significant relation between financial stimuli and stock market returns.

A difference in reaction on both types of stimulus packages within a country itself can possibly be explained by the prospect theory or the fact that both financial stimuli solve different problems. The inconsistent policy regarding both stimuli could also be a possible explanation for the different reactions.

In addition to the two main models, a dummy variable 'Monday' was added to model 1 and model 2 to investigate the weekend effect. The results show that the reported number of cases and deaths during

the weekends do not have an additional impact on the stock market returns on Monday. The addition of the yield to maturity to model 1 and 2, as a control variable for the macroeconomic situation, did also not change the outcome of the models.

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# APPENDIX

## Appendix 1: Table with data of the descriptive statistics

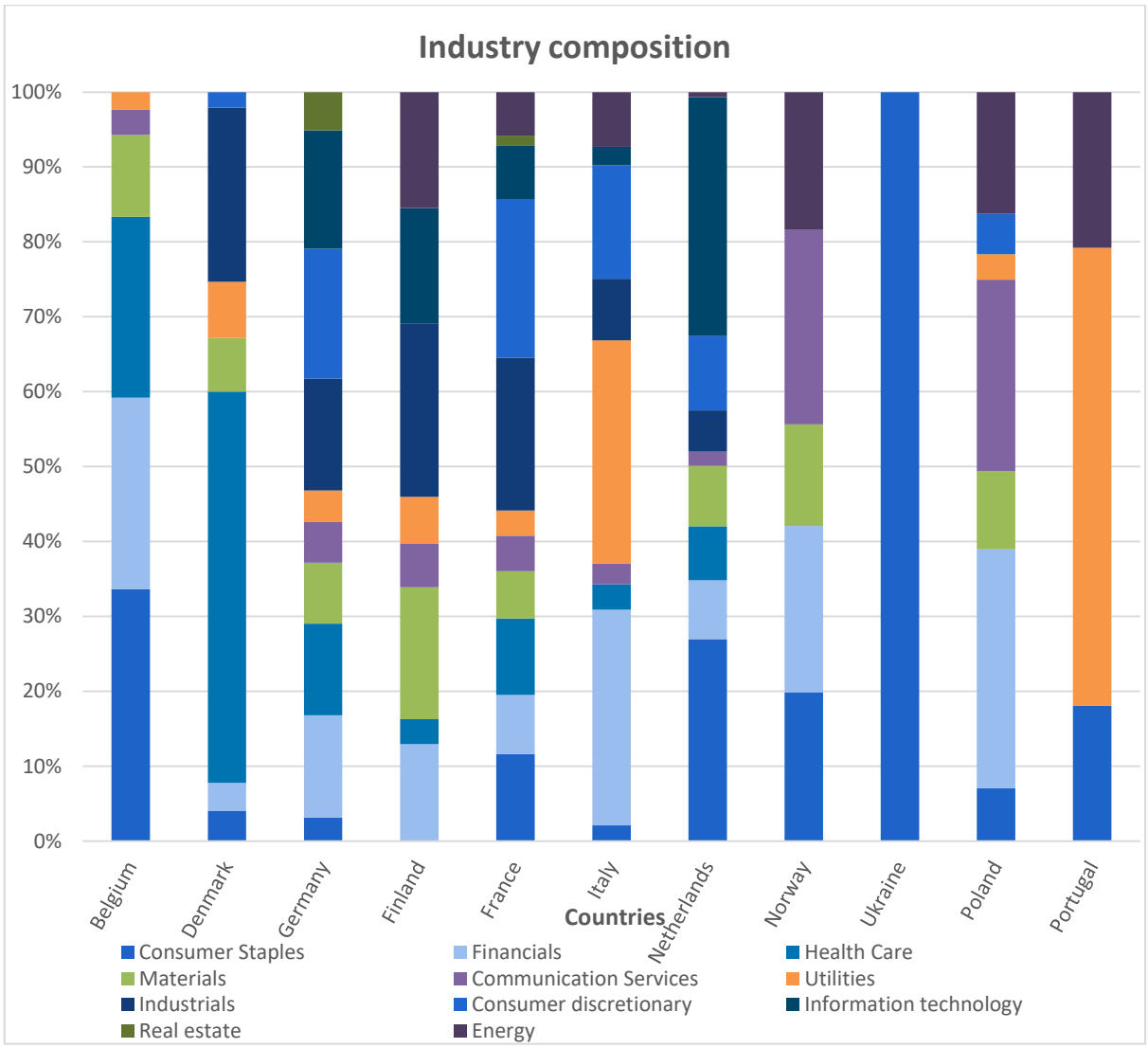
| | | Cases | | | Deaths | | | Stringency index | |
|---|---|---|---|---|---|---|---|---|---|
| | Date 1st confirmed case | Total | Per capita | Max on 1 day | Total | Per capita | Max on 1 day | Average | Maximum |
| **Europe** | | | | | | | | | |
| Belgium | 4/02/2020 | 464540 | 4,01% | 22189 | 12209 | 0,1053% | 321 | 48,43 | 81,48 |
| Denmark | 27/02/2020 | 48241 | 0,83% | 1476 | 724 | 0,0125% | 22 | 44,56 | 72,22 |
| Germany | 28/01/2020 | 560379 | 0,67% | 19059 | 10661 | 0,0127% | 315 | 48,21 | 76,85 |
| Finland | 30/01/2020 | 16400 | 0,30% | 344 | 359 | 0,0065% | 43 | 35,84 | 67,59 |
| France | 25/01/2020 | 1466433 | 2,25% | 52518 | 37435 | 0,0574% | 2004 | 48,80 | 87,96 |
| Italy | 31/01/2020 | 731588 | 1,21% | 31756 | 39059 | 0,0646% | 971 | 54,52 | 93,52 |
| Netherlands | 28/02/2020 | 367715 | 2,15% | 11102 | 7453 | 0,0435% | 234 | 45,09 | 79,63 |
| Norway | 27/02/2020 | 20634 | 0,38% | 1071 | 282 | 0,0052% | 13 | 36,88 | 79,63 |
| Ukraine | 4/03/2020 | 402194 | 0,92% | 11532 | 7375 | 0,0169% | 197 | 64,69 | 88,89 |
| Poland | 3/03/2020 | 395481 | 1,04% | 21897 | 5875 | 0,0155% | 298 | 52,26 | 83,33 |
| Portugal | 3/03/2020 | 146847 | 1,44% | 4656 | 2590 | 0,0254% | 60 | 65,74 | 87,96 |
| Spain | 1/02/2020 | 1259366 | 2,69% | 55019 | 36495 | 0,0781% | 1179 | 53,08 | 85,19 |
| United Kingdom | 1/02/2020 | 1053864 | 1,55% | 26687 | 46853 | 0,0690% | 1224 | 54,42 | 79,63 |
| Sweden | 6/02/2020 | 133327 | 1,32% | 4056 | 6024 | 0,0596% | 115 | 44,88 | 64,81 |

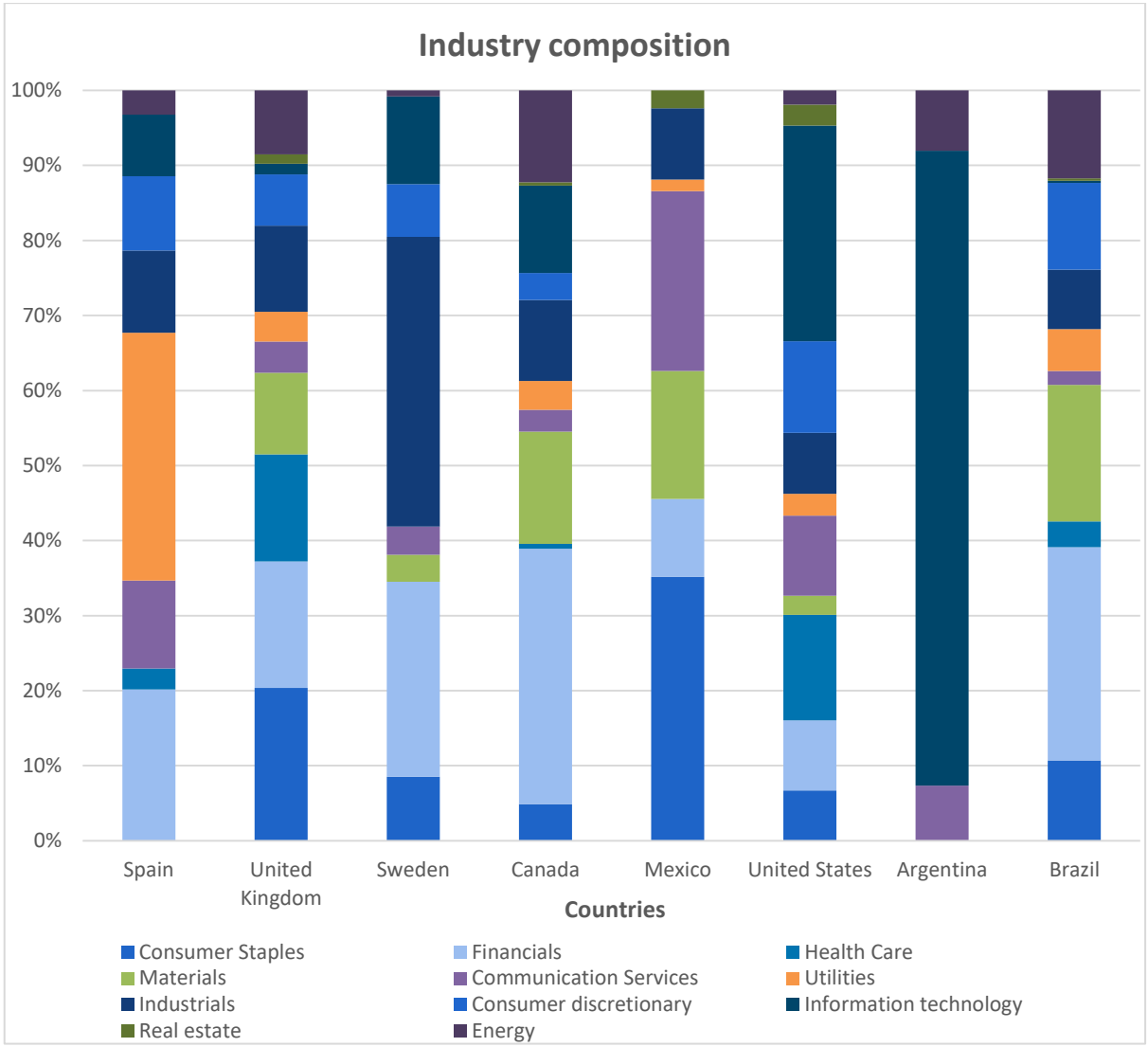
| | | Cases | | | Deaths | | | Stringency index | |
|---|---|---|---|---|---|---|---|---|---|
| | Date 1st confirmed case | Total | Per capita | Max on 1 day | Total | Per capita | Max on 1 day | Average | Maximum |
| **North America** | | | | | | | | | |
| Canada | 26/01/2020 | 240263 | 0,64% | 4722 | 10208 | 0,0270% | 222 | 51,46 | 74,54 |
| Mexico | 14/01/2020 | 933155 | 0,72% | 9044 | 92100 | 0,0714% | 3013 | 54,69 | 82,41 |
| United States | 21/01/2020 | 9291245 | 2,81% | 101273 | 231551 | 0,0700% | 4928 | 53,33 | 72,69 |
| **South America** | | | | | | | | | |
| Argentina | 4/03/2020 | 1183118 | 2,62% | 18326 | 31623 | 0,0700% | 3351 | 86,25 | 100 |
| Brazil | 26/02/2020 | 5554206 | 2,61% | 69074 | 160253 | 0,0754% | 1595 | 56,85 | 81,02 |
| Colombia | 7/03/2020 | 1093256 | 2,15% | 13056 | 31670 | 0,0622% | 400 | 78,88 | 90,74 |
| **Africa** | | | | | | | | | |
| Egypt | 15/02/2020 | 107925 | 0,11% | 1774 | 6291 | 0,0061% | 97 | 52,94 | 84,26 |
| Morocco | 3/03/2020 | 225070 | 0,61% | 4320 | 3826 | 0,0104% | 73 | 66,59 | 93,52 |
| South Afrcia | 6/03/2020 | 727595 | 1,23% | 13944 | 19465 | 0,0328% | 572 | 62,50 | 87,96 |
| **Asia** | | | | | | | | | |
| China | 3/01/2020 | 91369 | 0,01% | 15141 | 4739 | 0,0003% | 1290 | 68,30 | 81,94 |
| Japan | 15/01/2020 | 102281 | 0,08% | 2064 | 1780 | 0,0014% | 101 | 31,46 | 47,22 |
| South Korea | 20/01/2020 | 26807 | 0,05% | 909 | 472 | 0,0009% | 9 | 47,52 | 82,41 |
| **Oceania** | | | | | | | | | |
| Australia | 25/01/2020 | 27602 | 0,11% | 721 | 907 | 0,0036% | 59 | 53,97 | 79,17 |
| New Zealand | 28/02/2020 | 1612 | 0,03% | 95 | 25 | 0,0005% | 4 | 37,51 | 96,3 |

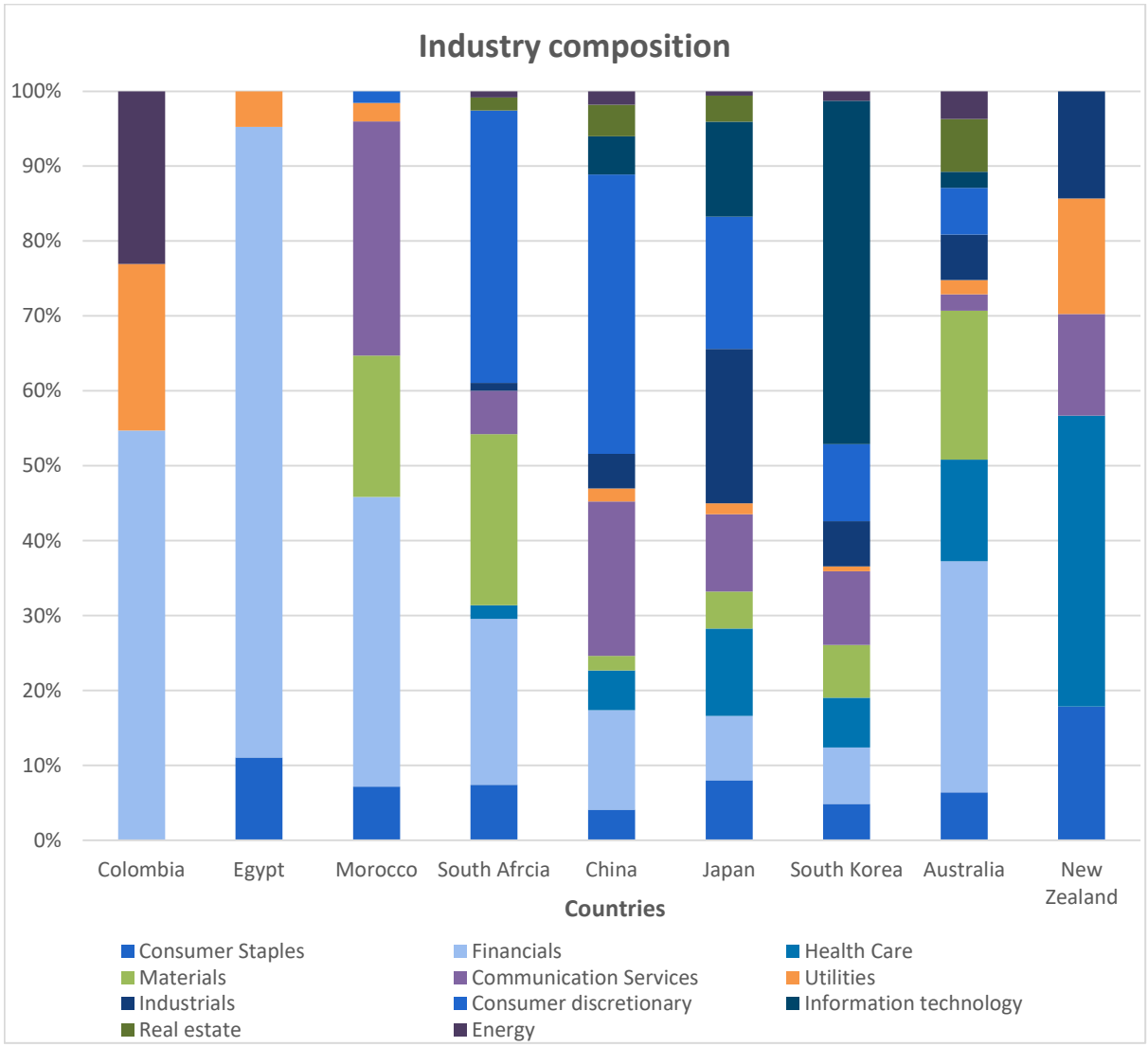
| | Income support | | Debt and contract relief | | Daily returns | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Average | Maximum | Average | Maximum | μ before pandemic | μ during pandemic | Minimum | Maximum | σ before pandemic | σ during pandemic |
| **Europe** | | | | | | | | | | |
| Belgium | 1,54 | 2 | 1,18 | 2 | 0,021% | -0,115% | -15,185% | 7,360% | 1,045% | 2,348% |
| Denmark | 1,52 | 2 | 1,30 | 2 | 0,046% | 0,094% | -7,429% | 3,650% | 1,078% | 1,397% |
| Germany | 1,51 | 2 | 0,30 | 1 | 0,029% | -0,022% | -12,489% | 10,406% | 1,063% | 2,099% |
| Finland | 1,51 | 2 | 0,49 | 1 | 0,034% | 0,025% | -9,816% | 8,467% | 1,087% | 1,839% |
| France | 1,51 | 2 | 0,91 | 2 | 0,045% | -0,061% | -12,322% | 8,467% | 1,015% | 2,088% |
| Italy | 0,75 | 1 | 1,26 | 2 | 0,034% | -0,078% | -17,131% | 8,632% | 1,344% | 2,296% |
| Netherlands | 1,51 | 2 | 0,72 | 1 | 0,049% | 0,025% | -9,955% | 7,187% | 0,970% | 1,760% |
| Norway | 1,49 | 2 | 1,44 | 2 | 0,038% | -0,054% | -8,119% | 5,615% | 1,020% | 1,743% |
| Ukraine | 0,77 | 1 | 0,73 | 1 | 0,010% | -0,095% | -10,803% | 12,042% | 1,398% | 2,194% |
| Poland | 0,90 | 2 | 0,73 | 1 | 0,008% | -0,124% | -13,472% | 6,309% | 1,065% | 2,136% |
| Portugal | 0,77 | 1 | 1,18 | 2 | 0,044% | -0,021% | -11,378% | 10,866% | 1,147% | 2,040% |
| Spain | 1,48 | 2 | 1,46 | 2 | 0,014% | -0,122% | -14,327% | 7,833% | 1,170% | 2,204% |
| United Kingdom | 1,49 | 2 | 1,50 | 2 | 0,029% | -0,099% | -10,827% | 8,866% | 0,853% | 1,898% |
| Sweden | 1,55 | 2 | 0,76 | 1 | 0,038% | 0,026% | -10,712% | 7,072% | 1,031% | 1,903% |

| | Income support | | Debt and contract relief | | Daily returns | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Average | Maximum | Average | Maximum | μ before pandemic | μ during pandemic | Minimum | Maximum | σ before pandemic | σ during pandemic |
| **North America** | | | | | | | | | | |
| Canada | 1,52 | 2 | 0,75 | 1 | 0,025% | 0,001% | -12,465% | 12,537% | 0,695% | 2,263% |
| Mexico | 0,08 | 1 | 0,17 | 2 | 0,011% | -0,046% | -6,865% | 5,358% | 0,855% | 1,655% |
| United States | 1,44 | 2 | 0,72 | 1 | 0,046% | 0,061% | -12,118% | 9,409% | 0,833% | 2,312% |
| **South America** | | | | | | | | | | |
| Argentina | 0,73 | 1 | 1,45 | 2 | 0,004% | 0,030% | -14,752% | 12,600% | 2,388% | 3,438% |
| Brazil | 0,70 | 1 | 0,75 | 1 | 0,074% | -0,033% | -14,575% | 14,143% | 1,328% | 2,919% |
| Colombia | 0,69 | 1 | 1,51 | 2 | 0,029% | -0,158% | -16,608% | 17,060% | 0,968% | 2,908% |
| **Africa** | | | | | | | | | | |
| Egypt | 0,51 | 1 | 1,47 | 2 | 0,062% | -0,100% | -16,318% | 8,088% | 1,451% | 2,132% |
| Morocco | 0,73 | 1 | 1,36 | 2 | 0,030% | -0,054% | -9,790% | 5,573% | 0,643% | 1,433% |
| South Afrcia | 0,64 | 1 | 1,03 | 2 | 0,022% | -0,002% | -9,041% | 7,497% | 1,153% | 2,106% |
| **Asia** | | | | | | | | | | |
| China | 0,67 | 1 | 0,56 | 2 | 0,036% | 0,106% | -5,986% | 4,990% | 1,218% | 1,560% |
| Japan | 0,66 | 1 | 1,51 | 2 | 0,029% | -0,008% | -5,532% | 7,311% | 1,135% | 1,446% |
| South Korea | 0,71 | 1 | 0,75 | 1 | 0,031% | 0,049% | -7,530% | 9,204% | 0,845% | 1,876% |
| **Oceania** | | | | | | | | | | |
| Australia | 0,77 | 1 | 1,45 | 2 | 0,036% | -0,024% | -9,888% | 7,407% | 0,824% | 2,037% |
| New Zealand | 1,51 | 2 | 1,11 | 2 | 0,056% | 0,054% | -5,358% | 6,423% | 0,814% | 1,450% |

# Appendix 2: Industry composition per country




Industry composition
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Spain
United Kingdom
Sweden
Canada
Mexico
United States
Argentina
Brazil
Countries
Consumer Staples
Financials
Health Care
Materials
Communication Services
Utilities
Industrials
Consumer discretionary
Information technology
Real estate
Energy


Industry composition
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Colombia
Egypt
Morocco
South Afrcia
China
Japan
South Korea
Australia
New Zealand
Countries
Consumer Staples
Financials
Health Care
Materials
Communication Services
Utilities
Industrials
Consumer discretionary
Information technology
Real estate
Energy