



CORRELATION BETWEEN COVID – 19 AND EQUITY MARKETS

Student: Carlos Jose Calvo Vidal.

al205408@uji.es

Research in financials economics and accounting

Course 2020-2021.

Supervisor: Luisa Nieto Soria.

JEL classification: C01,C12, C16,G10.

ABSTRACT :

The equity markets are sensitive to political, social or economic developments. In this case, we focus on a health one, Covid-19. It will be exposed the level at which share prices were exposed , and how it correlates with the spread of the virus . The Pearson coefficient will indicate the C -19 correlation with the return and volatility figures, in the world's main financial indices.. Due to decision-making by Central Banks and governments, the impact was amortised, and indices had upward returns in the period computed : March 2020- March 2021. There were also different yields according to the sector they represented, with the technology being the least affected by the crisis.

INDEX

ABSTRACT.....	1
INDEX.....	2
LIST OF FIGURES.....	3
LIST OF TABLES.....	3
INTRODUCTION.....	5
METHODOLOGY.....	5
FINANCIAL MARKETS: DEFINITION AND CHARACTERISTICS.....	6
THE INDICES OF MAIN STOCK EXCHANGES.....	9
MEASURES TO TANCKLE THE CRISIS.....	18
STOCK INDEX RETURN AND RISK ANALYSIS.....	27
CORRELATION BETWEEN COVID-19 AND FINANCIAL MARKETS.....	31
CONCLUSIONS.....	44
REFERENCES.....	46
APPENDIX 1.....	53
APPENDIX 2.....	54
APPENDIX 3.....	56

List of figures

- Figure 1: Capitalization of equity markets.....	8
- Figure 2: Weekly indices return in March 2020.....	26
- Figure3 : Sector breakdown and annual return of the main indices...	29
- Figure 4: linear relation: sector-annual return.....	30
- Figure 5: Scatter splot: Nyse composite return/volatility - C-19	34
- Figure 6: Scatter splot: Nikkei 225 return/volatility - C-19.....	35
- Figure 7: Scatter splot:NASDAQ technology return/volatility- C-19.	35
- Figure 8: Scatter splot: S&P 500 return/volatility - C-19.....	35
- Figure 9: Scatter splot: Dow Jones return/volatility - C-19.....	36
- Figure 10:Normal Q-Q plot : Dow jones volatility- C-19.....	38
- Figure 11:Normal Q-Q plot : S&P 500 volatility- C-19.....	38
- Figure 12: Normal Q-Q plot : Nikkei 225 volatility- C-19.....	39
- Figure 13: Fitted values-residuals plot :Nikkei 225- volatility-C 19..	39
- Figure 14: Weekly evolution: NASDAQ technology – Covid-19.....	42
- Figure 15: Weekly evolution: Nikkei 225 – Covid-19.....	42
- Figure 16: Weekly evolution: FTSE 100 – Covid-19.....	42
- Figure 17: Weekly evolution: S&P 500 – Covid-19.....	43
- Figure 18: Weekly evolution: Dow Jones – Covid-19.....	43
- Figure 19: Weekly evolution: Euronext 100 – Covid-19.....	43

List of tables

- Table 1: Return-risk figures of each stock index.....	25
- Table 2: Return correlation with Covid 19.....	31
- Table 3: Volatility correlation with Covid 19.....	31
- Table 4: Correlation hypotesis testing.....	35
- Table 5: Standard deviation of C-19 variation.....	38
- Table 6: Initial weekly returns and weekly variation of C-19	39

Correlation between C-19 and equity markets : Introduction.

The objective of this dissertation is analyzing how the appearance of the Covid 19 pandemic affected the behavior of equity markets in the world. Although the effects of a disease could be directed towards the health sector, in the current economy, most of its segments are linked, so the significance of this factor can be observed at the global level.

It will comment, in a chronological way, the analogies and differences in the decisions taken by the authorities in economic matters. It will see how each country has a way of dealing with these problems, but in the end, all these activities have common points.

On the other hand, the uncertainty about an event that could paralyze the activity of the companies, is a critical factor affecting fluctuation of the share prices. If this situation becomes serious, it could be experienced a growing panic in financial markets and it could lead to a severe crisis.

In this dissertation, it will be investigated to what level the stock losses reached, and it will be compared the different markets, to show the degree of contagion of them. This crisis arose in China, but it did not affect only the markets of Shanghai and Hong Kong, it also expanded to the rest of the world.

Methodology

It will be developed taking into account largest stock exchanges, by market capitalization. It will be obtained the returns and volatility values of their indices, These two variables, will be compared with C-19 cases, applying the Pearson correlation coefficient, which will also be put into practice in the calculation of the synchronization between the evolution of the disease and the behavior of investors. It has also been checked if the relationship is linear, making a regression analysis and verifying it through the hypothesis contrast.

Financial markets. Definitions and characteristics.

Markets can be defined as the medium where supply and demand exchange goods and services. They were only physical sites in the past, but nowadays there is a tendency to negotiate through the internet. In the financial markets are found different classes of financial assets, according to the information available from them, buyers and sellers must agree on a price. (Court and Tarradellas, 2010).

All markets have these common features :

- Mediate between buyer and seller.
- Ensure the safety of operations.
- Provide liquidity at reasonable prices.
- Provide transparent information on values.
- Create indices that reflect the health of their members.

The different types of assets that are traded may be :

- Fixed income or debt: it is fixed a remuneration until its maturity date. This financial instruments are the obligations, bonds or treasure bills.
- Equity or stocks: Shares, which can pay dividends, but the return is highly associated with the price increases.
- Derivatives: They work from the assets described above, and some others like futures, stock options, swaps, warrants, etc.

According to the moment of acquiring securities, financial markets can be:

- Primary markets: Companies and government offer new debt to investors. Investment banks can buy those securities and renegotiate them in the secondary markets.
- Secondary markets: They form the stock exchanges and allow trading the securities from the primary market in an indefinite way as long as the companies have liquidity.

Companies, issuing shares, and the governments, issuing letters and bonds, seek financing and interact with investors forming financial markets.

In this dissertation we will focus on the stock market, which can be of different types :

- Common shares: they represent an aliquot part of the companies. They are entitled to vote and to receive a remuneration based on the profits of the undertaking : dividends or a number of stocks.
- Preference shares: They give preference to repayment of the capital, which is contributed in case of dissolution of the company and a minimum dividend is received even if the firm does not make profits.

There are different ways of valuing shares:

- Par value: corresponds to that one they had when the business was born.
- Book value : Since the company has evolved, now its net worth is different. If it is updated and divided by the number of shares, we get this valuation.
- Market value : It is the quoted price that takes into account the profits generated and the expectations around its potential.

Therefore, it could be said that we have three assessments, one focused on the past, another that refers to the present, and the last one has incorporated a look towards the future.

This dissertation seeks to analyze the companies according to the quoted price, because their markets are regulated and highly capitalised, where the available information is varied and they can be considered efficiently.

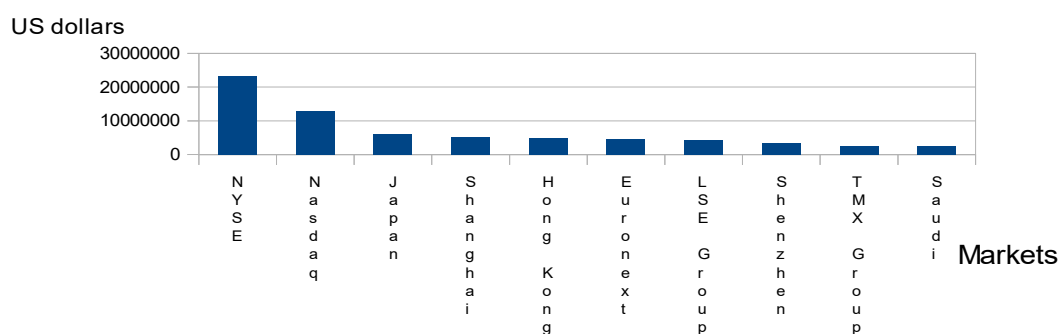
These markets have common points, but each can develop specific operating rules, so they will be treated separately. In the end, it will be analyzed their yields and volatilities, and how the impact of globalization conditions that the price of some shares may be affected by other markets, especially if they are from the same sector.

The evolution of equity markets can be carried out through indices, which are constructed with a representative number of securities, reflecting the treated market. They are indicators that fluctuate according to the prices of the shares listed in them. Its value may be affected equally as changes in its shares, but are generally weighted by the capitalization of each quoted component, since when it is higher, its influence on the index will be greater. They are useful for measuring performance on an individual basis, but also across sectors or across the whole market.(Palma, 2020).

When an index is higher than another, does not mean that it has more capitalization, stocks or volume, since they only serve to make comparisons of returns from a number that is taken as a starting point at a given date. Indices can also be more specific and represent only sectors, high - low capitalizations, or dividend yields. They can also be the underlying asset or reference of derivative products.

Market capitalization is obtained by multiplying the number of shares outstanding by the price per share. (Palma, 2020). To do this dissertation, we have chosen the markets that have higher figures, which also correspond to those that are more developed and offer more possibilities of study.

Figure 1 : Capitalization of equity markets



Source: World Federation of Exchanges. Author's own creation

In this figure, it is compared the values in US dollars that "The World Federation of Exchanges" has published by the end of 2019.

The indices of main stocks exchanges.

Each market can develop many indices with different capitalization . Due to globalization, there are indices working with securities that are listed in different markets, such as the Dow Jones , whose majority of components proceed from the New York market "NYSE", but also some of the other electronic market "NASDAQ".

The most common thing aforesaid was to invest in portfolios of shares buying each one individually. Nowadays investors can do it buying indices, or finding other financial tools that replicate them. In addition, the investor will have to pay less fees than buying the securities separately.

When investors make a portfolio, choosing indices that belong to the same market, they should be careful with the incorporation of repeated values, being more thorough with the selection, looking toward different industries.

From now on, it will be presented a description of the 5 most capitalized markets from "figure 1", and their most representative indices, according to their websites, where besides information, investors can operate in their stocks markets:

-NYSE:

.NYSE composite Index: It has about 2000 American components. It is a float adjusted market capitalization weighted index that shows the performance of common stocks listed on the NYSE market. It is adjusted to eliminate the effects of capitalization and changes to the list, calculating the price and total return of each stock. It is updated with corporate actions too. There are three subsets associated with this sectors: "Financial", "Health care" and "Energy".

-NYSE US 100 index : It is weighted as the previous index. but selection is made of the 100 securities of greater capitalization, which must reside in the USA.

-Dow Jones Industrial Average: It is formed by 30 companies with great capitalization in the USA. At first, it had only heavy industry sectors, but later it incorporated securities of almost all types, excepting transportation and utilities, which are dealt with in another variant of this index. It is calculated by price weighting and does not take into account shares held by small investors, as is the case with the capitalization method. The industry more represented is "Technology information" (SP global, 2021).

-S&P 500: It has 500 of the largest companies in the country, which, by its size, is used to measure the economy of USA. Each security must exceed four billion dollars of capitalization, representing 80 % of the total NYSE market. It is found some OTC titles. The technological and financial sectors are the most represented. It is updated by capitalization weighting, counting only the shares available in the market. Other conditions are the degree of internationalization, the time it has been listed on the stock exchange and a minimum volume of 250,000 shares traded in the last 6 months.

-NYSE FANG + TM index : it includes technology firms such as Facebook, Apple, Amazon, Netflix , Alphabet's google, and other high-growth titles. It has a minimum number of 10 components, and the weight of them in the index is equitable, because each company participates with a similar volume of investment. Shares of the NYSE and NASDAQ are only chosen, and it is updated according to its price and total return.

-NYSE bitcoin index: It refers to the value that a bitcoin would have in US dollars, taking into account the price and volume of transactions made in US currency.

NASDAQ

It is a three-tier market, with different conditions depending on its capitalization, and having financial and liquidity requirements, being more strict in large-capitalizations. The most exclusive. is the "Global select market", then we find "Global market" and the "Capital market", which has small businesses that need to raise capital.

-NASDAQ 100 index: It includes 100 non-financial securities, both local and foreign, updated according their capitalization, including technology companies, like "Computer hardware and software, Telecommunications or Biotechnology. This industry represents about 57 % of the index. Between the initial and subsequent conditions for listing on the index, they must have an average daily traded volume of 200,000 shares.

-NASDAQ composite index: It is composed by around 2.500 domestic and foreign securities, which are listed on the NASDAQ market. It is updated by capitalization weighting and although it have not geographical, sectoral, capitalization or liquidity conditions, we can invest in eight sub-indices, covering the most important sectors such as "banking", "informatics", "finance", "industrials", "insurance" or "telecommunications and transport".

-NASDAQ 100 technology sector: All their securities have an equal weight in the index, and are chosen according to the classification "industry classification benchmark", where they must appear in the technology sector.

-NASDAQ US multi-asset diversified income index: In addition to common stocks, we find Real Estate Funds, High Yield Corporate Bonds, Preferred shares and debt for energy projects "MLPs". Each value is weighted according to index of origin, with the intention that it is equitable, 20% for each of the 5 segments. It only allows US securities.

Japan Exchange Group :

It is divided into four sections. The first and second ones, are the main in terms of size and liquidity, in that order, and the next is the section "Mothers", with high-growth companies. Last alternative is JASDAQ, which is divided into "Standard", if it has a certain size, or "Growth" if it stands out for its future potential. They will level up if they are successful.

On the other hand, the Tokio Commodity Exchange became into a wholly-owned subsidiary of Japan Exchange Group in 2019.

-Topix: It has around 2200 securities and it is used as a benchmark for securities traded across the market. The index is weighted on the basis of free float capitalization. Due to its high number of securities, it is used as a guide for investors. This index belongs to the first section, which is the one that demands more conditions in revenue, ordinary profit and capitalization to quote inside. All the firms are Japanese.

-Nikkei 225 index: It also belongs to the first section, where are found 225 components. It is adjusted by the price of its components, which are reviewed periodically to guarantee liquidity, according to the negotiated value of each security and the fluctuation of its price. An attempt is also made to maintain a balanced number of values belonging to 6 sectors into which the industry is divided: "technology", "financials", "consumer goods", "materials" "capital goods/others" and "transportation and utilities". The first one represents more than half of the industry breakdown. This index is a reference for measuring changes in all of them.

-Jasdaq index: Initially it belonged to the Osaka Stock Exchange, which, after merging with the Tokyo Stock Exchange, became in "Japan Exchange Group". The weighting of each security is adjusted just like Topix, but the conditions to quote are more flexible. It is focused on companies with a contrasted size or in growth phase, which cannot be located in the "main market" (first and second section). In 2020, it had 699 components: 662 of them belonged to the sub-index "Standard" and 37 to the "Growth".

Shanghai stock exchange:

All indices of this market are weighted by free float capitalization.

-SSE composite index : It measures the entire Shanghai market, both the "A" shares, which are quoted in Chinese currency, and the "B" shares that are quoted in foreign currency. At the beginning of this century an institution was created for negotiate "A" shares with foreign investment, but historically those flows were directed to "B" shares. "Financials" is the most represented industry, covering about 28%.

-SSE 180 index: It offers the 180 most representative securities. It is an indicator of the “blue chips” and their derivatives.

-SSE 50 index: It is built by the companies with the most market influence, which have great liquidity and capitalization.

-SSE 380 index: Indicator of the national economy with developing and profitable enterprises, and excluding those that have losses and do not offer dividends, or are listed in SSE 180 index.

-SSE 100 index: It concentrates the best securities of the SSE 380 Index, in terms of increase rate of revenue, net profit and ROE.

-SSE 150 index: It comprises the best firms in terms of increase rate of revenue, net profit and ROE, excluding SSE 180 Index and SSE 380 Index.

-SSE 150 and SSE 180 are focused on older sectors such as “finance”, “energy”, “raw materials” and “heavy industry”, while SSE 380, SSE 100 and SSE 150, covers new sectors such as “renewable energy”, “bio-technology” or “consumer markets”.

Hong Kong Exchanges and Clearing:

In addition to securities, it offers listed derivatives and OTC derivatives.

-Hang Seng index: It works as a benchmark for the entire Hong Kong market. Currently, about 40% of it are financial firms. It is weighted by free float adjusted capitalisation, and it includes the most liquid and capitalised companies in Hong Kong. It is possible to invest in 4 sub-indices: “financial”, “utilities”, “properties” and “industry”. It has 50 components, although in the near future they want to increase that number. Since 2006, the “H shares”, which are from Mainland Chinese companies, are quoted in Hong Kong dollars. It excludes, among others, “B” Biotech firms and foreign companies.

-Hang Seng composite index : It includes 95% of the capitalization in the Hong Kong market. It has no limit on the number of components, and now it is around 500. It demands conditions to quote according to the monthly market value of the last 12 months, and the monthly turnover velocity of the traded / issued shares in the last year. It has two series of sub-indices: "size"(large, medium and small capitalization), and "industry" (12 indexes). It is weighted by free float adjusted capitalization. It includes voting shares of foreign companies that have the majority of commercial transactions outside Great China.

-Hang Seng TECH index : 30 largest technology companies listed in Hong Kong Market. Includes Great China securities and some foreign firms, under certain rules. The most important criterion for entering this index is market value. In addition, companies must meet criteria of belonging to this industry classification and have a certain commercial exposure oriented towards various branches of the sector. It operates with the same weighting as the previous two indices.

-CES Gaming Top 10 Index: The index is oriented towards the sector of "Casino", "lottery" and "betting services". They must meet liquidity conditions such as a daily traded average of at least 20 million Hong Kong dollars in the last 6 months. The 10 companies are chosen by capitalization and are also weighted as the previous indices.

Indices quoted in this market are classified according to whether they are listed in Hong Kong, Mainland China or both. The indices described above are listed in Hong Kong. The last index treated, however, does not belong to the Hang Seng indices of the Hong Kong market, because it is created by "China Securities Index co.", which is a supplier of indices of the Shanghai and Shenzhen Exchanges, but the "CES Gaming Top 10 Index" refers to the Hong Kong Market.

Euronext :

It is an European stock exchange, that includes 400 indices, among which investors can distinguish 6 of the main national indicators of the continent, each with a family of other indices that have been created in sectors or different investment strategies. Milan Stock Exchange are pending to be incorporated. The following indices are weighted by free float capitalization

-AEX Index, in The Netherlands: index that contains the 25 best companies in capitalization of Euronext Amsterdam. They must meet the criterion of negotiated volume above 25% of quoted shares, in the last 12 months. Otherwise they will contribute in other family indices with less conditions. Non-market securities may be quoted if they have a significant number of assets: 33 %, or employees: 15 %, in the Netherlands.

-Bel 20 Index, in Belgium: index with the top 20 of companies with better capitalization in the EURONEXT Brussels market, generating a traded volume greater or similar to 25 % of the outstanding shares in the last year. Companies with another relevant market can be quoted here, if they have a staff of at least 15 % in this country.

-CAC 40, in France: It is composed by the 40 leading securities in terms of free float adjusted capitalization. with a traded volume, in the last year, of at least 20% of the issued shares in the Euronext Paris Market . If they come from another relevant market, they are admitted here, having a significant presence of assets or employees in France, or derivate instruments trading in Paris.

-ISEQ 20, in Ireland : 20 applicants of this index must have a high ranking in the value of regulated turnover and free float adjusted capitalization. In addition of Dublin securities, It admits firms incorporated from North Ireland, Republic of Ireland or if they have its centre of economic interest there.

-OBX, in Norway : index where are selected the 25 securities with the best volume traded last 6 months, listed in Euronext Oslo. There are revisions every 6 months, and among others, there are conditions about the size and the presence of values coming from outside of the European Economic Area. No component in this index is listed in EURONEXT 100 or NEXT 150.

-PSI 20, in Portugal: It is calculated by free float adjusted capitalization, which must be at least of 100 million euros. There are present the 20 most brilliant securities, that also have a daily turnover of at least 15 % of the shares issued in the last 12 months. Only shares listed in Euronext Lisboa are supported.

EURONEXT also develops international indices, showing a combination of securities from those countries:

-EURONEXT 100:

The index is calculated on the basis of free float adjusted capitalization. Securities must have been traded at least 20 % in the last 12 months. If that time has not elapsed, an extrapolation will be made. The "CAC-40 market" is represented with about 63 %.

-NEXT 150: It is similar to the previous index, not choosing components listed in "EURONEXT 100". The CAC-40 market is represented with about 44 %.

-Euronex France Germany leaders 50 Index: This index has two versions, where the components weighting can be different or equal, including in the latter case, the letters "EW" in its definition. The 25 most capitalized values of each country, the CAC 40 and the main German Market, are chosen by Euronext. It is an interesting index, because it includes stock quotes from Germany, which together with France define the axis of the European Union, and is not elaborated with the typical 6 countries that appears in the other indices.

LSE Group:

This equity markets are divided into four index families, according to the region: "Russel US" (America), "FTSE Global Equity" (Global), "FTSE UK" (Europe, Africa and Middle East) and "FTSE China" (Asia Pacific). All of them are free float capitalization-weighted indices. European indices also adjusted for dividends. We are going to focus on this last group, which is the closest to the geographical environment of London, where it is found the headquarters of this market. Within it we can find the following indicators:

-FTSE 100 index : The constiuents traded are the 100 higher capitalization securities on the London Stock Exchange. "Financial services" and "Industrial goods/services" lead the sector brakdown, with values of around 11 %.

-FTSE 100 total return index : In addition to capital, it takes into account dividends.

-FTSE 100 equally weighted net of tax index: Applies dividend tax when it is calculated.

-FSE 250 index: We find mid-caps companies, covering 15% of the market, and not listed in "FTSE 100".

-FTSE all share index: it is added "FTSE 100", "FTSE 250" and small capitalization values. It is covered 98-99% of the market, with around 600 securities.

Measures to tankle the crisis

Due to the special situation created by the C-19, the different Central Banks and State Governments faced a new crisis that did not happen in a long time. It demanded to take measures as quicly and as efectively as possible. According to CNMV, it will be analized some of the most important decisions taken by the different authorities in economic matters. It will explained, in chronological order , what could have been their effect on the markets previously treated :

USA

Even	Effects
US Federal Reserve lowered interest rates twice in March, from a range of 1,50% -1.75% to a drastic 0%-0,25%.	Fixed Income securities is becoming less attractive and investors could be focused on equitiy markets due to the health-economic crisis.
US Federal Reserve: Purchase of corporate bonds in the secondary market, which then extends to the primary market: Those programmes were "Secondary Market Corporate Credit Facility" and "Primary Market Corporate Facility". In addition 700.000 million dollars of asset purchases entailing treasurys and mortgage-backed securities.	This measure provides liquidity both, to companies in the primary market, and to investors in the stock exchange market.
US Federal Reserve: Cash injection of USD 2,3 billions, destined for households and small businesses.	It restores confidence to investors and companies.
US Federal Reserve forecast a GDP contraction of 6,5% for 2020.	Unexpected negative information due to the appearance of the sudden pandemic, affecting equity prices.
Threat of Tariffs to other countries.	These protectionist measures are negative for the equity market, especially in the sectors involved.

US Federal Reserve: Do not plan to raise interest rates for a long time.	Initially it is positive for equities, because it was expected that they could rise after the last falls in share prices, although it can be interpreted as the economy does not take off.
Corporate debt risk premium rose 400 fundamental points in March, but there was a decline in the corporate bond yield in the third quarter of 2020, although during the year there were increases in the three ratings : high yield, AAA y BBB.	The fact that fixed income investments offers higher interest payments does not favor equities markets.
IMF forecasts US GDP growth at 3,1% in 2021, worsening its latest forecast by 1,4%. It was comunicated in October, but at the end of 2020, the IMF improved its growth predictions in 2021 and 2022. In both cases, this rise was about 1%.	Negative news that could affect equities investments became in information well received by the market.
Rise of Corporate non-financial bonds issued, taking advantage of low interest rates.	It affects little, but is negative, because there are more possibilities for investors to go to another market.
New vaccines for C-19 and forecasts for the upcoming US elections.	Positive information that can reactive the economy.
The volume of equity issuance doubled in 2020.	This data, accompanied by an upward trend in trading volume, indicates the US market recovery.
Downward trend of 3 month-interest rates in 2020, ending 167 fundamental points lower than the previous year.	Favorable data to invest in shares, although in a sligh way, because in a stock market a long term investments is thought by investors
Slight increase in banks risk premium during the year 2020.	If it continues to rise, it may affect the interest rate charged by banks, to help the financing of projects.

Corporate debt risk premium continues to fall, finishing the year 6 fundamental points lower than the previous year. In the other hand, the US bond yield drops 100 fundamental points in this period.	It is positive that the interest rate and investor remuneration of the corporate debt decrease, because this event stimulates equity markets.
--	---

EUROPEAN UNION

Event	Effects
Monetary policy in March: ECB purchases of assets, valued in 120.000 millions Euro, for example, to finance banks, eliminating their stress tests. It were later added 750.000 million Euros, throught of the "Pandemic Emergency Purchase Programme".	Banks will be able to finance bussines and this favoured both, equity returns and fixed income .
Tax measures: Cancellation or delay of tax collection and lendings to the public sector.	It generates less presure on the public debt and the country risk premium. It has less repercussion on the stock market.
EU approved aid programmes for States and companies, close to 1.5 % of GDP, mostly through the "European Stability Mechanism", 240.000 millions Euro of 550.000 million Euro.	Another measure providing liquidity in a global level on European markets, having a positive impact on equity investments.
Brexit.	It is negative, but it has been discounted by stock market for a long time.
Interest rates on long-term public debt fell in countries like France or Germany, but not in peripheral economies. The first ones were safe assets in the first quarter of 2020.	It can create differences in the markets synchronization in the EU, because the peripheral economies could have more problems.

<p>Increase of the risk premium for corporate fixed income, very noticeable for bonds with low ratings. It was about 10 %.</p>	<p>In times of crisis such as the Covid-19, companies with fewer guarantees and liquidity still suffer more than others. The investments are targeted mainly to the most qualified fixed income, and the equity markets are not benefited.</p>
<p>Government gross debt issuances fall by 12 %, and private debt by 4,5 %, in the first quarter of 2020.</p>	<p>Markets are paralyzed by the effect of the pandemic on it.</p>
<p>USA threat to apply new tariffs to Spain, France and Germany in June of 2020.</p>	<p>The lack of commercial freedom harms the development of companies and damages the investor confidence in equities.</p>
<p>The IMF forecast that French GDP will fall by 12,5 % in 2020, and Germany 7,8%. It was communicated in the second quarter of 2020.</p>	<p>The above news and the progress of the crisis worsen the forecast for the most critical PIBs in the EU.</p>
<p>ECB: Asset Purchase Programmes widened to 2,77 billion euros, including public debt (2,24 billion euros), and private debt (220,000 million euros). On the other hand, The “Pandemic Emergency Purchase” reached 345.000 million Euros, but It would be increased to 600,0000 million Euros soon.</p>	<p>It generates liquidity, improving the health of markets and countries. In addition it slows the rise of market interest rates.</p>
<p>Public and corporate debt offer less interest rates, since bonds purchases by ECB.</p>	<p>This benefits the equity market, as an investment with more risk, but looking for more profit.</p>
<p>GDP falls in EU by 14,7%, in second quarter of 2020, compared with the same period in the previous year. The IMF forecasts GDP increases by 4,2 % in Germany , by 6 % in France, worsening by more that of one point last forecast.</p>	<p>News like this, is a reflection that the economy is badly damaged and it affects credibility in the equity markets.</p>

ECB creates “TLTRO III”, a financing program for credit institutions. It offers favorable conditions.	This measure will impact in the development of investments.
Interest rates are maintained in the last quarter of 2020. In the other hand purchasing programmes will continue until 2022.	The money supply growth can generate inflation.
Return on 10-year bond for EU continues to fall due to positive developments such as “not hard” Brexit deal or “European Recovery Fund” approval for Covid-19.	There is a continued pressure on the ECB to financing the most needy sectors.
Slight decrease in bank risk premium during 2020, and decline of bank debt due to Central Bank financing.	The banking sector also needs to be driven by the ECB to correct the damage caused by a collapse in its operation.
The corporate debt in 2020 is 30 fundamental points lower than the previous year.	Fixed income was, in general, less attractive than the equities in 2020.
Volume of equity issuance rose by 63 %.	Market return was higher than other alternatives
6-month and 12-month interest rates ended the year close to -0,50 % . It lowered about 20 fundamental points in 2020.	This figures were much lower than US ones at the beginning of 2020. ECB focused in other monetary policy instruments.

CHINA

Event	Effects
Equity issuances fell by 5.1 % in the first quarter of 2020.	Equity is not a refuge for investors in this period of uncertainty.
The Chinese Popular Bank lowers interest rates several times, to a minimum of 2.95 %, and injects liquidity into market.	This bank applies the same policies of monetary expansion as in other countries, confirming that the crisis is global.

In the second quarter of 2020, China is the only large economy for which the IMF forecasts a GDP growth in 2020 : 1 %.	In China the C-19 crisis appeared earlier than in the rest of the world, and in the first quarter of 2020 it was already more treated than in other countries.
In the third quarter of 2020, the IMF expects a GDP growth by 2% over the year.	This predictions continues to improve, being good for stock market investment.
Equity issuances increase about 80 % in 2020.	Confidence returns to stock markets at the end of the year.

JAPAN

Event	Effects
Gross sobereign debt issuance fell 1,8% in the first quarter of 2020.	Market conditions were not the best in obtaining financing
Interest rates remain unchanged since 2016.	It is a economic culture of inflation control since Japan anf Germany have experienced a rise in the prices of goods after the Second World War. That is why the way of proceeding is different of other countries, which change their interest rates to face the C-19 crisis.
The Bank of Japan creates a financing program for companies affected by Covid-19, without charging interest. It also buys public and corporate bonds. It is decided to doubled ETF purchases, to 12 million yen a year. On the other hand, it is increased the J-REITs purchases to 180.000 million yen a year.	Since the interest rates are not used as monetary strategy, there are few more tools to improve this serious economic situation.
The volume of equity issuance decreases by 24.3% in the first quarter of 2020.	The lack of confidence of the securities issuer and the investors´s distrust lead to a sharp drop in market indices.

The IMF forecast that GDP will fall by 5.8% in the entire year. In addition, GDP reduction of 10,1 % in the second quarter of 2020.	The stock prices will be adversely affected, due to negative and unexpected information.
The bank of Japan holds interest rates at 0.1% in the third quarter of 2020. The 3-year interest rates fall by 6 fundamental points during the year.	Policy of keeping interest rates low, to facilitate the financing of investments.
Equity issuance registered a rise by 31% in the third quarter of 2020, and 80% in the entire year, over the same period of the previous year.	An economic recovery is being observed in the second half of the year, like other countries.
Rise of non-financial private debt issuance to take advantage of low rates in the third quarter of 2020.	Fixed income also recovers and attracts more conservative investors.
IMF forecast of GDP rise by 2.3 % in 2021, worsening 0.1% latest prediction.	It is one of the lowest forecast of the big countries, so it should not be received well in equities market.
The 3-month, 6-month and 12-month interest rates drops slightly during the year. For example, the first one falls about 4 fundamental points.	It is observed the slow pace of changes in interest rates, which on the other hand, is also what the investors expects, based on historical data.
Debt issuance decline by 40% during the year, including sovereign debt. The latter only rose 4 fundamental points in 2020.	It contrasts with the rise in equities issuance.

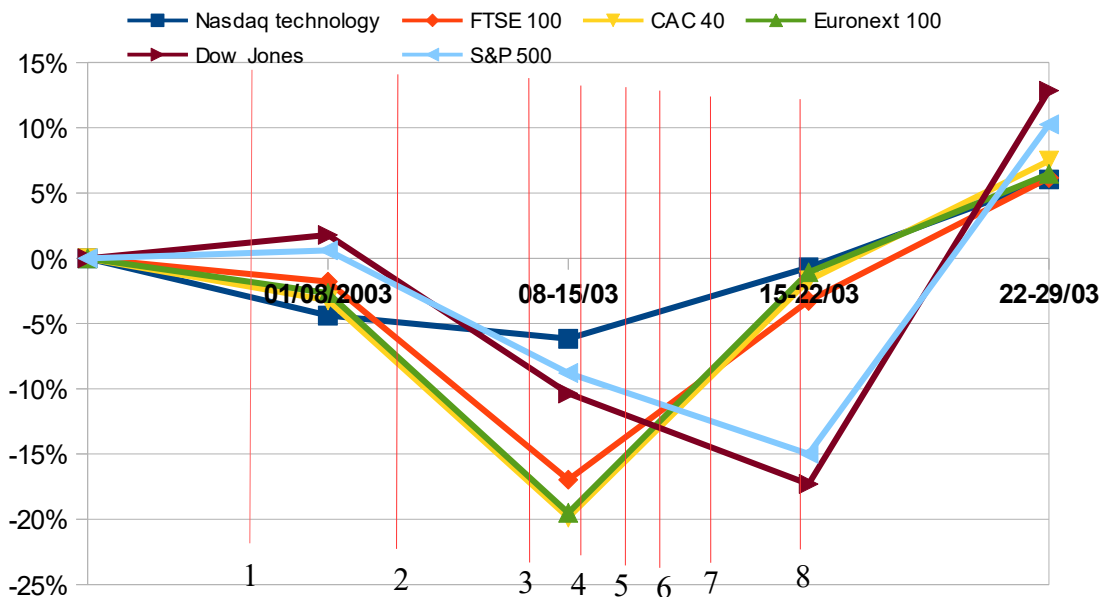
UNITED KINGDOM

Event	Effects
It was created The "TFSME" scheme , to help small and medium-sized enterprises with favourable credit conditions. In addition, private and public asset purchases were increased to 645.000 million pounds in March.	This time, this measure was focused on the public sector, and to a greater extent, it will affect only its distinct area. On the other hand, if the companies have cashflow deficit, they will not easily find investors .

The Bank of England lowered interest rates twice, from 0.75 % to 0.10%.	This is done in order to reactivate the economy and financings.
The UK government is financed by the program "Ways and Means Facility", thanks to which, it can borrow from the Bank of England, without having to issue more debt in the market.	Measure that affects not directly to the equity markets, although an investor usually looks for countries with high ratings.
GDP fell about 21,5% in the second quarter of 2020.	It was influenced by the Covid-19 and Brexit.
There was a threat of Tariff increases from USA to some English goods, in the second quarter of 2020.	Negative decision for the stock market progress, by the comercial blockade.
The uncertainly of BREXIT, in the third quarter of 2020, because there is no agreement on this matter.	Another information that causes unrest and possible capital flight from markets with higher risk profiles.
The IMF forecast a GDP rise by 5.9% in 2021, which is worse than the last one by 0.4%.	If this predictions continues to worsen, it will be unwelcome by the stok market, and will be more harmful by the current crisis situation.
The oficial interest rates remain at 0.1%, but the Bank of England considered to enter negative figures in the last quarter of 2020.	Due to these figures, investors can only find moderate gains on equity investments, but a marked stagnation of interest rates can mean that the economy remain damaged.
Sovereign bond interest rates decreased about 60 bp, and the sovereign risk premiu practically did not change in 2020.	The initial decrease in March was compensated as the year progressed.
3-month, 6-month and 12-month interest rates lowed about 80 bp in 2020	They were close to 0%, making investments less costly.
The IMF forecasted a GDP increase about 5,3 % in 2021. It was higher than the last predicted: 4.5% in October.	That were great news to finish 2020.

This graph shows the evolution of 6 indices, to check how they responded to these 8 decisions of the ECB in this month, which are represented by the vertical red lines, with their number.

Figure 2 Weekly Indices returns in March 2020.



Source: Investing.com. Author's own creation.

- 1 3 March : FED lowered interest rates: 50 bp.
- 2 12 March: BCE :purchases of assets (APP): 120.000 millions euro.
- 3 15 March :FED lowered interest rates: 100 bp. It began the Assets purchasing : 700.000 million dollars.
- 4 17 March: FED created the "CPFF", to support the flow of credit to households and businesses.
- 5 18 March: ECB established a new purchases program: 750.000 million euros.(PEPP). The FED creates "MMLF" to assistance Mutual funds.
- 6 19 March:FED announced temporary liquidity arrangements with other Central Banks.
- 7 20 March:FED extended last program to other Central Banks.
- 8 23 March: FED established the "ESF" to support employers, consumers and bussines: 30 billion dollars. On the other hand, it is created the "PMCCF" and the "SMCCF" to support primary and secondary markets.

Stock index return and risk analysis.

Table 1 shows index performance between 8 March 2020 and 7 March 2021

Table 1: Return-risk figures of each stock index

Index	Standard deviation	Weekly Return (mean)	Annual return
NYSE composite	4,58%	0,51%	26,59%
NYSE US 100	4,31%	0,41%	21,46%
Dow Jones	4,60%	0,49%	25,27%
S&P 500	4,13%	0,58%	30,15%
NASDAQ 100	4,01%	1,01%	51,56%
NASDAQ composite	4,10%	1,03%	52,66%
NASDAQ technology	4,65%	1,10%	55,96%
NASDAQ Multiasset diversified	5,64%	0,12%	6%
SSE composite	2,47%	0,31%	16%
Nikkei 225	4,48%	0,74%	38,27%
JASDAQ	3,45%	0,48%	25,17%
TOPIX	3,92%	0,57%	29,38%
Hang Seng	3,03%	0,25%	13,07%
Hang Seng composite	3,28%	0,49%	25,35%
Hang Seng tech	5,43%	1,13%	58,87%
CAC 40	4,71%	0,34%	17,72%
AEX	3,99%	0,30%	25,04%
BEL 20	4,84%	0,48%	15,49%
ISEQ 20	4,74%	0,56%	29,24%
PSI 20	4,27%	0,09%	4,88%
Euronext 100	4,32%	0,35%	18,02%
Next 150	4,59%	0,52%	27,28%
FTSE 100	3,95%	0,13%	6,72%
FTSE 100 Total Return	3,96%	0,18%	9,54%
FTSE 100 Net of tax	4,40%	0,33%	17,34%
FTSE 250	4,89%	0,33%	17,40%

Source: Investing.com. Author's own creation

The best behavior of the total period corresponds to the NASDAQ market, with profitability values around 55% , and 4% of risk, only surpassed by the Hang Seng Tech Index of Hong Kong with profits of 59 % and standard deviation close to 5,5 %.

The NYSE market obtained returns of 25%. Risk was about 4,25 %.

On the other hand, we find the FTSE 100 index, with returns of less than 10 %, accompanied of risk slightly higher than 3,90 %.

The Chinese indices obtained profits over 15% . The risk was a little lower than 2,5 %.

The Japanese indices made a return close to 30 %. It was associated with a risk from 3,5 % to 4,5 %.

In the European indices, returns were about 15-25%. Risk was similar to Japanese and FTSE 100 indices

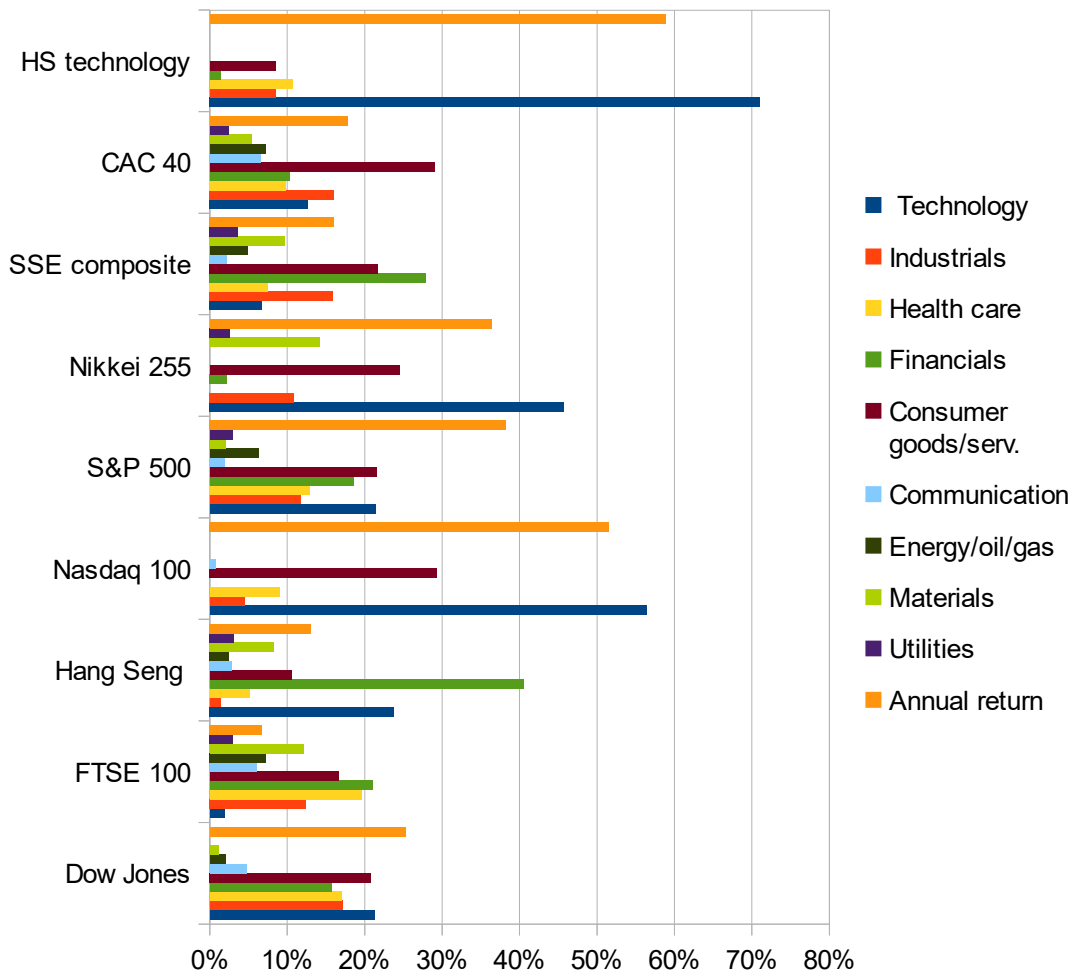
Finally, in Hong Kong, the market indices offers a great variety of results, finding returns of 13%, 26% and 60%. Standard deviations were around 3%, except for the highest return, wich shows a risk that exceeds 5%.

In general, technological sector stood out above the others, driven by firms looking for on line solutions to their works.

In the following graph it is presented the annual performance and the breakdown sector of six of the most representative indices . The FTSE 100 index classification was more extensive than the other five, so it has been included "media" in the sector "communication". In the other hand, "travel","food beverage and tobacco" and "retailers" have been considered as "consumer goods/services". Finally "basic resources" has been incorporated in "materials". In the other index, Hang Seng, "properties & construction" was integrated in "materials".

According to the table in Appendix 2, this data were extracted from the factsheets of the main indices.

Figure 3 : Sector breakdown and annual return of main Indices

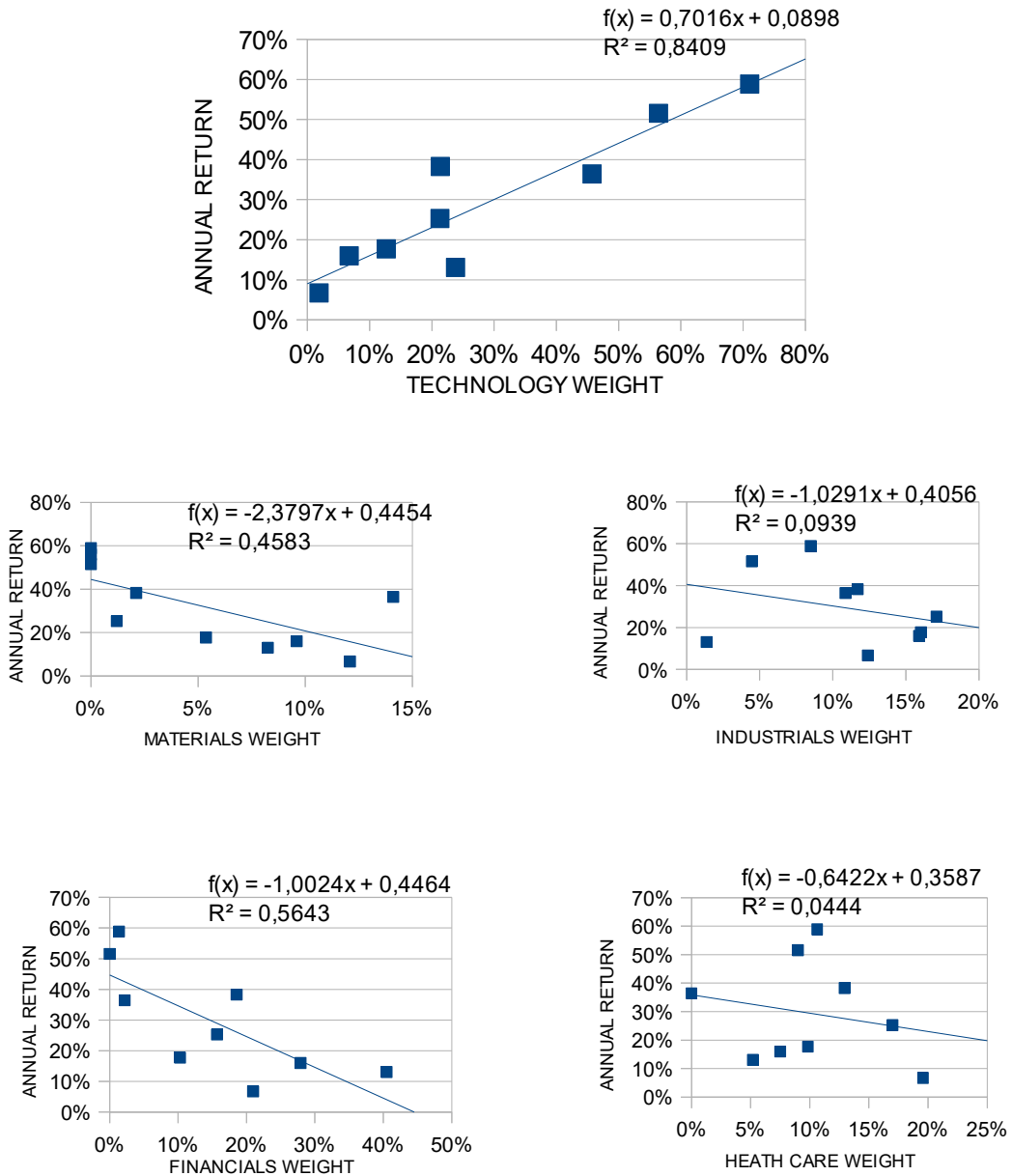


Source: S&P Global, FTSE Russell, Hang Seng indexes, NASDAQ global information services, Nikkei indexes, China securities index co., Euronext. and investing.com. Author’s own creation.

The indices with higher yields had a large presence of technological companies.

In these graphs it can be detected that only the technology sector has an upward trend, with high reliability in the linear regression model. Among the bearish sectors, “financials” and “materials”, both also have an acceptable R^2 coefficient, while in “industrials” and “health care” we can appreciate the downward trend, but the linear model has less precision.

Figure 4: linear relation sector-annual return



Source: Figure 3. Author’s own creation.

Correlation between Covid-19 and financial markets.

Despite the fact we are in an increasingly globalized market, we will investigate how the presence of Covid-19 has affected the performance of the shares of the world's main stock exchanges.

To carry out this study, we will use different mathematical tools .It will indicate how this economic environment has developed in the last year.

Pearson's correlation coefficient

It is used to know how intense is the association between two quantitative and continuous variables. Its value ranges between 1 and -1. The relation will be direct if it is positive, while if it is negative, the relation would be inverse. When it is close to zero, although there is no linear relationship, this one could be exponential or logarithmic. If this coefficient adopts the values of 1 and -1 , indicates perfect correlation, both in one sense and the other. It is based on the use of typified values, that is the deviations of each observation from its mean taking into account the standard deviation.(Camacho, 2018)

$$r_{x,y} = \sum(Z_x \times Z_y) / N$$

$$Z_x = (X - \bar{X}) / S_x \quad Z_y = (Y - \bar{Y}) / S_y$$

$r_{x,y}$ = Pearson's correlation coefficient

Z_x = standardized score of "x"

Z_y = standardized score of "y"

X = value of "x"

Y = value of "y"

\bar{X} = mean of "x"

\bar{Y} = mean of "y"

S_x = standard deviation of "x"

S_y = standard deviation of "y"

N = number of values of each variable

From this formula it is deduced that the linear correlation would be defined by the covariance between the two variables, adjusted by the standard deviation of each one of them: But, unlike covariance, this measure does not depend on the scale in which it was computed.

$$r_{xy} = S_{xy} / S_x \times S_y$$

$r_{x,y}$ = Pearson's correlation coefficient

S_x = standard deviation of "x"

S_y = standard deviation of "y"

S_{xy} = covariance

We must bear in mind that it is not comparing the relationship with two yields, but between a yield and a disease, which have different forms of development. For example, if the disease variation changes by 200% in a period, it would not be reasonable for the index to replicate the same amount. This is why these values are useful for establishing comparisons, but not for drawing specific conclusions.

In the next table, it is compared correlation of the index weekly return and weekly volatility with the percentage of weekly variation of C-19 cases per 100.000 population.

In the case of the European indices, as they are composed by values of 5 countries, to calculate the figures of C-19, we have transferred the proportion of variation of C-19 cases in each country, according to the proportion of shares of the country present in the index.

The period runs from 15 March 2020 to 7 March 2021:

Table2: Return correlation with C-19.

Index	Covariance	Correlation	Index	Covariance	Correlation
NYSE composite	-0,0176	-0,3285	HS composite	-0,0010	-0,0581
NYSE US 100	0,0177	-0,3419	HS tech	0,0005	0,0180
Dow Jones	0,0188	-0,3419	CAC 40	-0,0009	-0,0520
S&P 500	0,0173	-0,3473	AEX	-0,0005	-0,0395
NASDAQ 100	0,0018	-0,0353	BEL 20	-0,0013	-0,0770
NASDAQ composite	0,0013	-0,0243	ISEQ 20	-0,0045	-0,1240
NASDAQ technology	0,0034	0,0579	PSI 20	-0,0014	-0,0421
NASDAQ Multiasset div.	0,0019	0,0273	Euronext 100	-0,0009	-0,0627
SSE composite	0,0007	-0,0521	Next 150	-0,0030	-0,1824
Nikkei 225	0,0040	0,2356	FTSE 100	0,0013	0,0862
JASDAQ	0,0020	0,0363	FTSE 100 Total Return	0,0013	0,0830
TOPIX	0,0004	0,1313	FTSE 100 Net of tax	-0,0002	-0,0102
Hang Seng	0,0009	-0,0559	FTSE 250	-0,0014	-0,0677

Source : Investing.com. Author's own creation

Table 3: volatility correlation with C-19.

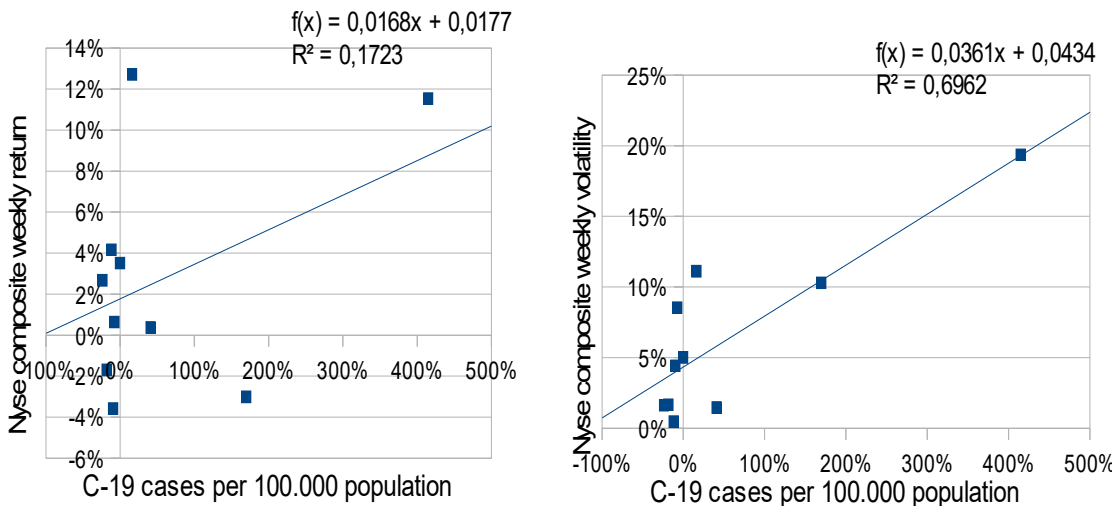
Index	Covariance	Correlation	Index	Covariance	Correlation
NYSE composite	0,0149	0,3420	HS composite	-0,0003	-0,0270
NYSE US 100	0,0185	0,4378	HS tech	0,0014	0,0791
Dow Jones	0,0205	0,4433	CAC 40	0,0027	0,1817
S&P 500	0,0166	0,4117	AEX	0,0041	0,3560
NASDAQ 100	-0,0033	-0,0955	BEL 20	0,0008	0,0642
NASDAQ composite	-0,0034	-0,0950	ISEQ 20	0,0023	0,0899
NASDAQ technology	-0,0019	-0,0454	PSI 20	0,0104	0,4532
NASDAQ Multiasset div.	-0,0112	-0,1926	Euronext 100	0,0031	0,2571
SSE composite	0,0008	0,0887	Next 150	0,0028	0,2343
Nikkei 225	0,0084	0,5194	FTSE 100	0,0032	0,2750
JASDAQ	0,0049	0,4233	FTSE 100 Total Return	0,0033	0,2758
TOPIX	0,0067	0,4702	FTSE 100 Net of tax	0,0038	0,2712
Hang Seng	-0,0005	-0,0489	FTSE 250	0,0047	0,28

Source : Investing.com. Author's own creation

In general, the different return-C-19 coefficients are very low, indicating that there is a small linear relationship between the variables. The only market that shows higher return correlations is the NYSE, with values around 0,3, and not even the other large US market, the NASDAQ, approaches those values. The volatility-C-19 correlations show greater figures, finding another markets, such as the Japanese case, that surpasses NYSE, with figures about 0,5. In addition the European indices reach coefficients of more than 0,2, but in the remaining cases this coefficient is lower. NASDAQ values are even negative.

To show this data visually, it is plot the scatter graphics of the some indices evolution in relation to Covid-19 variation, from 22 March to 31 May 2020. On the left side of the page , it is represented the weekly return. The index volatility is on the right. It has been computed the first weeks of the period, because there was more impact in financial markets, although below of each graph are the determination coefficients of the total period.(15 March 2020 to 7 March 2021).

Figure 5 :Scatter splot: Nyse composite return/volatility - C-19

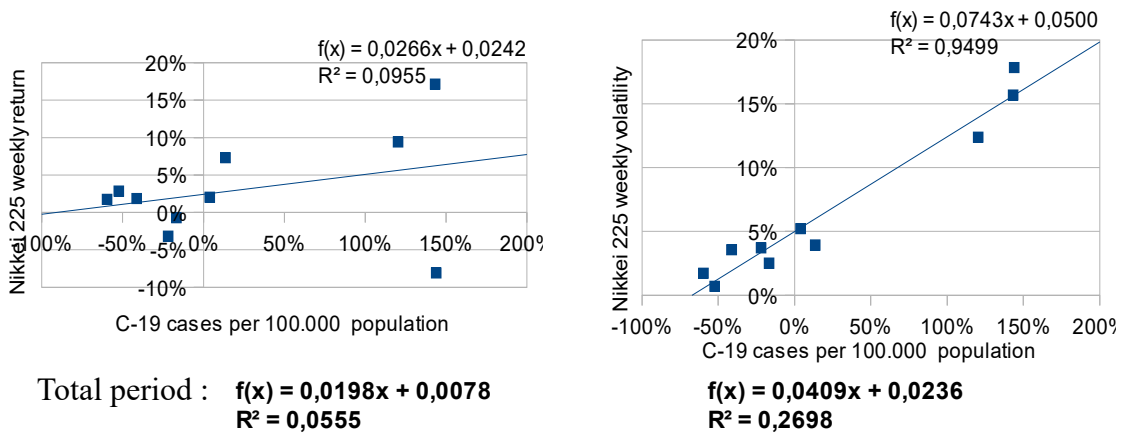


Total period: $f(x) = -0,0109x + 0,0110$
 $R^2 = 0,1079$

$f(x) = 0,0093x + 0,0291$
 $R^2 = 0,1170$

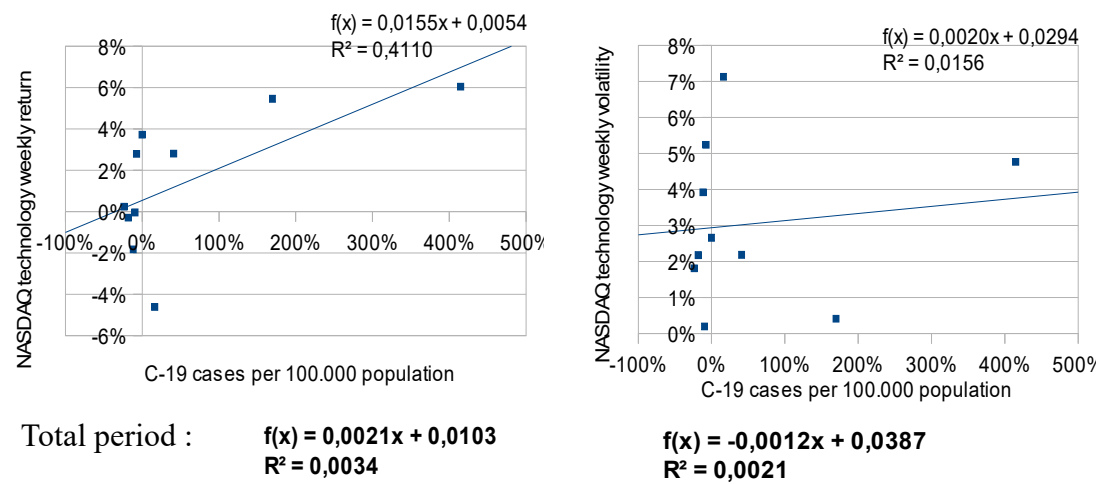
Source: Investing.com and WHO. Author's own creation.

Figure 6: Scatter plot: Nikkei 225 return/volatility - C-19



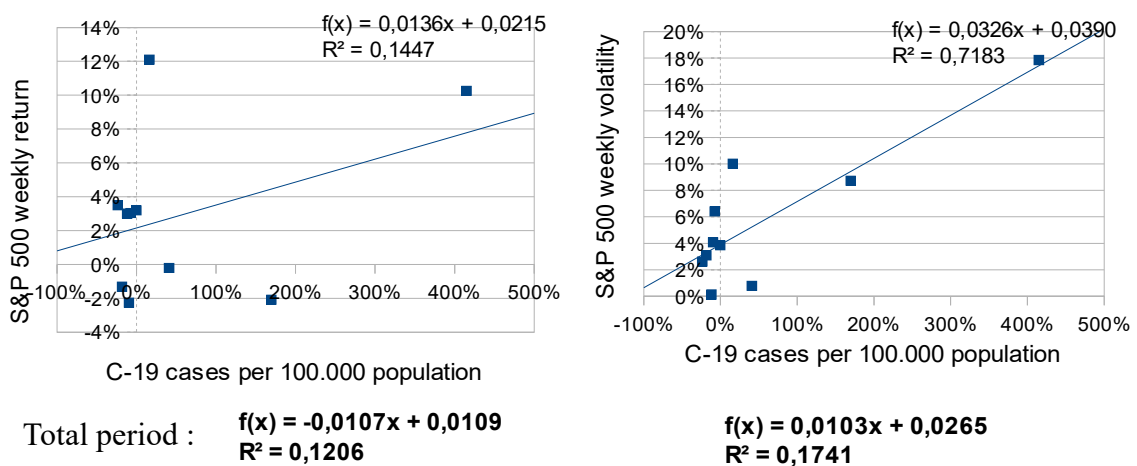
Source: Investing.com and WHO. Author's own creation.

Figure 7: Scatter plot:NASDAQ technology return/volatility - C-19



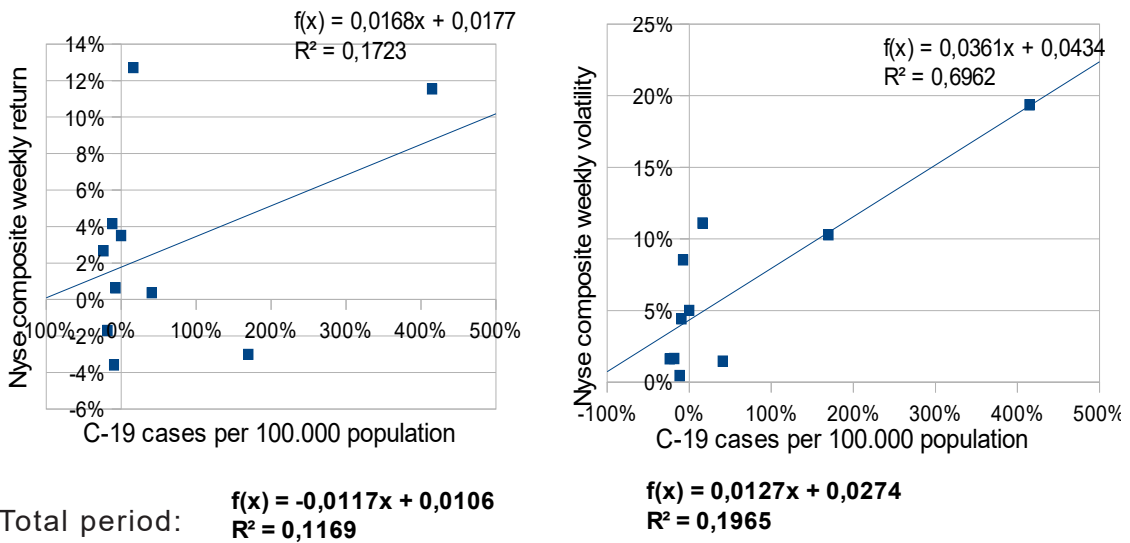
Source: Investing.com and WHO. Author's own creation.

Figure 8 :Scatter plot: S&P 500 return/volatility - C-19



Source: Investing.com and WHO. Author's own creation.

Figure 9 :Scatter plot: Dow Jones return/volatility - C-19



Source: Investing.com and WHO. Author's own creation.

In these graphs has been made a linear regression, and from then, the coefficient of determination “R²” has been calculated. It reflects the variability of the index return or index volatility that is explained by the variable “C-19”. (Orellana, 2008).

$$\hat{Y}_i = \hat{\beta}_0 + \hat{\beta}_1 X_i \quad \longrightarrow \quad \text{Estimated linear regression equation}$$

$$\hat{\beta}_1 = \text{Cov}(x, y) / S^2_x$$

$$(Y_i - \bar{Y}) = (Y_i - \hat{Y}_i) + (\hat{Y}_i - \bar{Y}) \quad \Rightarrow \quad \sum (Y_i - \bar{Y})^2 = \sum (Y_i - \hat{Y}_i)^2 + \sum (\hat{Y}_i - \bar{Y})^2$$

$$R^2 = \frac{\sum (\hat{Y}_i - \bar{Y})^2}{\sum (Y_i - \bar{Y})^2}$$

\hat{Y}_i = predicted values of “Y”

\bar{Y} = mean of “Y”

Y_i = value of “Y”

X = value of “x”

R^2 = coefficient of determination

$\hat{\beta}_0$ = constant/ intercept

Cov = Covariance

S_x = variance of “x”

\bar{X}_i = mean of “x”

$\hat{\beta}_1$ = estimate of the regression slope

These representations suggest that equity volatilities were much more explained by C-19, with “R²” figures over 69 %, excluding all the Nasdaq technology correlations. When we take into account the total period, the determination coefficients obtained are lower. In the cases of the return correlation, the results are not the expected, because they were positive, when the typical evolution would have been to obtain losses.

Statistical inference: According to “F” distribution , we can reject the null hypothesis, $H_0: \hat{\beta}_1 = 0$, comparing “F” statistic with “F” distribution table. (appendix 4):

$$“F” > F_{\alpha, k, n-k-1}, \quad F = \left(\frac{\sum (\hat{Y}_i - \bar{Y})^2 / n}{\sum ((Y_i - \hat{Y}_i)^2 / (n-k-1))} \right)$$

k= degrees of freedom.

n= number of values of each variable.

α = level of significance.

“F” = “F” statistic. (Using “R studio” program, it can be obtained this data).

Table 4 : Correlation hypothesis testing. (n= 10, $\alpha= 0,05$).

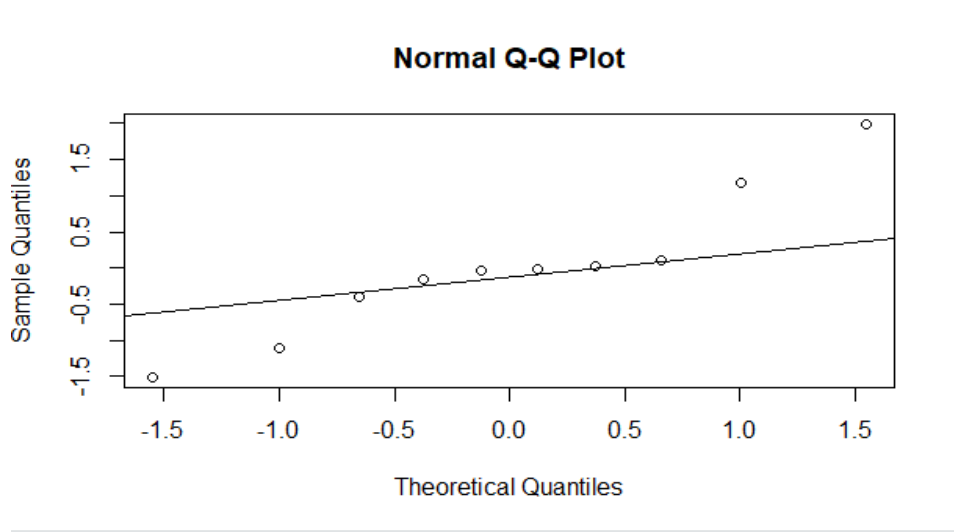
	“F”statistic	F _{0,05,1, 8}
Nyse composite return correlation	1,66	5,32
Nyse composite volatility correlation	18,34	5,32
Nikkei 225 return correlation	0,84	5,32
Nikkei 225 volatility correlation	151,60	5,32
NASDAQ technology return correlation	5,58	5,32
NASDAQ technology volatility correlation	0,12	5,32
S&P 500 return correlation	1,35	5,32
S&P 500 volatility correlation	20,40	5,32
Dow Jones return correlation	2,23	5,32
Dow Jones volatility correlation	27,63	5,32

Source : Author’s own creation

There are five cases where we cannot reject “H₀”. Only one of them is a return correlation. (Nasdaq Technology).

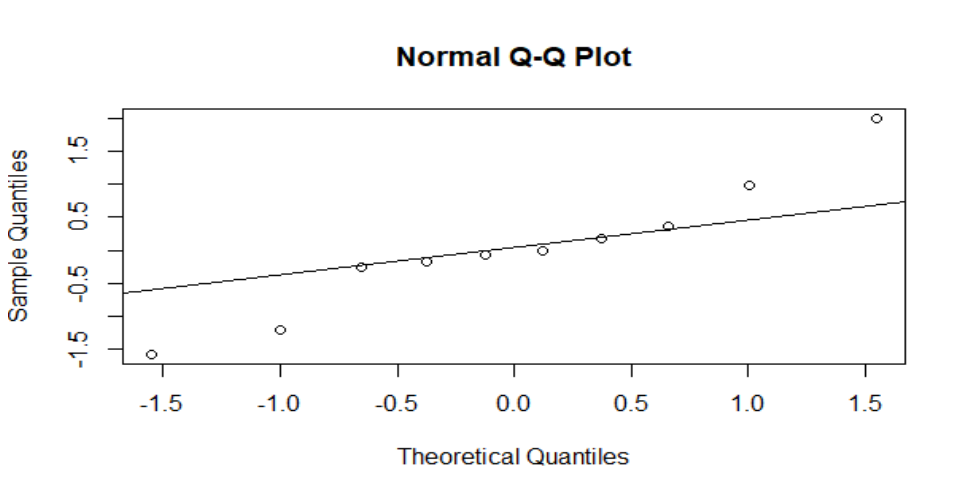
In order to accept the results of the statistical inference, focusing on three cases where R^2 is greater, the criteria of linearity, homoscedastity, normality and analysis of outliers must be met. The linearity criterion can be measured with the goodness of fit: R^2 . Normality can be checked by analyzing the residual quantiles $(\hat{Y}_i - Y_i)$, against the theoretical quantiles of the normal distribution. It will be calculated with the program "R studio". Here are the graphs of Dow jones , S&P 500 and Nikkei 225 volatility:

Figure 10 : Normal Q-Q plot : Dow jones volatility- C-19



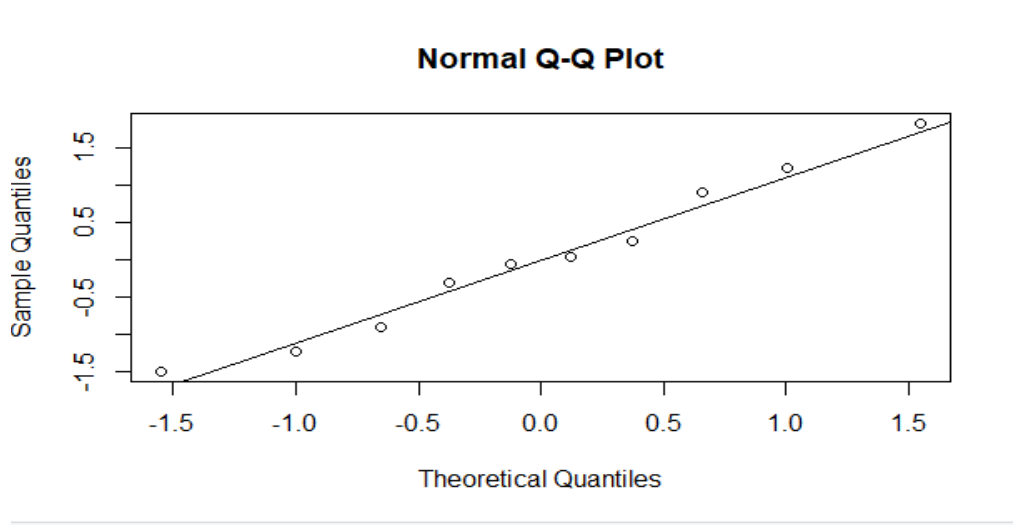
Source:Investing.com. Author's own creation.

Figure 11 : Normal Q-Q plot : S&P 500 volatility- C-19



Source:Investing.com. Author's own creation.

Figure 12: Normal Q-Q plot : Nikkei volatility- C-19

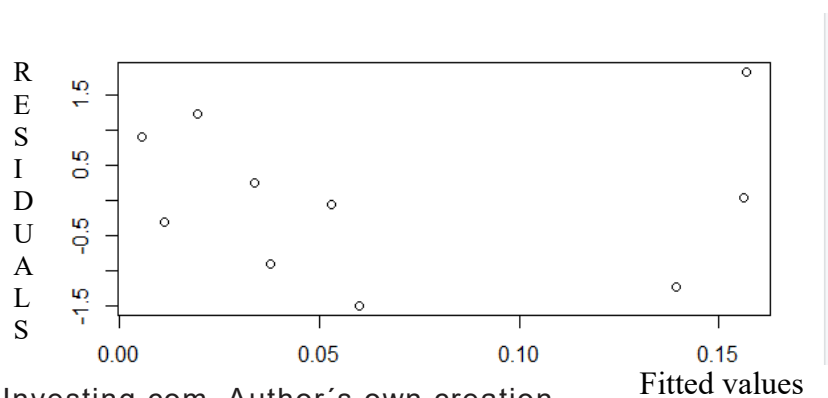


Source:Investing.com. Author's own creation.

The quantiles tested are close to the normal distribution, which should give a straight line, except for the outliers of the tails in Dow Jones and S&P 500.

Homoscedastiy is analyzed in the graphs, checking that fitted values and residuals do not follow any pattern, and they are uniformly distributed. The graphics of the 3 indices are very similar. Therefore , only the Nikkei 225 figure is shown:

Figure 13 :Fitted values-residuals plot :Nikkei volatility-C 19



Source:Investing.com. Author's own creation.

No definite pattern is observed in the represented area, but once again the outliers question the statistical inference.

But, why is the correlation NYSE return - Covid-19 higher than the other ones ?

On the one hand, we have that the standard deviations of the US indices are slightly greater than those of the majority of the other indices. (Table1). In addition, the standard deviation of C-19 is more than twice greater in the USA than in other countries, with the American figures being about 128% and the other ones below 50%. (Table5).

This conclusions do not explain the question, because they would make this correlation lower.

Table 5 :Standard deviation of C-19 variation.

Country	USA	CHINA	JAPAN	EU	UK
C-19 standard deviation	128,17%	59,92%	45,79%	45,65%	49,36%

Source: WHO. Author's own creation.

But we still have to analyze the index returns -C-19 covariances . Looking at table 2, the main difference is the covariance between the markets and covid-19, which are still much lower in the other countries. However, if we eliminate the first three weeks of the period, the covariance of the NYSE with the Covid_19 decreases considerably, being very similar to the values of the other indices. Therefore, what has happened is that the NYSE showed much more sensitivity to the immense variations of covid-19, but then return to more discrete figures.

As it has seen in this first weeks, the "NYSE market returns - Covid-19" relationship was very negative, which is in accordance to a covariance with red numbers in the full annual period, but much higher in absolute value than the rest of the indices, which are far from equalizing these data.

If we compare both, the evolution of the market indices, through of weekly returns, and the weekly variation of C-19 cases per 100,000 population, in the first three weeks of the period, we obtain this table. There are two different values of C-19 in Europe, according to the proportions of this virus with the proportion of participation of EURONEXT and NEXT 150 in each country.

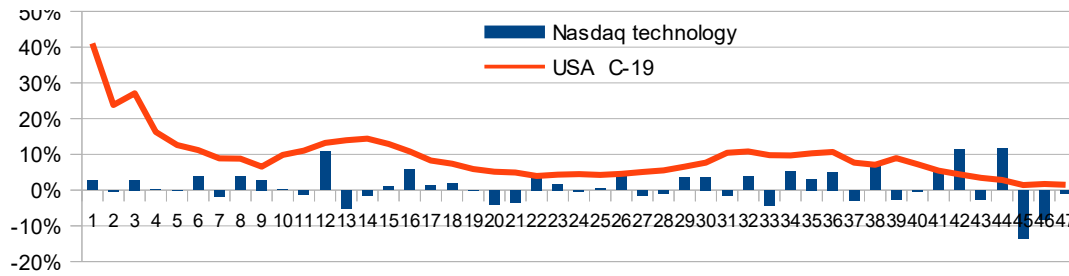
Table 6: Initial weekly returns and weekly variation of C-19 .

Index	Week 1	Week 2	Week 3	C-19 average	Week 1	Week 2	Week 3
NYSE composite	-15,84%	11,54%	-3,01%	USA	804,80%	414,90%	169,67%
NYSE US 100	-16,10%	11,14%	-2,16%				
Dow Jones	-17,30%	12,84%	-2,70%				
S&P 500	-14,98%	10,26%	-2,08%				
NASDAQ 100	-1,64%	1,50%	5,25%				
NASDAQ composite	-1,57%	1,73%	6,01%				
NASDAQ technology	-0,70%	6,04%	5,46%				
NASDAQ Multiasset d.	-0,75%	1,08%	2,57%				
SSE composite	-4,91%	0,97%	-0,30%	CHINA	138,10%	87,33%	-30,13%
Hang Seng	-5,11%	2,98%	-1,06%				
Hang Seng composite	-6,23%	3,95%	-1,03%				
Hang Seng tech	-7,77%	4,21%	0,85%				
Nikkei 225	-5,04%	17,14%	-8,09%	JAPAN	-18,15%	143,23%	143,89%
JASDAQ	1,09%	9,26%	-6,31%				
TOPIX	1,71%	13,74%	-9,21%				
Euronext 100	-1,07%	6,47%	-2,78%	UE	207,62%	135,98%	29,19%
Next 150	-4,88%	5,37%	-1,68%		228,63%	139,02%	27,15%
FTSE 100	-3,27%	6,16%	-1,72%	UK	190,49%	195,94%	79,27%
FTSE 100 Total Return	-3,24%	6,29%	-2,02%				
FTSE 100 Net of tax	-6,97%	6,84%	-5,66%				
FTSE 250	-12,65%	8,66%	-4,54%				

Source:Investing.com and WHO. Author's own creation.

We will see graphically how the performance of the most representative indices evolved with respect to the percentage of new weekly cases of Covid-19 (cases variation, not average variation.). The period computer is from 12 April 2020 to 7 March 2021.

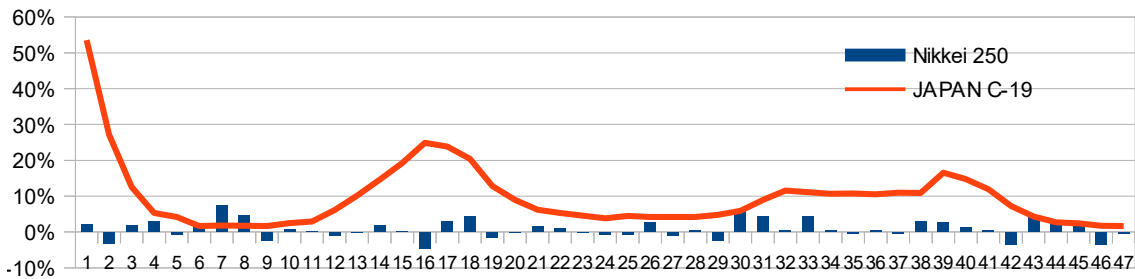
Figure 14: Weekly evolution: NASDAQ technology - Covid-19



Source: WHO and Investing.com. Author’s own creation

When the Covid-19 appeared, there was small volatility, being this measure higher at the end of the period.

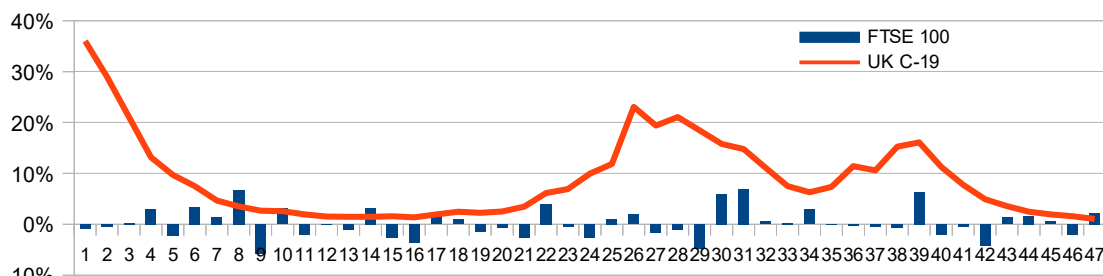
Figure 15 Weekly evolution: Nikkei 225 – Covid-19.



Source: WHO and Investing.com . Author’s own creation.

There were more movements on the rise when the Covid-19 began to stabilize, than the downward movements when this virus appeared.

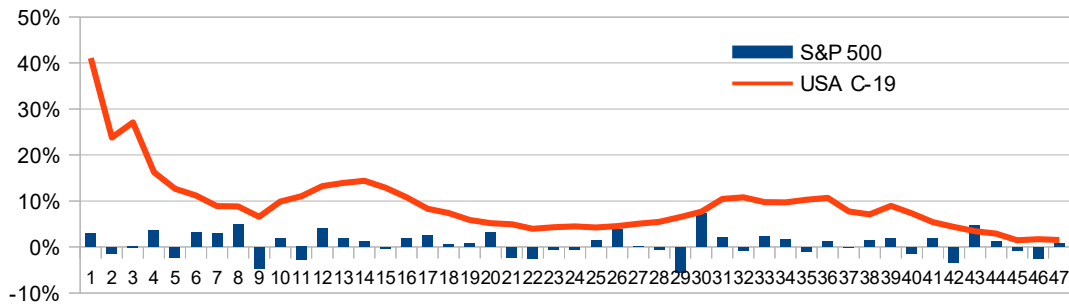
Figure 16: Weekly evolution: FTSE 100 - Covid-19



Source: WHO and Investing.com. Author’s own creation.

Volatility delayed in reacting and it is not observed in the first seven weeks. It was also high at the second and third peaks of Covid-19, but majority of positive yields were obtained.

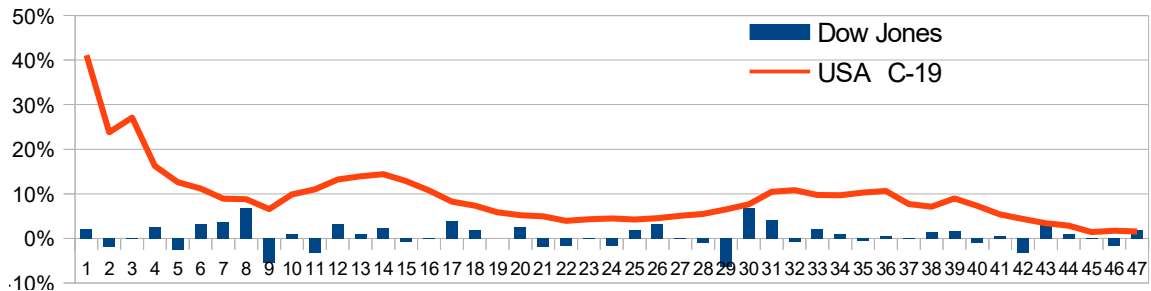
Figure 17: Weekly evolution: S&P 500 - Covid-19



Source: WHO and Investing.com. Author's own creation

When we find downward movements, they are accompanied, even in the first weeks, by higher intensity upwards returns.

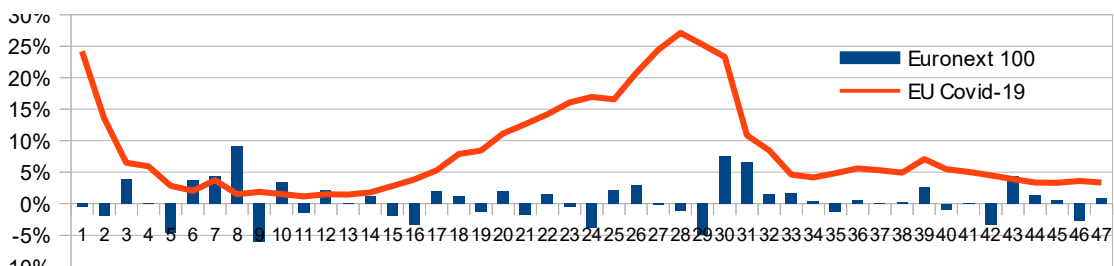
Figure 18: Weekly evolution: Dow Jones – Covid-19.



Source: WHO and Investing.com. Author's own creation.

This return evolution is very similar to the previous index, with slightly greater movements at the beginning of the period.

Figure 19 Weekly evolution: Euronext 100 – Covid-19.



Source: WHO and Investing.com. Author's own creation.

There was higher volatility than in the previous indices. The upward reaction was important when the first and second peaks of C-19 stabilized.

Conclusions

It seems that the appearance of Covid-19 leads equity exchanges to a critical crisis, but only in the first weeks, because the authorities early applied a series of monetary policies and programs to activate the economy with Central Banks money injections and interest rate decreases. It had a positive response. In fact, the correlation between the stock markets returns and the advance of the virus is minimal: only make mention of NYSE market, with correlations about 0,3-0,4. In this sense, it would be normal to find negative results, but it were even found positive, at the end of the computed period . That is to say, both rose, the evolution of pandemic expansion and stock returns.

The majority of stock indices ended the year with a positive balance, which is still remarkable, when this health problem has not yet been solved. It's just like the market discounted it.

It is necessary to detail the behavior of the Nasdaq, including the highest return indices: they were revalued close to 50%. The technology sector was therefore less affected. On the other hand, we find the NYSE market, which although at first it was the most penalized market , after they leveled its results with the rest of indices. The european indices were the least yields had in the computed period. The majority of them were below of 20%.

The volatility correlations were higher than return correlations, with the exception of the Chinese indices, whose crisis was already assimilated by the Chinese market at the beginning of the period. .If we look only the first weeks of the analyzed period, these correlations and their coefficients of determination grow, especially in the NYSE, in Japan and EU, with "R²" values from 0.7 to 0.9, obtaining satisfactory results in the regression contrast test.

It can be found some limitations in this study: correlation between equity yields is not the same study as between an economic variable and another health variable, so more that find a perfect linear relationship, this dissertation sought to make comparisons of them.

The presence of outliers in the study indicates that a more robust regression could be made. In most cases these influential data distort the homogeneity of variances and normality graphs.

In addition C-19 data was downloaded in March 2021, but have since been updated by WHO.

Finally, regressions were calculated with a reduced dataset.(n=10).

Among future lines of study, it can be found other variables that have influenced the equity markets and try to explain the correlation with other kind of regression.

References:

-Amaya Brenes,S., 2016. *Composicion y tecnicas de elaboracion del indice S&P 500. Evolucion durante el periodo de crisis*. University of Seville. Available at:

<https://idus.us.es/handle/11441/44503>. (Accessed 5 March 2021).

-Camacho Martinez-Vara de Rey, C. 2018. *Coeficiente de correlacion lineal de Pearson*. Available at:

<http://personal.us.es/vararey/adatos2/correlacion.pdf>. (Accessed 18 March 2021).

-CNMV, 2020. Boletín de la CNMV trimestre 1. Available at:

<https://www.cnmv.es/Portal/Publicaciones/BoletinCNMV.aspx>. (Accessed 20 March 2021).

-CNMV; 2020.Boletín de la CNMV trimestre 2. Available at:

<https://www.cnmv.es/Portal/Publicaciones/BoletinCNMV.aspx>.(Accessed 20 March 2021).

-CNMV;2020. Boletín de la CNMV trimestre 3. Available at:

<https://www.cnmv.es/Portal/Publicaciones/BoletinCNMV.aspx>.(Accessed 20 March 2021).

-CNMV, 2020 Boletín de la CNMV trimestre 4. Available at:

<https://www.cnmv.es/Portal/Publicaciones/BoletinCNMV.aspx>.(Accessed 20 March 2021).

-Court,E., Tarradellas,J., 2010. *Mercado de capitales*. Mexico: Prentice hall. Available at :

<https://docplayer.es/59098075-Mercado-de-capitales.html>.(Accesed 9 June 2021).

-China exchange services company limited, 2018. *CES gamin top 10 index methodology*. Available at:

<http://index.cesc.com/index/pdf/>.(Accessed 18 March 2021).

-China securities index co, *Brief introduction and organization structure*. Available at:
<http://www.csindex.com.cn/en/about/brief-introduction>.(Accessed 18 March 2021).

-China securities index co, 2021. *SSE index*. Available at:
<http://www.csindex.com.cn › 000001factsheeten>.(Accessed 19 May 2021).

-China securities index co, 2021. *SSE index*. Available at:
<http://www.csindex.com.cn › 000001factsheeten>.(Accessed 19 May 2021).

-EURONEXT, Indices. Available at:
<https://live.euronext.com/en/products/indices>. (Accessed 1 April 2021).

-EURONEXT, 2020. *Index rule book AEX family*. Available at:
<https://live.euronext.com/en/products-indices/index-rules>.(Accessed 1 April 2021).

-EURONEXT, 2020. *Index rule book BEL family*.:Available at:
<https://live.euronext.com/en/products-indices/index-rules>. (Accessed 1 April 2021).

-EURONEXT, 2020. *Index rule book CAC family*. Available at:
<https://live.euronext.com/en/products-indices/index-rules>.(Accessed 1 April 2021).

-EURONEXT, 2020. *Index rule book EURONEXT 100 Index NEXT 150 Index*.
Available at :
<https://live.euronext.com/en/products-indices/index-rules>.(Accessed 19 May 2021).

-EURONEXT; 2020. *Index rule book EURONEXT France Germany Leaders Family*.
Available at:
<https://live.euronext.com/en/products-indices/index-rules>.(Accessed 1 April 2021).

-EURONEXT, 2021, *CAC 40 factsheet*. Available at:
<https://live.euronext.com/en/products-indices/index-factsheets> .(Accesed 15 June 2021).

- EURONEXT, 2021. *Index rule book ISEQ family*. Available at:
<https://live.euronext.com/en/products-indices/index-rules>. (Accessed 1 April 2021).
- EURONEXT,2020. *Index rule book OBX family*. Available at:
<https://live.euronext.com/en/products-indices/index-rules>. (Accessed 1 April 2021).
- EURONEXT,2020.*Index rule book PSI 20 family*. Available at:
<https://live.euronext.com/en/products-indices/index-rules>. (Accessed 1 April 2021).
- FTSE Russell. 2021. FTSE 100 Index*. Available at:
<https://www.ftserussell.com/analytics/factsheets/home/search>. (Accessed 9 May 2021).
- Hang Seng indexes.2021.*Hang seng index*. Available at:
<https://www.hsi.com.hk/eng/resources-education/factsheets>.(Accessed 19 May 2021).
- Hang Seng indexes company, 2021. *Hang Seng Tech index*. Available at:
<https://www.hsi.com.hk/eng/indexes/all-indexes/hstech>.(Accessed 13 June 2021)
- Hang Seng Indexes company, *Hang Seng Index & sub-indexes*. Available at: <https://www.hsi.com.hk/eng/indexes/all-indexes/hsi>. (Accessed 8 March 2021).
- Hang Seng Indexes company, 2021 .*Hang Seng history and milestones*. Available at:
<https://www.hsi.com.hk/eng/indexes/all-indexes/hsi>.(Accessed 8 March 2021).
- Hang Seng indexes company limited, 2020. *Index methodology for managing the Hang Seng Index*. Available at:
<https://www.hsi.com.hk/eng/resources-education/index-methodologies>.(Accessed 8 March 2021).
- Hang Seng indexes company limited, 2020. *Index methodology for managing the Hang Seng Composite Index*, Available at:

<https://www.hsi.com.hk/eng/resources-education/index-methodologies>. (Accessed 8 March 2021).

-Hang Seng indexes company limited, 2020. Hang Seng Tech Index. Available at:

<https://www.hsi.com.hk/eng/resources-education/index-methodologies>.
(Accessed 8 March 2021).

--ICE data services, 2018, *NYSE Bitcoin Index*. Available at
:<https://www.theice.com/market-data/indices/equity-indices/methodologies>.
(Accessed 21 April 2020).

-ICE data services, 2018, *NYSE FANG+ Index* . Available at:
<https://www.theice.com/market-data/indices/equity-indices/methodologies>.
(Accessed 20 April 2021).

-ICE data services, 2018, *NYSE Index Series*. Available at:
<https://www.theice.com/market-data/indices/equity-indices/methodologies>.
(Accessed 20 April 2021).

-Investing.com, 2021.*Historical data*. Available at:
<https://es.investing.com/indices/>. (Accessed 15 March 2020).

-Japan Exchange Group, 2020.*Overview of IPO*. Available at:
<https://www.jpx.co.jp/english/equities/listing-on-tse/new/basic/index.html>.
(Accessed 6 March 2021).

-Japan Exchange group, 2021.*Topix component stock weight*. Available at:
https://www.jpx.co.jp/english/markets/indices/topix/tvdivq00000030ne-att/TOPIX_weight_en.xlsx. (Accessed 29 April 2021).

-Japan exchange Group, 2021,*What is topix ?*. Available at:
<https://www.jpx.co.jp/english/markets/indices/topix/>. (Accessed 29 April 2021).

- LSE group. *Featured indexes*. Available at:
<https://www.ftserussell.com/index/category/equity>. (Accessed 11 March 2021).
- LSE group. *FTSE UK index series*. Available at:
<https://www.ftserussell.com/products/indices/uk>. (Accessed 11 March 2021).
- Moreno,J.;D, Gutierrez, M. *Caracterizacion de los activos y carteras: rentabilidad y riesgo*. Available at:
<http://ocw.uc3m.es/economia-financiera-y-contabilidad/economia-financiera-1/material-de-clase-1/tema-3-caracterizacion-de-los-activos-y-carteras-financieras-rentabilidad-y-riesgo/view>.(Accessed 24 April 2021).
- Nasdaq Global information services, 2018.*The Nasdaq-100 Index*. Available at:
<https://www.nasdaq.com › docs › Nasdaq-100Index>. (Accessed 19 May 2021).
- NASDAQ OMX, 2012. *NASDAQ 100 Index Methodology*. Available at:
<https://indexes.nasdaqomx.com/Resource/Index/Methodology>. (Accessed 29 April 2021).
- NASDAQ OMX, 2013. *NASDAQ US Multiasset diversified income Index*. Available at:
https://indexes.nasdaqomx.com/docs/Q13.0313.MultiAsset.Index.Performance.Sheet_226c.pdf. (Accessed 29 April 2021)
- NASDAQ OMX, 2020. *NASDAQ Composite Index Methodology*. Available at:
<https://indexes.nasdaqomx.com/Resource/Index/Methodology>.(Accessed 29 April 2021).
- NASDAQ OMX, 2020. *NASDAQ 100 technology sector Index Methodology*. Available at:
<https://indexes.nasdaqomx.com/Resource/Index/Methodology>.(Accessed 29 April 2021).

- NASDAQ OMX, 2021. *NASDAQ Initial listing*. Available at:
<https://listingcenter.nasdaq.com/assets/initialguide.pdf>. (Accessed 29 April 2021).
- Nikkei Indexes. 2020. *Nikkei stock average. Index guidebook*. Available at:
<https://indexes.nikkei.co.jp/en/nkave/index/profile?idx=nk225>. (Accessed 29 April 2021).
- Nikkei indexes.2021.*Nikkei stock average monthly factsheet*.Available at:
<https://indexes.nikkei.co.jp/en/nkave/index/profile?idx=nk225>. (Accessed 19 May 2021).
- Orellana, L. 2008. *Analisis de regresión*. Buenos Aires University. Available at:
<https://docplayer.es/19865801-Analisis-de-regresion-el-analisis-de-regresion-involucra-el-estudio-la-relacion-entre-dos-variables-cuantitativas-en-general-interesa.html>.(accessed 21 June 2021).
- Palma,M., 2020. The stock market index: importance of the Dow Jones, S&P 500 and Nasdaq in the economy. *Revista Científica Apuntes de Economía y Sociedad*. Available at:
http://revistas.unanleon.edu.ni/index.php/apunteseconomiasociedad/article/view/vol1_2_2020_arto2.(Accessed 3 March 2021).
- Shanghai stock exchange, *SSE indices system construction*. Available at:
<http://english.sse.com.cn/markets/indices/overview/>.(Accessed 1 April 2021).
- S&P Global.2021.*Equity.Dow Jones Industrial Average*. Available at:
<https://www.spglobal.com/spdji/en/indices/equity/dow-jones-industrial-average/#overview> .(Accessed 19 May 2021).
- Taype Huaman, I., 2018. *Evaluación de la frontera eficiente de media varianza. Utilizado diferentes medidas de riesgo*. Universidad Santiago de Cali. Colombia. Available at:
https://repository.icesi.edu.co/biblioteca_digital/handle/10906/84372. (Accessed 24 April 2021).

-The World federation of exchanges , 2020. *Annual statistics guide 2019 v7*. WFE statistics team. Available at:
<https://www.world-exchanges.org/our-work/articles/2019-annual-statistics-guid.e>. (Accessed 20 January 2021).

-Tokio stock exchange, 2019. *New listing guidebook. JASDAQ*. Available at:
<https://www.jpx.co.jp/english/equities/listing-on-tse/new/guide/>. (Accessed 29 April 2021).

-Tokio stock exchange,2021, *JASDAQ Index summary*. Available at:
<https://www.jpx.co.jp/english/markets/indices/line-up/index.html>. (Accessed 29 April 2021).

-UAM, 2008. *Tablas estadísticas*. Available at:
http://verso.mat.uam.es/~pablo.fernandez/tablas_Probl_2007-2008.pdf.
(Accessed 16 June 2021).

-Vallejo,C., Torres,O.,2012. *Manual de la inversion en bolsa*. Madrid:Inversor Ediciones S.L. Available at:
<https://docplayer.es/14165-Manual-de-la-inversion-en-bolsa-tomo-i-novena-edicion-revisada-ampliada-y-actualizada.html>. (Accessed 30 April 2021).

- WHO, 2021.*COVID 19 Cases cumulative total per 100,000 population*. Available at :
<https://covid19.who.int/table>. (Accessed 15 March 2021).

Appendix 1: sector breakdown table:

	T e c h n o l o g y	I n d u s t r i a l s	H e a l t h c a r e	F i n a n c i a l s	C o n s u m e r g o o d s / s e r v	C o m m u n i c a t i o n	E n e r g y / o i l / g a s	M a t e r i a l s	U t i l i t i e s	A n n u a l r e t u r n
Dow Jones	21,30%	17,10%	17,00%	15,70%	20,80%	4,70%	2,00%	1,20%	0,00%	25,27%
FTSE 100	1,86%	12,39%	19,58%	20,97%	16,59%	6,03%	7,24%	12,09%	2,99%	6,72%
Hang Seng	23,79%	1,37%	5,20%	40,50%	10,50%	2,85%	2,47%	8,26%	3,14%	13,07%
Nasdaq 100	56,41%	4,46%	9,01%	0,00%	29,34%	0,78%	0,00%	0,00%	0,00%	51,56%
S&P 500	21,36%	11,71%	12,95%	18,56%	21,53%	1,98%	6,30%	2,11%	2,92%	38,27%
Nikkei 255	45,73%	10,87%	0,00%	2,21%	24,50%	0,00%	0,00%	14,11%	2,57%	36,42%
SSE composite	6,70%	15,90%	7,50%	27,90%	21,70%	2,20%	4,90%	9,60%	3,60%	16,00%
CAC 40	12,69%	16,03%	9,84%	10,30%	29,02%	6,51%	7,15%	5,37%	2,42%	17,72%
Hang Seng technology	71,05%	8,49%	10,63%	1,38%	8,45%	0,00%	0,00%	0,00%	0,00%	58,87%

Source : Source: S&P Global, FTSE Russell, Hang Seng indexes, NASDAQ global information services, Nikkei indexes, China securities index co. and Euronext. Author's own creation.

Appendix 2: C-19 per 100.000 population. (USA, China, Japan and U.K.)

Date	USA C-19	Variation	CHINA C-19	Variation	JAPAN C-19	Variation	UK C-19	Variation
01-08/03/2020	217		80859		455		352	
08-15/03/2020	1718	1501	81048	189	780	325	2244	1892
15-22/03/2020	15299	13581	81498	450	1046	266	7740	5496
22-29/03/2020	85228	69929	82341	843	1693	647	24005	16265
29/03-05/4/2020	273808	188580	82930	589	3271	1578	53164	29159
05-12/04/2020	492881	219073	83482	552	6748	3477	85810	32646
12-19/04/2020	695353	202472	84201	719	10361	3613	116695	30885
19-26/04/2020	860772	165419	84338	137	13182	2821	150498	33803
26/04-03/05/2020	1093880	233108	84393	55	14839	1657	182299	182299
03-10/05/2020	1271645	177765	84430	37	15628	789	206238	23939
10-17/05/2020	1432265	160620	84494	64	16285	657	226173	19935
17-24/05/2020	1592599	160334	84525	31	16550	265	243085	16912
24-31/05/2020	1734040	141441	84570	45	16851	301	254394	11309
31/05-07/06/2020	1886794	152754	84629	59	17141	290	263242	8848
07-14/06/2020	2010391	123597	84729	100	17429	288	270289	7047
14-21/06/2020	2208829	198438	84997	268	17864	435	277172	6883
21-28/06/2020	2452048	243219	85190	193	18390	526	282450	5278
28/06-05/07/2020	2776366	324318	85306	116	19522	1132	286724	4274
05-12/07/2020	3163581	387215	85522	216	21502	1980	290954	4230
12-19/07/2020	3618497	454916	85937	415	24642	3140	295213	4259
19-26/07/2020	4084043	465546	86839	902	29382	4740	299834	4621
26/07-02/08/2020	4523888	439845	88302	1463	36689	7307	303956	4122
02-09/08/2020	4897958	374070	89149	847	45439	8750	309767	5811
09-16/08/2020	5258565	360607	89761	612	54714	9275	317448	7681
16-23/08/2020	5567217	308652	90141	380	61747	7033	324605	7157
23-30/08/2020	5855521	288304	90351	210	67264	5517	332756	8151
30/08-06/09/2020	6144138	288617	90517	166	71419	4155	344168	11412
06-13/09/2020	6386832	242694	90666	149	75218	3799	365178	21010
13-20/09/2020	6662003	275171	90840	174	78657	3439	390362	25184
20-27/09/2020	6960152	298149	90966	126	81690	3033	429281	38919
27/09-04/10/2020	7256234	296082	91121	155	85339	3649	480021	50740
04-11/10/2020	7583748	327514	91305	184	88912	3573	590848	110827
11-18/10/2020	7966729	382981	91489	184	92656	3744	705432	114584
18-25/10/2020	8403121	436392	91674	185	96534	3878	854014	148582
25/10-01/11/2020	8952086	548965	91921	247	101146	4612	1011664	157650
01-08/11/2020	9636579	684493	92195	274	107086	5940	1171445	159781
08-15/11/2020	10641431	1004852	92428	233	116677	9591	1344360	172915
15-22/11/2020	11789012	1147581	92648	220	130179	13502	1493387	149027
22-29/11/2020	12939666	1150654	93329	681	144653	14474	1605176	111789
29/11-06/12/2020	14191298	1251632	94160	831	160098	15445	1705975	100799
06-13/12/2020	15648098	1456800	94950	790	177287	17189	1830960	124985
13-20/12/2020	17314834	1666736	95716	766	195880	18593	2040151	209191
20-27/12/2020	18648989	1334155	96324	608	217312	21432	2256009	215858
27/12-03/01/2020	19974413	1325424	96894	570	240954	23642	2599793	343784
03-10/01/2021	21761186	1786773	97518	624	280775	39821	3017413	417620
10-17/01/2021	23344423	1583237	98625	1107	322296	41521	3357365	339952
17-24/01/2021	24604325	1259902	99931	1306	360661	38365	3617463	260098
24-31/01/2021	25676612	1072287	100877	946	386742	26081	3796092	178629
31/01-07/02/2021	26547977	871365	101272	395	403435	16693	3929839	133747
07-14/02/2021	27309503	761526	101515	243	414472	11037	4027110	97271
14-21/02/2021	27702074	392571	101669	154	424507	10035	4105679	78569
21-28/02/2021	28174978	472904	101878	209	431740	7233	4170523	64844
28/02-07/03/2021	28602211	427233	102064	186	438956	7216	4213347	42824

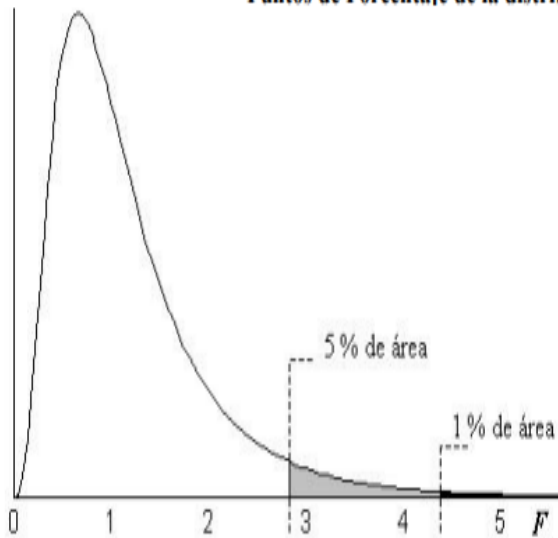
C-19 cases per 100.000 population in Europe .

Date	IRELAND C - 19	Variation	PORTUGAL C - 19	Variation	NORWAY C - 19	Variation	NETHERLANDS C - 19	Variation	BELGIUM C - 19	Variation	FRANCE C - 19	Variation
01-08/03/2020	19		21		147		131		343		698	
08-15/03/2020	129	110	169	148	907	760	936	805	1635	1292	4436	3738
15-22/03/2020	785	656	1280	1111	1926	1019	3580	2644	5036	3401	14292	9856
22-29/03/2020	2415	1630	5170	3890	3845	1919	9650	6070	12969	7933	37145	22853
29/03-05/4/2020	4604	2189	10524	5354	5510	1665	16565	6915	22681	9712	67757	30612
05-12/04/2020	8928	4324	15987	5463	6320	810	24186	7621	33997	11316	92787	25030
12-19/04/2020	14758	5830	19685	3698	6984	664	31398	7212	42041	8044	110721	17934
19-26/04/2020	18561	3803	23683	3998	7467	483	36921	5523	47982	5941	122876	12155
26/04-03/05/2020	21176	2615	25190	1507	7759	292	39980	3059	51142	3160	129458	6582
03-10/05/2020	22760	1584	27406	2216	8069	310	42125	2145	54215	3073	137008	7550
10-17/05/2020	24048	1288	28810	1404	8197	128	43634	1509	56323	2108	140008	3000
17-24/05/2020	24582	534	30471	1661	8309	112	44820	1186	57839	1516	142173	2165
24-31/05/2020	24929	347	32203	1732	8411	102	46027	1207	59009	1170	148436	6263
31/05-07/06/2020	25183	254	34351	2148	8504	93	47091	1064	59852	843	150022	1586
07-14/06/2020	25295	112	36463	2112	8606	102	48391	1300	60554	702	152460	2438
14-21/06/2020	25374	79	38841	2378	8708	102	49264	873	61224	670	154562	2102
21-28/06/2020	25437	63	41189	2348	8815	107	49857	593	61827	603	156156	1594
28/06-05/07/2020	25509	72	43569	2380	8895	80	50334	477	62464	637	158734	2578
05-12/07/2020	25611	102	46221	2652	8965	70	50747	413	63149	685	161275	2541
12-19/07/2020	25750	139	48390	2169	9015	50	51494	747	64513	1364	164247	2972
19-26/07/2020	25869	119	49955	1565	9085	70	52664	1170	66882	2369	169222	4975
26/07-02/08/2020	26109	240	51310	1355	9208	123	54671	2007	70677	3795	175920	6698
02-09/08/2020	26644	535	52537	1227	9468	260	57925	3254	75043	4366	185353	9433
09-16/08/2020	27191	547	53981	1444	9850	382	62419	4494	78784	3741	202118	16765
16-23/08/2020	27908	717	55452	1471	10197	347	66022	3603	82254	3470	223419	21301
23-30/08/2020	28720	812	57448	1996	10543	346	69550	3528	85373	3119	256829	33410
30/08-06/09/2020	29534	814	59943	2495	11120	577	73760	4210	88990	3617	300511	43682
06-13/09/2020	30730	1196	63310	3367	11866	746	80915	7155	95002	6012	353986	53475
13-20/09/2020	32538	1808	68025	4715	12645	779	91802	10887	104950	9948	420855	66869
20-27/09/2020	34560	2022	72939	4914	13406	761	105709	13907	116145	11195	503662	82807
27/09-04/10/2020	37768	3208	78247	5308	14149	743	131592	25883	134534	18389	580707	77045
04-11/10/2020	41714	3946	85574	7327	15221	1072	167855	36263	171997	37463	691372	110665
11-18/10/2020	48678	6964	98055	12481	16136	915	219431	51576	242312	70315	838149	146777
18-25/10/2020	56108	7430	116109	18054	17232	1096	280298	60867	347039	104727	1055946	217797
25/10-01/11/2020	61456	5348	141279	25170	19563	2331	350206	69908	448816	101777	1331812	275866
01-08/11/2020	64855	3399	173540	32261	23225	3662	403280	53074	504029	55213	1714361	382549
08-15/11/2020	67526	2671	211266	37726	27226	4001	441226	37946	538383	34354	1918345	203984
15-22/11/2020	70143	2617	255970	44704	31438	4212	477979	36753	561157	22774	2089353	171008
22-29/11/2020	71942	1799	290706	34736	34747	3309	512067	34088	577441	16284	2169811	80458
29/11-06/12/2020	73948	2006	318640	27934	37371	2624	549167	37100	592676	15235	2241830	72019
06-13/12/2020	75756	1808	344700	26060	40022	2651	602361	53194	609333	16657	2324603	82773
13-20/12/2020	78776	3020	370787	26087	42775	2753	675467	73106	627105	17772	2418439	93836
20-27/12/2020	85394	6618	392996	22209	44932	2157	752653	77186	639788	12683	2507532	89093
27/12-03/01/2020	96926	11532	423870	30874	48278	3346	812467	59814	650920	11132	2599127	91595
03-10/01/2021	140727	43801	476187	52317	53792	5514	865087	52620	665632	14712	2721692	122565
10-17/01/2021	169780	29053	539416	63229	57734	3942	906007	40920	679842	14210	2846971	125279
17-24/01/2021	186184	16404	624469	85053	60565	2831	943266	37259	695069	15227	2985259	138288
24-31/01/2021	195303	9119	711018	86549	62575	2010	974215	30949	711908	16839	3126351	141092
31/01-07/02/2021	202548	7245	761906	50888	64483	1908	1001353	27138	727423	15515	3262505	136154
07-14/02/2021	208796	6248	784079	22173	66236	1753	1025416	24063	740231	12808	3389716	127211
14-21/02/2021	214328	5532	796339	12260	68107	1871	1051554	26138	755576	15345	3521249	131533
21-28/02/2021	218980	4652	803844	7505	70034	1927	1083620	32066	772458	16882	3671208	149959
28/02-07/03/2021	222699	3719	809412	5568	73493	3459	1115117	31497	788949	16491	3814830	143622

Source: WHO.

Appendix 3: F-Distribution table

Puntos de Porcentaje de la distribución F



Ejemplo:

Para $n_1 = 9, n_2 = 12$ grados de libertad:

$$P[F > 2.80] = 0.05$$

$$P[F > 4.39] = 0.01$$

n_2	5% (normal) y 1% (negritas) puntos para la distribución de F																								
	n1 grados de libertad (para el mayor cuadrado medio)																								
	1	2	3	4	5	6	7	8	9	10	11	12	14	16	20	24	30	40	50	75	100	200	500	∞	
1	161	199	216	225	230	234	237	239	241	242	243	244	245	246	248	249	250	251	252	253	253	254	254	254	
	4052	4999	5404	5624	5764	5859	5928	5981	6022	6056	6083	6107	6143	6170	6209	6234	6260	6286	6302	6324	6334	6350	6360	6366	
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.40	19.41	19.42	19.43	19.45	19.45	19.46	19.47	19.48	19.48	19.49	19.49	19.49	19.50	
	98.50	99.00	99.16	99.25	99.30	99.33	99.36	99.38	99.39	99.40	99.41	99.42	99.43	99.44	99.45	99.46	99.47	99.48	99.48	99.48	99.49	99.49	99.50	99.50	
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.76	8.74	8.71	8.69	8.66	8.64	8.62	8.59	8.58	8.56	8.55	8.54	8.53	8.53	
	34.12	30.82	29.46	28.71	28.24	27.91	27.67	27.49	27.34	27.23	27.13	27.05	26.92	26.83	26.69	26.60	26.50	26.41	26.35	26.28	26.24	26.18	26.15	26.13	
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.94	5.91	5.87	5.84	5.80	5.77	5.75	5.72	5.70	5.68	5.66	5.65	5.64	5.63	
	21.20	18.00	16.69	15.98	15.52	15.21	14.98	14.80	14.66	14.55	14.45	14.37	14.25	14.15	14.02	13.93	13.84	13.75	13.69	13.61	13.58	13.52	13.49	13.46	
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.70	4.68	4.64	4.60	4.56	4.53	4.50	4.46	4.44	4.42	4.41	4.39	4.37	4.37	
	16.26	13.27	12.06	11.39	10.97	10.67	10.46	10.29	10.16	10.05	9.96	9.89	9.77	9.68	9.55	9.47	9.38	9.29	9.24	9.17	9.13	9.08	9.04	9.02	
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.03	4.00	3.96	3.92	3.87	3.84	3.81	3.77	3.75	3.73	3.71	3.69	3.68	3.67	
	13.75	10.92	9.78	9.15	8.75	8.47	8.26	8.10	7.98	7.87	7.79	7.72	7.60	7.52	7.40	7.31	7.23	7.14	7.09	7.02	6.99	6.93	6.90	6.88	
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.60	3.57	3.53	3.49	3.44	3.41	3.38	3.34	3.32	3.29	3.27	3.25	3.24	3.23	
	12.25	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72	6.62	6.54	6.47	6.36	6.28	6.16	6.07	5.99	5.91	5.86	5.79	5.75	5.70	5.67	5.65	
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.31	3.28	3.24	3.20	3.15	3.12	3.08	3.04	3.02	2.99	2.97	2.95	2.94	2.93	
	11.26	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91	5.81	5.73	5.67	5.56	5.48	5.36	5.28	5.20	5.12	5.07	5.00	4.96	4.91	4.88	4.86	
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.10	3.07	3.03	2.99	2.94	2.90	2.86	2.83	2.80	2.77	2.76	2.73	2.72	2.71	
	10.56	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35	5.26	5.18	5.11	5.01	4.92	4.81	4.73	4.65	4.57	4.52	4.45	4.41	4.36	4.33	4.31	
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.94	2.91	2.86	2.83	2.77	2.74	2.70	2.66	2.64	2.60	2.59	2.56	2.55	2.54	
	10.04	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94	4.85	4.77	4.71	4.60	4.52	4.41	4.33	4.25	4.17	4.12	4.05	4.01	3.96	3.93	3.91	

Source: UAM

