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How Does Uncertainty Affect Stock Markets?

Constructing a New Index

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Abstract

The research tries to assess the impact of the measurement uncertainty in the different countries and corresponding categories aggregations created on the respective stock market price movements. For this analysis, I have constructed an uncertainty index for 36 OECD countries based on the frequency of internet searches – 100 different key expressions selected and translated for each country's native language that capture a broad range of topics between January of 2005 and December of 2020. The created index spikes both in international and country-specific historical events. The findings also suggest that, in general, the created index has predictive capabilities on share price movements, notably during periods of generalized fear and uncertainty across countries. Overall, the proposed models present results that better explain the share price movements in emerging economies than in advanced ones.

Keywords: *Uncertainty, Stock Market, Crisis, Measurement, Google Trends, Indexes*

Como é que a Incerteza Afeta o Mercado de Ações?

Construção de um novo Índice

João Calvo Matos

Abril 2021

Resumo

Esta dissertação procura avaliar o impacto da incerteza nos mercados de ações em diferentes países e respetivos grupos geográficos e económicos. Para esta análise, construí um índice medidor de incerteza para 36 países da OCDE, com base na frequência de pesquisas na Internet – foram selecionadas e traduzidas para a respetiva língua de cada país 100 expressões-chave que captam um vasto leque de tópicos entre o período de janeiro de 2005 e dezembro de 2020. O índice criado aumenta tanto em acontecimentos de caracter internacional, bem como em eventos mais específicos de cada país. As conclusões sugerem também que, em geral, o índice criado tem capacidade de prever flutuações futuras em preços das ações, nomeadamente durante períodos de medo generalizado e incerteza entre os países. Em geral, os modelos propostos apresentam resultados que melhor explicam a movimento dos preços das ações em economias emergentes do que em economias consideradas mais avançadas.

Palavras-chave: *Incerteza, Mercado de Ações, Crise, Google Trends, Índices*

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1. Introduction

The world is an uncertain place. In a fast-pacing society, everything is in constant change, and it can be tricky to predict what is coming next. The interconnected system in which we live can get disrupted at any time and bring unpleasant consequences. It can be just in our personal lives or on a global scale. The only certainty in this uncertain living is that we cannot prepare ourselves for everything that the future might bring.

This research primary purpose is to develop a new index based on web search queries that can first correctly measure uncertainty according to his different sources, secondly study whether the created index can be a good predictor of the stock market at a country bases level and thirdly aggregate different countries according to their geographical and economic characteristics to better understand which ones the index performs the best and understand its reasoning.

The new index construction is based on previous research and complements them by using first a web search data source, secondly a broad list of keyword expressions that include different sources of uncertainty and including, thirdly, a large sample of countries. This dissertation might also open new doors for future studies using the power of web search queries as a valuable tool of uncertainty measurement.

The created index successfully reflects major country-specific and global events that spiked the uncertainty reflected on the index. There is also evidence that, in general, the developed index moves in the same direction as other alternative indexes of uncertainty. Besides, the evidence supports the fact that this measure of uncertainty is a better predictor of share prices crisis periods. The evidence also suggests that the index lagged values can predict share prices.

According to the Dictionary, the word Uncertainty refers to "something that you cannot be sure about; a situation that makes you not be or feel certain" (Oxford Dictionary of English, 12th edition). The sources of this "feel" can be from the individual's level (such as a family's financial situation) or a more collective level (geopolitical situations, legislation policy, natural disasters, among others.) Nevertheless, the collective level of sources of uncertainty tends to reflect the individual's ones.

Concerns about the near future uncertainty have increased with the recent Coronavirus Pandemic Crisis. This fear and uncertainty have reached all the sectors of society and for different reasons. A politician fears the impact of the financial crisis in future elections. An

investor fears for the performance of the firms where he is a shareholder. A CEO fears the financial impact on his firms and difficult expenses cut decisions. A parent fears losing his job and being unable to give healthy meals and proper education to his kids. A child fears for the health of his grandfather that is ill. A doctor fears being unable to have enough resources and being forced to decide who lives.

Furthermore, there is also the individual's irrational behaviour under uncertainty periods. Under stress, the human response tends to overreact and go beyond the rational one. Additionally, this uncertainty effect can be magnified by the news media coverage and social media (Lerman and Ghosh, 2010). This effect was observed at the beginning of the Coronavirus outbreak that originated a panic buying among the consumers (March 2020).

In the increasingly connected world, uncertainty tends to be more linked to a broad spectrum of society. Moreover, the consequences are as well reflected in those different sectors. This rapid spread of uncertainty can be linked to weaker financial performances in firms and lead to a steep economic decline (IMF reports).

Researching and finding new ways of measuring uncertainty and using it to predict stock markets' performance and evolution has been a topic of great interest for different researchers. Even though measuring uncertainty can be a highly challenging and problematic task, developments in data mining and processing techniques have been built over the years.

For many years, financial, economic, and statistical researchers have studied the variables that explain the variations in stock market returns. More recently, in addition to the traditional equity valuation models, there has been increasing research on new data drivers that previously were not being measured, namely the individual's perception and irrational responses to uncertainty.

This dissertation can be of interest to an academic researcher to develop and improve future proxies for uncertainty. Additionally, investors can be better informed regarding near-future share market fluctuations.

The content of this dissertation research organizes as follows: first, chapter 2 presents the insights regarding previous literature and research developments; then, chapter 3 describes data collection and index construction; chapter 4 presents a detailed descriptive statistic of the newly constructed index; chapter 5 presents the methodology and the different models used; chapter 6 focuses on the main results and findings reached; chapter 7 recognizes the dissertation's limitations and finally, chapter 8 highlights the main conclusions.

2. Literature Review

2.1. The "Uncertainty"

The concept of uncertainty differs across the different fields of study. For the analytical chemistry area, the term is related to scientific measurement results (Hund, Massart & Smeyers-Verbeke, 2001). In statistics, uncertainty arises from the lack of data and modelling error, resulting in confident intervals to include uncertainty in a specific statistic (Hodges, 1987). For psychologists, uncertainty is linked to a greater search for more information (Liemieux & Peterson, 2011). Moreover, uncertainty can be defined in the economics and financial field by the individuals' inability to forecast certain events likelihood (Knight, 1921).

The impact of uncertainty is different for each economic agent. Rather than an objective uncertainty that is not observed, the individuals base their own decisions on their unique perspective of uncertainty and its consequences (Scotti, 2016).

Prior literature regarding the effects of uncertainty covers an extensive list of economic areas. It is already well known that an increase in uncertainty creates an incentive for firms to delay investments (Bernanke, 1983) or permanently reduce future firms' investments until the high uncertainty disappears (Dixit, 1989). The effect is intensified when the uncertainty is related to economic policy. In Rodrik research (1991), it is shown that even when the announced policy reforms appear to be favourable from a business perspective, it can create doubts about the policies likely survival.

The reduction in firms' investments is also related to the expected change of consumers' behaviour in periods of high uncertainty (Bloom, 2014). The combined effects of firms' reduction in hiring and investment and consumer spending intensify the effect of a macroeconomic recession.

Additional literature found that uncertainty about future fiscal modifications affects inflation dynamics (Drazen & Helpman, 1990) when concerning its effects on the expectations of future regulations and policies changes.

Stein and Stone (2013) also find evidence in their research that uncertainty discourages firms' investments and hiring. Despite this, there is also an indication of a linkage between high uncertainty periods and an increase in the firms' research and developments spending.

2.2. Stock price movements

The most common was to estimate expected stock returns are dividend yields and dividend-to-price ratio (Fama & French, 1988). Kothari and Shanken (1992) also state that dividends and other expected return variables can explain nearly 90% of the stock price returns. In most of these studies, expectations of cash flows are frequently proxied by dividend yields, dividend-to-price ratio, and earning variables. These models assume that the investors have the correct belief about the individual asset returns without considering the major unexpected factors. Culter and his colleagues (1988) present evidence that the stock price movements can also be attributed to macroeconomic news and other information sources.

Managers also play a crucial role in stock price movements, questioning the valuation models' actual efficiency (Shiller et al., 1986). Evidence that some managers manipulate the dividend payments, giving more importance to their target dividend levels than to the actual dividend payout ratios (Baker et al., 2001).

The efficiency model developed by Shiller (1981) already points out that the fluctuations in stock prices are much larger than the real dividend, showing that the standard deviation of the real dividends movements is an unreliable measure of the uncertainty regarding those future dividends.

The evolution of stock prices is highly related to the implied stock market volatility (French et al., 1987). In addition to the cash-flow related models developed over the years, the researchers present a linkage between stock prices and macroeconomic aggregative events, such as business cycles or change in the structure of risk factors across the economy. Fama and French (1989) have shown empirical evidence that stock returns have a default spread related to the business risk conditions. This and other research developed over the years (Schwert, 1990) suggest that an investor that holds stocks also pays close attention to other factors in the global economy that might affect future expected returns and adjusts his investment strategies.

Bialkowski et al. (2008) find that stock prices present temporarily elevated volatility levels during periods of elections in several countries. In more specific research, Gemmill (1992) and Goodell and Vahamaa (2013) find evidence that the implied volatility of stock price indexes of Great Britain and the U.S. are related to the British outcome parliamentary election and U.S. presidential election, respectively.

Complementing the expected cash flows, economic uncertainty can also originate significant variations on the share price markets. (Bansal & colleagues, 2005). This uncertainty is reflected mostly in the consumptions volatility, which subsequently affects the valuation ratios (Boguth & Kuehn, 2013). These changes in volatility have a negative impact on stock returns (French et al.,1987).

2.3. Measuring Uncertainty

Bloom (2014) recognized the difficulty of measuring uncertainty, which is heterogeneous and depends continuously on the considered period. Nevertheless, over the years, different researchers have attempted to develop an accurate measure indicator. The most common measures are either finance, forecast, news or even report-based indexes.

The implied Volatility Index (VIX) created by the Chicago Board Options Exchange (CBOE) is an accurate proxy of uncertainty fluctuations (Bekaert, Hoerova and Duca, 2013). The index is one of the most widely used predictors of market shocks by investors. The VIX is an index based on the price of options and the expected implied return volatility of the S&P500 index (Whaley, 2009).

Other measures focus on the diversions and disagreements of researchers and forecasters responding to surveys. Bachmann et al. (2013) use the dispersion of expectations across specialists to evaluate the level of uncertainty.

Other indexes measure uncertainty based on the newspapers coverage frequency. The Economic Policy Uncertainty Index (EPU), created by Baker, Bloom and Davis (2016), uses a news bank database to reflect the media coverage of economic policy in different countries.

More recently, Ahir, Bloom and Furceri (2018) created the IMF's World Uncertainty Index. This index focuses on the count of the word *uncertainty* in geopolitical reports.

The reliability of these different measures differs across different sample periods and macroeconomic factors. Sarwar and Khan (2016) concluded that VIX could better explain the variation of stock market returns in emerging markets during the financial crisis.

2.3.1. Google Trends based index

More recent literature uses Internet search data to develop uncertainty indices. The most commonly used one is Google Trends. It is a tool developed by the leading search engine in the market. Sirotkin (2012) recognized the value of using a search query time series as an evaluation framework for different research fields. A search engine targets the average internet user that is unlikely to be an expert in more traditional information-gathering systems.

Over the years, the Google Trends has been used to create indexes in several areas, such as in the surveillance of disease outbreaks (Carmeiro & Mylonakis, 2009), election outcomes (Lui et al., 2011), the automobile industry (Carrière-Swallow & Labbé, 2013), personal well-being (Algan et al., 2016), unemployment rates and job search (Baker & Fradkin, 2017), in country-specific GDP modelling (Gotz & Knetsch, 2019), and more recently in the info-epidemiological studies of the Coronavirus epidemic (Strzelecki & Rizun, 2020).

The first use of the Google Trends search query in major economic research was done by Vosen and Schmidt (2011). They created an indicator for private consumption. Da, Engelberg and Gao (2011) introduced the use of this tool to measure the investors' interest in specific stocks ticket symbols, recognizing its predictive capabilities for stock prices.

Further research focused on the relationship between information demand and stock market volatility. Markellos and Vlastaskis (2012) conclude that search for information using the search engine Google increases during periods of high volatility. Additionally, Papadamou et al. (2020) find evidence that in specific events, such as during the recent Coronavirus outbreak, a causal linkage can be established between the Google trends metrics and stock market implied volatility.

Dzielinski (2011) created a new measure of uncertainty using the volume of interest search for the word "economy". The researcher compares his new index with alternatives measures of uncertainty in a small sample of countries. More comprehensive research included a more extensive set of keywords variables in Google Trends to quantify the impact of uncertainty. (Bontempi et al. 2019).

2.4. Research Questions and Hypothesis

The question of this thesis is: *Can a Google Trends based uncertainty index better explain the stock price movements?* The research question is answered by testing a new uncertainty index based on Google Trends as a predictor of share prices. From it, the following hypotheses can be established:

Hypothesis I: *The new created Index is aligned with other measures of volatility and uncertainty.*

This hypothesis primary goal is to verify if the created index moves in the same direction as other uncertainty proxies. It would not be reasonable to have a new uncertainty index that moves in the opposite direction of other uncertainty measures.

Hypothesis II: *The uncertainty index can graphically reflect major global and country-specific events.*

Here, the purpose is to analyze if, from the graphical representation, the index movements identify significant events that triggered the increasing fear of uncertainty. I expect to find a few spikes in the data values in the consider period length.

Hypothesis III: *The uncertainty index causes the variation in the share prices.*

I tried to understand in which direction the causality relation is moving. If it is the uncertainty index movement that causes variation in the share prices, or if it is the other way around.

Hypothesis IV: *The uncertainty index can better explain the share prices evolution during a significant crisis.*

The rationale here is that the uncertainty index is more reliable in periods of generalized distress due to the higher volume of data that can be captured from the search queries.

Hypothesis V: *The uncertainty index can help to predict share prices.*

This hypothesis goal is to test whether the newly developed index is a significant driver of share price movements that are unexplained by basic macroeconomic indicators.

3. Data Collection

This dissertation selected only countries that present evidence to be democratic societies with transparent and free-market economies. An example of the importance of this criterion can be found in the case of China. Despite being a country with a significant impact on global affairs, it is known for its Internet censorship. This situation would substantially impact on this new index development since Google services are blocked in this specific country (Lee and Liu, 2012).

Following the Chang et al. (2015) sample proposal, I decided to include the list of the 37 country members of the Convention on the Organization for Economic Cooperation and Development (OECD).[1] Furthermore, the sample is restricted to 36 countries[2] from where we have available all data that we need for the analysis. The period considered in this dissertation was between Jan-2005 and Dec-2020. More information regarding the OECD membership criteria and these countries can be found in Appendix 1 and 2, respectively.

3.1. Uncertainty Index

The basis for creating this uncertainty index based on google trends is that the individuals, when facing uncertainty in their daily lives, feel the need to gather more information to be as well prepared as possible for the near future (Da et al.,2011). In the 21st century, most of the information needed is gathered from simple searches on the Web, being Google the leading one in the market (more than 85% market share[3]). Considering this, it is reasonable to choose Google Trends as the primary source of search volumes.

Google Trends presents a Search Volume Index (SVI) that considers the total number of Google users in a given geographic area and specific period. In a particular query time series extracted from this Google service, the respective maximum SVI value is always normalized to be 100.

[1] Available at: https://www.oecd.org/

[2] Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), Chile (CHL), Colombia (COL), Czech Republic (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Hungary (HUN), Iceland (ISL), Ireland (IRL), Israel (ISR), Italy (ITA), Japan (JPN), South Korea (KOR), Latvia (LVA), Luxembourg (LUX), Mexico (MEX), Netherlands (NLD), New Zealand (NZL), Norway (NOR), Poland (POL), Portugal (PRT), Slovak Republic (SVK), Slovenia (SVN), Spain (ESP), Sweden (SWE), Switzerland (CHE), Turkey (TUR), United Kingdom (GBR) and the United States of America (USA).

[3] Available at: https://www.statista.com/statistics/216573/worldwide-market-share-of-search-engines/

Before constructing the index, I selected a list of "keywords" that involves the different sources of uncertainty in an economy. Additionally, those keywords are adjusted to the type of "expressions" that online users would use in search engines when they want to be more informed regarding a specific topic. Baker et al. (2016) created a list for the news bank based index. I decided to use the same eight categories from their newspaper research. The categories are:

- Fiscal Policy;
- Monetary Policy;
- Health Care;
- National Security;
- Regulation:
- Foreign Sovereign Debt and Crisis;
- Entitlement Programs;
- Trade Policy.

The final list includes 100 keyword expressions that individuals might use to get information from online search engines in periods of uncertainty. The list of keywords on which the uncertainty index is built is presented in Appendix 3.

I constructed the index using a Python algorithm where I did different steps to achieve a monthly uncertainty index for each of the countries.

Firstly, I translated each keyword expression to the official and most spoken language of each country. I used 19 different languages, being present in Appendix 2, being each language considered for each of the 36 countries. The translation of each keywords used a Google Translate API from the Python library "googletrans 3.0.0".

Secondly, I extracted from Google Trends the total search volume for each keyword (in the country-selected language) for every month between Jan-2005 and Dec-2020. The data was gathered using the Web Scraping Python model[4].

[4] The Model has the potential to be automatically run in a specific day of each month to build the index of upcoming months.

Thirdly, I computed the actual uncertainty index by summing all the keyword expression frequencies in a specific month for each country from the considered sample. It is essential to notice that in each country, all SVIs were scaled to the same keyword.

Then, given the presence of seasonality, which is a common characteristic of Google Trends data, I applied the X11 ARIMA seasonal adjustment method, as explained by Shiskin et al. (1967).

Next, I created three categories to aggregate the different countries. One category considered its geographic location (Asia, Europe, North America, Oceania, and South America), the other considered its economic status (advanced and emerging). In the end, it was created a third one aggregating all the countries considered in the sample. The arithmetic mean of the values for each month's index was applied in each category group. Further details regarding the composition of each category are present in the descriptive statistics section.

Finally, to better compare the index between the countries and different categories, each country's data was scaled, using its monthly average index as a benchmark for the whole period.

In most of the following empirical models, the uncertainty index is used as the independent variable to understand better its usefulness in predicting stock market prices.

3.2. Independent variables

I considered four independent variables that are used in the methodology of this dissertation. The variables are the uncertainty index, CBOE Volatility Index, the inflation rate and the interest rates.

Independent Variable I: *Uncertainty Index*

The uncertainty index was constructed and explained in the previous section.

Independent Variable II: *VIX*

This Chicago Board Options Exchange's index variable represents the market expectation volatility, and it is computed from the price inputs of the S&P 500 index. The choose of this variable was based on its international recognition of a measure of volatility. This independent

variable is the only one used in the models that are not specific to a country. Only the monthly values are extracted.

The CBOE VIX Index was extracted from Thomson Reuters.

Independent Variable III: *Inflation Rate*

The inflation rate variable is measured by the consumer price index (CPI), using a sample of prices of a set of goods and services typically purchased by a defined group of households. The variable is measured in terms of the respective country's annual growth rate.

The inflation rates were collected from the OECD database using the dataset JSON API.

Independent Variable IV: *Interest Rates*

Another variable used was the short-term interest rates (or treasury bill rates). It is a country-specific variable based on the 3-month money market rates applied between the country's financial institutions or the short-term government bonds issued. The variable is extracted as a percentage.

The short-term interest rates were collected from the OECD database using the dataset JSON API.

3.3. Dependent variables

The shares prices dependent variable is a country-specific share price index presented by the OECD Economic Outlook. The index is determined by the national and foreign stock exchanges, presenting monthly values as the simple average of the daily closing values.

The share prices were also collected from the OECD database using the dataset JSON API.

4. Descriptive Statistics

The descriptive statistics section will be split into two distinct parts. First, the proposal of several statistical indicators for both individually and across the categories created. Second, the analysis of the countries aggregated data divided by year.

Currently, there are 37 OECD member countries. For this dissertation 36 countries were used. From these, 3 (8.3%) are in Asia, 26 (72.2%) in Europe, 3 (8.3%) in North America, 2 (5.6%) in Oceania and 2 (5.6%) in South America.

Following the IMF'sclassification[5], the sample considers 30 (83.3%) countries as advanced economies and 6 (16.7%) as emerging economies. In the considered sample of OECD country members, no country is simultaneously an emerging economy and located in Asia or Oceania, neither an advanced economy and located in South America.

4.1. Countries and categorical statistical analysis

I scaled all the uncertainty index data of each country, taking into consideration their respective average.

In most of the countries, the maximum index value was reached around Mar. 2020, with a few exceptions that reach their peak between Sep. 2008 and Mars 2009. Both values represent the recent coronavirus pandemic and the Lehman Brothers bankruptcy that resulted in the global financial crisis, respectively. One specific country is South Korea that reached its maximum in Nov. 2010. This specific month corresponds to a South Korea island's bombardment by North Korea forces, representing one of the worst clash between the two countries since the end of the Korea War[6].

The minimum index value differs across the countries, and no clear conclusion can be taken. Nevertheless, the minimum value should indicate the absence of no significant event.

Regarding the standard deviation, Greece is the country with the highest average variability in its uncertainty index. This situation can be interpreted by the country's recent history of government instability and consecutive bailout programs. Besides, Greece is a European Union

[5] Available at: https://www.imf.org/en/Publications/WEO
[6] Available at: https://www.bbc.com/news/world-asia-pacific-11818005

country with high internet penetration across the population, which better captures the fluctuations of fear and uncertainty. On the opposite side, the United States is the country with the lowest standard deviation. This could be due to its considerable size that aggregated many different shocks.

Except for Estonia and Iceland, all the other countries have a positive skew. This follows what was seen in the country's graphical representation (available in Appendix 4), where most countries have a few isolated periods with high index values that generally represent a reaction to a significant "event" that occurs in that specific country or at an international level.

In all the countries, it can be observed a leptokurtic distribution, which is indicated from their positive kurtosis value. This means that all countries individual's index distribution has a higher peak and taller tails than a normal distribution.

When it comes to the Jarque-Bera test, only Iceland, South Korea, and Sweden present a normally distributed index. The remaining countries reject the null hypothesis of at least a 10% confidence level. We can conclude that for most countries, the uncertainty index data is not normally distributed.

When analyzing whether the countries index has a unit root, it was performed the Dickey-Fuller test. The results show that all countries have a stationary index. It represents one of the robustness checks that seasonality filters were successfully applied. Additionally, there is also evidence of any trend of the indexes data.

A more comprehensive and detailed analysis of the representation of each country's index with their respective annotations of significant national and international events can be seen in Appendix 4.

When aggregating the countries by their geographic location and economic status, all the maximum values are reached in Mar. 2020. Here, the minimum values also differ across the categories, not allowing to reach any inference. Nevertheless, the minimum is reached in Mar. 2007 when only considering the advanced economies and in Mar. 2019 in the emerging economies.

Regarding the index volatility, Asia is the continent with the highest standard deviation, followed by North America and South America. Also, advanced economies have a lower standard deviation than emerging economies. These observations are similar to the findings that

Ahir and his colleagues (2018) reached on their IMF's World Uncertainty Index. Additionally, it follows the intuition that emerging economies are more influenced by macroeconomic factors and instability on their monetary, fiscal e regulatory policy.

In the economic status aggregation, a higher kurtosis value is observed in advanced economies more than in emerging economies. This indicates that advanced economies have a higher number of outliers (peaks of uncertainty) than emerging economies. We can also conclude that all the groups' indexes do not follow a normal distribution, with a 1% confidence interval.

Detailed statistics regarding the countries' aggregation by geographic location and economic status can be found in Appendixes 5 and 6.

Exhibit I

Descriptive Statistics regarding Australia, Austria, Belgium, Canada, Chile, Colombia, Czech Republic, Denmark, Estonia, Finland, France, Greece, Hungary, and Ireland between Jan-2005 and Dec-2020. (** and *** indicate significance at the 5% and 1% levels, respectively.)

Countries	Uncertainty Index													
	Mean	Median	Max. Value	Max. Date	Min. Value	Min. Date	Std. Dev.	Skew.	Kurt.	JB test statistic	p-value	tau-stat	tau-crit	Stacionary
AUS	1	0.984	1.458	2020-03	0.824	2019-04	0.060	1.545	8.246	281.655	0.000***	-5.743	-2.877	yes
AUT	1	0.976	1.596	2020-03	0.770	2006-11	0.082	1.532	8.353	288.905	0.000***	-5.743	-2.877	yes
BEL	1	0.995	1.559	2020-03	0.805	2007-04	0.058	1.909	13.020	872.152	0.000***	-5.743	-2.877	yes
CAN	1	0.985	1.680	2020-03	0.790	2012-12	0.072	1.990	13.712	990.601	0.000***	-5.743	-2.877	yes
CHE	1	1.000	1.706	2020-03	0.760	2008-03	0.072	1.657	13.400	902.526	0.000***	-5.743	-2.877	yes
CHL	1	0.974	1.588	2020-03	0.847	2005-10	0.058	2.394	17.072	1677.071	0.000***	-5.743	-2.877	yes
COL	1	0.912	1.391	2020-03	0.800	2012-12	0.082	1.383	5.492	106.179	0.000***	-5.743	-2.877	yes
CZE	1	0.990	1.426	2020-03	0.785	2007-09	0.068	0.867	5.459	68.442	0.000***	-5.743	-2.877	yes
DEU	1	0.986	1.424	2020-03	0.817	2018-07	0.075	0.685	4.321	27.405	0.000***	-5.743	-2.877	yes
DNK	1	0.985	1.364	2020-03	0.802	2013-07	0.059	0.987	5.977	96.513	0.000***	-5.743	-2.877	yes
ESP	1	0.953	1.859	2020-03	0.785	2016-08	0.124	1.984	7.835	299.133	0.000***	-5.743	-2.877	yes
EST	1	1.037	1.944	2020-03	0.370	2007-07	0.173	-0.229	4.162	11.344	0.003***	-5.743	-2.877	yes
FIN	1	0.989	1.606	2020-03	0.703	2007-06	0.072	1.395	9.755	404.446	0.000***	-5.743	-2.877	yes
FRA	1	0.997	1.615	2020-03	0.796	2007-07	0.096	1.222	5.893	109.207	0.000***	-5.743	-2.877	yes
GBR	1	1.003	1.414	2020-03	0.805	2010-12	0.063	0.740	5.701	71.321	0.000***	-5.743	-2.877	yes
GRC	1	0.885	3.542	2020-03	0.273	2005-04	0.371	1.587	6.676	180.200	0.000***	-5.743	-2.877	yes
HUN	1	0.985	1.508	2008-10	0.765	2016-06	0.085	1.146	5.903	103.970	0.000***	-5.743	-2.877	yes
IRL	1	0.981	1.503	2020-03	0.797	2007-11	0.073	1.506	6.816	180.132	0.000***	-5.743	-2.877	yes

Exhibit II

Descriptive Statistics regarding Iceland, Israel, Italy, Japan, South Korea, Latvia, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Switzerland, Turkey, United Kingdom, and United States between Jan-2005 and Dec-2020. (** and *** indicate significance at the 5% and 1% levels, respectively.)

Countries	Uncertainty Index													
	Mean	Median	Max. Value	Max. Date	Min. Value	Min. Date	Std. Dev.	Skew.	Kurt.	JB test statistic	p-value	tau-stat	tau-crit	Stacionary
ISL	1	1.026	1.673	2008-11	0.220	2005-01	0.237	-0.277	2.523	4.394	0.333	-5.743	-2.877	yes
ISR	1	1.022	2.023	2020-03	0.394	2006-03	0.202	0.494	3.855	12.848	0.002***	-5.743	-2.877	yes
ITA	1	0.972	1.488	2020-03	0.829	2013-03	0.069	1.436	7.026	186.126	0.000***	-5.743	-2.877	yes
JPN	1	0.984	1.579	2020-04	0.810	2016-09	0.084	1.269	6.858	161.896	0.000***	-5.743	-2.877	yes
KOR	1	0.987	1.436	2010-11	0.642	2007-07	0.110	0.252	3.163	2.129	0.345	-5.743	-2.877	yes
LUX	1	1.009	1.639	2020-03	0.497	2006-11	0.132	0.238	3.994	8.813	0.012**	-5.743	-2.877	yes
LVA	1	0.950	1.730	2008-09	0.596	2006-09	0.145	1.070	4.635	55.581	0.000***	-5.743	-2.877	yes
MEX	1	0.942	1.447	2009-04	0.807	2016-08	0.114	1.354	3.993	64.756	0.000***	-5.743	-2.877	yes
NLD	1	0.995	1.377	2020-03	0.827	2018-02	0.062	0.731	5.382	58.730	0.000***	-5.743	-2.877	yes
NOR	1	1.023	1.739	2020-03	0.638	2007-07	0.089	0.437	8.934	270.476	0.000***	-5.743	-2.877	yes
NZL	1	0.976	1.799	2020-03	0.809	2012-11	0.072	2.692	19.323	2243.082	0.000***	-5.743	-2.877	yes
POL	1	0.976	1.288	2020-03	0.721	2019-04	0.114	0.174	2.174	6.540	0.038**	-5.743	-2.877	yes
PRT	1	0.949	1.689	2020-03	0.712	2005-09	0.108	1.520	6.713	175.637	0.000***	-5.743	-2.877	yes
SVK	1	0.933	1.647	2009-01	0.610	2018-07	0.180	0.600	2.824	11.686	0.003***	-5.743	-2.877	yes
SVN	1	0.997	1.864	2020-03	0.526	2007-12	0.167	0.511	3.995	15.273	0.000***	-5.743	-2.877	yes
SWE	1	1.005	1.386	2020-03	0.711	2006-12	0.110	-0.066	2.348	3.692	0.158	-5.743	-2.877	yes
TUR	1	0.885	1.411	2020-05	0.694	2017-08	0.109	1.039	3.886	39.549	0.000***	-5.743	-2.877	yes
USA	1	0.977	1.533	2020-03	0.898	2012-12	0.055	2.561	14.633	1228.340	0.000***	-5.743	-2.877	yes

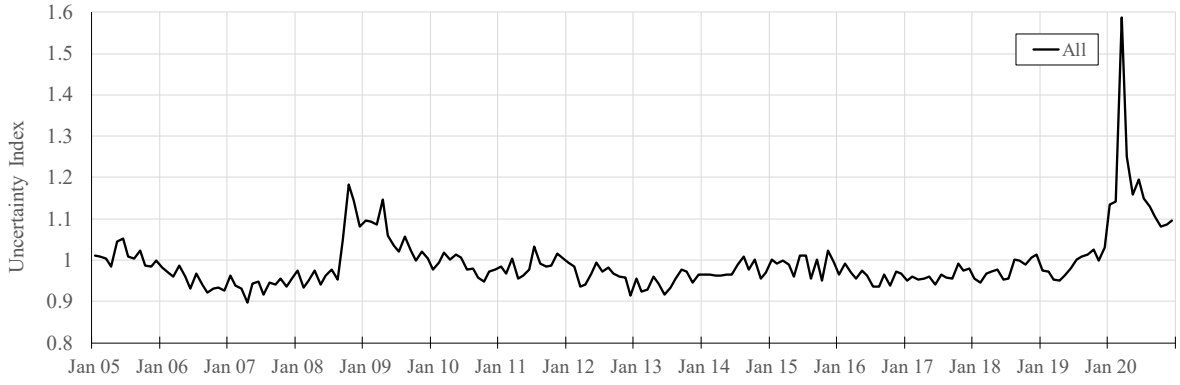
4.2. Countries aggregated analysis by year

In this last section of the descriptive statistics section, I decided to analyze all the countries indexes together[7]. Additionally, the resulting index was analyzed individually in each year considered.

In exhibit IV, it is present the graphical representation of the index considering all countries aggregated. It can observe there the two major "spikes" on the values of the index. The first one corresponds to the subprime crisis that started in September of 2008 and led to the global financial crisis; the second one represents the recent coronavirus pandemic outbreak when in March 2020, most of the countries considered in the sample announced national lockdowns.

When comparing the two global events, the 2020 medical crisis led to a significantly higher uncertainty value than the previous 2008 financial crisis. The observation can be explained by the high number of keywords categories that the pandemic affected[8].

Exhibit III
Graphical representation of the uncertainty index created with all the countries considered aggregated.



During the turbulent year of 2008, the maximum index value was reached in October. This month was known by the worldwide run for bank deposit withdraws and governments' increase of bank deposits protections.

In 2020, the maximum value occurred in March. In this month, the majority of the countries considered in the samples declared national lockdowns due to the spread of the coronavirus.

[7] Similar to the other categorical analysis, it was taken de average of the monthly index values of all countries.
[8] "Health Care" - virus and pandemic; "National Security" - borders closure, "Regulation" – jobs; "Entitlement Programs" – subsidies; and "Trade Policy").

Supporting the previous finding, the index data also clearly shows the year of 2020 and 2008 as the ones with the highest average amount of variation. Additionally, these two years also present the highest positive value of skewness.

This section validates the previously defined hypothesis that the created uncertainty index can graphically reflect major global and country-specific events.

Exhibit IV
Descriptive Statistics regarding all countries aggregate, divided by year

Year	Uncertainty Index								
	Mean	Median	Max. Value	Max. Date	Min. Value	Min. Date	Std. Dev.	Skew.	Kurt.
2005	1	1.006	1.051	2005-06	0.984	2005-11	0.016	0.889	3.230
2006	1	0.950	0.987	2006-04	0.921	2006-09	0.020	0.240	1.497
2007	1	0.942	0.963	2007-01	0.897	2007-04	0.013	-1.088	4.400
2008	1	0.974	1.183	2008-10	0.933	2008-02	0.069	1.199	5.649
2009	1	1.046	1.145	2009-04	0.999	2009-10	0.036	0.714	2.871
2010	1	0.979	1.019	2010-03	0.948	2010-10	0.018	-0.017	2.210
2011	1	0.986	1.033	2011-07	0.955	2011-04	0.017	0.432	2.933
2012	1	0.966	0.995	2012-06	0.914	2012-12	0.019	-0.646	3.001
2013	1	0.949	0.973	2013-10	0.916	2013-06	0.014	-0.305	2.339
2014	1	0.966	1.007	2014-08	0.955	2014-11	0.013	1.222	3.322
2015	1	0.997	1.022	2015-11	0.951	2015-10	0.018	-0.734	2.391
2016	1	0.965	0.991	2016-02	0.936	2016-07	0.013	-0.238	2.592
2017	1	0.959	0.991	2017-10	0.939	2017-06	0.010	0.721	3.685
2018	1	0.974	1.012	2018-12	0.945	2018-02	0.020	0.111	1.446
2019	1	0.989	1.029	2019-12	0.949	2019-04	0.024	-0.002	1.637
2020	1	1.138	1.588	2020-03	1.081	2020-10	0.084	2.776	11.419

5. Methodology

In this section, three different models are proposed to answer the research questions of this thesis. Firstly, Granger Causality models are used to interpret the causal effect between the evolution of the uncertainty index created and the share prices. Secondly, it is applied regressions for each country, analyzing the possible linkage between the share price indexes and the country-specific uncertainty index and other selected dependent variables. Lastly, several panel data regressions are done, including all the considered countries in the study and separated by the geographic location and economic status categories.

5.1. Granger causality test

The Granger causality concept[9] was introduced by Granger (1969). The test allows a researcher to determine whether one time series can be helpful to predict another. Given the empirical discussion where some researchers have presented some limitations regarding the Granger causality analysis (He & Maekawa, 2001; Grosche, 2012), this model results are not analyzed as absolute insights but rather only used as suggestive indicators.

This research uses the version of the bootstrap panel causality test introduced by Kónya (2006) and used by Chang et al. (2015). It is possible to analyze the country-specific causality effects by accounting for heterogeneity and cross-sectional dependency. Besides, it is taken into consideration that the Granger causality test is a favourable response to both large and small samples.

Pearson (2004) explains that cross-section dependency across the OECD countries must be addressed to avoid data bias distortions. This way, it is used the cross-section dependency test based on the Language Multiplier test (CD_{LM}). The test has the null hypothesis of no cross-sectional dependence for the panel data.

Furthermore, I have also tested whether the slope coefficients are homogeneous. Granger (2003) referred to the importance of conducting this test to prevent misleading analysis. Here, I use the Breusch-Pagan test with the null hypothesis of homoskedasticity.

[9] The conclusion of Granger causality in a certain model can be applied when X can better predict the evolution of Y than only using the past values of Y.

The proposed model studies the country-specific causal relationship between the Uncertainty Index and the Share Price within 36 OECD countries. Herewith, four different hypotheses are presented. Firstly, the neutral hypothesis that shows there is no Granger causality between the share prices and the uncertainty index. Secondly, the hypothesis that says there is one-way Granger causality from the share prices to the uncertainty index. Thirdly, the hypothesis that tells us there is one-way Grander causality from the uncertainty index to the share prices. Lastly, the hypothesis that says there is a two-way Granger causality between the share prices index and uncertainty index.

This model also uses the natural logarithmic transformation since it is a convenient means of transforming highly skewed variables into more normalized data.

Next, after verifying the presence of both cross-section dependency and slope heterogeneity, we can use the panel causality test as proposed by Kónya (2006). The system to be used is as follows:

$$log\ (SP)_{1t} = \alpha + \sum_{j=1}^{m} \beta_{1j} * log\ (SP)_{1t-j} + \sum_{j=1}^{n} \beta_{2j} * log\ (UI)_{1t-j} + \varepsilon_{1t}$$

$$log\ (SP)_{2t} = \alpha + \sum_{j=1}^{m} \beta_{1j} * log\ (SP)_{2t-j} + \sum_{j=1}^{n} \beta_{2j} * log\ (UI)_{2t-j} + \varepsilon_{2t}$$

$$\vdots$$

$$log\ (SP)_{Nt} = \alpha + \sum_{j=1}^{m} \beta_{1j} * log\ (SP)_{Nt-j} + \sum_{j=1}^{n} \beta_{2j} * log\ (UI)_{Nt-j} + \varepsilon_{36t}$$

and

$$log\ (UI)_{1t} = \alpha' + \sum_{j=1}^{m} \beta'_{1j} * log\ (UI)_{1t-j} + \sum_{j=1}^{n} \beta'_{2j} * log\ (SP)_{1t-j} + \varepsilon_{1t}$$

$$log\ (UI)_{2t} = \alpha' + \sum_{j=1}^{m} \beta'_{1j} * log\ (UI)_{2t-j} + \sum_{j=1}^{n} \beta'_{2j} * log\ (SP)_{2t-j} + \varepsilon_{2t}$$

$$\vdots$$

$$log\ (UI)_{Nt} = \alpha' + \sum_{j=1}^{m} \beta'_{1j} * log\ (UI)_{Nt-j} + \sum_{j=1}^{n} \beta'_{Nj} * log\ (SP)_{Nt-j} + \varepsilon_{36t}$$

where *U.I.* is the uncertainty index, *S.P.* is the stock price index, *m* and *n* denote the number of lagged variables, α and α' are the individual intercepts, β_j and β'_j are the slope coefficients, ε_{it} represent the residual terms, N represents the country and *t* the monthly period. For simplicity, it is given the system lags results from 1 to 4.

Over the last 15 years, the percentage number of numbers with any critical event has been significantly smaller when comparing the more "normal" months. Considering the full-period length of available data, the model might have different results when considering specific recognized distress periods. With this, it is essential also to run the Granger-causality model in smaller periods.

The proposed model will be replicated, taking into consideration three different periods: The first one has to do with one model considering the full length of available data (Jan-2005 to Dec-2020). This study seeks to understand the causality effect across the full length of available data. This model aims to test the previously proposed hypothesis: *The uncertainty index causes variations in share prices*.

The second is the partial period from Oct-2007 to Mar-2009. The goal is to better understand the causality effect during the global financial crisis. The monthly period that captures the crisis was selected following other researches done for the same global event. The third, the partial period of Jan-2020 to Dec-2020. The focus is the recent ongoing Coronavirus pandemic outbreak. These last two models aim to test the following hypothesis: *The uncertainty index can better explain the share prices evolution during a significant crisis*.

5.2. Multiple linear regression

This section studies how uncertainty affects each country's stock prices by computing the coefficients and testing their significance using Ordinary Least Squares (OLS) regressions. The main objective is to understand how the created index uncertainty impacts the share prices across the different countries considered.

For all the models, I used, as the dependent variable, the logarithmic scale of the share prices. The independent variables used are the country-specific logarithmic scale of the uncertainty index created, the logarithmic scale of the VIX index, the inflation rate, and the interest rate. It is important to indicate that the VIX index is the only non-country-specific variable. All the independent variables are lagged one month.

We run a set of regressions based on the following model:

$$\log (SP)_t = \alpha + \beta_1 * \log (UI)_{t-1} + \beta_2 * \log (VIX)_{t-1} + \beta_3 * (INF)_{t-1} + \beta_4 * INT_{t-1} + \varepsilon$$

Where the *S.P.* is the share price index, *U.I.* is the uncertainty index, *INF* is the country-specific inflation rate, *INT* is the country-specific interest rate and *t* the monthly period.

In this section, each country is studied in an isolated and independent form. The main objective is to understand how the country-specific uncertainty index can explain the stock price index evolution.

Additionally, we test for the existence of multicollinearity in the models. To better understand any significant correlations among the independent variables, it was constructed correlation matrixes for each country. The correlation testing used the threshold of correlations larger than 0.7 for multicollinearity.

This model aims to test the following hypothesis: *The uncertainty index can help to predict share prices.* More specifically, the model seeks to determine in which countries the uncertainty index can better explain the share prices and in which ones it fails.

5.3. Panel data regressions

In this section part, the methodology applied consists of considering all the data under analysis a panel data, with each country's observations. Following the steps explained by Peterson (2004), he took into consideration several steps to avoid biased estimates from both cross and time correlation of residuals.

Before studying the regression results, the assumption of homoskedasticity is checked with the White and Breusch-Pagan test. Both tests have the null hypothesis that the error variances across all the independent variables are equal (homoscedasticity).

Besides the assumption of non-autocorrelation is also checked with the Durbin-Watson test. This test allows verifying for autocorrelation between the residuals of the model (Tilman, 1975). The Durbin-Watson statistic will have a value between 0 and 4, signalling a positive correlation only if less than 2.

The violation of these two assumptions is a reason to exclude a pooled model in favor of a Fixed Effects/ Random Effects model (Baltagi, Jung & Song, 2010).

Finally, a Hausman-test was done for each model to assess the estimators' consistency and determine whether to use the fixed effects model or random effects (Linzer and Clark, 2014). This test of endogeneity has the null hypothesis of the preferred one being the random-effects model. The general model can be stated as follows:

$$\log (SP)_{it} = \alpha + \beta_1 * \log (UI)_{i,t-1} + \beta_2 * \log (VIX)_{i,t-1} + \beta_3 * (INF)_{i,t-1} + \beta_4 * INT_{i,t-1} + \varepsilon$$

Where the S.P. is the share price index, U.I. is the uncertainty index, INF is the country-specific inflation rate, INT is the country-specific interest rate, t the monthly period, and i is the country, geographic location or economic status (depending on the model).

The explained steps will be replicated, considering three different panel data sets. First, one regression model considering the full list of countries available (36 I.D.s). This first study seeks to understand the uncertainty index's prediction capabilities, considering the full length of available data. Second, five different panel data regressions considering the respective geographic locations of the countries. Third, two different panel data regressions, considering the countries' economic status. The two last models aim to determine which geographic location or economic status category uncertainty index can better explain the share prices.

This model also aims to test the following hypothesis: *The uncertainty index can help to predict share prices.* More precisely, the model seeks to determine how the different considered countries categories explain the share prices movements.

6. Results

6.1. Correlation matrix analysis

Following the approach of Ahir et al. (2018), I checked the correlation between the uncertainty index created and other measures of uncertainty and volatility. The first index used was the VIX volatility index, already explained in the descriptive statistics section. The second was the World Uncertainty Index, created by Ahir et al. (2018). The index was funded and supported by the IMF and is based on the EIU country reports[10]. The third and last index used was the Economic Policy Uncertainty Index presented by Baker et al. (2016). The index underlies newspaper coverage across time[11]. In short, the internet search-based index is compared with a volatility index, a report-based index and a news-based index. Overall, the created Uncertainty index is compared to a finance volatility-based index (VIX), a news-based index (EPUI), and a country report based Index (WUI).

This section aims to test the following hypothesis: *The new created Index is aligned with other measures of volatility and uncertainty.*

Exhibit IV summarises the correlation coefficients between the uncertainty index created for each country and other indexes. It is concluded that in most of the countries, the indexes present a positive correlation. However, some countries present a negative correlation with at least one of the variables. We also have the situation of Germany, Italy and the Netherlands that present a negative correlation with both the WUI and EPUI.

The WUI index presents the highest number of negative correlations with the created uncertainty index (6 countries in total). This observation can be explained by the fact that the WUI indicator is only available every quarter. The low data frequency results in a lower accuracy when analyzing the uncertainty across a particular country. In contrast, the VIX volatility index is the only reference index that always positively correlates with the uncertainty index created across the countries. Nevertheless, this correlation varies between 0.013 (in Luxembourg) and 0.611 (in Turkey).

[10] Quarterly data available at: https://worlduncertaintyindex.com/data/
[11] Monthly data available at: https://www.policyuncertainty.com/

The VIX index has the highest correlation with Japan, being the lowest with Israel. Regarding the WUI, the highest correlation was Israel's created index and the lowest with Hungary. Finally, in the EPUI, the highest correlation was with France. The lowest correlation was with the Netherlands.

Exhibit V
Correlation with other uncertainty indexes considering each country individually.

Countries	AUS	AUT	BEL	CAN	CHE	CHL	COL	CZE	DEU	DNK	ESP	EST
UI / VIX	0.506	0.407	0.249	0.33	0.194	0.394	0.595	0.477	0.225	0.274	0.219	0.039
UI / WUI	0.063	0.129	0.309	0.277	0.444	0.162	0.043	0.069	-0.022	0.264	0.153	0.425
UI / EPUI	0.230	0.068	0.125	0.177	0.380	-0.022	0.149	0.126	-0.201	0.261	0.267	0.400

Countries	FIN	FRA	GBR	GRC	HUN	IRL	ISL	ISR	ITA	JPN	KOR	LUX
UI / VIX	0.138	0.072	0.042	0.324	0.507	0.139	0.196	0.011	0.097	0.702	0.145	0.013
UI / WUI	0.339	0.578	0.446	0.523	-0.105	0.054	0.502	0.632	-0.039	0.089	0.340	0.313
UI / EPUI	0.267	0.715	0.480	0.668	0.165	0.160	0.483	0.693	-0.181	0.207	0.455	0.359

Countries	LVA	MEX	NLD	NOR	NZL	POL	PRT	SVK	SVN	SWE	TUR	USA
UI / VIX	0.452	0.316	0.372	0.245	0.445	0.477	0.479	0.359	0.284	0.041	0.611	0.514
UI / WUI	0.313	-0.041	-0.065	-0.033	0.519	0.408	0.223	0.425	0.439	0.328	0.523	0.008
UI / EPUI	0.105	0.013	-0.309	0.543	0.471	0.320	0.538	0.548	0.182	0.663	0.180	0.229

Except for Asia, all the other continents' uncertainty index has a higher correlation with the VIX volatility measure. South America is the continent with a lower correlation with the other indicators.

Within the economic status, advanced economies show a higher correlation with the other indicators. The observation follows the initial intuition that the created uncertainty index will be more efficient in countries known to have a higher and more uniform internet penetration across the population.

Aggregating all the countries, the created uncertainty index presents a higher correlation with VIX, followed by the EPUI and WUI.

The uncertainty index created is positively correlated with the other uncertainty measures across the different aggregation categories, indicating that its variation follows the other indexes in the same direction. The positive correlation small value can be explained by the different methods and sources of measuring uncertainty in the different indexes. While the EPUI and WUI are based on predefined news databases and reports written by journalists and experts, respectively, the newly created index is based on a search engine that any individual can use (qualified or not).

Exhibit VI
Correlation with other uncertainty indexes considering the countries aggregated by their geographic location and economic status.

	Continent					Economic Status		All countries
	Asia	Europe	North America	Oceania	South America	Advanced	Emerging	
UI / VIX	0.275	0.549	0.419	0.559	0.170	0.481	0.284	0.560
UI / WUI	0.324	0.454	0.139	0.303	0.111	0.492	0.251	0.173
UI / EPUI	0.758	0.502	0.118	0.202	0.082	0.582	0.050	0.484

Detailed statistics regarding the correlation between the variables used in the models can be found in Appendix 7.

6.2. Granger causality test

First, I will present and discuss the Granger-causality model results considering the full period length. Next, the model results only considering the global financial crisis period. Finally, the model considering the recent Coronavirus outbreak.

Exhibit VI presents the results of the tests. The Langrage Multiplier test presents a value that rejects the null hypothesis of no cross-sectional dependency between the created uncertainty index and the share price index. This result follows previous research that discussed the high degree of globalization and market integration across different countries. (Bruno et al., 2014) The Breusch-Pagan test presents strong evidence to reject the null hypothesis of slope homogeneity. We can conclude that the directional causal linkages between the uncertainty index and share price index may differ across these OECD countries. Both null hypotheses are rejected at 1% significance level.

Exhibit VII
Cross-sectional dependence and slope homogeneity tests, considering the full period.

Langrage Multiplier test		Breusch-Pagan-Test	
CD_{LM}	p-value	F-Stat	p-value
38.198	0.000***	561.550	0.000***

For several countries, there is no evidence of any causality linkage between the two variables.

On one hand, the null hypothesis that uncertainty index does not Granger-cause share prices is rejected in 15 countries (42% of the total sample) in at least one of the lags considered (Australia, Colombia, Denmark, Finland, South Korea, Luxembourg, Latvia, Mexico,

Netherlands, Norway, Poland, Slovak Republic, Slovenia, Sweden, and Turkey). This can suggest that a variation in the individuals' uncertainty sentiment can predict the share prices movement in these countries. When investors and general citizens are worried about the future, they tend to search for more information before making any decisions regarding their stock market investments.

On the other hand, the null hypothesis that share prices do not Granger-cause uncertainty index is rejected in 27 countries (75% of the total sample) in at least one of the considered lags (Australia, Canada, Chile, Colombia, Czech Republic, Germany, Estonia, France, United Kingdom, Greece, Hungary, Ireland, Iceland, Israel, Italy, Japan, South Korea, Luxembourg, Latvia, Mexico, Norway, New Zealand, Portugal, Slovenia, Sweden, and Turkey). This suggests that when there are share prices movements, investors tend to feel more uncertain about the near future and consequently search more online.

Additionally, there are 11 countries (30%) that present evidence of a two-way Granger-causality relation and 6 countries (17%) without any casual linkage between the two considered variables (neutral hypothesis).

The main conclusion from this model is that when considering the full period between Jan-2005 and Dec-2020, the investors tend to seek more information on the Web only after observing the stock market movements.

Exhibit VIII

Granger causality results considering the full period length.

Ho: Uncertainty index does not Granger-cause Share Prices.

(*, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.)

Lag	1		2		3		4	
Countries	**F-test**	**p-value**	**F-test**	**p-value**	**F-test**	**p-value**	**F-test**	**p-value**
AUS	11.473	0.001***	3.405	0.041**	3.386	0.019**	3.029	0.018**
AUT	2.128	0.146	0.142	0.867	0.110	0.954	0.104	0.981
BEL	1.207	0.273	0.168	0.846	1.004	0.392	1.434	0.225
CAN	0.376	0.540	0.350	0.705	0.670	0.572	0.824	0.511
CHE	1.223	0.270	1.018	0.363	1.699	0.169	1.638	0.167
CHL	0.417	0.519	0.291	0.748	0.745	0.527	0.669	0.615
COL	0.902	0.343	0.785	0.458	2.787	0.042**	2.348	0.056*
CZE	2.528	0.114	1.567	0.211	0.861	0.462	1.384	0.241
DEU	0.001	0.981	0.054	0.948	0.478	0.698	0.381	0.822
DNK	1.597	0.208	1.546	0.216	1.975	0.119	2.901	0.023**
ESP	0.090	0.764	0.269	0.764	1.584	0.195	1.487	0.208
EST	0.499	0.481	0.671	0.512	1.099	0.351	1.491	0.207
FIN	0.014	0.906	0.650	0.523	2.453	0.065*	2.624	0.036**
FRA	2.130	0.146	2.268	0.106	1.702	0.168	1.522	0.198
GBR	0.028	0.868	0.046	0.955	0.144	0.933	0.223	0.925
GRC	0.019	0.890	0.002	0.998	0.025	0.995	0.531	0.713
HUN	0.168	0.682	0.085	0.919	0.168	0.918	0.453	0.770
IRL	0.639	0.425	0.389	0.678	0.589	0.623	0.456	0.768
ISL	0.037	0.847	1.468	0.233	1.163	0.325	1.015	0.401
ISR	1.221	0.271	1.667	0.192	1.082	0.358	1.944	0.105
ITA	0.071	0.790	0.560	0.572	1.042	0.375	1.212	0.307
JPN	1.724	0.191	0.469	0.626	1.775	0.153	1.476	0.211
KOR	5.776	0.025**	3.405	0.035**	2.034	0.111	2.875	0.024**
LUX	7.752	0.005***	3.704	0.026**	3.155	0.026***	2.987	0.020**
LVA	8.393	0.004***	3.308	0.039**	2.289	0.079**	1.901	0.112
MEX	1.745	0.188	1.423	0.244	3.364	0.012**	3.357	0.011**
NLD	4.341	0.041**	1.739	0.179	1.322	0.269	0.960	0.431
NOR	0.441	0.507	0.075	0.928	2.975	0.033**	2.173	0.073*
NZL	0.019	0.891	0.918	0.401	1.628	0.185	1.846	0.122
POL	2.162	0.143	2.586	0.078*	1.966	0.121	1.538	0.193
PRT	0.008	0.927	0.965	0.383	0.803	0.493	0.657	0.623
SVK	0.666	0.415	1.200	0.304	3.880	0.010**	4.175	0.002***
SVN	7.600	0.006***	3.946	0.021**	2.899	0.036**	2.970	0.021**
SWE	0.533	0.466	0.888	0.413	1.992	0.117	2.398	0.052*
TUR	0.721	0.397	1.826	0.164	1.231	0.300	2.016	0.094*
USA	0.410	0.523	0.081	0.922	1.544	0.205	1.094	0.361

Exhibit IX

Granger causality results considering the full period length.

Ho: Share Price does not Granger-cause Uncertainty Index

(*, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.)

Lag	1		2		3		4	
Countries	**F-test**	**p-value**	**F-test**	**p-value**	**F-test**	**p-value**	**F-test**	**p-value**
AUS	3.973	0.048**	1.585	0.208	0.726	0.538	0.230	0.921
AUT	1.357	0.246	0.382	0.683	0.160	0.923	0.247	0.911
BEL	0.413	0.521	0.127	0.881	0.142	0.935	0.530	0.714
CAN	0.078	0.781	2.439	0.090*	1.068	0.364	0.905	0.462
CHE	2.502	0.115	0.729	0.484	2.017	0.113	1.394	0.238
CHL	5.125	0.025**	1.059	0.349	0.696	0.556	0.532	0.712
COL	4.483	0.036**	4.103	0.018**	3.605	0.015**	2.491	0.045**
CZE	2.832	0.094*	0.679	0.508	0.495	0.686	0.388	0.817
DEU	3.679	0.057*	0.743	0.477	0.696	0.556	0.594	0.668
DNK	4.928	0.028*	3.018	0.051*	1.749	0.159	1.243	0.294
ESP	0.099	0.753	0.092	0.912	0.080	0.971	0.177	0.950
EST	2.841	0.094*	0.623	0.537	0.745	0.527	0.502	0.735
FIN	2.227	0.137	1.132	0.325	0.976	0.405	0.854	0.493
FRA	5.872	0.016**	3.125	0.046**	1.410	0.241	1.146	0.337
GBR	8.222	0.004***	4.937	0.008***	3.658	0.013**	2.903	0.023**
GRC	0.196	0.658	3.223	0.042**	1.868	0.137	1.884	0.115
HUN	6.222	0.013**	1.241	0.291	0.727	0.537	1.014	0.401
IRL	3.227	0.074*	1.095	0.337	0.786	0.503	0.631	0.641
ISL	21.916	0.000***	8.285	0.000***	5.637	0.001***	5.950	0.000***
ISR	23.483	0.000***	4.836	0.009***	2.422	0.067*	1.723	0.147
ITA	23.022	0.000***	8.209	0.000***	5.155	0.002***	2.966	0.021**
JPN	0.028	0.868	7.619	0.000***	5.546	0.001***	4.011	0.003***
KOR	1.738	0.189	3.048	0.049**	2.341	0.001***	1.674	0.158
LUX	12.498	0.001***	5.327	0.005***	2.945	0.034**	1.951	0.104
LVA	3.576	0.060*	0.769	0.465	0.530	0.662	0.253	0.907
MEX	4.951	0.027**	0.462	0.631	0.472	0.702	0.758	0.554
NLD	2.166	0.143	0.906	0.406	0.285	0.836	0.242	0.914
NOR	6.399	0.012**	2.005	0.138	1.242	0.296	0.831	0.507
NZL	9.994	0.002***	3.261	0.041**	2.433	0.067*	1.758	0.139
POL	2.548	0.112	0.293	0.746	0.507	0.678	1.434	0.225
PRT	0.017	0.897	0.095	0.909	0.076	0.973	3.079	0.018**
SVK	0.893	0.346	0.753	0.472	0.470	0.704	0.493	0.741
SVN	6.810	0.008***	1.628	0.199	1.728	0.163	1.901	0.112
SWE	18.359	0.000***	4.701	0.010**	2.760	0.044**	2.159	0.075*
TUR	1.514	0.220	0.734	0.482	4.801	0.003***	4.352	0.002***
USA	0.373	0.542	0.233	0.792	0.411	0.746	0.238	0.917

All the previous steps are repeated, now only considering the financial crisis of 2008. The preliminary tests present similar results from the previous data sample. Both null hypotheses are rejected at 1% significance level, confirming the cross-sectional dependency between the two variables and slope heterogeneity.

Exhibit X
Cross-sectional dependence and slope homogeneity tests, considering the 2008 crisis.

Langrage Multiplier test		**Breusch-Pagan-Test**	
CD_{LM}	**p-value**	**F-Stat**	**p-value**
20.673	0.000***	353.777	0.000***

Here, the null hypothesis that the uncertainty index does not Granger-cause Share Prices is rejected in 20 countries (56% of the total sample) in at least one of the considered lags (Australia, Austria, Colombia, Czech Republic, Germany, Denmark, Spain, Estonia, France, United Kingdom, Hungary, Italy, South Korea, Luxembourg, New Zealand, Poland, Portugal, Slovak Republic, Sweden, and the United States). For more than half of the considered countries, there is evidence that, during a financial crisis, an increase in uncertainty will lead to major share prices movements.

Moreover, the null hypothesis that share prices do not Granger-cause uncertainty index is rejected in 7 countries (20% of the total sample) in at least one of the lags considered (Canada, Estonia, Finland, Greece, Mexico, Portugal and the Slovak Republic). In 3 countries, there is a causal linkage in both directions, and in 16 countries, there is no evidence of any linkage between the two considered variables.

Exhibit XI

Granger causality results considering the 2008 global financial crisis.
(*, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.)

	Ho: Uncertainty Index does not granger cause Share Price.				Ho: Share Price does not granger cause Uncertainty Index			
Lag	**1**		**2**		**1**		**2**	
Countries	**F-test**	**p-value**	**F-test**	**p-value**	**F-test**	**p-value**	**F-test**	**p-value**
AUS	7.007	0.033**	12.904	0.018**	2.012	0.199	1.630	0.304
AUT	4.008	0.085*	2.555	0.193	0.042	0.844	0.055	0.947
BEL	0.578	0.472	0.653	0.568	0.040	0.848	0.086	0.919
CAN	0.876	0.380	0.633	0.577	0.607	0.461	3.650	0.208*
CHE	0.524	0.493	1.033	0.435	0.845	0.388	0.116	0.894
CHL	0.000	0.997	1.583	0.312	0.000	0.993	1.172	0.398
COL	4.561	0.070*	21.449	0.007***	0.805	0.400	0.280	0.770
CZE	30.762	0.001***	36.077	0.003***	0.589	0.468	1.130	0.408
DEU	6.222	0.084*	0.997	0.445	0.045	0.838	0.786	0.515
DNK	4.192	0.079*	11.015	0.024**	0.380	0.557	14.402	0.191
ESP	4.921	0.049**	1.440	0.292	3.103	0.106	1.963	0.202
EST	21.234	0.002***	16.268	0.012**	2.099	0.191	5.180	0.078*
FIN	1.262	0.298	0.593	0.595	3.647	0.098*	2.647	0.185
FRA	6.117	0.039**	0.217	0.814	0.089	0.774	0.135	0.877
GBR	4.177	0.031**	2.194	0.259	0.248	0.636	0.005	0.995
GRC	0.221	0.652	0.030	0.971	0.098	0.764	9.222	0.032**
HUN	0.024	0.880	15.878	0.012**	0.674	0.439	2.169	0.230
IRL	0.287	0.609	0.137	0.876	1.116	0.326	0.670	0.561
ISL	0.005	0.946	0.088	0.917	1.474	0.264	2.250	0.221
ISR	0.016	0.902	0.286	0.766	0.401	0.547	0.874	0.484
ITA	6.258	0.038**	2.492	0.198	0.275	0.616	0.390	0.700
JPN	0.364	0.565	0.875	0.484	0.229	0.647	0.108	0.900
KOR	0.185	0.680	4.775	0.087*	0.453	0.522	0.225	0.808
LUX	0.329	0.584	11.341	0.022**	1.347	0.284	1.759	0.283
LVA	1.120	0.325	0.262	0.781	1.046	0.340	1.200	0.391
MEX	0.032	0.862	1.192	0.393	6.818	0.035**	2.331	0.213
NLD	0.483	0.510	0.822	0.502	0.722	0.424	1.044	0.432
NOR	1.962	0.204	1.663	0.298	0.052	0.826	22.315	0.154
NZL	3.294	0.092*	15.558	0.013**	0.533	0.489	3.956	0.113
POL	3.286	0.074*	1.475	0.301	0.182	0.680	0.171	0.847
PRT	4.387	0.054*	0.209	0.817	3.553	0.092*	1.918	0.227
SVK	0.743	0.417	33.287	0.003***	4.010	0.085*	0.888	0.480
SVN	1.544	0.254	0.549	0.616	1.289	0.294	1.034	0.435
SWE	5.104	0.058*	33.908	0.003***	0.805	0.399	1.268	0.375
TUR	0.611	0.460	0.376	0.709	0.569	0.475	3.650	0.125
USA	15.652	0.005***	10.049	0.028**	0.429	0.533	2.395	0.207

To conclude, the previously explained model steps are once again repeated, this time considering the year 2020. As expected, the required tests also reject the null hypotheses at 1% significance level, confirming the cross-sectional dependency and slope heterogeneity.

Exhibit XII

Cross-sectional dependence and slope homogeneity tests, considering the 2020 pandemic.

Langrage Multiplier test		**Breusch-Pagan-Test**	
CD_{LM}	**p-value**	**F-Stat**	**p-value**
27.811	0.000***	298.498	0.000***

The null hypothesis that the uncertainty index does not Granger-cause Share Prices is rejected in 23 countries (64% of the total sample) in at least one of the considered lags (Australia, Belgium, Canada, Chile, Colombia, Germany, Denmark, Spain, Finland, France, United Kingdom, Ireland, Italy, Luxembourg, Mexico, Netherlands, New Zealand, Portugal, Slovak Republic, Slovenia, Sweden, Turkey and the United States). Besides, the null hypothesis that share prices do not Granger-cause Share Prices is rejected in 6 countries (17% of the total sample) in at least one of the considered lags (Switzerland, United Kingdom, Greece, Italy, Japan, and the Netherlands). In the United Kingdom, Italy and Netherland, it is observed a two-way causality linkage between share prices and the created uncertainty index.

During a global crisis, I observe in most countries that an increase in internet search results in a significant movement of share prices. In comparison with the previous model that considered the full period length, it can be suggested that the measured uncertainty has a more broad impact across countries on share prices in periods of extreme uncertainty and fear across several sectors of the society.

The results are in line with previous studies that conclude that uncertainty measures tend to better predict stock market returns in periods of a financial crisis (Sarwar and Khan, 2017).

Exhibit XIII

Granger causality results considering the 2020 coronavirus pandemic.

(*, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.)

	Ho: Uncertainty Index does not granger cause Share Price.				Ho: Share Price does not granger cause Uncertainty Index			
Lag	**1**		**2**		**1**		**2**	
Countries	**F-test**	**p-value**	**F-test**	**p-value**	**F-test**	**p-value**	**F-test**	**p-value**
AUS	10.220	0.033**	2.393	0.416	0.493	0.521	0.775	0.626
AUT	0.012	0.916	1.358	0.380	0.034	0.860	4.227	0.134
BEL	0.381	0.564	25.618	0.038**	3.845	0.107	6.963	0.126
CAN	4.151	0.097*	0.049	0.953	3.990	0.102	9.800	0.178
CHE	2.153	0.186	0.894	0.478	10.856	0.01**	0.250	0.790
CHL	0.895	0.381	7.107	0.072*	0.731	0.425	0.607	0.601
COL	6.592	0.042**	2.177	0.261	2.436	0.170	2.746	0.210
CZE	0.176	0.696	18.474	0.162	1.645	0.269	8.879	0.231
DEU	4.043	0.084*	1.940	0.258	1.907	0.210	1.454	0.335
DNK	0.340	0.591	152.500	0.057*	2.749	0.173	4.492	0.316
ESP	6.272	0.046**	2.576	0.223	0.025	0.879	0.298	0.762
EST	2.785	0.139	0.266	0.779	2.338	0.170	3.238	0.146
FIN	6.643	0.049**	8.660	0.104	2.689	0.162	2.395	0.295
FRA	8.387	0.023**	2.764	0.391	0.509	0.515	1.299	0.527
GBR	4.292	0.096*	1.707	0.369	14.256	0.012**	3.206	0.238
GRC	0.044	0.840	1.038	0.454	7.682	0.03**	3.380	0.170
HUN	0.782	0.427	0.328	0.777	4.021	0.115	3.367	0.360
IRL	3.638	0.098*	1.131	0.408	1.709	0.232	0.668	0.562
ISL	2.121	0.219	13.272	0.191	0.519	0.511	10.765	0.211
ISR	1.645	0.269	4.240	0.325	0.060	0.819	0.210	0.839
ITA	14.184	0.009***	3.614	0.159	30.944	0.002***	0.167	0.854
JPN	0.052	0.828	0.149	0.868	10.885	0.016**	0.064	0.939
KOR	0.035	0.859	2.433	0.291	2.779	0.156	0.675	0.597
LUX	8.366	0.044**	7.190	0.255	2.220	0.210	1.584	0.490
LVA	1.357	0.261	0.897	0.432	0.370	0.551	0.539	0.596
MEX	5.684	0.075*	0.274	0.804	2.844	0.167	8.975	0.230
NLD	8.183	0.035**	105.708	0.009***	5.895	0.053*	1.727	0.367
NOR	0.590	0.472	1.538	0.347	0.238	0.643	0.218	0.816
NZL	3.056	0.035**	2.265	0.306	0.842	0.401	2.437	0.291
POL	1.702	0.233	3.809	0.119	2.888	0.133	3.267	0.144
PRT	3.554	0.092*	2.385	0.173	1.610	0.236	0.465	0.649
SVK	3.587	0.087*	5.127	0.043**	0.831	0.383	0.805	0.485
SVN	6.197	0.055*	2.429	0.292	0.170	0.697	0.417	0.706
SWE	0.813	0.418	852.211	0.024**	2.329	0.202	6.203	0.273
TUR	12.598	0.023**	1.985	0.449	1.676	0.265	11.894	0.201
USA	8.867	0.041**	1.358	0.519	0.760	0.433	7.388	0.252

6.3. Multiple linear regression

This section analyses the multiple linear regression models that were run for each country.

The multicollinearity is one problem that I've checked before running the model. In Appendix 7, I present the correlation between the considered variables for the model. In none of the countries there is a correlation higher than 0.7. This evidence suggests that none of the model results are affected by multicollinearity.

First, we analyze the results of the F-statistic test. The test null hypothesis is that all of the regression coefficients are equal to zero. In other words, this allows us to test whether the model has any predictive capabilities. From the results presented in Exhibit XIX and XV, the hypothesis is rejected with an 1% significant level in all the countries' models. This confirms that the chosen set of independent variables improves the predicting power of the model.

To analyze the statistical significance of each independent variable, the t-statistic[12] results are taken into consideration. It is considered a t-distribution to analyze whether the null hypotheses will be rejected (statistically significant) or not (not statistically significant).

The uncertainty index variable is significant in 29 countries (80% of the sample). In these, the index coefficient is negative, which follows the initial intuition that an increase in uncertainty will decrease the share prices. The coefficient interpretation is that when the uncertainty index increases by 1%, the share prices index decreases β%, ceteris paribus. The only positive significant coefficients that cannot be explained are in Ireland, Latvia, and New Zealand.

Except for a few countries, the VIX variable has a significant negative impact on the share prices, which is aligned with previous studies (Thielen, 2016). From the coefficient comparison, it is also observed that VIX's impact on the share prices is lower than the introduced uncertainty index.

The R-squared across the different countries differ between 0.148 (in Norway) and 0.769 (in Japan). The average value was 0.455, which indicates that, on average, the independent variables explain 45,5% of the movements on the share prices.

The overall finding suggests that uncertainty has a negative impact on share prices.

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[12] Ratio of the coefficient to its standard error

Exhibit XIV

Multiple linear regression results considering for the first 18 countries from the sample considered.
(*, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.)

Countries	Log(UI $_{t-1}$)	Log(VIX $_{t-1}$)	INF $_{t-1}$	INT $_{t-1}$	Const.	F-Statistic	Prob (F-stat)	R-Squared
AUS	-0.924***	-0.070***	0.007	-0.008***	2.066***	36.200	0.000***	0.426
	(0.142)	(0.026)	(0.006)	(0.003)	(0.035)			
AUT	-0.601***	-0.292***	-0.005	0.034***	2.391***	51.790	0.000***	0.517
	(0.128)	(0.034)	(0.007)	(0.004)	(0.046)			
BEL	-0.317**	-0.352***	-0.015***	0.005	2.372***	38.250	0.000***	0.440
	(0.154)	(0.032)	(0.004)	(0.004)	(0.040)			
CAN	-0.278**	-0.137***	0.004	-0.015***	2.157***	11.790	0.000***	0.204
	(0.118)	(0.029)	(0.006)	(0.004)	(0.041)			
CHE	-1.473***	0.047	-0.005	-0.018***	1.974***	17.060	0.000***	0.253
	(0.270)	(0.053)	(0.004)	(0.004)	(0.068)			
CHL	-1.524***	0.210***	-0.010*	-0.030***	1.901***	85.520	0.000***	0.640
	(0.150)	(0.039)	(0.006)	(0.005)	(0.057)			
COL	-0.472***	-0.193***	-0.009**	0.062***	2.210***	63.020	0.000***	0.566
	(0.128)	(0.030)	(0.004)	(0.005)	(0.037)			
CZE	0.365	-0.147***	-0.074***	-0.041***	2.181***	66.550	0.000***	0.580
	(0.281)	(0.056)	(0.012)	(0.007)	(0.069)			
DEU	-0.125*	-0.154***	0.010***	-0.057***	2.206***	81.640	0.000***	0.629
	(0.074)	(0.051)	(0.003)	(0.005)	(0.063)			
DNK	0.224	-0.222***	-0.020***	0.017***	2.256***	13.180	0.000***	0.224
	(0.162)	(0.038)	(0.006)	(0.005)	(0.047)			
ESP	-0.956***	-0.290***	-0.008	0.016***	2.306***	39.030	0.000***	0.445
	(0.124)	(0.029)	(0.007)	(0.004)	(0.037)			
EST	-0.759***	-0.195***	0.007	-0.022***	2.158***	35.190	0.000***	0.419
	(0.169)	(0.037)	(0.010)	(0.005)	(0.050)			
FIN	-0.035	-0.249***	0.017**	0.153***	2.373***	163.200	0.000***	0.697
	(0.056)	(0.067)	(0.007)	(0.009)	(0.084)			
FRA	-0.957***	-0.033	0.023***	-0.022***	2.098***	37.830	0.000***	0.481
	(0.208)	(0.052)	(0.004)	(0.003)	(0.066)			
GBR	-0.429***	-0.243*	-0.069***	0.084***	2.061***	75.310	0.000***	0.610
	(0.123)	(0.126)	(0.008)	(0.007)	(0.155)			
GRC	-0.660***	-0.487***	0.020***	-0.011	2.514***	29.380	0.000***	0.411
	(0.251)	(0.067)	(0.006)	(0.009)	(0.084)			
HUN	-0.171***	-0.107***	-0.006*	-0.020***	2.071***	58.700	0.000***	0.548
	(0.055)	(0.026)	(0.003)	(0.003)	(0.033)			
IRL	0.644***	-0.305***	-0.048***	0.054***	2.385***	105.300	0.000***	0.687
	(0.146)	(0.027)	(0.005)	(0.004)	(0.034)			

Exhibit XV

Multiple linear regression results considering for the last 18 countries from the sample considered.
(*, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.)

Countries	Log(UI $_{t-1}$)	Log(VIX $_{t-1}$)	INF $_{t-1}$	INT $_{t-1}$	Const.	F-Statistic	Prob (F-stat)	R-Squared
ISL	0.367	-0.312***	0.027***	-0.123***	2.327***	22.750	0.000***	0.314
	(0.238)	(0.063)	(0.007)	(0.032)	(0.078)			
ISR	-0.225**	-0.024	-0.008	-0.044***	2.124***	31.660	0.000***	0.392
	(0.103)	(0.035)	(0.006)	(0.006)	(0.044)			
ITA	-0.246	-0.164**	0.012***	-0.023***	2.282***	22.960	0.000***	0.316
	(0.167)	(0.076)	(0.003)	(0.004)	(0.095)			
JPN	-0.351***	-0.226***	0.001	0.069***	2.247***	131.000	0.000***	0.769
	(0.074)	(0.034)	(0.006)	(0.004)	(0.045)			
KOR	-1.614***	0.009	0.003	-0.017***	1.964***	77.680	0.000***	0.617
	(0.141)	(0.043)	(0.007)	(0.005)	(0.066)			
LUX	-1.257***	-0.172***	-0.023***	0.007*	2.194***	32.580	0.000***	0.399
	(0.181)	(0.034)	(0.007)	(0.004)	(0.043)			
LVA	1.296***	-0.405***	0.010	-0.018***	2.540***	30.910	0.000***	0.386
	(0.195)	(0.049)	(0.009)	(0.004)	(0.065)			
MEX	-0.366*	-0.199***	0.010	-0.044***	2.264***	22.320	0.000***	0.310
	(0.093)	(0.065)	(0.010)	(0.008)	(0.079)			
NLD	-0.211*	-0.180***	0.010**	-0.034***	2.266***	47.470	0.000***	0.495
	(0.121)	(0.039)	(0.004)	(0.005)	(0.053)			
NOR	-0.022	-0.121***	-0.016***	0.021***	2.190***	9.240	0.000***	0.148
	(0.105)	(0.038)	(0.005)	(0.004)	(0.049)			
NZL	0.607***	0.039	-0.003	0.066***	1.930***	28.710	0.000***	0.368
	(0.115)	(0.047)	(0.006)	(0.008)	(0.062)			
POL	-0.339**	0.110	0.015	0.034***	1.861***	19.280	0.000***	0.278
	(0.152)	(0.075)	(0.010)	(0.010)	(0.093)			
PRT	-0.146**	-0.240***	-0.021***	0.057***	2.248***	90.210	0.000***	0.653
	(0.060)	(0.025)	(0.003)	(0.004)	(0.033)			
SVK	0.439**	-0.191***	0.029***	-0.059***	2.148***	58.260	0.000***	0.547
	(0.176)	(0.041)	(0.006)	(0.008)	(0.052)			
SVN	-0.013***	-0.190***	0.001	-0.021***	2.187***	13.690	0.000***	0.211
	(0.047)	(0.035)	(0.007)	(0.007)	(0.044)			
SWE	-0.221	-0.174***	0.015***	-0.063***	2.074***	97.460	0.000***	0.670
	(0.185)	(0.065)	(0.002)	(0.004)	(0.098)			
TUR	-0.184*	-0.215***	-0.008**	-0.009***	2.271***	46.480	0.000***	0.489
	(0.101)	(0.020)	(0.004)	(0.002)	(0.026)			
USA	-0.617**	-0.237***	-0.010	-0.005	2.267***	15.540	0.000***	0.234
	(0.240)	(0.047)	(0.006)	(0.004)	(0.062)			

6.4. Panel data regressions

In this section I present and discuss the results for the panel data regression model. First, I'll check the different model assumptions by using different tests. Next, I'll consider the five models for each geographic location of the sample that are discussed . Then, I'll present the results for the two models considering the economic status. Finally, I'll show the aggregated results for the model that compiles the 36 countries from the considered sample.

The results from the White-test and Breusch-Pagan-test allows us to reject the null hypothesis of homoscedasticity. This confirms the presence of heteroscedasticity in all the panel data models. Across them, the null hypothesis is rejected with a 1% confidence level, except for the one that includes all the countries located in South America, which is rejected with a 5% confidence level.

The Durbin-Watson-test presents an output between 0 and 2 in all the panel data models. This signifies strong evidence of a confirmed positive autocorrelation between the residuals in each of the models.

Exhibit XVI

White-Test, Breusch-Pagan-Test and Durbin-Watson-test results, considering the country's geographic location. (*, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.)

Continent	White-Test		Breusch-Pagan-Test		Durbin-Watson-Test	
	F-Stat	p-value	F-Stat	p-value	Result	Conclusion
Asia	34.103	0.000***	28.981	0.000***	0.158	Positive
Europe	75.939	0.000***	58.403	0.000***	0.095	Positive
North America	237.038	0.000***	246.298	0.000***	0.231	Positive
Oceania	16.593	0.000***	32.982	0.000***	0.165	Positive
South America	4.015	0.018**	7.637	0.005**	0.303	Positive

Exhibit XVII

White-Test, Beusch-Pagan-Test and Durbin-Watson-test results, considering the country's economic status. (*, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.)

Economic Status	White-Test		Breusch-Pagan-Test		Durbin-Watson-Test	
	F-Stat	p-value	F-Stat	p-value	Result	Conclusion
Advanced	130.849	0.000***	100.042	0.000***	0.093	Positive
Emerging	8.794	0.000***	14.140	0.000***	0.262	Positive

Exhibit XVIII

White-Test, Beusch-Pagan-Test and Durbin-Watson-test results, considering all countries aggregated. (*, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.)

	White-Test		Breusch-Pagan-Test		Durbin-Watson-Test	
	F-Stat	p-value	F-Stat	p-value	Result	Conclusion
All Countries	132.206	0.000***	76.327	0.000***	0.091	Positive

The violation of these two assumptions allows us to exclude a pooled model in favour of a Fixed Effects/ Random Effects model.

Next, the Hausman-test permits us to reject the null hypothesis for the models of Asia, North America, South America and All Countries. In these models, the fixed effects are preferred over the random-effects model. Appendix 8 summarises the test results.

The selected model results are presented in exhibit XIX. In all models, the created uncertainty index lagged value is significant, with a 99% confidence interval. Once again, and except for Oceania, the result follows the initial intuition that an increase in uncertainty will decrease the share prices. The coefficient interpretation is that when the uncertainty index increases by 1%, the share prices index decreases β%, ceteris paribus. At Oceania, we can deduce from the fact that it only has two considered countries that the positive coefficient arises from the respective coefficient positive value of New Zealand, observed in the previous linear regression section.

As for emerging countries, the uncertainty index tends to have a more significant impact on share prices here than in advanced countries. The non-significant result on VIX in the model can explain part of the finding. The low correlation between the created index and VIX in emerging countries already discussed in a previous section is also recalled. In fact, the lagged value of VIX is significant, with a 99% confidence in all models, except when only considering the emerging countries.

The inflation rate, has a significant impact with a 99% confidence on share prices in Europe, South America, Advanced, Emerging Economies, and when all countries considered. In the remaining categories, despite having positive coefficients, it is not significant in at least a 90% confidence interval. These results are in line with previous research (Gultekin, 1983).

Moreover, interest rates present are significantly negatively combined with share prices. The only exception is in Europe with a non-significant also negative coefficient. Giovannini and Jorion (1987) already reached similar findings in their research

The R-squared across the different geographic locations differs between 0.096 (in Europe) and 0.423 (n South America). The model seems to better explain the share prices movements in emerging economies than in advanced economies. Considering all the countries, the selected independent variables explain 9% of the share prices movements.

Exhibit XIX

Panel data regression results, considering the country's geographic location, economic status and all countries aggregated.
(*, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.)

	Continent					Economic Status		All Countries
	Asia	**Europe**	**North America**	**Oceania**	**South America**	**Advanced**	**Emerging**	
Log(UI t-1)	-0.024***	-0.204***	-1.121***	0.581***	-1.461***	-0.092***	-0.966***	-0.204***
	(0.061)	(0.028)	(0.090)	(0.131)	(0.144)	(0.026)	(0.072)	(0.024)
Log(VIX t-1)	-0.183***	-0.241***	-0.102***	-0.274***	0.123***	-0.241***	0.004	-0.205***
	(0.022)	(0.013)	(0.024)	(0.030)	(0.034)	(0.011)	(0.021)	(0.010)
INF t-1	0.005	0.009***	0.003	0.005	-0.009***	0.005***	0.013***	0.008***
	(0.003)	(0.001)	(0.004)	(0.004)	(0.003)	(0.001)	(0.002)	(0.001)
INT t-1	-0.040***	-0.001	-0.017***	-0.018***	-0.022***	-0.003**	-0.030***	-0.008***
	(0.004)	(0.001)	(0.003)	(0.002)	(0.003)	(0.001)	(0.002)	(0.001)
Const.	2.206***	2.270***	2.106***	2.375***	1.934***	2.268***	1.998***	2.229***
	(0.028)	(0.021)	(0.034)	(0.040)	(0.046)	(0.017)	(0.054)	(0.013)
Observations	576	4992	576	384	384	5760	1152	6912
Nº of IDs	3	26	3	2	2	30	6	36
R-Squared	0.309	0.096	0.389	0.281	0.423	0.086	0.439	0.090

7. Discussion

Although the solid reasoning that underlies the several steps of the creation of the new index and analysis performed, some challenges cannot be ignored when using this dissertation proposed measure of index and respective findings.

A primary source of drawbacks arises from obtaining the uncertainty index measure from monthly data. The main reasons that underlie the decision of using monthly data were computer power constraints and limited accessibility when getting a significant amount of data from Google services[13]. The analysis on this dissertation is based on the impact of uncertainty in share markets. Taking into consideration that these markets are open usually in all business days and that the uncertainty sentiment can drastically change within two days, it is recognized that this data constrain might have an impact on the results. A possible solution for future research is to disperse the data extraction into different servers.

Also, the translation of the chosen search key expressions is based on Google Translate. Despite an increase improvement of the translator accuracy over the last years, there are still a few constraints in some situations (Argondizzo, 2019)[14]. The problem arises when it is used a small number of combined words for a specific keywords' expression[15]. In addition, it was not taken into consideration the small language deviations among the countries that have the same official language. Future research could improve the accuracy of the index by using the help of each country's natives or professional translation experts for the different languages.

Another obstacle relates to the representativeness of the selected countries sample. The main reason to choose the list of OECD country members was to limit the number of countries without free access to internet and information on the analyzed sample. Despite this, the sample is unbalanced regarding the countries' economic status and geographic location that could have an impact on the obtained results.

[13] To avoid abusive data extraction, Google services such as the Google Trends have a quota limit on data requests. One solution limited solution that was used for this thesis was the creation of multiple Google IDs.
[14] Available at: https://www.argotrans.com/blog/accurate-google-translate-2019/
[15] E.g.: Idiomatic expressions.

8. Conclusion

In the increasingly connected world, the impact of uncertainty across society's different sectors cannot be ignored. The individual's irrational behaviour under uncertainty periods tends to overreact and go beyond what is rational. This rapid spread of uncertainty can have a significant impact on the individuals' life, to weaken financial performances in firms, and consequently, lead to a broader economic decline.

Past literature has already recognized the increasing impact of uncertainty on globalized financial institutions, which traditional valuation models fail to capture. Some researchers already proposed different proxy measures of uncertainty based on financial, news or reports data sources. More recently, Internet search data such as Google Trends have been introduced as an alternative proxy of uncertainty. Nevertheless, most of them were limited in either the keyword expressions list used in the search query or the sample of countries analyzed.

I develop a new uncertainty index based on Google Trends search data. I computed for 36 OECD countries by focusing in 100 keywords expressions, translated to the most spoken language in each country.

The constructed index reflected major country-specific and global events that increased the values of uncertainty substantially. Graphically, the Global financial crisis of 2008 and the recent Coronavirus outbreak can be observed in most countries. Some countries present few isolated spikes in uncertainty considered in at least one of the keyword expressions pre-select categories. When considering the economic status, the emerging countries present a higher standard deviation and lower positive kurtosis deviation than advanced economies. It proves that advanced economies have lower uncertainty volatility but a higher number of outliers when comparing to emerging economies. In other words, advanced countries have shown to have a more stable uncertainty fluctuation across time, but higher "jumps" in specific "events".

Regarding the alignment with other measures of uncertainty, I found that, in general, the created index moves in the same direction as alternative indexes of uncertainty. The more significant exceptions are Germany, Italy and the Netherlands that negatively correlate with two of the alternative indexes. The newly created index is aligned with other measures of volatility and uncertainty. VIX is the only reference index that positively correlates with the index created across all countries. Additionally, all the considered continents' uncertainty index, except for Asia, has the highest correlation with the VIX volatility measure. South America is the

continent with a lower correlation with the other indicators. Advanced economies also show a higher correlation with the other indicators than emerging economies. This finding demonstrates that the created uncertainty index is more accurate and aligned with alternative indexes in countries known to have a higher and more uniform internet penetration across the population.

Moreover, the causal relationship between the created uncertainty index and the share prices differs across different periods. When considering the full period length (which is dominated by uneventful intervals), there is evidence in 75% of the countries that share prices cause variation in the uncertainty index. In contrast, when considering the global financial crisis of 2008 and the global pandemic of 2020, 56% and 64% of the countries, respectively, present evidence that the created index causes variation in the share prices. The results follow previous research findings that a measure of uncertainty is a better predictor of share prices in periods of recognized distress.

I also find that in 80% of the considered countries sample, the lagged value of the created uncertainty index has a significant impact on the share prices. With the exception of Ireland, Latvia and New Zealand, an increase in the measured uncertainty predicts a decline in the share price value.

In the considered categories, the lagged value of the uncertainty index is found to have a significant negative impact on future share price movements, excluding the countries located in Oceania. I also find that the measured uncertainty has an increased effect on the share prices of emerging countries. This observation can be explained by the high volatility of uncertainty observed in these countries. Another explanation can be the lower internet penetration among the general population. There are a higher percentage of skilled and educated investors in these countries seeking to get more information online.

This research can be useful for future studies. First, it could be used as a starting point to introduce future improved measures of uncertainty. Second, provides an easier comparative analysis of the different impacts of uncertainty across countries that could be implemented. And third, it is based on a data source that captures the uncertainty sentiment of all the population of a specific country..

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10. Appendixes

Appendix 1. OECD Membership and the Values of the Organization with the main Characteristics and respective evidence criteria.[16]

Characteristic	As Evidenced By
Rules-based open market economy	a) Evidence of progress towards adherence to the Declaration on International Investment and Multinational Enterprises; b) Completed Investment Policy Review which demonstrates progressregarding the Policy Framework for Investment; c) Evidence of progress towards accession to the Convention on Combating Bribery of Foreign Public Officials in International Business Transactions; d) Adherence to the OECD Corporate Governance Principles.
Tax transparency and international cooperation	a) Membership of the Global Forum on Exchange of Information and Transparency for Tax Purposes; b) Membership of the Inclusive Framework on BEPS.
Stable and transparent financial system	a) Evidence of progress towards adherence to the Code of Liberalisation of Capital Movements and to the Code of Liberalisation of Current Invisible Operations.
Access to information	a) Adherence to the Recommendation on Good Statistical Practice; b) Adherence to the Recommendation on Principles for Internet Policy Making.
Ability to sustain the accession process and membership obligations	a) Agreement to provide adequate resources and coordination for the accession process.
Active participation and engagement in OECD substantive committees	a) Participant or Associate/Member status in OECD committees (with particular focus on committees whose instruments support the evidence of the state of readiness): including the track record and level of participation.
Comparability of data and evidence-based analysis and policy development	a) Completion of at least one peer review; b) Provision of the necessary country data required by at least one OECD flagship publication.
Regional or global role in the world economy	a) Constructive membership in other international and regional organisations/institutions, consistent with the aims and undertakings of the OECD; b) Recognised ability to contribute to and support the Organisation's involvement in Global or Regional Governance.

[16] Available at: https://www.oecd.org/about/document/enlargement.htm

Appendix 2. List of countries, Alpha-2-code, Alpha-3-code, most spoken official language, ISO-639 country code, continent and economic status

Countries	Country Alpha-2-code	Country Alpha-3-code	Most Spoken Official Language	ISO-639 Language Code	Continent	Economic Status
Australia	AU	AUS	English	en	Oceania	Advanced
Austria	AT	AUT	German	de	Europe	Advanced
Belgium	BE	BEL	Dutch	nl	Europe	Advanced
Canada	CA	CAN	English	en	North America	Advanced
Chile	CL	CHL	Spanish	es	South America	Emerging
Colombia	CO	COL	Spanish	es	South America	Emerging
Czech Republic	CZ	CZE	Czech	cs	Europe	Advanced
Denmark	DK	DNK	Danish	da	Europe	Advanced
Estonia	EE	EST	Estonian	et	Europe	Advanced
Finland	FI	FIN	Finish	fi	Europe	Advanced
France	FR	FRA	French	fr	Europe	Advanced
Germany	DE	DEU	German	de	Europe	Advanced
Greece	GR	GRC	Greek	el	Europe	Advanced
Hungary	HU	HUN	Hungarian	hu	Europe	Emerging
Iceland	IS	ISL	Icelandic	is	Europe	Advanced
Ireland	IE	IRL	English	en	Europe	Advanced
Israel	IL	ISR	Hebrew	iw	Asia	Advanced
Italy	IT	ITA	Italian	it	Europe	Advanced
Japan	JP	JPN	Japanese	ja	Asia	Advanced
South Korea	KR	KOR	Korean	ko	Asia	Advanced
Latvia	LV	LVA	Latvian	lv	Europe	Advanced
Luxembourg	LU	LUX	French	fr	Europe	Advanced
Mexico	MX	MEX	Spanish	es	North America	Emerging
Netherlands	NL	NLD	Dutch	nl	Europe	Advanced
New Zealand	NZ	NZL	English	en	Oceania	Advanced
Norway	NO	NOR	Norwegian	no	Europe	Advanced
Poland	PL	POL	Polish	pl	Europe	Emerging
Portugal	PT	PRT	Portuguese	pt	Europe	Advanced
Slovak Republic	SK	SVK	Slovak	sk	Europe	Advanced
Slovenia	SI	SVN	Slovenian	sl	Europe	Advanced
Spain	ES	ESP	Spanish	es	Europe	Advanced
Sweden	SE	SWE	Swedish	sv	Europe	Advanced
Switzerland	CH	CHE	French	fr	Europe	Advanced
Turkey	TR	TUR	Turkish	tr	Europe	Emerging
United Kingdom	GB	GBR	English	en	Europe	Advanced
United States	US	USA	English	en	North America	Advanced

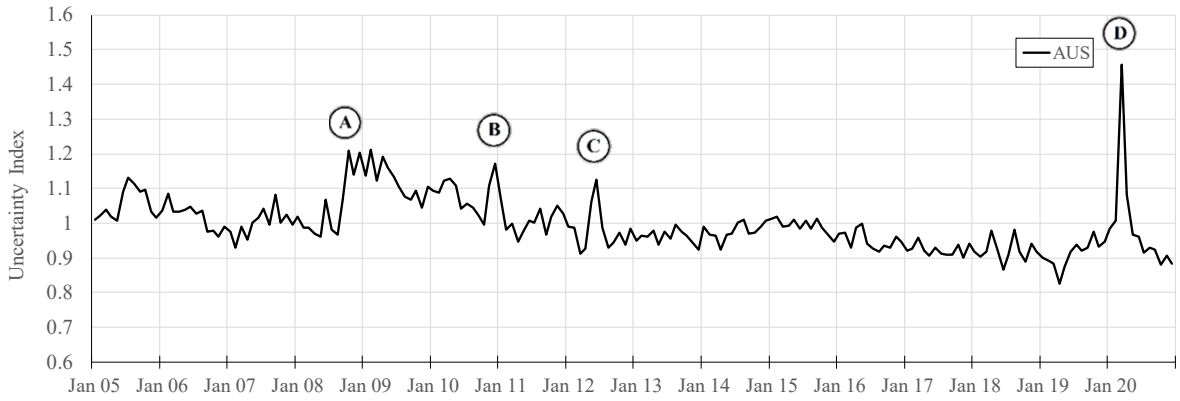
Appendix 3. List of Keywords used for the construction of the Index (English – en)

Category	Keyword
Fiscal Policy	taxes rates
	taxation
	taxed
	government spending
	fiscal stimulus
	budget deficit
	government debt
	national debt
	debt ceiling
	fiscal stimulus
Monetary Policy	money supply
	monetary policy
	federal reserve
	central bank
	lending rates
	interest rates
	lender of last resort
	European Central Bank
Health Care	health care reform
	health insurance
	Virus
	Bacterias
	World Health Oganization
	CDC
	Public Health
	affordable care
	pandemic
National Security	national security strategy
	war
	military
	conflict
	terrorism
	war on terror
	defence spending
	military spending
	police
	military base
	borders closure
	naval blockade
	no-fly zone
	military invasion
Regulation	federal regulation
	banking supervision
	financial reform
	capital requirement
	deposit insurance
	jobs
	union rights
	minimum wage
	living wage

Category	Keyword
Regulation	closed shop
	wages and hours
	workers compensation law
	antitrust
	competition policy
	monopoly power
	patent law firms
	unfair business practice
	competition law
	class action law
	punitive damages
	energy policy
	energy tax
	carbon tax
	travel restriction
	immigration policy
Foreign Sovereign Debt and Crisis	sovereign debt
	currency crisis
	currency devaluation
	currency revaluation
	currency manipulation
	euro crisis
	Eurozone crisis
	European debt
	Asian financial crisis
	Asian crisis
	Russian financial crisis
	Russian crisis
	exchange rate policy
Entitlement Programs	entitlement program
	entitlement spending
	government entitlements
	social security
	crisis
	government welfare
	welfare reform
	subsidies
	unemployment insurance
	food stamps
	social housing
Trade Policy	import tariffs
	import duty
	government subsidies
	government subsidy
	balance of trade
	world trade organization
	trade treaty
	trade agreement
	trade policy
	trade act

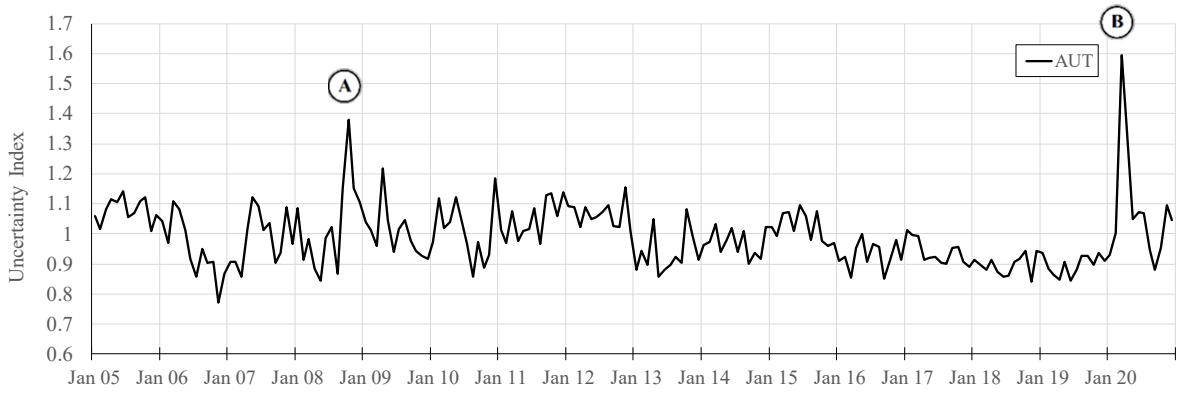
Appendix 4. Uncertainty Index

I. Australia



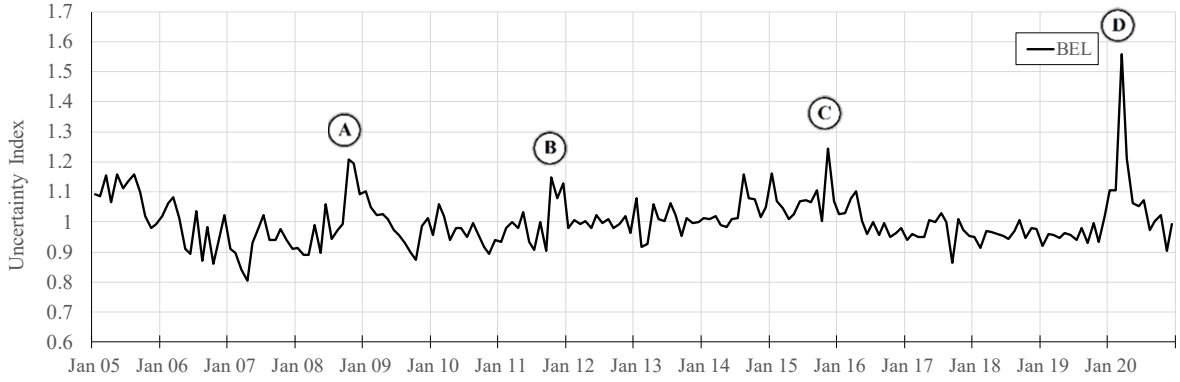
	Date	Key events
A	Oct-08	Global financial crisis.
B	Dec-10	Queensland floods, 200.000 citizens were affected, $30 billion GDP Loss.
C	Jul-12	Introduction of an highly controversial carbon tax.
D	Mar-20	COVID-19 pandemic lockdown.

II. Austria



	Date	Key events
A	Oct-08	Global financial crisis.
B	Mar-20	COVID-19 pandemic lockdown.

III. Belgium

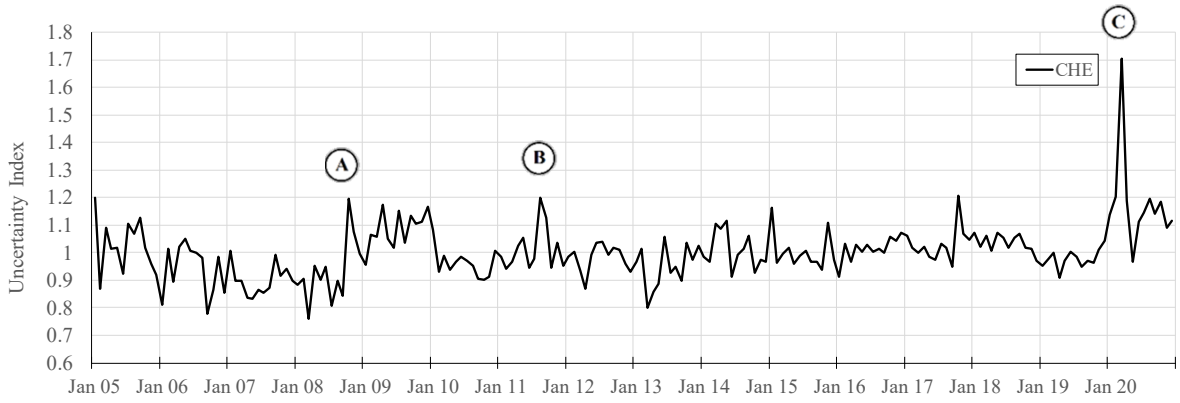


	Date	Key events
A	Oct-08	Global financial crisis.
B	Oct-11	Agreement for institutional reform, after 541 days without an elected government.
C	Nov-15	Brussels lockdown due to potential terrorism attacks.
D	Mar-20	COVID-19 pandemic lockdown

IV. Canada

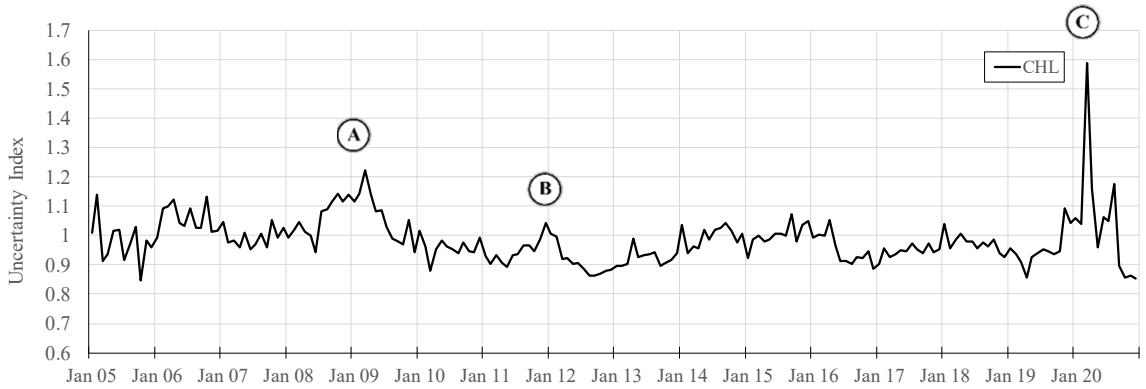
	Date	Key events
A	Oct-08	Global financial crisis.
B	Mar-20	COVID-19 pandemic lockdown.

V. Switzerland



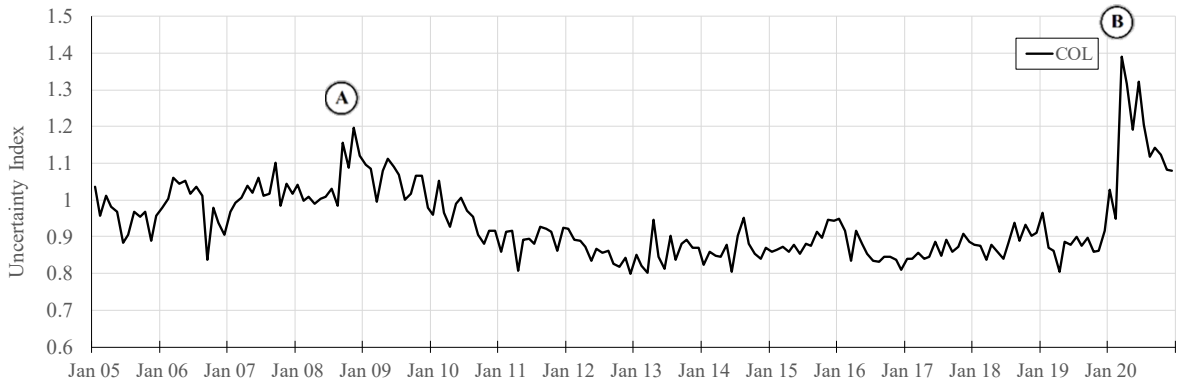
	Date	Key events
A	Oct-08	Global financial crisis.
B	Aug-11	Swiss National Bank announces new dratic measures to reduce the value of the franc.
C	Mar-20	COVID-19 pandemic lockdown.

VI. Chile



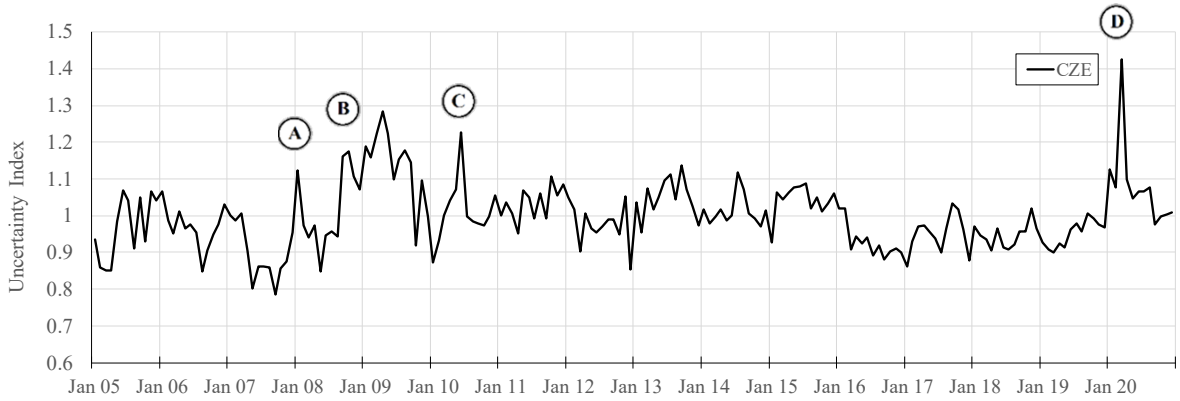
	Date	Key events
A	Oct-08	Global financial crisis.
B	Dec-11	Chile massive forest fires across the country.
C	Mar-20	COVID-19 pandemic lockdown.

VII. Colombia



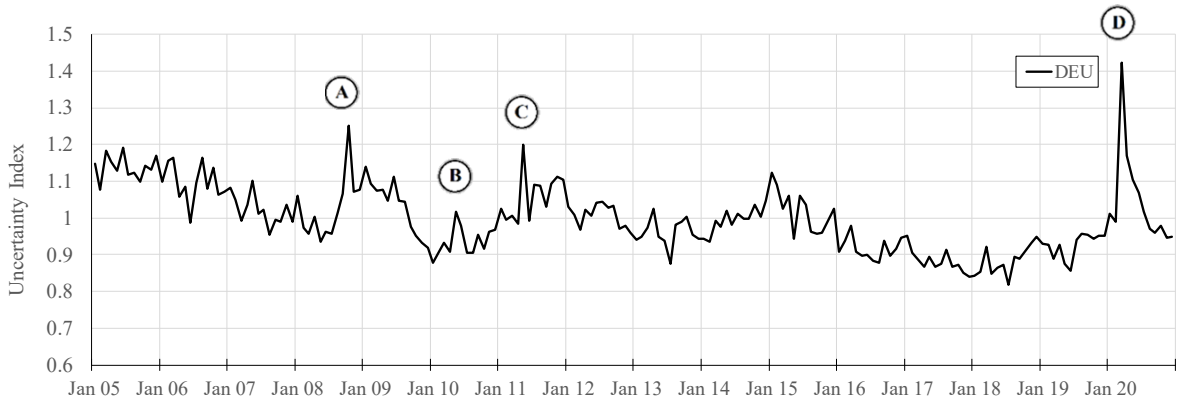
	Date	Key events
A	Oct-08	Global financial crisis.
B	Mar-20	COVID-19 pandemic lockdown.

VIII. Czech Republic



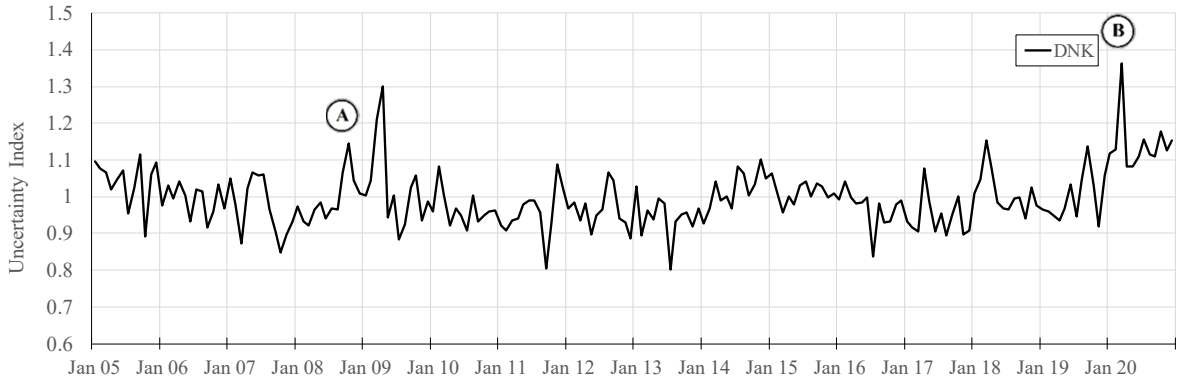
	Date	Key events
A	Jan-08	Czech presidential election.
B	Oct-08	Global financial crisis.
C	Jun-10	Czech legislative election.
D	Mar-20	COVID-19 pandemic lockdown.

IX. Deutschland



	Date	Key events
A	Oct-08	Global financial crisis.
B	May-10	Resignation of Horst Köhler as president of Germany.
C	Jun-11	E. coli O104:H4 outbreak.
D	Mar-20	COVID-19 pandemic lockdown.

X. Denmark

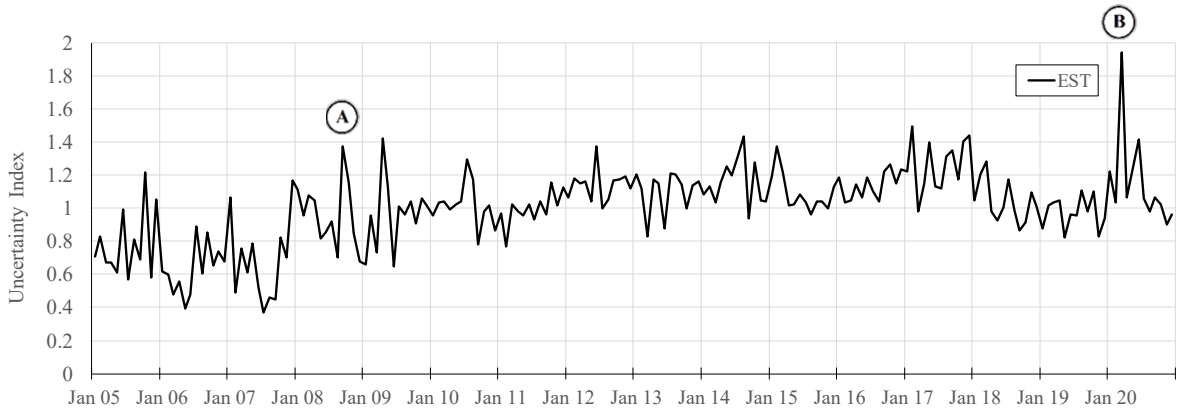


	Date	Key events
A	Oct-08	Global financial crisis.
B	Mar-20	COVID-19 pandemic lockdown.

XI. Spain

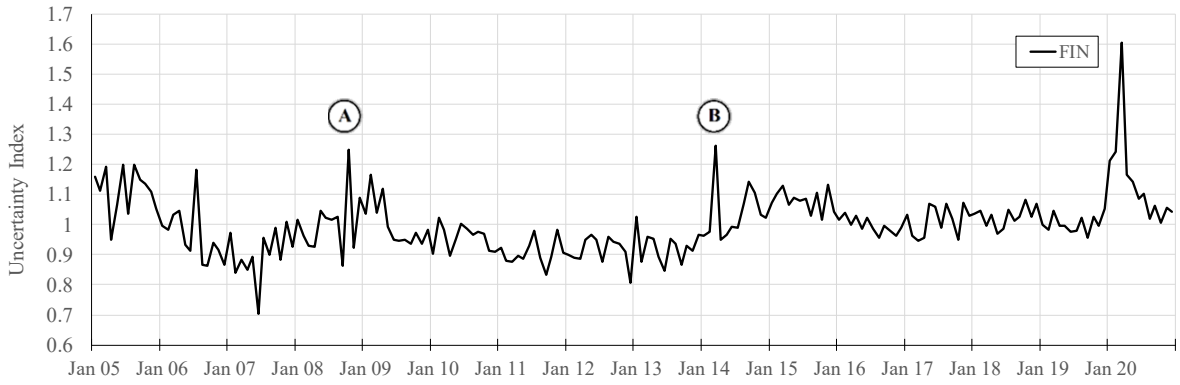
	Date	Key events
A	Oct-08	Global financial crisis.
B	Nov-15	Catalonia Independence crisis.
C	Aug-17	Barcelona terrorist attacks.
D	Mar-20	COVID-19 pandemic lockdown.

XII. Estonia



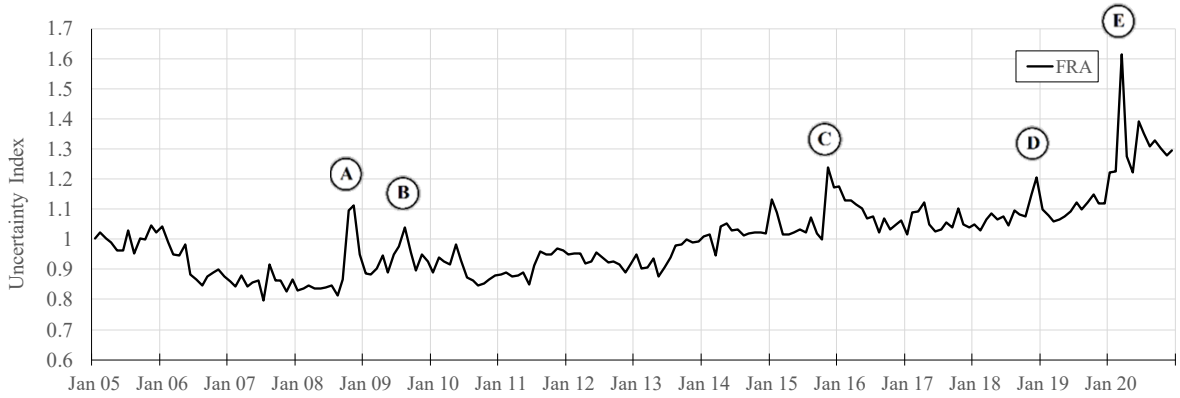
	Date	Key events
A	Oct-08	Global financial crisis.
B	Mar-20	COVID-19 pandemic lockdown.

XIII. Finland



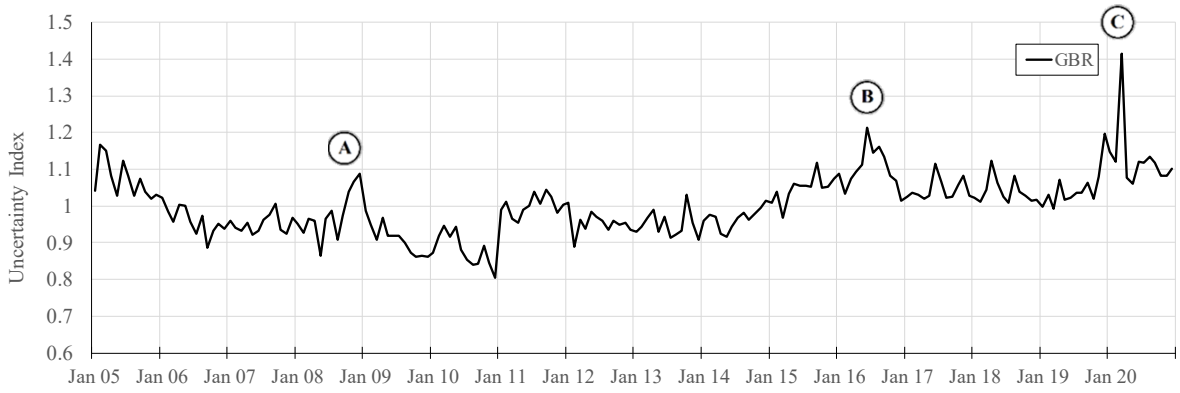
	Date	Key events
A	Oct-08	Global financial crisis.
B	Mar-14	Debate over apllication for NATO membership; Repercussions for Russia's relations.
C	Mar-20	COVID-19 pandemic lockdown.

XIV. France



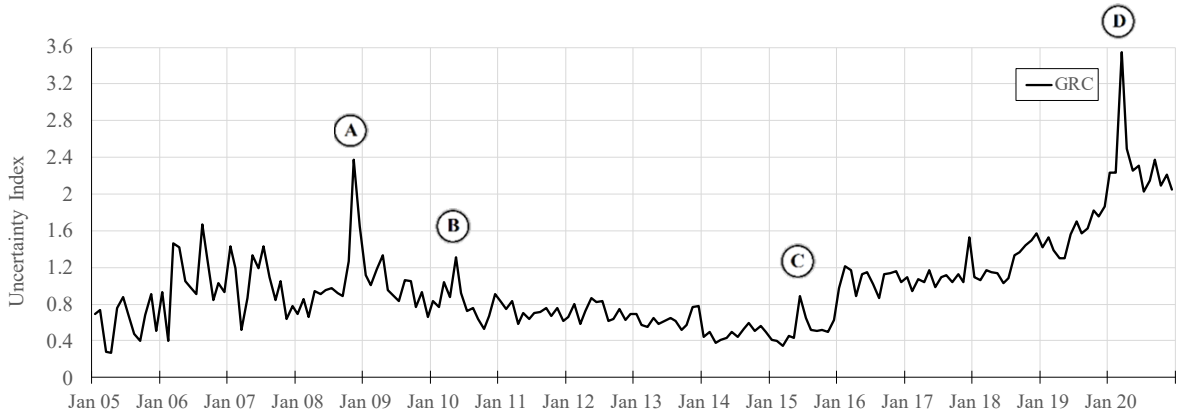
	Date	Key events
A	Oct-08	Global financial crisis.
B	Aug-09	Swine flu pandemic.
C	Nov-15	Coordenated terrorism attacks in Paris.
D	Dec-18	Yellow Vest' violent protests across the country.
E	Mar-20	COVID-19 pandemic lockdown.

XV. United Kingdom



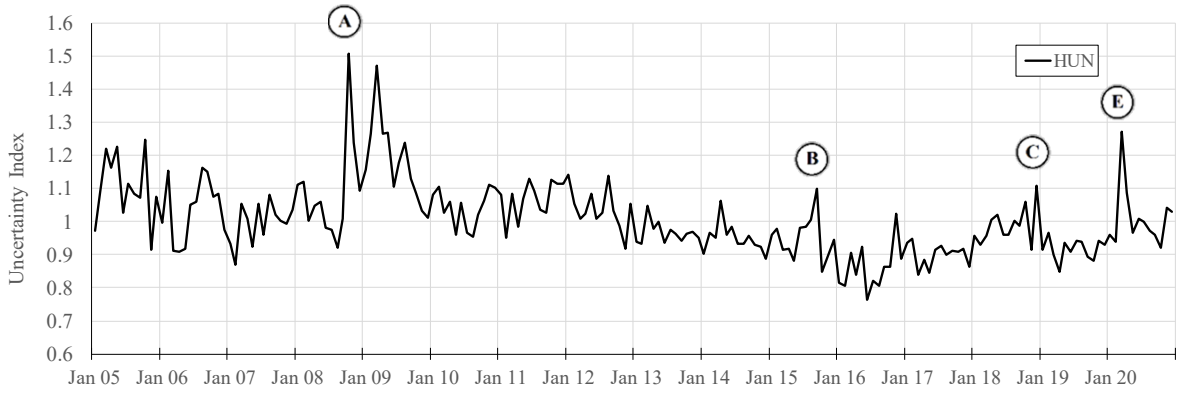
	Date	Key events
A	Oct-08	Global financial crisis.
B	Jun-16	United Kingdom European Union membership referendum.
C	Mar-20	COVID-19 pandemic lockdown.

XVI. Greece



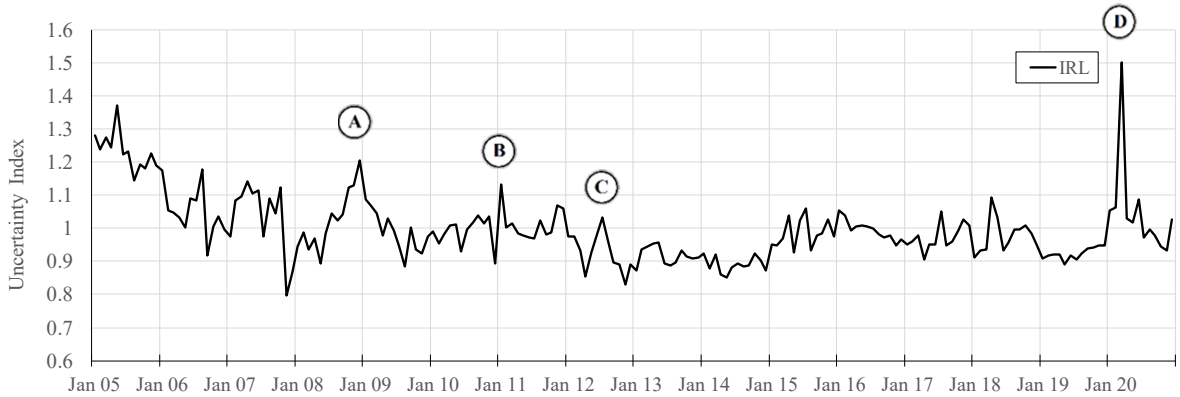
	Date	Key events
A	Oct-08	Global financial crisis.
B	May-10	First bailout plan- Economic Adjustment Programme.
C	Jun-15	Defaults $2 billion payment to IMF; Restricted cash withdrawals; Possible Euro exit.
D	Dec-17	Anti-labor reform protests turn violent in Athens.
E	Mar-20	COVID-19 pandemic lockdown.

XVII. Hungary



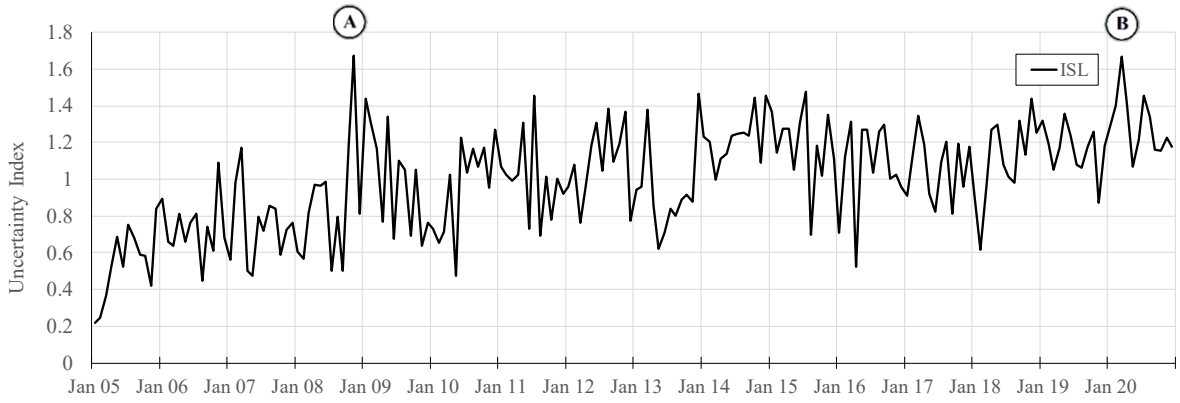
	Date	Key events
A	Oct-08	Global financial crisis.
B	Sep-15	Migrant crisis - Tensions with EU.
C	Dec-18	Massive demonstrations and protests held against the government of Viktor Orbán.
D	Mar-20	COVID-19 pandemic lockdown.

XVIII. Ireland



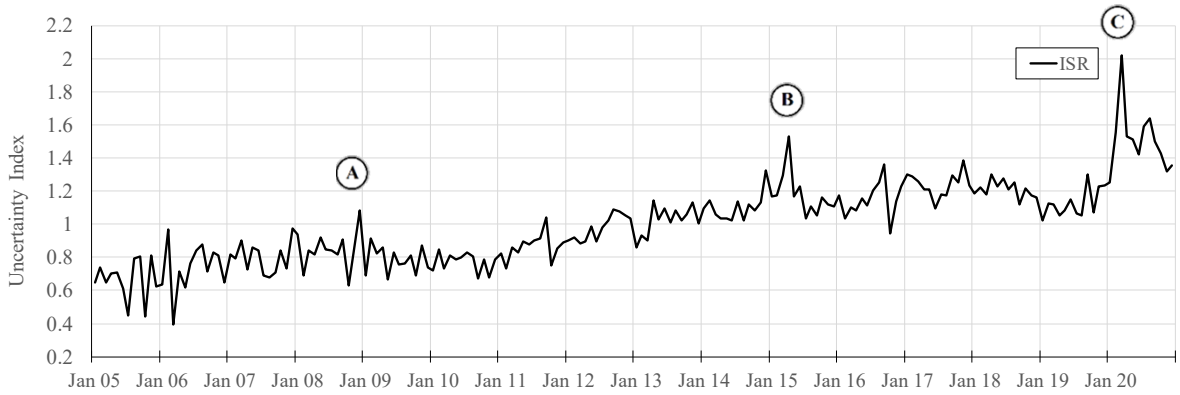
	Date	Key events
A	Oct-08	Global financial crisis.
B	Feb-11	€ 3.6 billion rescue package deal and governmen collapse in general ellections.
C	Jul-12	Referendum on Fiscal Stability Treaty.
D	Mar-20	COVID-19 pandemic lockdown.

XIX. Iceland



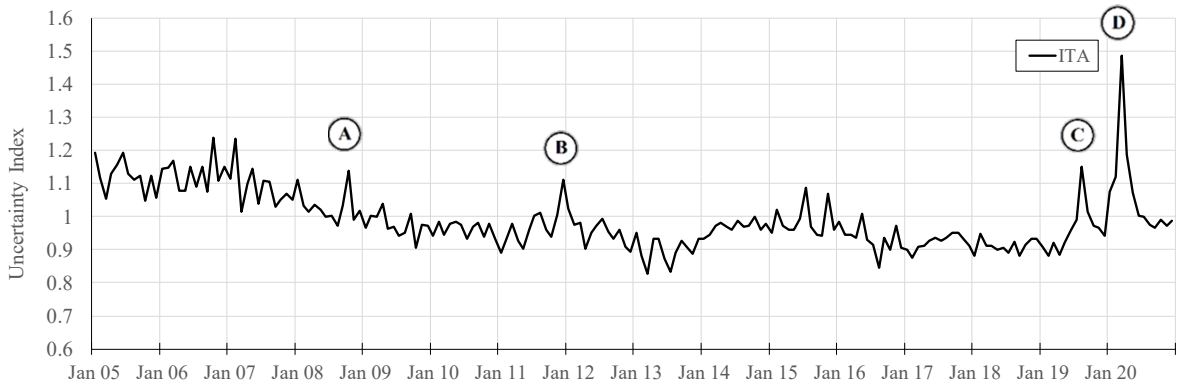
	Date	Key events
A	Oct-08	Global financial crisis.
B	Mar-20	COVID-19 pandemic lockdown.

XX. Israel



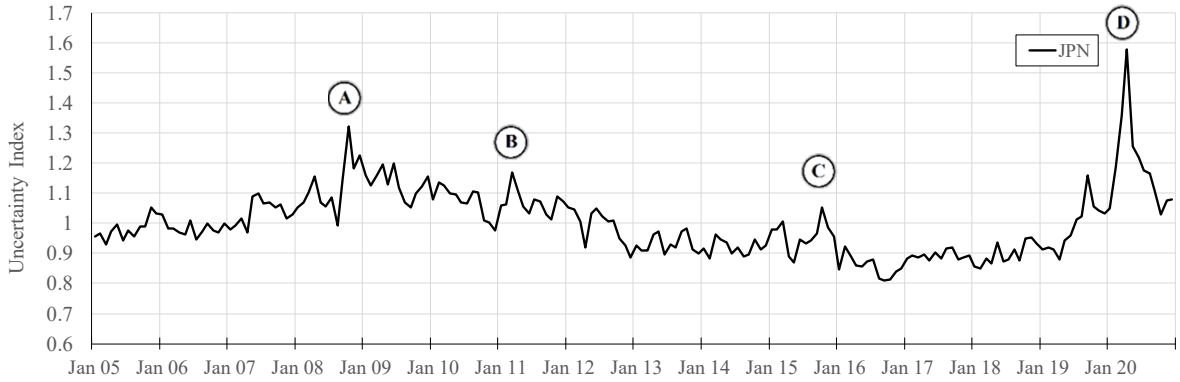
	Date	Key events
A	Oct-08	Global financial crisis.
B	Apr-15	Israeli legislative election.
C	Mar-20	COVID-19 pandemic lockdown.

XXI. Italy



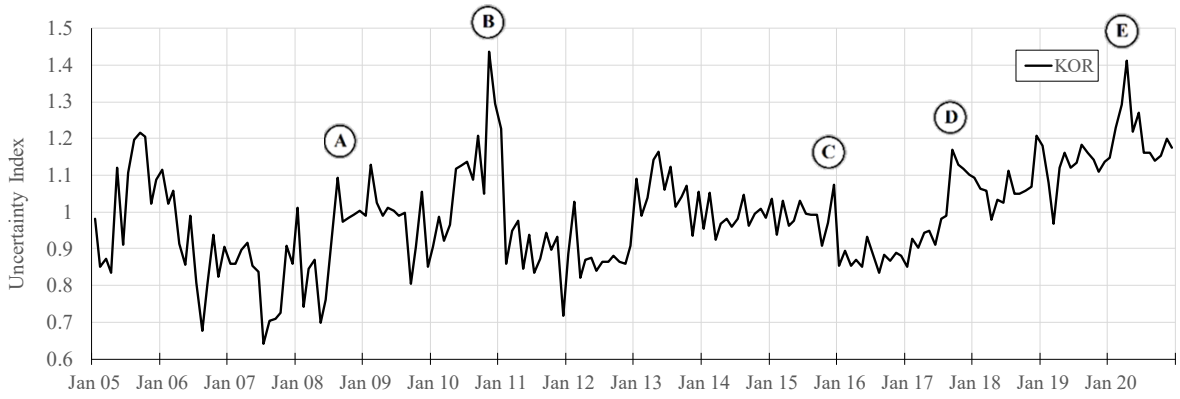
	Date	Key events
A	Oct-08	Global financial crisis.
B	Dec-11	Senate passes Monti's austerity package.
C	Aug-19	Italian government crisis.
D	Mar-20	COVID-19 pandemic lockdown.

XXII. Japan



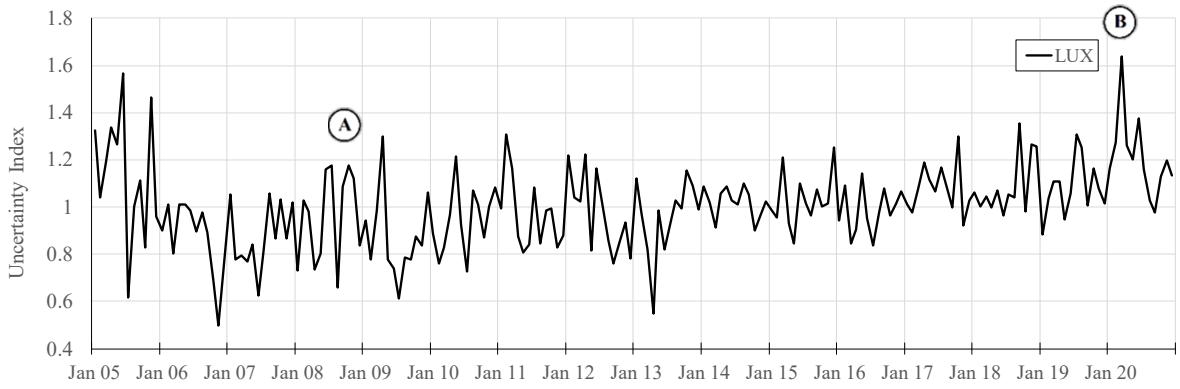
	Date	Key events
A	Oct-08	Global financial crisis.
B	Mar-11	Earthquake and tsunami - Fukushima nuclear plant meltdown.
C	Oct-15	Japanese Government raises sales tax for first time in 17 years.
D	Mar-20	COVID-19 pandemic lockdown.

XXIII. South Korea



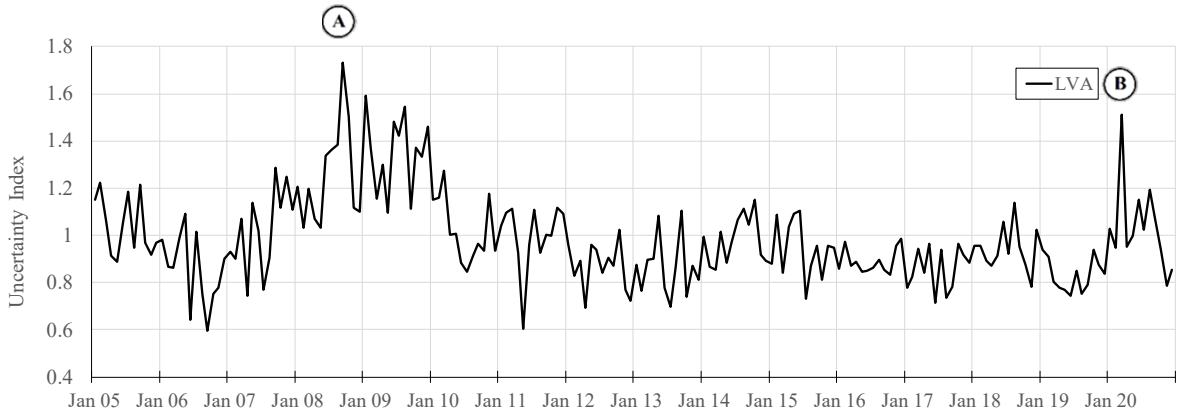
	Date	Key events
A	Oct-08	Global financial crisis.
B	Nov-10	North Korean artillery hits South Korean island.
C	Jan-16	South Korean legislative election.
D	Sep-17	Increasing tensions with North Koreak; Nuclear weapons testing.
E	Mar-20	COVID-19 pandemic lockdown.

XXIV. Luxembourg



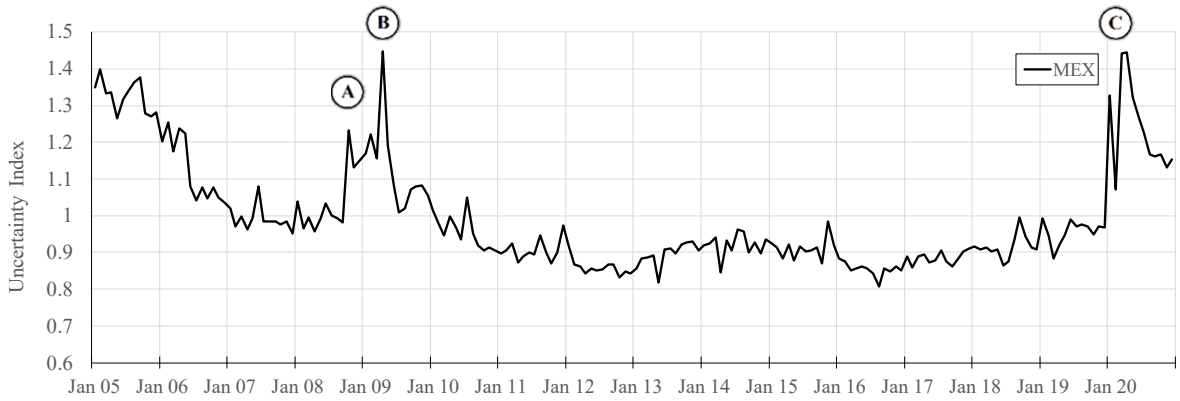
	Date	Key events
A	Oct-08	Global financial crisis.
B	Mar-20	COVID-19 pandemic lockdown.

XXV. Latvia



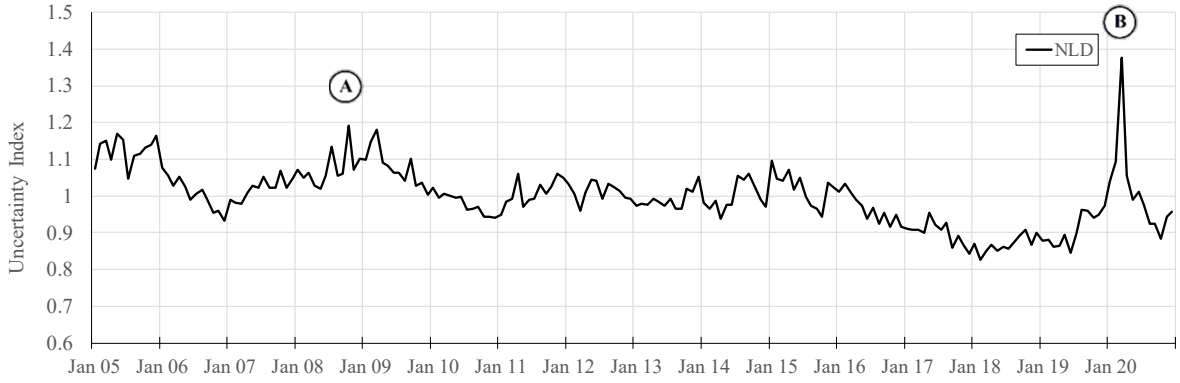
	Date	Key events
A	Oct-08	Global financial crisis.
B	Mar-20	COVID-19 pandemic lockdown.

XXVI. Mexico



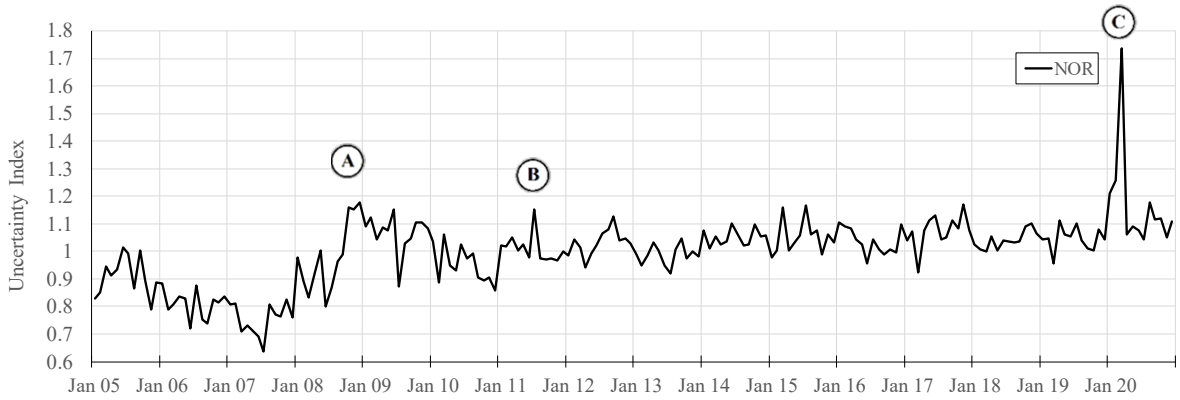
	Date	Key events
A	Oct-08	Global financial crisis.
B	Apr-09	Swine-Origin Influenza A (H1N1) Virus outbreak.
C	Mar-20	COVID-19 pandemic lockdown.

XXVII. Netherlands



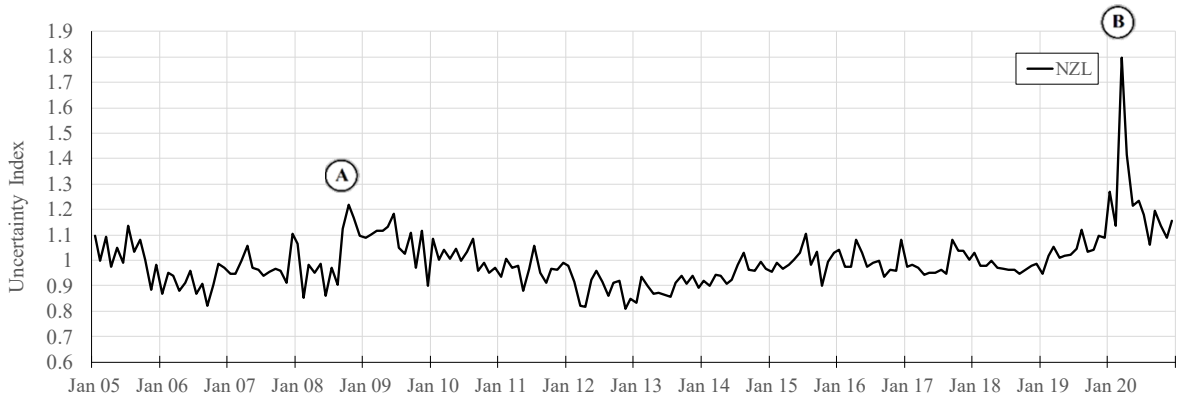
	Date	Key events
A	Oct-08	Global financial crisis.
B	Mar-20	COVID-19 pandemic lockdown.

XXVIII. Norway



	Date	Key events
A	Oct-08	Global financial crisis.
B	Jul-11	Domestic terrorist attacks by Anders Behring Breivik against the government.
C	Mar-20	COVID-19 pandemic lockdown.

XXIX. New Zealand

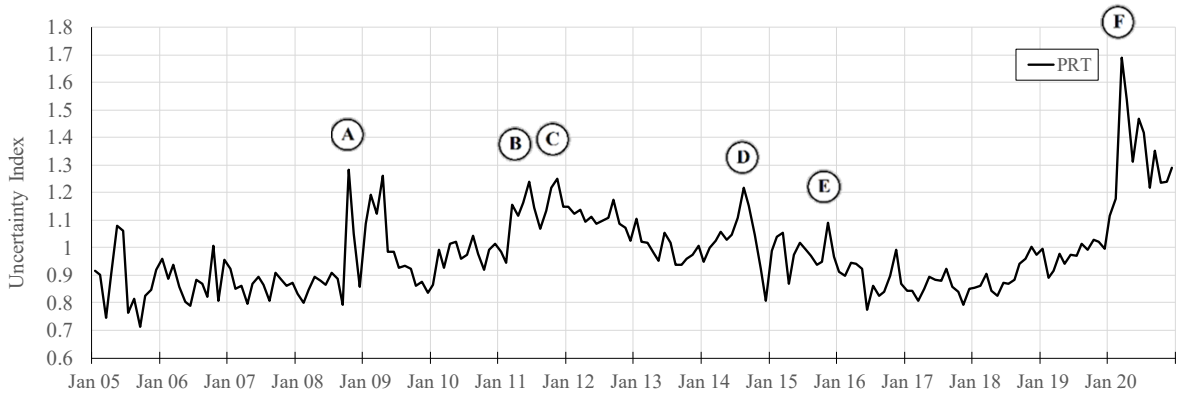


	Date	Key events
A	Oct-08	Global financial crisis.
B	Mar-20	COVID-19 pandemic lockdown.

XXX. Poland

	Date	Key events
A	Oct-08	Global financial crisis.
B	Mar-20	COVID-19 pandemic lockdown.

XXXI. Portugal

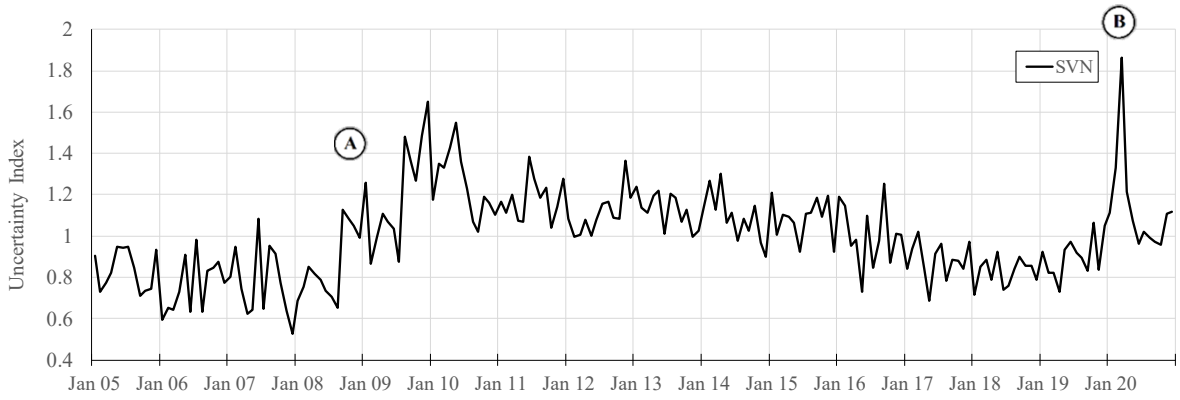


	Date	Key events
A	Oct-08	Global financial crisis.
B	Mar-11	Socrates´ government is Dissolved; Official internacional request for financial help.
C	Jun-11	Portuguese legislative election.
D	Aug-14	BES empire collapse.
E	Nov-15	Portuguese legislative election.
F	Mar-20	COVID-19 pandemic lockdown.

XXXII. Slovak Republic

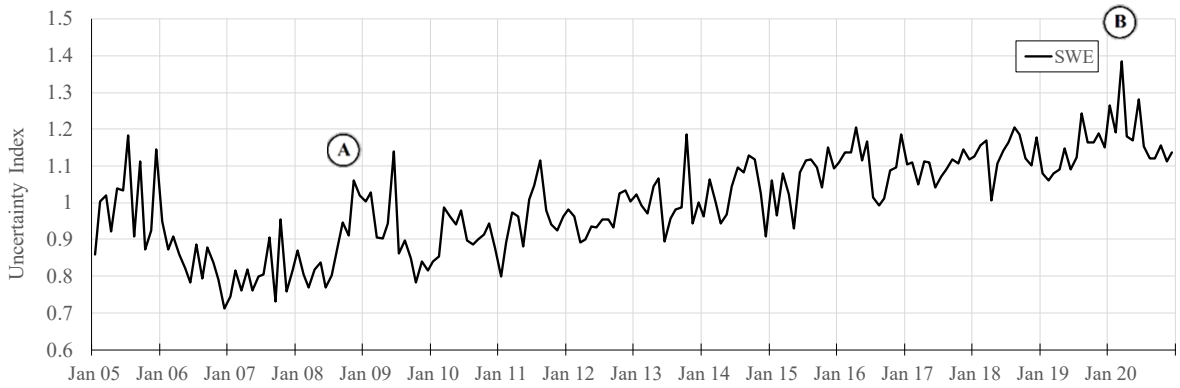
	Date	Key events
A	Oct-08	Global financial crisis.
B	Mar-20	COVID-19 pandemic lockdown.

XXXIII. Slovenia



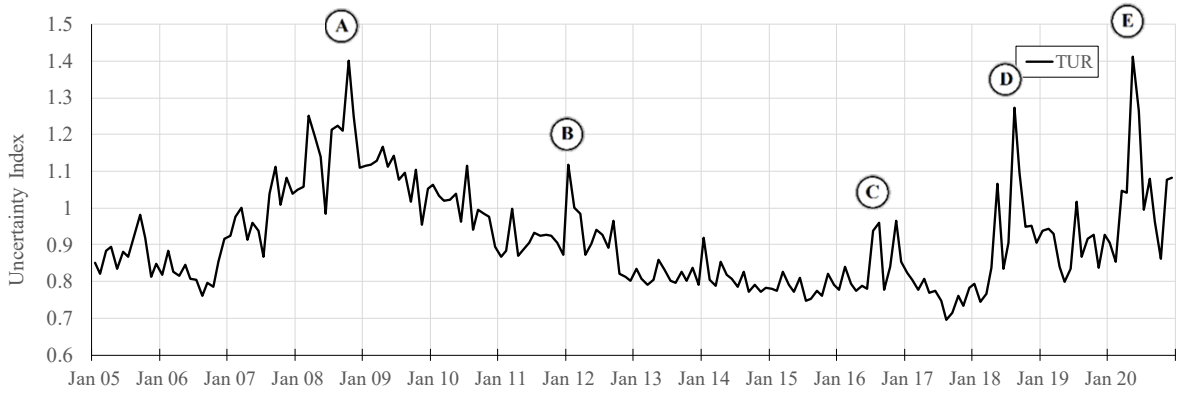
	Date	Key events
A	Oct-08	Global financial crisis.
B	Mar-20	COVID-19 pandemic lockdown.

XXXIV. Sweden



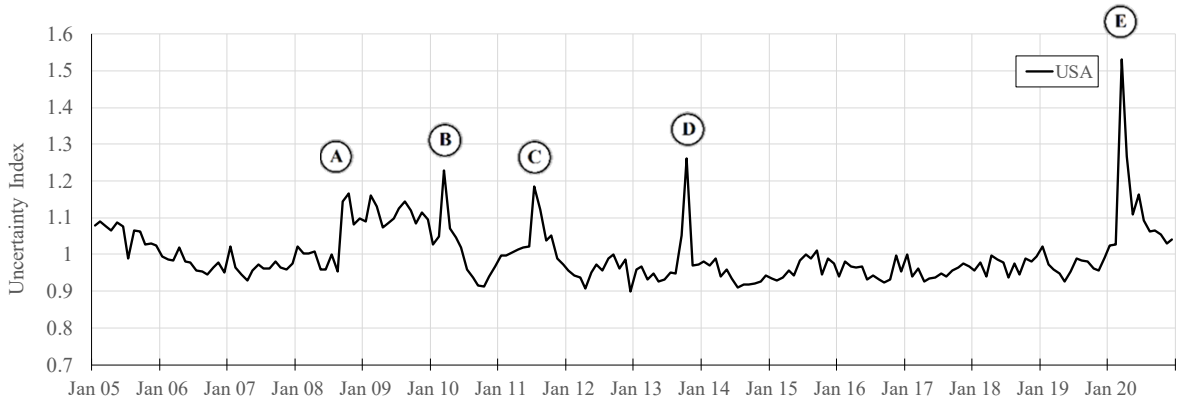
	Date	Key events
A	Oct-08	Global financial crisis.
B	Mar-20	COVID-19 pandemic lockdown.

XXXV. Turkey



	Date	Key events
A	Oct-08	Global financial crisis.
B	Jan-12	Kurdish protests across Turkey
C	Jul-16	Coup attempt by the Turkish Armed Forces.
D	2018	Turkish currency and debt crisis.
E	Mar-20	COVID-19 pandemic lockdown.

XXXVI. United States of America



	Date	Key events
A	Oct-08	Global financial crisis.
B	Mar-10	Obama's healthcare bill passed by Congress.
C	Jul-11	Debt-ceiling crisis.
D	Oct-13	United States federal government shutdown.
E	Mar-20	COVID-19 pandemic lockdown.

Appendix 5. Descriptive Statistics regarding the Continents between Jan-2005 and Dec-2020

Continent	Uncertainty Index													
	Mean	Median	Max. Value	Max. Date	Min. Value	Min. Date	Std. Dev.	Skew.	Kurt.	JB test statistic	p-value	tau-stat	tau-crit	Stacionary
Asia	1	0.991	1.559	2020-03	0.800	2007-07	0.078	0.078	1.631	288.231	0.000***	-3.975	-2.877	yes
Europe	1	0.977	1.600	2020-03	0.881	2007-04	0.044	0.044	3.926	5936.717	0.000***	-6.176	-2.877	yes
North America	1	0.968	1.552	2020-03	0.844	2012-12	0.073	0.073	1.733	317.457	0.000***	-4.376	-2.877	yes
Oceania	1	0.984	1.628	2020-03	0.867	2012-03	0.053	0.053	3.174	3527.321	0.000***	-6.653	-2.877	yes
South America	1	0.944	1.490	2020-03	0.831	2019-04	0.061	0.063	1.968	607.943	0.000***	-3.784	-2.877	yes

Appendix 6. Descriptive Statistics regarding the Economic Status between Jan-2005 and Dec-2020

Economic Status	Uncertainty Index													
	Mean	Median	Max. Value	Max. Date	Min. Value	Min. Date	Std. Dev.	Skew.	Kurt.	JB test statistic	p-value	tau-stat	tau-crit	Stacionary
Advanced	1	0.983	1.638	2020-03	0.882	2007-04	0.044	0.044	4.108	6991.526	0.000***	-5.658	-2.877	yes
Emerging	1	0.954	1.338	2020-03	0.832	2019-04	0.069	0.071	1.043	54.694	0.000***	-3.182	-2.877	yes

Appendix 7. Correlation between the considered variables for each country.

Countries	Correlations							
	UI / VIX	**UI / INT**	**UI / INF**	**VIX / INT**	**VIX / INF**	**INT / INF**	**SP / UI**	**SP / VIX**
AUS	0.506	0.368	0.132	0.007	0.011	0.601	-0.573	-0.394
AUT	0.407	0.149	0.139	0.154	-0.050	0.420	-0.302	-0.423
BEL	0.249	-0.121	-0.073	0.154	0.015	0.468	-0.212	-0.601
CAN	0.330	-0.056	-0.086	-0.176	-0.243	0.446	-0.210	-0.366
CHE	0.194	-0.393	-0.221	0.078	-0.109	0.612	0.081	-0.337
CHL	0.394	0.032	0.276	0.027	0.164	0.381	-0.374	-0.182
COL	0.595	0.237	0.121	0.144	0.106	0.814	-0.554	-0.192
CZE	0.477	-0.034	-0.080	0.277	0.202	0.667	-0.359	-0.266
DEU	0.225	0.443	0.068	0.154	-0.139	0.559	-0.503	-0.399
DNK	0.274	-0.039	-0.210	0.285	0.173	0.671	-0.166	-0.204
ESP	0.219	0.165	0.022	0.154	-0.163	0.669	-0.007	-0.221
EST	0.039	-0.445	-0.315	0.418	0.008	0.548	-0.024	-0.388
FIN	0.138	-0.207	-0.367	0.154	0.117	0.616	0.075	-0.344
FRA	0.072	-0.617	-0.443	0.154	-0.039	0.559	0.401	-0.465
GBR	0.042	-0.155	-0.355	-0.013	0.113	0.353	0.272	-0.594
GRC	0.324	-0.150	-0.156	0.154	0.079	0.680	-0.120	-0.050
HUN	0.507	0.488	0.351	0.307	0.150	0.508	-0.425	-0.248
IRL	0.139	0.329	0.244	0.154	-0.233	0.659	0.206	-0.476
ISL	0.185	-0.407	-0.194	0.217	0.567	0.729	-0.494	-0.225
ISR	-0.011	-0.704	-0.571	-0.081	0.318	0.451	0.626	-0.315
ITA	0.097	0.523	0.179	0.154	0.077	0.657	0.559	-0.334
JPN	0.702	0.392	-0.254	0.359	-0.206	-0.055	-0.282	-0.424
KOR	0.145	-0.470	-0.340	0.074	0.278	0.713	-0.058	-0.236
LUX	0.013	-0.275	-0.045	0.154	-0.096	0.579	-0.359	-0.135
LVA	0.400	0.577	0.320	0.432	0.141	0.556	-0.301	-0.230
MEX	0.316	0.500	0.054	-0.024	0.145	0.398	-0.726	-0.267
NLD	0.372	0.464	0.045	0.154	0.085	0.213	-0.507	-0.438
NOR	0.245	-0.481	0.072	0.251	0.030	0.090	0.355	-0.257
NZL	0.445	-0.226	-0.270	-0.088	-0.243	0.543	0.345	-0.212
POL	0.477	0.620	0.440	0.189	0.400	0.540	-0.607	-0.445
PRT	0.479	-0.261	-0.147	0.154	-0.143	0.588	-0.192	-0.193
SVK	0.359	0.683	0.386	0.077	0.156	0.628	0.245	-0.011
SVN	0.284	-0.401	-0.373	0.083	0.007	0.719	-0.381	0.038
SWE	-0.041	-0.716	-0.186	0.098	-0.004	0.459	0.653	-0.259
TUR	0.611	0.287	0.120	-0.013	-0.072	-0.064	-0.296	-0.213
USA	0.514	-0.051	-0.100	-0.192	-0.280	0.551	-0.295	-0.391

Appendix 8. Descriptive

Continent	Hausman-Test		Chosen Model
	chi-Squared	p-value	
Asia	160.026	0.000***	Fixed Effect
Europe	2.697	0.747	Random Effect
North America	16.038	0.006***	Fixed Effect
Oceania	4.406	0.492	Random Effect
South America	22.907	0.006***	Fixed Effect

Economic Status	Hausman-Test		Chosen Model
	chi-Squared	p-value	
Advanced	-29.653	1.000	Random Effect
Emerging	3.880	0.566	Random Effect

	Hausman-Test		Chosen Model
	chi-Squared	p-value	
All Countries	60	0.000***	Fixed Effect