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**Economic Dynamics: Analyzing Structural Breaks and Covid-19  
Responses Worldwide**

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Dissertation

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**NOVA Information Management School**  
**Instituto Superior de Estatística e Gestão de Informação**  
Universidade Nova de Lisboa

**ECONOMIC DYNAMICS: ANALYZING STRUCTURAL BREAKS AND  
COVID-19 RESPONSES WORLDWIDE**

By

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Master Thesis presented as partial requirement for obtaining the Master's degree in Statistics and Information Management, with a specialization in Information Management.

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João Duarte

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## ABSTRACT

This research explores the far-reaching implications of the Covid-19 pandemic on major global macroeconomic variables, aiming to identify structural breaks with a meticulous examination of their occurrence and timing. Employing the Bai and Perron procedure for testing multiple structural breaks, break dates were systematically organized by variable and country. This facilitated a comprehensive analysis of potential correlations between government responses to the pandemic and the occurrence or extent of these structural breaks. A subsequent cluster analysis, integrating break dates and government response data, sought to uncover patterns and relationships. Significant structural breaks emerged in key indicators such as GDP, Household Disposable Income, Industrial Production, and Unit Labor Costs, primarily concentrated in the 3rd and 4th quarters of 2020. Surprisingly, variables like unemployment, share prices, producer prices, and stock returns during 2020 exhibited no structural breaks, suggesting potential medium to long-term effects or a temporal misalignment in the analysis. Despite profound economic shifts, no conclusive evidence materialized linking government responses to the occurrence or extent of these structural breaks, prompting further inquiry into the nuanced dynamics of pandemic-induced economic disruptions. This research provides crucial insights for policymakers, offering a snapshot of the pandemic's economic consequences and highlighting avenues for future research. Special attention is warranted in countries like Russia, China, Argentina, India, Indonesia, South Africa, Bulgaria, Romania, Costa Rica, Croatia and Saudi Arabia, where data collection proved to be challenging and additional data is essential for robust conclusions given the limited reporting.

## KEYWORDS

Structural Breaks; Structural Change; Time-Series; Covid-19 pandemic; European Union

### Sustainable Development Goals (SGD):



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## LIST OF ABBREVIATIONS AND ACRONYMS

**ADF** - Augmented Dickey-Fuller

**AIC** – Akaike Information Criterion

**BIC**- Bayesian Information Criterion

**B&P** - Bai and Perron

**Covid-19** - Covid-19 Pandemic

**GDP** - Gross Domestic Product

**HDI** - Household Disposable Income

**IND\_PROD** - Industrial Production

**IPI**- Industrial Production

**ME** – Moving Estimate

**OLS CUSUM** – Ordinary Least-Squares Cumulative Sum

**OLS MOSUM** – Ordinary Least-Squares Moving Sum

**OxCGRT** - Oxford Coronavirus Government Response Tracker

**PPI** - Producer Price Index

**RE** – Recursive Estimate

**REC-CUSUM** - Recursive Cumulative Sum

**REC- MOSUM** - Recursive Moving Sum

**RMSE**- Root Mean Square Error

**Unit Labor Costs** - ULC

## INTRODUCTION

Structural changes are defined as alterations on the structure of time series data, that can be caused by consumer patterns to technological advancements, policy changes, natural disasters, or global crises. Structural breaks are a specific case of structural change, where there is a significant change in the regression coefficients or the statistical properties, such as the mean or variance. This problem has a major tradition in economic theory, and although the term structural break was not commonly used by classical economists, several of them, refer to changes in patterns between variables (Silva & Teixeira, 2008). The study of changepoint started in quality control with the work of Page (Page, 1954, 1995) and since then, the methodology for testing structural changes has seen incredible development, being applied to multiple fields, including Economics (Alessandro Casini & Pierre Perron, 2018), Finance (Mensi et al., 2019), Engineering (Lazariv et al., 2013), Climatology (Lund et al., 2007), among others.

One event that can be classified as a global crisis is the Covid-19 pandemic. It unleashed unprecedented disruptions in global economies, leading to widespread concerns about the structural integrity of time series data and economic models. This has been raising critical questions regarding the occurrence and implications of structural breaks caused by the pandemic, as well as the potential influence of countries' responses on the outcomes. With that in mind, this thesis aims to address two primary research questions:

- (1) Did the Covid-19 pandemic result in significant structural breaks in major economic variables across different countries?
- (2) What are the timings of these breaks?

With these questions, one aims to identify the presence of structural breaks in major economic variables across different countries, explore the underlying factors and regional variations that contribute to these breaks and assess the potential influence of countries' responses to the pandemic on the outcomes of these breaks.

To achieve these objectives, data on 9 essential economic variables across countries representing diverse continents will be collected.

The selected variables for analysis include the Consumer Price Index (CPI), Gross Domestic Product (GDP), Household Disposable Income, Industrial Production, Investment, Share Prices, Unemployment Rate, Unit Labor Costs, and Producer Price Index (PPI). These variables were chosen due to their ability to provide a comprehensive overview of the economic conditions in each country. To ensure a representative global perspective, countries were selected from various regions, including Europe, the Americas, Africa, Asia, and Oceania.

The data of responses to Covid-19 is from the Oxford Coronavirus Government Response Tracker (OxCGRT) (Hale et al., 2021). This dataset provides a comprehensive and standardized collection of information on various government interventions, including containment and closure policies, economic support measures, health system policies, and public information campaigns.

By assessing the presence of structural breaks in these variables and incorporating data on each country's response to the pandemic, a cluster analysis will be conducted to explore potential associations between response strategies and economic outcomes.

This study seeks to contribute to existing knowledge by providing a comprehensive overview of the structural breaks caused by the Covid-19 pandemic and their relationship with different response measures. The findings will shed light on regions most affected by the pandemic and identify effective response strategies for mitigating economic disruptions, thereby assisting policymakers and economists in dealing with future disruptions of a similar nature. Furthermore, the conclusions drawn can serve as a basis for future research, allowing for more nuanced and detailed studies that will provide a deeper understanding of the variables impacting both the pandemic outcomes and the occurrence of structural breaks.

In the upcoming chapters, this study is structured as follows: Literature and Theoretical Framework: This chapter delves into the extensive body of literature related to structural breaks and changepoint analysis. It provides historical context and methodological insights, with a particular focus on the Bai and Perron (1998) framework, laying the foundation for the subsequent analysis. Introduction to Structural Breaks: Building upon the theoretical framework, this chapter offers a comprehensive exploration of the concept of structural breaks. It outlines their historical significance, methodological approaches, and their relevance in various fields. Data and Methods: This chapter details the data selection process, sources, and data transformations applied. It also discusses the methodology used for modeling and testing structural breaks in the time series data under examination. Results and Findings: In this pivotal chapter, the study presents its empirical findings. It explores whether the Covid-19 pandemic induced significant structural breaks in key economic variables across diverse countries, elucidates the timing of these breaks, and assesses the potential influence of government responses. Conclusion: The final chapter encapsulates the study's conclusions, emphasizing its contributions to existing knowledge. It also addresses limitations and provides guidance for future research and policy implications.

## LITERATURE REVIEW AND THEORETICAL FRAMEWORK

### 1.1. STRUCTURAL BREAKS

The field of structural changes has witnessed significant developments in recent decades, with various tests being formulated to detect and analyze structural changes in time series. Perron (2005) pointed out that these developments happened in parallel with advances in the analysis of unit roots as both have identical features and use similar tools.

Understanding structural breaks allows us to grasp significant changes in economic models or the structure of univariate series. The presence of structural breaks influences the development of models as it signifies a change in the relationship of the underlying variables. Accounting for these breaks may be necessary to accurately represent the dynamics of the system and improve forecast accuracy. This has been applied in economics to understand the impacts of global financial crises (Martins & Damásio, 2020) and technological advances (Damásio & Mendonça, 2023). Additionally, in the case of univariate time series, studying structural breaks provides insights into the impact of specific events, such as policy changes, financial crises, or natural disasters. These insights are valuable for policymakers when formulating appropriate responses and designing effective policies to mitigate the effects of such events. By considering and incorporating the presence of structural breaks, researchers can better capture the nuances of economic phenomena and make informed decisions based on the identified breaks.

Building upon the understanding of structural changes, we shall explore the various tests used to detect and analyze them. The tests can be broadly divided between F-statistics tests and generalized fluctuation tests (Z. Zeileis et al., 2003). F-statistics tests can be classified as tests for single break with a known date, tests for single break with unknown date, and tests for multiple breaks.

Tests for single break with a known date are used when researchers have a specific time-period in mind for when a structural change occurred. Some of the most used tests are the Wald (Abraham, 1943) and the Chow (Chow, 1960) tests. These tests fit the same regression model to two separate subsamples and construct an F-test for the parameters of the two models; if the difference is significant, then there is a structural break.

In situations where the exact timing of a structural change is uncertain, tests for a single break with an unknown date are employed. The pioneering work of Quandt (Quandt, 1960) introduced the concept of using a likelihood ratio test (*Sup F* test) to detect a break date that maximizes it, but the limiting distributions were not yet known. Subsequently, this idea underwent further advancements by Deshayes and Picard, Worsley, James, James and Siegmund, Hawkins, Kim and Siegmund (Perron, 2005), leading to the development of the Quandt-Andrews (Andrews, 1993) and Zivot-Andrews test (Zivot & Andrews, 1992), which offers a more comprehensive and generalized approach. Then, the limiting distributions used with Quandt's test were derived by Andrews and Ploberger with the optimal tests (Andrews & Ploberger, 1994). For the Quandt-Andrews test, the method is to use the maximum of the likelihood ratio test over all possible values of the parameter. It is necessary to formulate a null hypothesis that there is a unit root or trend in the time series without a structural change, and an alternative hypothesis that suggests the presence of a structural break. Afterwards, the regression model must be estimated, typically by OLS method. An iterative procedure is used to estimate the

potential breakpoint. After obtaining the breakpoint, the test statistic is calculated based on the t-ratios of the coefficient estimates and the estimated breakpoint. Subsequently, the critical value is determined, considering the significance level and the degrees of freedom. If the test statistic exceeds the critical value, the null hypothesis is rejected. These types of tests are limited as they only allow for one break.

There is another class of tests, proposed by Andrews and Ploberger (Andrews & Ploberger, 1994): the optimal tests. This is a general framework for constructing optimal tests when there is a nuisance parameter that is present only under the alternative hypothesis. To derive these optimal tests, a weighted average power criterion function is employed, resembling the one used by Wald and resulting in what is commonly known as the Sup-Wald test. This test statistic is defined as the supremum of the Wald test statistics over a range of values of the nuisance parameter. This allows the test to capture the potential uncertainty in the nuisance parameter and provides robustness to its estimation (Andrews & Ploberger, 1994). Having a nuisance parameter can bring difficulties as its estimation can be challenging, also the test statistic can be sensitive to sample sizes and the test is limited to a single break test.

Tests for multiple break dates are used when researchers suspect that more than one structural change has occurred in a time series. These tests can be challenging to implement due to the potential for multiple false positives, but they can provide valuable insights into the evolution of a system over time. Popular tests in this family include the Bai-Perron (BP) test (Bai & Perron, 2003, 1998; Jushan Bai, 1997). This methodology extends the approach of the F-tests for '0' vs  $\ell$  breaks and  $\ell$  vs  $\ell + 1$  breaks, with an arbitrary but fixed  $\ell$ .

The basic idea of the BP test is to partition the sample into different segments and estimate the number and timing of breaks in the data. This is done by comparing the likelihood of a model with a single set of parameters to that of a model with multiple sets of parameters, each corresponding to a different segment. The test proceeds in two steps. In the first step, the number of breaks is estimated using an information criterion, such as the Bayesian Information Criterion (BIC) or the Akaike Information Criterion (AIC). In the second step, the timing of the breaks is estimated using a sequential testing procedure. The BP test has been widely used in econometrics, statistics, and other fields, for detecting and analyzing multiple structural breaks. It has been further developed to allow to relax the general framework (Qu & Perron, 2006). However, it is important to note that implementing tests for multiple breaks can be challenging due to the potential for multiple false positives. Another popular method for multiple structural change testing is the PELT (Pruned Exact Linear Time) (Killick et al., 2012).

There are other developments in the field of structural breaks: machine learning techniques for both detection and forecasting of breaks (Linden & Yarnold, 2016) and testing for breaks in Markov chain models (Damásio, 2018; Damásio et al., 2018; Damásio & Nicolau, 2020; Song, 2014). These approaches offer alternative methods for identifying and analyzing structural breaks in time series data and have contributed to expanding the toolbox available to researchers in this field.

The generalized fluctuation framework for testing began with the introduction of the CUSUM tests on the cumulated sums of recursive residuals (Brown et al., 1975), and then building on that work, the use of least-squares residuals was thought to be able to better approximate the true disturbances under the null hypothesis, arising the OLS-CUSUM test (Ploberger & Krämer, 1992). Similar to these tests are the MOSUM tests with recursive and least-squares residuals (Chu et al., 1995a), which are

based not on cumulative but moving sums, that is, for each observation, it computes the sum of residuals on a moving window of observations.

There are two other classical tests, the Recursive Estimates (RE) (Kuan & Chen, 1994) and Moving Estimates (ME) (Chu et al., 1995b). The Moving Estimate (ME) test is a statistical method used to identify breaks or changes in the mean of a time series. It achieves this by analyzing moving residuals, which are the differences between the observed values and the estimated values based on a moving average or other predictive model. The ME test calculates cumulative sums of these moving residuals and compares them against critical values to determine if there are statistically significant shifts in the mean. By monitoring the cumulative sums, the ME test can detect changes in the overall level or average value of the time series.

The Recursive Estimates (RE) test, on the other hand, focuses on detecting breaks in the variance or volatility of a time series. It combines information about both the mean and variance by using recursive residuals. Recursive residuals are the differences between the observed values and the predictions made by recursively updating a model based on past data points. The RE test calculates cumulative sums of these recursive residuals and compares them against critical values to identify significant variations in the variance or volatility of the time series. By analyzing the cumulative sums of the recursive residuals, the RE test can detect changes in the dispersion or variability of the time series.

In summary, the different tests for structural changes are designed to detect and analyze structural changes in time series data, depending on the researchers' knowledge of when the changes occurred and the number of structural changes they expect to find. For the purposes of this research, the BP test will be used as it allows for testing of multiple breaks without requiring *a priori* knowledge of the dates of the breaks, after identifying the break dates, generalized fluctuation tests will be applied to derive the significance of the breaks.

## 1.2. BAI AND PERRON TEST

The BP procedure considers multiple shifts in a linear model estimated by least squares, allowing for general forms of serial correlation and heteroskedasticity in the errors, lagged dependent variables, trending regressors, as well as different distributions for the errors and the regressors across segments (Bai & Perron, 1998). When a lagged dependent variable is allowed, there must be no serial correlation in the errors (Bai & Perron, 2003). This procedure considers a general case where not all parameters are subject to shifts. The specific test employed within the Bai and Perron procedure is typically a likelihood ratio test (LR). This test compares the likelihood of two models: one assuming no breaks (null hypothesis) and the other assuming a specific number of breaks (alternative hypothesis). The test assesses whether the addition of breaks significantly improves the fit of the model to the data. By iteratively applying the LR test and adding breaks, the Bai and Perron procedure selects the model with the fewest breaks that fits the data well.

The BP test is a model selection approach that involves estimating a sequence of models with different numbers of breaks and selecting the model that best fits the data. The test follows these steps (Bai & Perron, 2003):

1. The regression model is estimated for the sample period.
2. The sample period is divided into two or more subsamples.

3. A separate regression model is estimated for each subsample.
4. The coefficients of the estimated models are tested to determine if they are statistically different across subsamples.
5. Steps 2-4 are repeated for a different number of subsamples. The goal is to find the optimal number of breaks that adequately captures the underlying structural changes without overfitting the data.
6. Finally, the model with the fewest breaks is selected, using the minimum BIC (Bayesian information criteria) partition.

We can consider a linear regression with  $m$  breaks ( $m+1$  regimes):

$$y_t = x'_t \beta + z'_t \delta_j + u_t, \quad t = T_{j-1} + 1, \dots, T_j \quad (1)$$

The vector coefficients are  $\beta$  and  $\delta_j$  ( $j = 1, \dots, m + 1$ ).  $\beta$  represents the coefficients associated with the independent variables that are common across all regimes,  $z'$  represents the vector of independent variables specific to each regime, and  $\delta_j$  represents the coefficients associated with the variables unique to each regime ( $j = 1, \dots, m + 1$ ) (Bai & Perron, 2003). These coefficients help to quantify the impact of structural changes on the relationship between the regime-specific variables and the dependent variable.

In Matrix language, the model can be written as:

$$Y = X\beta + \bar{Z}\delta + U \quad (2)$$

The method of estimation is based on the least-squares principle. For each  $m$ -partition  $(T_1, \dots, T_m)$ , so the least-squares estimates of  $\beta$  and  $\delta$  are obtained by minimizing the sum squared residuals.

$$(Y - X\beta - \bar{Z}\delta)'(Y - X\beta - \bar{Z}\delta) = \sum_{i=1}^{m+1} \sum_{t=T_{i-1}+1}^{T_i} [y_t - x'_t \beta - x'_t \delta_i]^2 \quad (3)$$

The estimates based on the  $m$ -partition will become  $\hat{\beta}(\{T_i\})$  and  $\hat{\delta}(\{T_i\})$ . These are the global minimizers of the sum squared residuals across all partitions.

$$(\hat{T}_1, \dots, \hat{T}_m) = \underset{T_1, \dots, T_m}{\operatorname{argmin}} S_T(T_1, \dots, T_m) \quad (4)$$

Where  $S_T(T_1, \dots, T_m)$  are the sum squared residuals given  $\hat{\beta}(\{T_i\})$  and  $\hat{\delta}(\{T_i\})$ .

The goal is to estimate the coefficients and breakpoints  $(T_1, \dots, T_m)$  using ordinary least squares (OLS). This approach allows for partial structural changes, providing more precise estimates and powerful tests. The estimated break points are obtained by minimizing the sum of squared residuals (SSR) over the available data.

Estimating the breakpoints and coefficients can become a computational burden, so this procedure makes use of the Dynamic Programming Algorithm. After computing the sum squared residuals of the relevant segments, dynamic programming is used to evaluate which partition achieves a global minimization of the sum squared residuals. Given  $SSR(\{T_{r,n}\})$  as the sum of squared residuals associated with the optimal partition containing  $r$  breaks and  $n$  observations, the optimal partition solves the recursive problem:

$$SSR(\{T_{m,T}\}) = \min_{m=h \leq j \leq T-h} [SSR(\{T_{m-1,j}\}) + SSR(j+1, T)] \quad (5)$$

The procedure evaluates the optimal one-break partition, then the optimal two-break partition, and continues the process until the optimal m-1 partitions are found. There have been further developments of this model, notably by extending it to multivariate systems for a single break and later for multiple breaks(Qu & Perron, 2006).

The Bai and Perron tests offer several advantages over other methods for detecting structural breaks. They do not require prior knowledge of the timing or location of the breaks, and they can identify multiple breaks. Additionally, these tests provide estimates of the break dates and magnitudes, which can be utilized for further analysis.

However, it is important to consider the limitations and assumptions of the BP tests when interpreting their results. These tests assume stationarity of the data and the absence of other stochastic trends or nonlinearities that could impact their performance. The choice of subsample sizes and model selection criteria can also affect its predictive power and result in type I error rates, making it necessary to carefully evaluate the results within the specific application context.

By utilizing the BP tests while considering their limitations, researchers can gain valuable insights into structural breaks and their implications for the analyzed time series data. This approach provides a rigorous framework for identifying and understanding significant changes in the underlying data generation process.

### 1.3. STRUCTURAL BREAKS AND COVID-19

The Covid-19 pandemic has triggered a surge of research investigating its impact on various aspects of society, including the economy. This subsection aims to explore the existing body of knowledge on the effects of the pandemic on major economic variables and the occurrence of structural breaks. By identifying gaps in the literature, this review will provide the foundation for the current study, highlighting the research hypothesis and framing the research questions within the context of the existing literature.

The pandemic can be classified as a global health crisis due to its widespread and severe impact. It might have caused structural breaks in several areas of the economy, and it had a significant disruptive impact on the everyday life of the world's population. There is extensive research on this topic, that ranges from the biology and immunology of the virus to the health system response, its socio-economic impacts, and even to the impact it had on the urban environment(Nigam et al., 2022). The current study aims to investigate the economic implications of the Covid-19 pandemic, focusing on the key indicators that play a crucial role in understanding the magnitude and scope of the economic impacts.

This study aims to broaden the understanding of the economic consequences of a health crisis and economic halt like the one experienced during Covid-19. Structural breaks in time-series data during this period have been recently studied in different markets and scenarios. The housing market has been studied, with evidence pointing to a shift away from high density areas in the US (Liu & Su, 2021). This effect was also felt in London with a potential acceleration of multiple home ownership (Gallent

& Madeddu, 2021). An Irish study points to short-term price changes with a urban-rural price switching effect (McCord et al., 2022), while in the US, this switching effect does not seem to be as present (Zhao, 2020). In Sweden, there were several counties within the country, with structural breaks present in the housing market (Rönningsberg & Hove, 2021).

One wonders what were the effects on unemployment rates, as there seems to be some correlation between surges in Covid-19 cases and an increase in unemployment rate (Su et al., 2022). Nonetheless, there is significant difference in impact between types of work and the ability to perform such job from home, with the more flexible jobs having had suffered the effects of Covid-19 to a lesser extent than those that were more strict in terms of ability to perform the work remotely (Adams-Prassl et al., 2020).

As is usual, the financial markets reacted to the news of the pandemic, with breaks appearing in the reaction to critical incidents, such as the closure of Russian Borders and Germanys' mandate to use of masks (Çütcü & Kılıç, 2020). These type of reactions seem to have been short lived, as evidence of the effect of the pandemic starting to ease at the end of march, with the quantitative easing programs announcements as a possible explanation (Karaviasa et al., 2022). The Cryptocurrency market was also impacted during Covid-19, with findings of structural breaks in the connectedness among cryptocurrencies (Ashish et al., 2022).

Overall, these studies demonstrate that the Covid-19 pandemic has had diverse and profound effects on various economic indicators, such as the housing, financial markets, and unemployment rates. The observed structural breaks in time series data provide empirical evidence of the magnitude and heterogeneity of the pandemic's impact across different regions and sectors. By analyzing these structural breaks, researchers can gain insights into the specific mechanisms through which the pandemic has altered economic dynamics, informing policy responses and future economic planning.

## DATA & METHODS

The diagram below is a visual representation of the steps taken in this analysis, from collecting the data to the final analysis. In the following subsections, a more detailed explanation of each step will be presented.

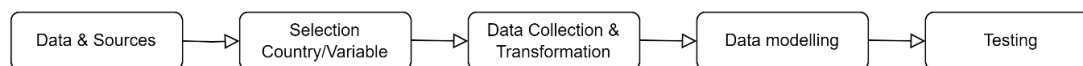


Figure 1- Diagram: overview of the analysis

### 1.4. DATA AND SOURCES

In this chapter, an overview of the data used in the analysis is provided. The data for this study was collected from the Organization for Economic Co-operation and Development (OECD). Quarterly data on multiple macroeconomic variables such as CPI,

GDP, household disposable income, industrial production, investment, share prices, unemployment, unit labor costs, and Producer Price Index was obtained. To ensure that the findings are representative of a wide range of economic conditions, 49 countries were used. The descriptive statistics of the chosen variables are presented in the appendix.

Before conducting any analysis, the data was preprocessed to ensure its quality and suitability for the research purposes. Since it is time-series data and given the constraints of the BP test, stationarity must be ensured. Several standard techniques were used to test seasonality and trend, including plotting the decomposed time series for each variable to visualize any clear trends or seasonality, the Ljung-Box test to check the presence of autocorrelation in the errors (Ljung & Box, 1978), and the Augmented Dickey-Fuller (ADF) test to test for unit-roots in the trend (Dickey & Fuller, 1978). These tests are needed to ensure that the series are stationary or to identify if they need a transformation to become stationary.

Evidence of trend was found in some variables, such as GDP and Industrial Production. To address this, logarithms and/or detrending was applied, also, seasonal differentiation in the 1<sup>st</sup> or 2<sup>nd</sup> order to the series that presented seasonality. After assuring that the series is stationary, testing can be done, proceeding with the Bai and Perron test for multiple structural breaks, implemented in R using the "strucchange" package.

When a structural change is encountered, it is necessary to test its statistical significance. To achieve this, there are several tests one can apply. The OLS-CUSUM process assesses whether the cumulative sum of squared residuals deviates significantly from zero over time (Ploberger & Krämer, 1992). The OLS-MOSUM test is an extension of the OLS-CUSUM test that incorporates a moving window or segment and calculates the sum of squared residuals within each segment and then combines these sums across the segments to identify potential structural breaks (Chu et al., 1995a). The Rec-CUSUM is similar the OLS-CUSUM but uses the recursive residuals, and the Rec-MOSUM uses the moving sum of the estimated residuals within each recursive estimation, considering a moving window instead of a static window (Brown et al., 1975). The final approach is using the Recursive estimates and Moving Estimates. The Recursive Estimates approach models parameters recursively as new data becomes

available over time, and is useful for dynamic models with temporal dependence (Kuan & Hornik, 1995). The Moving estimates repeatedly models' parameters using a fixed-size window of recent data (Kuan & Chen, 1994).

## 1.5. SELECTION OF COUNTRIES AND VARIABLES

In this section, we present the list of countries and variables that were selected for the study. We analyzed a set of 49 countries, representing each continent so that we have a representative sample of the world. This list has some limitations, such as lack of data for some countries, as is presented below in table 2. These countries either do not disclose all the indicators used in this study or do not present it in the same time granularity (quarter data).

The countries were grouped according to their respective continents, namely Europe, America, Africa, Asia, and Oceania. The limitations, previously mentioned, on lack of data for some series, may impact the final analysis, particularly for variables where data is missing in certain countries. For example, it may not be possible to assess the presence or absence of structural breaks, such as in the case of China, regarding variables like investment and unemployment.

As for the selection of macroeconomic variables, we have chosen some of the most important variables that are commonly used in econometric studies. However, due to data constraints, not all countries have information for all the variables we would like to study. Therefore, we present the following variables: Consumer Price index (CPI), Gross Domestic Product (GDP), Household disposable income (HDI), Industrial Production Index (IPI), Investment, Share prices, Unemployment rate, Unit labor costs (ULC) and Producer Price Index (PPI):

<b>Var:</b>	<b>Source:</b>	<b>Description:</b>
CPI	(OECD, 2023d)	The CPI is a widely used economic indicator that measures changes in the average prices of goods and services consumed by households. It is commonly used to assess inflation rates and purchasing power. You can refer to reputable sources such as the International Monetary Fund (IMF) or central bank publications that highlight the importance of CPI in economic analysis and policymaking. Measure in annual growth rate.
GDP	(OECD, 2023a)	GDP is a fundamental measure of economic activity and is commonly used to gauge the overall health and growth of an economy. It is widely recognized as a key macroeconomic indicator. Sources like the World Bank, International Monetary Fund (IMF), or national statistical agencies provide extensive literature on GDP and its significance in analyzing economic performance.
HDI	(OECD, 2023b)	Household disposable income represents the income available to households after deducting taxes and adding government transfers. It is an important indicator of households' financial well-being and consumption capacity. OECD publications or national statistical agencies often provide insights into the significance of household disposable income and its relationship to economic outcomes and inequality.
Industrial production	(OECD, 2023c)	Industrial production measures the output of the manufacturing, mining, and utilities sectors. It is an essential indicator of economic activity and can reflect changes in production capacity and business cycles. International organizations like the United Nations Industrial Development Organization (UNIDO) or reports from national statistical agencies can provide literature on the significance of industrial production in economic analysis

Investment	(OECD, 2023e)	Investment is a key driver of economic growth and reflects spending on capital goods and infrastructure. It is often used to assess the level of business confidence and future economic prospects. Reports from organizations such as the World Bank, IMF, or national investment agencies can provide insights into the importance of investment in economic development.
Share Prices	(OECD, 2023g)	Share prices, or stock market indices, are used to track the performance of the stock market and can provide indications of investor sentiment and overall market conditions. Publications from financial institutions, stock exchanges, or academic journals in finance can provide literature on the significance of share prices in analyzing economic trends and investor behavior.
Unemployment	(OECD, 2023h)	The unemployment rate is defined as the percentage of the Labour force actively looking for employment while being unemployed. It is a crucial indicator of labor market conditions and can reflect changes in economic performance and job creation. Reports from national labor market agencies, the International Labour Organization (ILO), or academic studies on labor economics can provide literature on the significance of the unemployment rate in economic analysis.
Unit-Labour-Costs	(OECD, 2023i)	Unit labor costs represent the labor costs associated with producing one unit of output and are an important measure of labor productivity and cost competitiveness. Publications from international organizations or academic research, provide insights into the significance of unit labor costs in analyzing economic performance and competitiveness.
Producer Price Indice	(OECD, 2023f)	Measured in annual growth rate. Producer price indices in manufacturing measure the rate of change in prices of products sold as they leave the producer. They exclude any taxes, transport, and trade margins that the purchaser may have to pay. PPIs provide measures of average movements of prices received by the producers of various commodities.

Table 1- Variables description and source

## 1.6. DATA COLLECTION AND PREPARATION

In this chapter, the process for data collection, preparation and transformation needed to apply the testing procedures is presented. The data for this study was collected from the OECD website, which serves as a reliable source of economic indicators for various countries. The dataset includes information for each chosen variable across multiple countries.

The data collection process presented some difficulties as not all countries were initially in the scope of the study present data for the selected variables, do not present it in the period of the analysis or do not present it with the required granularity (quarter data).

Acronym	Country Name	CPI	GDP	HDI	IND_PROD	Investment	Labour cost	share Prices	PPI	Unemployment
ISL	Iceland	-	-	No Data	-	-	No Data	-	No Data	-
EST	Estonia	-	-	No Data	-	-	-	-	-	-
ARG	Argentina	-	-	No Data	No Data	-	No Data	No Data	-	No Data
BRA	Brazil	-	-	No Data	-	-	No Data	-	-	No Data
SVK	Slovak Republic	-	-	No Data	-	-	-	-	-	-
MEX	Mexico	-	-	-	-	-	No Data	-	-	-
ISR	Israel	-	-	No Data	-	-	-	-	-	-
TUR	Turkey	-	-	No Data	-	-	-	-	-	-
IND	India	-	-	No Data	-	-	No Data	-	-	No Data
LVA	Latvia	-	-	No Data	-	-	-	-	-	-
IDN	Indonesia	-	-	No Data	No Data	-	No Data	-	No Data	No Data
LUX	Luxembourg	-	-	No Data	-	-	-	-	No Data	-
ZAF	South Africa	-	-	No Data	No Data	-	No Data	-	-	No Data
RUS	Russia	-	-	No Data	-	-	No Data	-	-	No Data
CHE	Switzerland	-	-	No Data	-	-	-	-	No Data	-
NZL	New Zealand	-	-	No Data	-	-	-	-	-	-
CHN	China	-	-	No Data	No Data	No Data	No Data	-	No Data	No Data
CHL	Chile	-	-	-	-	-	No Data	-	-	-
COL	Colombia	-	-	No Data	-	-	No Data	-	-	-
LTU	Lithuania	-	-	No Data	-	-	-	No Data	-	-
SAU	Saudi Arabia	-	-	No Data	No Data	No Data	No Data	No Data	-	No Data
BGR	Bulgaria	No Data	-	No Data	-	-	No Data	-	-	No Data
ROU	Romania	No Data	-	No Data	-	-	No Data	-	No Data	No Data
CRI	Costa Rica	-	-	No Data	No Data	-	No Data	No Data	-	-
HRV	Croatia	No Data	-	No Data	-	-	No Data	-	-	No Data
OECD	OECD Europe	-	-	No Data	-	-	No Data	No Data	-	No Data
G-7	G7 Countries	-	-	No Data	-	-	No Data	No Data	-	-
G-20	G20 Countries	-	-	No Data	No Data	No Data	No Data	No Data	No Data	No Data
EA19	Euro Area 19	-	-	No Data	-	-	-	-	-	-
EU27_2020	EU27 2020	-	-	No Data	-	-	No Data	No Data	-	-
OECD	OECD	-	-	-	-	-	-	No Data	No Data	-

Table 2- countries and variables including cases where there was no available data.

After data collection, the data was imported into the R software for further analysis. The necessary columns, namely "LOCATION," "TIME," and "Value," were retained as they provide information about the country, quarter, and indicators' value, respectively. This selection allowed for the focus on relevant aspects of the data.

To facilitate the organization and analysis of the data, the table was pivoted from a wide format to a long format. This transformation involved reshaping the data so that the quarters were arranged as rows, while the countries were represented as columns. By adopting this structure, it became easier to examine and compare the indicators across different countries and time periods.

The timeframe chosen for the analysis is the first quarter of 2010 to the second quarter of 2022, which was chosen to allow for an adequate period before the Covid-19 pandemic and give as much time as possible after the potential structural changes during the Covid-19 pandemic, which is the focus of this study. As not all the time series had data available within this timeframe, for some variables (CPI, Industrial Production, and Unemployment), the analysis begins in 2011 or 2012.

Upon completing the removal of unnecessary columns, data cleaning and filtering process. The resulting dataset now represents concise and relevant set of information for the analysis of structural breaks. To facilitate further analysis, individual time series data frames were created for each country. These data frames contain the indicators' values over time, allowing for a country-specific examination of structural breaks during the Covid-19 period.

To meet the prerequisite of stationarity for the analysis of structural breaks in time series data, a rigorous stationarity test was conducted. The Augmented Dickey-Fuller (ADF) test was selected for this

purpose, employing a significance level of 5%. Prior to the application of transformations, the time series data exhibited non-stationarity.

Logarithmic transformation was applied to certain variables, such as CPI and Share Prices, to stabilize variance and reduce the impact of extreme values. By taking the logarithm of these series, we mitigated heteroscedasticity and ensured that the data conformed more closely to the assumptions of linear models. First-order differencing was performed for variables including GDP, HDI, Investment, and Unit Labor Costs. This difference removes the linear trend and periodic fluctuations from the data, contributing to the stationarity of the series. In cases where the first-order difference did not eliminate autocorrelation or non-stationarity, as observed in Share Prices and Unemployment, a second-order difference was employed. The second difference involves subtracting the first difference from itself, effectively removing the first-order trends, and further stabilizing the series. Lastly, detrending was applied to variables like CPI, IND\_PROD, Share Prices, Unemployment, and PPI. This procedure aimed to remove long-term trends and seasonality from the data. By detrending these series, we ensured that the structural breaks analysis focused on identifying changes that couldn't be attributed to these longer-term trends. The table below resumes the transformations made to the series and the result of ADF test.

<b>Variable:</b>	<b>Log</b>	<b>Differentiation:</b>	<b>Detrend:</b>	<b>ADF p-value &lt; 0,05:</b>
CPI	No	1 <sup>st</sup> order	Yes	Yes
GDP	No	1 <sup>st</sup> order	No	Yes
HDI	No	1 <sup>st</sup> order	No	Yes
IPI	Yes	1 <sup>st</sup> order	Yes	Yes
Investment	No	1 <sup>st</sup> order	No	Yes
Share Prices	Yes	2 <sup>nd</sup> order	No	Yes
Unemployment	Yes	2 <sup>nd</sup> order	Yes	Yes
ULC	No	2 <sup>nd</sup> order	No	Yes
PPI	No	2 <sup>nd</sup> order	No	Yes

Table 3- Transformations to time-series

By organizing the data into stationary time series data frames, it became possible to explore the dynamics and patterns of each country's economic indicators before and after the Covid-19 pandemic, with the confounding effects of non-stationarity addressed. This granular approach facilitates a comprehensive analysis of structural breaks and provides insights into their potential impacts on economic performance.

Additionally to information about the countries, information about the responses imposed by each country to the breakout of Covid-19 was collected from Oxford's "Covid-19 Government Response Tracker" dataset (Hale et al., 2021) and Variation in government responses to Covid-19 working paper.

**1.7. DATA MODELLING**

To comprehend the underlying patterns and dynamics of the univariate time series, it is imperative to model the data. Time series data possesses a sequential nature and temporal structure, comprising components such as trend, seasonality, cycle, and residuals. In this study, the ARIMA (Autoregressive Integrated Moving Average) model was chosen as the modeling framework.

The determination of the appropriate autoregressive and moving average orders was facilitated by analyzing the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF). The challenge to model the series arose with the number of series for each variable, so it was necessary to find the best model that would fit most series for a given variable. To test the fit of each model, the Ljung-Box Test and the root Mean Squared Error (RMSE) were calculated. The Ljung-Box test allows to test the presence of autocorrelation in the residuals, which is important to understand as the BP model does not allow for autocorrelation in the errors for models with lagged dependent variables as regressors (Bai & Perron, 2003). In addition to these measures, the Root Mean Squared Error (RMSE) was calculated. RMSE quantifies predictive accuracy, with a lower RMSE indicating better model predictions in relation to actual data. The RMSE assist in assessing model quality and comparing different models. The results of the chosen models are demonstrated in the next tables.

Country	CPI				GDP				HDI			
	ARIMA Model:	Ljung-box	RMSE	Num Obs	ARIMA Model:	Ljung-box	RMSE	Num Obs	ARIMA Model:	Ljung-box	RMSE	Num Obs
AUS	(3, 1, 3)	0,25	0,23	46	(1, 1, 1)	0,86	0,65	50	(2, 1, 2)	0,92	0,86	50
AUT	(3, 1, 3)	0,80	0,16	46	(1, 1, 1)	0,89	1,05	50	(2, 1, 2)	0,97	1,28	50
BEL	(3, 1, 3)	0,57	0,20	46	(1, 1, 1)	1,00	0,82	50	(2, 1, 2)	0,72	0,92	50
CAN	(3, 1, 3)	0,51	0,17	46	(1, 1, 1)	1,00	0,89	50	(2, 1, 2)	0,82	0,92	50
CZE	(3, 1, 3)	0,95	0,24	46	(1, 1, 1)	1,00	0,90	50	(2, 1, 2)	0,94	1,17	50
DNK	(3, 1, 3)	0,98	0,15	46	(1, 1, 1)	1,00	0,69	50	(2, 1, 2)	0,76	1,74	50
FIN	(3, 1, 3)	0,98	0,15	46	(1, 1, 1)	1,00	0,86	50	(2, 1, 2)	0,82	0,79	50
FRA	(3, 1, 3)	0,83	0,11	46	(1, 1, 1)	1,00	1,18	50	(2, 1, 2)	0,94	0,54	50
DEU	(3, 1, 3)	0,58	0,18	46	(1, 1, 1)	0,99	0,92	50	(2, 1, 2)	0,28	0,56	50
GRC	(3, 1, 3)	0,30	0,29	46	(1, 1, 1)	1,00	1,45	50				
HUN	(3, 1, 3)	0,75	0,32	46	(1, 1, 1)	1,00	1,14	50	(2, 1, 2)	0,98	1,70	50
ISL	(3, 1, 3)	0,76	0,24	46	(1, 1, 1)	0,23	2,12	50				
IRL	(3, 1, 3)	0,98	0,19	46	(1, 1, 1)	0,89	2,65	50	(2, 1, 2)	1,00	1,39	50
ITA	(3, 1, 3)	0,60	0,15	46	(1, 1, 1)	1,00	1,11	50	(2, 1, 2)	1,00	0,82	50
JPN	(3, 1, 3)	0,84	0,21	46	(1, 1, 1)	0,98	0,91	50				
KOR	(3, 1, 3)	0,18	0,15	46	(1, 1, 1)	0,48	0,50	50				
LUX	(3, 1, 3)	0,66	0,16	46	(1, 1, 1)	0,27	1,05	50				
MEX	(3, 1, 3)	0,68	0,21	46	(1, 1, 1)	1,00	1,18	50	(2, 1, 2)	0,41	1,70	50
NLD	(3, 1, 3)	0,92	0,19	46	(1, 1, 1)	0,99	0,74	50	(2, 1, 2)	0,95	0,93	50
NZL	(3, 1, 3)	0,38	0,24	46	(1, 1, 1)	0,98	0,99	50				
NOR	(3, 1, 3)	0,35	0,21	46	(1, 1, 1)	0,94	0,91	50				
POL	(3, 1, 3)	0,53	0,27	46	(1, 1, 1)	0,96	0,93	50	(2, 1, 2)	0,97	1,16	50
PRT	(3, 1, 3)	0,97	0,20	46	(1, 1, 1)	1,00	1,40	50	(2, 1, 2)	0,94	1,23	50
SVK	(3, 1, 3)	0,98	0,23	46	(1, 1, 1)	1,00	0,85	50				
ESP	(3, 1, 3)	0,14	0,23	46	(1, 1, 1)	1,00	1,35	50	(2, 1, 2)	1,00	1,56	50
SWE	(3, 1, 3)	0,93	0,16	46	(1, 1, 1)	1,00	0,93	50	(2, 1, 2)	0,36	0,88	50
CHE	(3, 1, 3)	0,84	0,14	46	(1, 1, 1)	1,00	0,66	50				
TUR	(3, 1, 3)	0,99	1,14	46	(1, 1, 1)	0,98	1,60	50				
GBR	(3, 1, 3)	0,98	0,14	46	(1, 1, 1)	1,00	1,30	50	(2, 1, 2)	0,48	0,89	50
USA	(3, 1, 3)	0,79	0,24	46	(1, 1, 1)	1,00	0,71	50		1,00	1,39	50
BRA	(3, 1, 3)	0,47	0,28	46	(1, 1, 1)	1,00	1,11	50				
CHL	(3, 1, 3)	0,20	0,21	46	(1, 1, 1)	1,00	1,42	50				
CHN	(3, 1, 3)	0,83	0,23	46								
EST	(3, 1, 3)	0,63	0,30	46	(1, 1, 1)	0,99	0,96	50				
IND	(3, 1, 3)	0,86	0,45	46	(1, 1, 1)	0,83	1,84	50				
IDN	(3, 1, 3)	0,31	0,32	46	(1, 1, 1)	0,99	0,45	50				
ISR	(3, 1, 3)	0,91	0,19	46	(1, 1, 1)	1,00	1,01	50				
RUS												
SVN	(3, 1, 3)	0,68	0,21	46	(1, 1, 1)	1,00	1,26	50		0,89	1,12	50
ZAF	(3, 1, 3)	0,53	0,26	46	(1, 1, 1)	0,99	1,06	50				
COL	(3, 1, 3)	0,78	0,20	46	(1, 1, 1)	0,94	1,38	50				
LVA	(3, 1, 3)	0,68	0,34	46	(1, 1, 1)	0,86	1,02	50				
SAU	(3, 1, 3)	0,65	0,53	46	(1, 1, 1)	0,75	1,47	50				
ARG					(1, 1, 1)	1,00	1,93	50				
LTU	(3, 1, 3)	0,38	0,32	46	(1, 1, 1)	1,00	0,73	50				
BGR					(1, 1, 1)	1,00	0,63	50				
ROU					(1, 1, 1)	1,00	1,13	50				
HRV					(1, 1, 1)	1,00	1,36	50				
CRI					(1, 1, 1)	0,96	0,98	50				

Table 4- Ljung-Box RMSE tests: CPI, GDP and HDI

Country	Industrial production				Investment				Share Prices			
	ARIMA Model:	Ljung-box	RMSE	Num Obs	ARIMA Model:	Ljung-box	RMSE	Num Obs	ARIMA Model:	Ljung-box	RMSE	Num Obs
AUS	(4, 1, 3)	0,79	0,00	46	(0, 1, 3)	0,99	1,49	50	(2, 2, 3)	0,64	0,03	49
AUT	(4, 1, 3)	0,99	0,01	46	(0, 1, 3)	0,84	1,79	50	(2, 2, 3)	0,96	0,05	49
BEL	(4, 1, 3)	0,99	0,01	46	(0, 1, 3)	0,98	2,33	50	(2, 2, 3)	0,45	0,04	49
CAN	(4, 1, 3)	0,91	0,01	46	(0, 1, 3)	1,00	1,96	50	(2, 2, 3)	0,74	0,04	49
CZE	(4, 1, 3)	1,00	0,01	46	(0, 1, 3)	0,78	1,09	50	(2, 2, 3)	0,80	0,05	49
DNK	(4, 1, 3)	0,56	0,01	46	(0, 1, 3)	0,88	1,95	50	(2, 2, 3)	0,93	0,04	49
FIN	(4, 1, 3)	1,00	0,01	46	(0, 1, 3)	0,52	1,65	50	(2, 2, 3)	0,94	0,05	49
FRA	(4, 1, 3)	1,00	0,01	46	(0, 1, 3)	1,00	1,80	50	(2, 2, 3)	0,29	0,05	49
DEU	(4, 1, 3)	1,00	0,01	46	(0, 1, 3)	1,00	1,38	50	(2, 2, 3)	0,47	0,05	49
GRC	(4, 1, 3)	0,87	0,01	46	(0, 1, 3)	0,61	6,95	50	(2, 2, 3)	0,88	0,09	49
HUN	(4, 1, 3)	1,00	0,01	46	(0, 1, 3)	0,98	3,40	50	(2, 2, 3)	0,94	0,05	49
ISL					(0, 1, 3)	0,82	7,49	50	(2, 2, 3)	0,76	0,04	49
IRL	(4, 1, 3)	0,94	0,03	46	(0, 1, 3)	0,70	35,62	50	(2, 2, 3)	0,95	0,05	49
ITA	(4, 1, 3)	1,00	0,01	46	(0, 1, 3)	1,00	2,17	50	(2, 2, 3)	0,67	0,06	49
JPN	(4, 1, 3)	1,00	0,01	46	(0, 1, 3)	0,42	1,06	50	(2, 2, 3)	0,95	0,05	49
KOR	(4, 1, 3)	1,00	0,01	46	(0, 1, 3)	0,50	1,48	50	(2, 2, 3)	0,52	0,04	49
LUX	(4, 1, 3)	1,00	0,01	46	(0, 1, 3)	0,85	6,23	50	(2, 2, 3)	0,93	0,07	49
MEX					(0, 1, 3)	1,00	2,78	50	(2, 2, 3)	0,97	0,04	49
NLD	(4, 1, 3)	0,96	0,01	46	(0, 1, 3)	1,00	6,66	50	(2, 2, 3)	0,18	0,04	49
NZL	(4, 1, 3)	1,00	0,01	46	(0, 1, 3)	1,00	2,61	50	(2, 2, 3)	0,55	0,03	49
NOR	(4, 1, 3)	0,93	0,01	46	(0, 1, 3)	0,79	2,47	50	(2, 2, 3)	0,07	0,04	49
POL	(4, 1, 3)	0,71	0,01	46	(0, 1, 3)	0,23	2,08	50	(2, 2, 3)	0,37	0,04	49
PRT	(4, 1, 3)	1,00	0,01	46	(0, 1, 3)	0,99	2,67	50	(2, 2, 3)	0,68	0,05	49
SVK	(4, 1, 3)	0,99	0,01	46	(0, 1, 3)	0,39	4,85	50	(2, 2, 3)	0,89	0,03	49
ESP	(4, 1, 3)	1,00	0,01	46	(0, 1, 3)	1,00	2,10	50	(2, 2, 3)	0,53	0,06	49
SWE	(4, 1, 3)	0,99	0,01	46	(0, 1, 3)	0,94	1,91	50	(2, 2, 3)	0,84	0,04	49
CHE	(4, 1, 3)	0,97	0,01	46	(0, 1, 3)	0,95	1,15	50	(2, 2, 3)	0,58	0,03	49
TUR	(4, 1, 3)	0,71	0,02	46	(0, 1, 3)	0,95	3,69	50	(2, 2, 3)	0,65	0,06	49
GBR	(4, 1, 3)	1,00	0,01	46	(0, 1, 3)	1,00	2,39	50	(2, 2, 3)	0,57	0,03	49
USA	(4, 1, 3)	1,00	0,01	46	(0, 1, 3)	0,99	0,86	50	(2, 2, 3)	0,75	0,03	49
BRA	(4, 1, 3)	1,00	0,01	46	(0, 1, 3)	0,91	3,13	50	(2, 2, 3)	0,84	0,06	49
CHL	(4, 1, 3)	0,94	0,01	46	(0, 1, 3)	0,92	3,21	50	(2, 2, 3)	0,97	0,05	49
CHN									(2, 2, 3)	0,68	0,06	49
EST	(4, 1, 3)	0,93	0,02	46	(0, 1, 3)	0,85	8,22	50	(2, 2, 3)	0,97	0,04	49
IND	(4, 1, 3)	1,00	0,02	46	(0, 1, 3)	1,00	5,00	50	(2, 2, 3)	0,81	0,05	49
IDN					(0, 1, 3)	1,00	0,67	50	(2, 2, 3)	0,85	0,04	49
ISR	(4, 1, 3)	0,98	0,01	46	(0, 1, 3)	0,58	2,20	50	(2, 2, 3)	0,37	0,03	49
RUS						0,77	2,22	50	(2, 2, 3)	0,97	0,05	49
SVN	(4, 1, 3)	0,99	0,01	46	(0, 1, 3)	0,51	2,56	50	(2, 2, 3)	0,96	0,04	49
ZAF					(0, 1, 3)	1,00	2,50	50	(2, 2, 3)	0,86	0,04	49
COL	(4, 1, 3)	1,00	0,01	46	(0, 1, 3)	1,00	3,93	50	(2, 2, 3)	1,00	0,05	49
LVA	(4, 1, 3)	0,99	0,01	46	(0, 1, 3)	0,85	3,44	50	(2, 2, 3)	0,91	0,04	49
SAU												
ARG					(0, 1, 3)	1,00	5,04	50				
LTU		1,00	0,01	46	(0, 1, 3)	0,94	2,53	50				
BGR	(4, 1, 3)	0,99	0,01	46	(0, 1, 3)	0,87	2,50	50	(2, 2, 3)	0,88	0,05	49
ROU	(4, 1, 3)	0,97	0,01	46	(0, 1, 3)	0,75	3,35	50	(2, 2, 3)	0,94	0,05	49
HRV	(4, 1, 3)	0,72	0,01	46	(0, 1, 3)	1,00	2,86	50	(2, 2, 3)	0,91	0,04	49
CRI	(4, 1, 3)				(0, 1, 3)	0,13	3,46	50				

Table 5- Ljung-Box RMSE tests: IND\_PROD, Investment and Share Prices

Country	Unemployment				Unit Labour Costos				Produce Price indice			
	ARIMA Model:	Ljung-box	RMSE	Num Obs	ARIMA Model:	Ljung-box	RMSE	Num Obs	ARIMA Model:	Ljung-box	RMSE	Num Obs
AUS	(3, 2, 3)	0,88	0,02	45	(2, 2, 2)	0,84	0,83	49				
AUT	(3, 2, 3)	1,00	0,03	45	(2, 2, 2)	1,00	0,85	49	(4, 1, 4)	0,93	0,70	49
BEL	(3, 2, 3)	0,82	0,02	45	(2, 2, 2)	0,92	0,69	49	(4, 1, 4)	0,85	1,83	49
CAN	(3, 2, 3)	1,00	0,03	45	(2, 2, 2)	0,87	0,74	49				
CZE	(3, 2, 3)	0,77	0,02	45	(2, 2, 2)	0,38	1,03	49	(4, 1, 4)	0,66	0,97	49
DNK	(3, 2, 3)	0,58	0,02	45	(2, 2, 2)	0,98	0,64	49	(4, 1, 4)	0,90	0,59	49
FIN	(3, 2, 3)	0,84	0,02	45	(2, 2, 2)	0,94	0,90	49	(4, 1, 4)	1,00	0,95	49
FRA	(3, 2, 3)	0,99	0,01	45	(2, 2, 2)	0,97	0,53	49	(4, 1, 4)	0,89	0,94	49
DEU	(3, 2, 3)	0,83	0,01	45	(2, 2, 2)	1,00	0,78	49	(4, 1, 4)	0,81	0,49	49
GRC	(3, 2, 3)	0,99	0,01	45	(2, 2, 2)	0,96	1,49	49	(4, 1, 4)	0,95	2,56	49
HUN	(3, 2, 3)	1,00	0,02	45	(2, 2, 2)	0,93	1,48	49	(4, 1, 4)	0,88	1,74	49
ISL	(3, 2, 3)	0,98	0,01	45					(4, 1, 4)	0,21	4,07	49
IRL	(3, 2, 3)	0,90	0,02	45	(2, 2, 2)	0,95	3,04	49	(4, 1, 4)	0,52	1,02	49
ITA	(3, 2, 3)	0,99	0,01	45	(2, 2, 2)	0,12	0,63	49	(4, 1, 4)	0,96	0,84	49
JPN	(3, 2, 3)	0,45	0,01	45	(2, 2, 2)	0,64	1,00	49	(4, 1, 4)	0,49	0,97	49
KOR	(3, 2, 3)	0,33	0,02	45	(2, 2, 2)	0,62	1,06	49	(4, 1, 4)	0,30	1,36	49
LUX	(3, 2, 3)	0,99	0,02	45	(2, 2, 2)	0,42	1,25	49	(4, 1, 4)	0,61	1,93	49
MEX	(3, 2, 3)	0,89	0,02	45					(4, 1, 4)	0,78	1,07	49
NLD	(3, 2, 3)	0,98	0,02	45	(2, 2, 2)	1,00	0,97	49	(4, 1, 4)	0,89	1,61	49
NZL	(3, 2, 3)	0,84	0,03	45	(2, 2, 2)	0,82	1,34	49				
NOR	(3, 2, 3)	0,93	0,03	45	(2, 2, 2)	0,31	0,93	49	(4, 1, 4)	0,92	0,98	49
POL	(3, 2, 3)	0,68	0,02	45	(2, 2, 2)	0,87	1,21	49	(4, 1, 4)	0,92	0,93	49
PRT	(3, 2, 3)	0,91	0,02	45	(2, 2, 2)	1,00	1,23	49	(4, 1, 4)	0,94	1,32	49
SVK	(3, 2, 3)	0,84	0,01	45					(4, 1, 4)	0,67	0,94	49
ESP	(3, 2, 3)	0,93	0,01	45	(2, 2, 2)	1,00	1,01	49	(4, 1, 4)	0,92	1,22	49
SWE	(3, 2, 3)	0,99	0,01	45	(2, 2, 2)	0,74	0,92	49				
CHE	(3, 2, 3)	0,92	0,02	45	(2, 2, 2)	0,86	0,50	49	(4, 1, 4)	0,98	0,45	49
TUR	(3, 2, 3)	0,06	0,02	45	(2, 2, 2)	0,94	2,34	49	(4, 1, 4)	0,91	2,54	49
GBR	(3, 2, 3)	0,95	0,01	45	(2, 2, 2)	1,00	1,46	49	(4, 1, 4)	0,87	0,85	49
USA	(3, 2, 3)	1,00	0,04	45	(2, 2, 2)	0,60	0,72	49				
BRA												
CHL	(3, 2, 3)	0,94	0,03	45								
CHN												
EST	(3, 2, 3)	0,46	0,04	45	(2, 2, 2)	0,63	1,47	49	(4, 1, 4)	1,00	0,91	49
IND												
IDN												
ISR	(3, 2, 3)	0,99	0,03	45	(2, 2, 2)	0,70	0,90	49	(4, 1, 4)	0,97	1,64	49
RUS												
SVN	(3, 2, 3)	0,55	0,03	45	(2, 2, 2)	1,00	1,20	49	(4, 1, 4)	0,72	0,45	49
ZAF									(4, 1, 4)	0,96	1,21	49
COL	(3, 2, 3)	0,96	0,03	45					(4, 1, 4)	1,00	0,76	49
LVA	(3, 2, 3)	0,98	0,02	45	(2, 2, 2)	0,83	1,24	49	(4, 1, 4)	0,91	0,61	49
SAU												
ARG												
LTU	(3, 2, 3)	0,80	0,02	45	(2, 2, 2)	0,99	0,97	49	(4, 1, 4)	0,82	1,97	49
BGR												
ROU												
HRV												
CRI		0,93	1,28	47					(4, 1, 4)	0,95	1,26	49

Table 6- Ljung-Box RMSE tests: Unemployment, ULC and PPI

## 1.8. TESTING

After preprocessing the time series data and ensuring stationarity, the analysis focused on detecting structural breaks using the "strucchange" package in R. Structural breaks refer to periods in the data where a significant change occurs, indicating a shift in the underlying dynamics of the series.

To identify these breaks, the BP test is used, which is a widely used method in the field. This test considers the time component of the series as an independent variable, treating it as a regressor in the model. By incorporating the temporal structure of the data, this approach enhances the accuracy of breakpoint detection and enables the identification of structural changes. The model can be written as:

$$ts = \beta_0 + \beta_1 * time + \sum_{i=1}^k \beta_i * X_{it} + \phi(\beta) * \theta(\beta) * \varepsilon_t \quad (6)$$

Where:

- $ts$ : The dependent variable (the univariate time series);
- $time$ : The regressor, representing time.
- $\beta_0$ : The intercept coefficient, representing the baseline level of the dependent variable.
- $\beta_1$ : The coefficient associated with the regressor, representing the slope or trend of the dependent variable over time.
- $\phi(\beta)$ : Autoregressive polynomial of ARIMA model.
- $\theta(\beta)$ : Moving average polynomial of ARIMA model.
- $\varepsilon$ : The error term, representing the random variability or residuals in the model.

In the BP test, the choice of the bandwidth (size of the data window relative to sample size) parameter ( $h$ ) is crucial. This parameter determines the sensitivity of the test in detecting breaks. We considered a value of 0.15, which has been widely adopted and recommended in previous studies. This value strikes a balance between capturing smaller, potentially spurious breaks and detecting larger, meaningful structural changes.

After conducting the structural break tests, the analysis focused on further investigating the time series that exhibited the presence of structural breaks. We calculated the break dates, which indicate the specific time points at which the identified breakpoints occur. These break dates provide valuable information regarding the timing of structural changes within the time series, enabling a more detailed investigation of their potential causes and implications.

To gain deeper insights into the nature of the detected breaks, additional tests were employed: the Recursive Estimates (RE) (Kuan & Chen, 1994) and Moving Estimates (ME) (Chu et al., 1995b) tests.

The Moving Estimate (ME) test is a statistical method used to identify breaks or changes in the mean or level of a time series. It achieves this by analyzing moving residuals, which are the differences between the observed values and the estimated values based on a moving average or other predictive models. The ME test calculates cumulative sums of these moving residuals and compares them against critical values to determine if there are statistically significant shifts in the mean. By monitoring the cumulative sums, the ME test can detect changes in the overall level or average value of the time series.

The Recursive Estimates (RE) (Kuan & Chen, 1994) test, on the other hand, focuses on detecting breaks in the variance or volatility of a time series. It combines information about both the mean and variance by using recursive residuals. Recursive residuals are the differences between the observed values and the predictions made by recursively updating a model based on past data points. The RE test calculates cumulative sums of these recursive residuals and compares them against critical values to identify significant variations in the variance or volatility of the time series. By analyzing the cumulative sums of the recursive residuals, the RE test can detect changes in the dispersion or variability of the time series.

To gain deeper insights into the breakpoints and accurately detect changes in the variance or volatility of the time series, several additional tests were employed alongside the RE test. These tests include OLS CUSUM, OLS MOSUM, Recursive CUSUM, and Recursive MOSUM. The OLS CUSUM test sums the between the estimated coefficients and their respective means over the sample period to identify

when there are significant deviations in the coefficients from their historical means, indicating a possible change. The OLS MOSUM test cumulatively sums these squared residuals over time to detect any significant changes in the mean of the squared residuals, indicating shifts in the model. The Recursive CUSUM recursively updates the parameters based on past data points and calculates the cumulative sum of the squared residuals; if significant deviations in the squared residuals from their historical mean are found, it indicates a structural break. The recursive MOSUM test focuses on the cumulative sum of the mean squared residuals; it detects shifts in the mean squared residuals, making it more sensitive to changes in the time series' predictive performance.

When employing a comprehensive approach to analyzing structural breaks in a time series, the combination of the ME test, RE test, and other tests such as the Bai and Perron test, allows for a more thorough investigation. This integrated analysis helps in identifying and understanding significant changes in both the mean and variance of the time series, providing insights into the underlying dynamics and factors driving these observed structural changes.

## **1.9. CLUSTER ANALYSIS**

In this subsection an overview of the data and methods used for the cluster analysis will be presented.

The break dates obtained during the testing procedures were saved in a data frame. Additionally, data on Testing, facial coverings mandates, cancelling of public events, closing of public transport, school closures and stay-at-home mandates was added from the Oxford's "Covid-19 Government Response Tracker" dataset (Hale et al., 2021). As the dataset of government responses does not contain aggregated information on G7, G20, OECD, OECD, EU 27 or EA19, and because this analysis focuses on the specific countries, these were disregarded from the initial break dates dataset. The final dataset used in the analysis contains the variables that demonstrate to have at least one break date, and the respective break, the stringency index, that encompasses the government's covid response regarding closures, economic support, public information campaigns, travel restrictions and healthcare policies. Additionally, the variables for testing and facial coverings were added as they are not incorporated in the index.

Country	Acronym	GDP	HDI	IND_PROD	Investment	Unit_labour_ costs	vaccination_2020	test_2020Q1	facial_coverings_ _20Q2	stringency_index_ 20Q2
South Korea	KOR	0	0	0	0	0	0	2	2	53,24
Australia	AUS	0	0	0	0	0	0	1	0	52,31
United Kingdom	GBR	0	0	3	0	0	3	1	2	71,3
Estonia	EST	0	0	0	0	0	1	1	1	37,96
Denmark	DNK	0	0	0	1	0	2	2	0	57,41
Spain	ESP	2	0	3	4	0	2	1	3	41,2
Japan	JPN	0	0	3	0	4	0	1	1	25,93
Hungary	HUN	0	0	0	0	4	1	1	2	49,07
Canada	CAN	4	0	0	0	0	2	2	2	68,98
Argentina	ARG	0	0	0	4	0	1	1	3	88,89
Slovenia	SVN	0	0	0	0	0	2	2	2	39,81
Finland	FIN	0	0	0	0	0	1	1	0	35,19
Brazil	BRA	0	0	0	0	0	0	1	4	77,31
Netherlands	NLD	0	0	0	0	0	0	1	2	59,26
United States	USA	0	0	3	0	0	1	1	4	68,98
Slovakia	SVK	0	0	0	0	0	1	2	3	38,89
Mexico	MEX	0	4	0	4	0	1	0	4	70,83
Belgium	BEL	0	0	0	4	0	1	1	2	51,85
Israel	ISR	0	0	0	0	0	3	1	3	69,44
India	IND	0	0	0	0	0	0	1	4	87,5
Latvia	LVA	0	0	0	0	0	1	1	2	50
Czechia	CZE	0	0	0	0	0	2	2	2	34,72
Poland	POL	0	0	0	0	0	2	1	2	50,93
Germany	DEU	0	0	4	0	0	2	1	2	63,43
Indonesia	IDN	0	0	0	4	0	0	1	4	62,5
South Africa	ZAF	0	0	0	0	0	0	2	3	76,85
Portugal	PRT	0	0	4	4	0	2	2	2	60,65
Italy	ITA	0	3	4	4	0	2	2	4	67,59
Austria	AUT	0	0	0	0	0	2	2	2	50
Switzerland	CHE	0	0	0	4	0	1	1	1	35,19
New Zealand	NZL	0	0	0	0	0	0	1	0	22,22
Chile	CHL	0	0	0	0	0	1	2	2	81,02
Sweden	SWE	3	0	3	0	0	2	1	0	59,26
France	FRA	4	4	4	4	0	0	1	2	51,85
Greece	GRC	0	0	0	0	0	2	0	2	44,44
Colombia	COL	0	0	0	4	0	0	1	4	87,04
Lithuania	LTU	0	0	0	0	0	2	2	0	37,04
Bulgaria	BGR	0	0	3	0	0	1	1	2	41,67
Romania	ROU	0	0	0	0	0	1	1	0	48,15
Costa Rica	CRI	1	0	0	0	0	3	1	2	73,61
Ireland	IRL	0	0	0	1	0	0	1	0	44,44
Iceland	ISL	0	0	0	0	0	2	2	0	39,81
Turkey	TUR	0	0	0	4	0	0	2	4	63,89
China	CHN	0	0	0	0	0	1	3	2	78,24
Saudi Arabia	SAU	0	0	0	0	0	3	2	3	71,3
Norway	NOR	0	0	0	0	0	1	1	0	40,74
Croatia	HRV	0	0	0	0	0	2	1	0	54,63
Luxembourg	LUX	0	0	4	0	0	2	1	2	27,78

Table 7- Break dates and restrictions Data frame

The values '0', '1', '2', '3' and '4' represent no break, break in Q1 2020, Q2 2020, Q3 2020 and Q4 2020, respectively. The stringency index represents the government's response to Covid-19, having values between '0' and '100', with the highest representing the strictest.

The remaining variables have values from 0-4, representing the various degrees of those restrictions, with '0' being the lowest and '4' the highest.

	GDP	HDI	IND_PROD	Investment	Unit Labour Costs	Vaccination	Test	Facial Coverings	Stringency Index
0	No Break	No Break	No Break	No Break	No Break	No availability	No testing policy.	No policy	
1	Break in Q1	Break in Q1	Break in Q1	Break in Q1	Break in Q1	Availability for ONE of following: key workers/ clinically vulnerable groups / elderly groups	Only those who both (a) have symptoms and also (b) meet specific criteria (e.g. keyworkers, admitted to hospital, came into contact with a known case, returned from overseas).	Recommended	Measured from 0
2	Break in Q2	Break in Q2	Break in Q2	Break in Q2	Break in Q2	Availability for TWO of following: key workers/ clinically vulnerable groups / elderly groups	Testing of anyone showing COVID-19 symptoms	Required in some specified shared/public spaces outside the home with other people present, or some situations when social distancing not possible	- 100. A higher score indicates a stricter response
3	Break in Q3	Break in Q3	Break in Q3	Break in Q3	Break in Q3	Availability for ALL of following: key workers/ clinically vulnerable groups / elderly groups	Open public testing (e.g. "drive through" testing available to asymptomatic people).	Required in all shared/public spaces outside the home with other people present or all situations when social distancing not possible	(i.e. 100 = strictest response)
4	Break in Q4	Break in Q4	Break in Q4	Break in Q4	Break in Q4	Availability for all three plus partial additional availability (select broad	-	Required outside the home at all times regardless of location or presence of other people	
5	-	-	-	-	-	Universal availability	-	-	

Table 8- Break dates and restrictions Data frame

## RESULTS AND DISCUSSION

In this section the results from the tests for structural breaks will be presented, starting with the break dates detected during covid, followed by different tests of statistical significance and finally the clustering analysis.

The BP test procedure was applied to all countries and variables available. It enabled to assess if there were breakpoints present, and if so, when were the break dates. The results are shown in the table below, where the break dates are shown to the series when a breakpoint was detected.

	Break Dates									
	GDP	HDI	IND_PROD	Investment	Unemployment	Unit_labour_costs	Producer Price indice	CPI	Share_Prices	
KOR	-	-	-	-	-	-	-	-	-	-
AUS	-	-	-	-	-	-	-	-	-	-
GBR	-	-	2020 Q3	-	-	-	-	-	-	-
EST	-	-	-	-	-	-	-	-	-	-
DNK	-	-	-	2020 Q1	-	-	-	-	-	-
ESP	2020 Q2	-	2020 Q3	2020 Q4	-	-	-	-	-	-
JPN	-	-	2020 Q3	-	-	2020 Q4	-	-	-	-
HUN	-	-	-	-	-	2020 Q4	-	-	-	-
CAN	2020 Q4	-	-	-	-	-	-	-	-	-
ARG	-	-	-	2020 Q4	-	-	-	-	-	-
SVN	-	-	-	-	-	-	-	-	-	-
FIN	-	-	-	-	-	-	-	-	-	-
BRA	-	-	-	-	-	-	-	-	-	-
NLD	-	-	-	-	-	-	-	-	-	-
USA	-	-	2020 Q3	-	-	-	-	-	-	-
SVK	-	-	-	-	-	-	-	-	-	-
MEX	-	2020 Q4	-	2020 Q4	-	-	-	-	-	-
BEL	-	-	-	2020 Q4	-	-	-	-	-	-
ISR	-	-	-	-	-	-	-	-	-	-
IND	-	-	-	-	-	-	-	-	-	-
LVA	-	-	2020 Q3	-	-	-	-	-	-	-
CZE	-	-	-	-	-	-	-	-	-	-
POL	-	-	-	-	-	-	-	-	-	-
DEU	-	-	2020 Q4	-	-	-	-	-	-	-
IDN	-	-	-	2020 Q4	-	-	-	-	-	-
ZAF	-	-	-	-	-	-	-	-	-	-
PRT	-	-	2020 Q4	2020 Q4	-	-	-	-	-	-
ITA	-	2020 Q3	2020 Q4	2020 Q4	-	-	-	-	-	-
AUT	-	-	-	-	-	-	-	-	-	-
CHE	-	-	-	2020 Q4	-	-	-	-	-	-
NZL	-	-	-	-	-	-	-	-	-	-
CHL	-	-	-	-	-	-	-	-	-	-
SWE	2020 Q3	-	2020 Q3	-	-	-	-	-	-	-
FRA	2020 Q4	2020 Q4	2020 Q4	2020 Q4	-	-	-	-	-	-
GRC	-	-	-	-	-	-	-	-	-	-
OECD	-	-	-	2020 Q4	-	-	-	-	-	-
G-7	-	-	2020 Q4	2020 Q4	-	-	-	-	-	-
G-20	-	-	-	-	-	-	-	-	-	-
COL	-	-	-	2020 Q4	-	-	-	-	-	-
EA19	-	-	-	-	-	-	-	-	-	-
LTU	-	-	-	-	-	-	-	-	-	-
BGR	-	-	2020 Q3	-	-	-	-	-	-	-
ROU	-	-	-	-	-	-	-	-	-	-
EU27_2020	-	-	-	-	-	-	-	-	-	-
CRI	2020 Q1	-	-	-	-	-	-	-	-	-
IRL	-	-	-	2020 Q1	-	-	-	-	-	-
ISL	-	-	-	-	-	-	-	-	-	-
TUR	-	-	-	2020 Q4	-	-	-	-	-	-
CHN	-	-	-	-	-	-	-	-	-	-
SAU	-	-	-	-	-	-	-	-	-	-
NOR	-	-	-	-	-	-	-	-	-	-
HRV	-	-	-	-	-	-	-	-	-	-
LUX	-	-	2020 Q4	-	-	-	-	-	-	-
LUX	-	-	-	-	-	-	-	-	-	-

Table 9- Break dates

There are multiple variables that present structural breaks, GDP, HDI, Industrial Production, Investment and Unit Labor costs.

The variable GDP shows five breaks in Spain, Sweden, Canada, France, and Costa Rica, with two of them happening during the 4<sup>th</sup> Quarter of 2020. Household Disposable Income shows to have had three breaks in Mexico, France, and Italy with the latter happening in the 3<sup>rd</sup> Quarter. Industrial Production was also affected, with 12 countries showing breaks, most of which being from the European continent, as well as Japan and USA. In terms of timing, half of those breaks were during the 3<sup>rd</sup> Quarter and the other half during the 4<sup>th</sup>. Investment shows 15 breaks with Argentina, Mexico, Indonesia, and Colombia being from outside Europe, most of them happened during the 4<sup>th</sup> Quarter, while Ireland's and Denmark's happened during the 1<sup>st</sup> Quarter. Unit Labor Costs show the presence of a break in Spain and Japan, both during the 4<sup>th</sup> Quarter. The rest of the variables do not show the presence of breaks during 2020. After assessing if there were breakpoints in the data, the Recursive and Moving Estimates tests were used with a significance level of 5%, to test if the breakpoints were statistically significant or not. The tables below show the p-values of the tests, with the tests that are statistically significant highlighted:

	RE								
	GDP	HDI	IND_PROD	Investment	Unemployment	Unit_labour_costs	PPI	CPI	Share_Prices
KOR	-	-	-	-	-	-	-	-	-
AUS	-	-	-	-	-	-	-	-	-
GBR	-	-	0,00	-	-	-	-	-	-
EST	-	-	-	-	-	-	-	-	-
DNK	-	-	-	0,01	-	-	-	-	-
ESP	0,00	-	0,00	0,00	-	-	-	-	-
JPN	-	-	0,00	-	-	0,00	-	-	-
OECD	-	-	-	0,00	-	-	-	-	-
HUN	-	-	-	-	-	0,00	-	-	-
CAN	0,00	-	-	-	-	-	-	-	-
ARG	-	-	-	0,00	-	-	-	-	-
SVN	-	-	-	-	-	-	-	-	-
FIN	-	-	-	-	-	-	-	-	-
BRA	-	-	-	-	-	-	-	-	-
NLD	-	-	-	-	-	-	-	-	-
USA	-	-	0,00	-	-	-	-	-	-
SVK	-	-	-	-	-	-	-	-	-
MEX	-	0,00	-	0,00	-	-	-	-	-
BEL	-	-	-	0,02	-	-	-	-	-
ISR	-	-	-	-	-	-	-	-	-
IND	-	-	-	-	-	-	-	-	-
LVA	-	-	-	-	-	-	-	-	-
CZE	-	-	-	-	-	-	-	-	-
POL	-	-	-	-	-	-	-	-	-
DEU	-	-	0,00	-	-	-	-	-	-
IDN	-	-	-	0,00	-	-	-	-	-
ZAF	-	-	-	-	-	-	-	-	-
PRT	-	-	0,00	0,00	-	-	-	-	-
ITA	-	0,00	0,00	0,00	-	-	-	-	-
AUT	-	-	-	-	-	-	-	-	-
CHE	-	-	-	0,00	-	-	-	-	-
NZL	-	-	-	-	-	-	-	-	-
CHL	-	-	-	-	-	-	-	-	-
SWE	0,00	-	0,00	-	-	-	-	-	-
FRA	0,00	0,00	0,00	0,00	-	-	-	-	-
GRC	-	-	-	-	-	-	-	-	-
OECD	-	-	-	0,00	-	-	-	-	-
G-7	-	-	0,00	0,00	-	-	-	-	-
G-20	-	-	-	-	-	-	-	-	-
COL	-	-	-	0,00	-	-	-	-	-
EA19	-	-	-	-	-	-	-	-	-
LTU	-	-	-	-	-	-	-	-	-
BGR	-	-	0,00	-	-	-	-	-	-
ROU	-	-	-	-	-	-	-	-	-
EU27_2020	-	-	-	-	-	-	-	-	-
CRI	0,00	-	-	-	-	-	-	-	-
IRL	-	-	-	0,05	-	-	-	-	-
ISL	-	-	-	-	-	-	-	-	-
TUR	-	-	-	0,00	-	-	-	-	-
CHN	-	-	-	-	-	-	-	-	-
SAU	-	-	-	-	-	-	-	-	-
NOR	-	-	-	-	-	-	-	-	-
HRV	-	-	-	-	-	-	-	-	-
RUS	-	-	-	-	-	-	-	-	-
LUX	-	-	0,00	-	-	-	-	-	-

	ME								
	GDP	HDI	IND_PROD	Investment	Unemployment	Unit_labour_costs	PPI	CPI	Share_Prices
KOR	-	-	-	-	-	-	-	-	-
AUS	-	-	-	-	-	-	-	-	-
GBR	-	-	0,01	-	-	-	-	-	-
EST	-	-	-	-	-	-	-	-	-
DNK	-	-	-	0,04	-	-	-	-	-
ESP	0,01	-	0,02	0,01	-	-	-	-	-
JPN	-	-	0,01	-	-	0,01	-	-	-
OECD	-	-	-	0,01	-	-	-	-	-
HUN	-	-	-	-	-	0,01	-	-	-
CAN	0,01	-	-	-	-	-	-	-	-
ARG	-	-	-	0,01	-	-	-	-	-
SVN	-	-	-	-	-	-	-	-	-
FIN	-	-	-	-	-	-	-	-	-
BRA	-	-	-	-	-	-	-	-	-
NLD	-	-	-	-	-	-	-	-	-
USA	-	-	0,01	-	-	-	-	-	-
SVK	-	-	-	-	-	-	-	-	-
MEX	-	0,02	-	0,01	-	-	-	-	-
BEL	-	-	-	0,04	-	-	-	-	-
ISR	-	-	-	-	-	-	-	-	-
IND	-	-	-	-	-	-	-	-	-
LVA	-	-	-	-	-	-	-	-	-
CZE	-	-	-	-	-	-	-	-	-
POL	-	-	-	-	-	-	-	-	-
DEU	-	-	0,03	-	-	-	-	-	-
IDN	-	-	-	0,01	-	-	-	-	-
ZAF	-	-	-	-	-	-	-	-	-
PRT	-	-	0,02	0,06	-	-	-	-	-
ITA	-	0,01	0,01	0,01	-	-	-	-	-
AUT	-	-	-	-	-	-	-	-	-
CHE	-	-	-	0,03	-	-	-	-	-
NZL	-	-	-	-	-	-	-	-	-
CHL	-	-	-	-	-	-	-	-	-
SWE	0,01	-	0,01	-	-	-	-	-	-
FRA	0,01	0,01	0,01	0,01	-	-	-	-	-
GRC	-	-	-	-	-	-	-	-	-
OECD	-	-	-	0,04	-	-	-	-	-
G-7	-	-	0,01	0,01	-	-	-	-	-
G-20	-	-	-	-	-	-	-	-	-
COL	-	-	-	0,02	-	-	-	-	-
EA19	-	-	-	-	-	-	-	-	-
LTU	-	-	-	-	-	-	-	-	-
BGR	-	-	0,06	-	-	-	-	-	-
ROU	-	-	-	-	-	-	-	-	-
EU27_2020	-	-	-	-	-	-	-	-	-
CRI	0,01	-	-	-	-	-	-	-	-
IRL	-	-	-	0,02	-	-	-	-	-
ISL	-	-	-	-	-	-	-	-	-
TUR	-	-	-	0,01	-	-	-	-	-
CHN	-	-	-	-	-	-	-	-	-
SAU	-	-	-	-	-	-	-	-	-
NOR	-	-	-	-	-	-	-	-	-
HRV	-	-	-	-	-	-	-	-	-
RUS	-	-	-	-	-	-	-	-	-
LUX	-	-	0,01	-	-	-	-	-	-

Table 10- RE and ME p-values

Regarding the Recursive estimates, all breakpoints are statistically significant, with p-values very close to zero apart from the break found in Ireland for Investment, where the p-value is of 0.05 and therefore the significance of this break is rejected. Regarding the Moving estimates, Ireland's break in Investment shows to be statistically significant, while the breaks for Bulgaria's Industrial Production show a p-value of 0.06, resulting in the rejection of the null hypothesis of the breaks not being statistically significant.

To complement the analysis, the statistical significance of the breaks was tested using the OLS-CUSUM, OLS-MOSUM, Recursive CUSUM and Recursive MOSUM tests.

	Rec MOSUM								
	GDP	HDI	IND_PROD	Investment	Unemployment	Unit_labour_costs	PPI	CPI	Share_Prices
KOR	-	-	-	-	-	-	-	-	-
AUS	-	-	-	-	-	-	-	-	-
GBR	-	-	0,518	-	-	-	-	-	-
EST	-	-	-	-	-	-	-	-	-
DNK	-	-	-	0,766	-	-	-	-	-
ESP	0,042	-	0,472	0,575	-	-	-	-	-
JPN	-	-	0,445	-	-	-	-	-	-
OECD	-	-	-	0,501	-	-	-	-	-
HUN	-	-	-	-	-	0,279	-	-	-
CAN	0,465	-	-	-	-	-	-	-	-
ARG	-	-	-	0,595	-	-	-	-	-
SVN	-	-	-	-	-	0,571	-	-	-
FIN	-	-	-	-	-	-	-	-	-
BRA	-	-	-	-	-	-	-	-	-
NLD	-	-	-	-	-	-	-	-	-
USA	-	-	0,521	-	-	-	-	-	-
SVK	-	-	-	-	-	-	-	-	-
MEX	-	0,470	-	0,527	-	-	-	-	-
BEL	-	-	-	0,769	-	-	-	-	-
ISR	-	-	-	-	-	-	-	-	-
IND	-	-	-	-	-	-	-	-	-
LVA	-	-	-	-	-	-	-	-	-
CZE	-	-	-	-	-	-	-	-	-
POL	-	-	-	-	-	-	-	-	-
DEU	-	-	0,413	-	-	-	-	-	-
IDN	-	-	-	0,339	-	-	-	-	-
ZAF	-	-	-	-	-	-	-	-	-
PRT	-	-	0,573	0,698	-	-	-	-	-
ITA	-	0,489	0,509	0,633	-	-	-	-	-
AUT	-	-	-	-	-	-	-	-	-
CHE	-	-	-	0,560	-	-	-	-	-
NZL	-	-	-	-	-	-	-	-	-
CHL	-	-	-	-	-	-	-	-	-
SWE	0,186	-	0,530	-	-	-	-	-	-
FRA	0,418	0,531	0,458	0,661	-	-	-	-	-
GRC	-	-	-	-	-	-	-	-	-
OECD	-	-	-	0,643	-	-	-	-	-
G-7	-	-	0,419	0,567	-	-	-	-	-
G-20	-	-	-	-	-	-	-	-	-
COL	-	-	-	0,619	-	-	-	-	-
EA19	-	-	-	-	-	-	-	-	-
LTU	-	-	-	-	-	-	-	-	-
BGR	-	-	0,587	-	-	-	-	-	-
ROU	-	-	-	-	-	-	-	-	-
EU27_2020	-	-	-	-	-	-	-	-	-
CRI	0,572	-	-	-	-	-	-	-	-
IRL	-	-	-	0,769	-	-	-	-	-
ISL	-	-	-	-	-	-	-	-	-
TUR	-	-	-	0,681	-	-	-	-	-
CHN	-	-	-	-	-	-	-	-	-
SAU	-	-	-	-	-	-	-	-	-
NOR	-	-	-	-	-	-	-	-	-
HRV	-	-	-	-	-	-	-	-	-
LUX	-	-	0,442	-	-	-	-	-	-

	Rec CUSUM								
	GDP	HDI	IND_PROD	Investment	Unemployment	Unit_labour_cost:	PPI	CPI	Share_Prices
KOR	-	-	-	-	-	-	-	-	-
AUS	-	-	-	-	-	-	-	-	-
GBR	-	-	0,971	-	-	-	-	-	-
EST	-	-	-	-	-	-	-	-	-
DNK	-	-	-	0,978	-	-	-	-	-
ESP	0,699	-	0,968	0,966	-	-	-	-	-
JPN	-	-	0,975	-	-	-	-	-	-
OECD	-	-	-	0,969	-	-	-	-	-
HUN	-	-	-	-	-	0,962	-	-	-
CAN	0,953	-	-	-	-	-	-	-	-
ARG	-	-	-	0,973	-	-	-	-	-
SVN	-	-	-	-	-	0,939	-	-	-
FIN	-	-	-	-	-	-	-	-	-
BRA	-	-	-	-	-	-	-	-	-
NLD	-	-	-	-	-	-	-	-	-
USA	-	-	0,970	-	-	-	-	-	-
SVK	-	-	-	-	-	-	-	-	-
MEX	-	0,964	-	0,970	-	-	-	-	-
BEL	-	-	-	0,975	-	-	-	-	-
ISR	-	-	-	-	-	-	-	-	-
IND	-	-	-	-	-	-	-	-	-
LVA	-	-	-	-	-	-	-	-	-
CZE	-	-	-	-	-	-	-	-	-
POL	-	-	-	-	-	-	-	-	-
DEU	-	-	0,964	-	-	-	-	-	-
IDN	-	-	-	0,956	-	-	-	-	-
ZAF	-	-	-	-	-	-	-	-	-
PRT	-	-	0,968	0,829	-	-	-	-	-
ITA	-	0,401	0,974	0,977	-	-	-	-	-
AUT	-	-	-	-	-	-	-	-	-
CHE	-	-	-	0,970	-	-	-	-	-
NZL	-	-	-	-	-	-	-	-	-
CHL	-	-	-	-	-	-	-	-	-
SWE	0,826	-	0,976	-	-	-	-	-	-
FRA	0,966	0,886	0,962	0,973	-	-	-	-	-
GRC	-	-	-	-	-	-	-	-	-
OECD	-	-	-	0,978	-	-	-	-	-
G-7	-	-	0,964	0,972	-	-	-	-	-
G-20	-	-	-	-	-	-	-	-	-
COL	-	-	-	0,963	-	-	-	-	-
EA19	-	-	-	-	-	-	-	-	-
LTU	-	-	-	-	-	-	-	-	-
BGR	-	-	0,973	-	-	-	-	-	-
ROU	-	-	-	-	-	-	-	-	-
EU27_2020	-	-	-	-	-	-	-	-	-
CRI	0,546	-	-	-	-	-	-	-	-
IRL	-	-	-	0,979	-	-	-	-	-
ISL	-	-	-	-	-	-	-	-	-
TUR	-	-	-	0,980	-	-	-	-	-
CHN	-	-	-	-	-	-	-	-	-
SAU	-	-	-	-	-	-	-	-	-
NOR	-	-	-	-	-	-	-	-	-
HRV	-	-	-	-	-	-	-	-	-
LUX	-	-	0,960	-	-	-	-	-	-

Table 11- Rec MOSUM and CUSUM p-values

For the recursive Moving Sum and cumulative Sum, there is a single breakpoint for GDP in Spain that is statistically significant for the Rec MOSUM, while the break does not appear to be statistically significant for the Rec CUSUM. This conflicting evidence indicates that the breakpoint occurred over an extended period rather than an instant change.

	OLS-MOSUM								
	GDP	HDI	IND_PROD	Investment	Unemployment	Unit_labour_costs	PPI	CPI	Share_Prices
KOR	-	-	-	-	-	-	-	-	-
AUS	-	-	-	-	-	-	-	-	-
GBR	-	-	0,613	-	-	-	-	-	-
EST	-	-	-	-	-	-	-	-	-
DNK	-	-	-	0,756	-	-	-	-	-
ESP	0,365	-	0,629	0,722	-	-	-	-	-
JPN	-	-	0,634	-	-	-	-	-	-
OECD	-	-	-	0,700	-	-	-	-	-
HUN	-	-	-	-	-	0,461	-	-	-
CAN	0,270	-	-	-	-	-	-	-	-
ARG	-	-	-	0,615	-	-	-	-	-
SVN	-	-	-	-	-	0,104	-	-	-
FIN	-	-	-	-	-	-	-	-	-
BRA	-	-	-	-	-	-	-	-	-
NLD	-	-	-	-	-	-	-	-	-
USA	-	-	0,630	-	-	-	-	-	-
SVK	-	-	-	-	-	-	-	-	-
MEX	-	0,429	-	0,639	-	-	-	-	-
BEL	-	-	-	0,763	-	-	-	-	-
ISR	-	-	-	-	-	-	-	-	-
IND	-	-	-	-	-	-	-	-	-
LVA	-	-	-	-	-	-	-	-	-
CZE	-	-	-	-	-	-	-	-	-
POL	-	-	-	-	-	-	-	-	-
DEU	-	-	0,684	-	-	-	-	-	-
IDN	-	-	-	0,574	-	-	-	-	-
ZAF	-	-	-	-	-	-	-	-	-
PRT	-	-	0,641	0,675	-	-	-	-	-
ITA	-	0,382	0,585	0,616	-	-	-	-	-
AUT	-	-	-	-	-	-	-	-	-
CHE	-	-	-	0,692	-	-	-	-	-
NZL	-	-	-	-	-	-	-	-	-
CHL	-	-	-	-	-	-	-	-	-
SWE	0,650	-	0,653	-	-	-	-	-	-
FRA	0,365	0,485	0,610	0,618	-	-	-	-	-
GRC	-	-	-	-	-	-	-	-	-
OECD	-	-	-	0,729	-	-	-	-	-
G-7	-	-	0,645	0,708	-	-	-	-	-
G-20	-	-	-	-	-	-	-	-	-
COL	-	-	-	0,650	-	-	-	-	-
EA19	-	-	-	-	-	-	-	-	-
LTU	-	-	-	-	-	-	-	-	-
BGR	-	-	0,622	-	-	-	-	-	-
ROU	-	-	-	-	-	-	-	-	-
EU27_2020	-	-	-	-	-	-	-	-	-
CRI	0,013	-	-	-	-	-	-	-	-
IRL	-	-	-	0,719	-	-	-	-	-
ISL	-	-	-	-	-	-	-	-	-
TUR	-	-	-	0,580	-	-	-	-	-
CHN	-	-	-	-	-	-	-	-	-
SAU	-	-	-	-	-	-	-	-	-
NOR	-	-	-	-	-	-	-	-	-
HRV	-	-	-	-	-	-	-	-	-
LUX	-	-	0,605	-	-	-	-	-	-

	OLS-CUSUM								
	GDP	HDI	IND_PROD	Investment	Unemployment	Unit_labour_costs	PPI	CPI	Share_Prices
KOR	-	-	-	-	-	-	-	-	-
AUS	-	-	-	-	-	-	-	-	-
GBR	-	-	0,997	-	-	-	-	-	-
EST	-	-	-	-	-	-	-	-	-
DNK	-	-	-	1,000	-	-	-	-	-
ESP	0,667	-	0,999	1,000	-	-	-	-	-
JPN	-	-	0,999	-	-	-	-	-	-
OECD	-	-	-	1,000	-	-	-	-	-
HUN	-	-	-	-	-	0,728	-	-	-
CAN	0,587	-	-	-	-	-	-	-	-
ARG	-	-	-	0,996	-	-	-	-	-
SVN	-	-	-	-	-	0,800	-	-	-
FIN	-	-	-	-	-	-	-	-	-
BRA	-	-	-	-	-	-	-	-	-
NLD	-	-	-	-	-	-	-	-	-
USA	-	-	0,993	-	-	-	-	-	-
SVK	-	-	-	-	-	-	-	-	-
MEX	-	0,932	-	0,998	-	-	-	-	-
BEL	-	-	-	1,000	-	-	-	-	-
ISR	-	-	-	-	-	-	-	-	-
IND	-	-	-	-	-	-	-	-	-
LVA	-	-	-	-	-	-	-	-	-
CZE	-	-	-	-	-	-	-	-	-
POL	-	-	-	-	-	-	-	-	-
DEU	-	-	0,997	-	-	-	-	-	-
IDN	-	-	-	0,952	-	-	-	-	-
ZAF	-	-	-	-	-	-	-	-	-
PRT	-	-	1,000	1,000	-	-	-	-	-
ITA	-	0,948	0,995	1,000	-	-	-	-	-
AUT	-	-	-	-	-	-	-	-	-
CHE	-	-	-	1,000	-	-	-	-	-
NZL	-	-	-	-	-	-	-	-	-
CHL	-	-	-	-	-	-	-	-	-
SWE	0,638	-	0,993	-	-	-	-	-	-
FRA	0,600	0,990	0,998	1,000	-	-	-	-	-
GRC	-	-	-	-	-	-	-	-	-
OECD	-	-	-	1,000	-	-	-	-	-
G-7	-	-	0,993	0,999	-	-	-	-	-
G-20	-	-	-	-	-	-	-	-	-
COL	-	-	-	1,000	-	-	-	-	-
EA19	-	-	-	-	-	-	-	-	-
LTU	-	-	-	-	-	-	-	-	-
BGR	-	-	0,965	-	-	-	-	-	-
ROU	-	-	-	-	-	-	-	-	-
EU27_2020	-	-	-	-	-	-	-	-	-
CRI	0,039	-	-	-	-	-	-	-	-
IRL	-	-	-	0,999	-	-	-	-	-
ISL	-	-	-	-	-	-	-	-	-
TUR	-	-	-	0,999	-	-	-	-	-
CHN	-	-	-	-	-	-	-	-	-
SAU	-	-	-	-	-	-	-	-	-
NOR	-	-	-	-	-	-	-	-	-
HRV	-	-	-	-	-	-	-	-	-
LUX	-	-	0,983	-	-	-	-	-	-

Table 12- OLS MOSUM and CUSUM p-values

When analyzing the breakpoints using the OLS-MOSUM and OLS-CUSUM tests, Costa Rica's breakpoints show to be statistically significant in both tests, suggesting the idea of the break occurring in both the mean and variance.

For the cluster analysis, data for covid responses was collected from oxford covid-19 government response tracker. The variables selected from this data source are vaccination, testing, facial coverings mandates, and stringency index. Additionally, the break dates for GDP, HDI, IPI, Investment, and unit labor costs were considered. A cluster analysis was performed to the data, but beforehand, the correlation between variables was assessed. There is no significant correlation between the economic and response's variables, apart from facial coverings, which has a correlation between 0.25 and 0.5 with HDI and Investment



Figure 2- Correlation Matrix

As there seems to not exist a significant correlation between variables, the cluster analysis did not group countries with breaks and without breaks separately. But there seems to be some differentiation between the number of breaks and the government’s response with the cluster each country is assigned to.

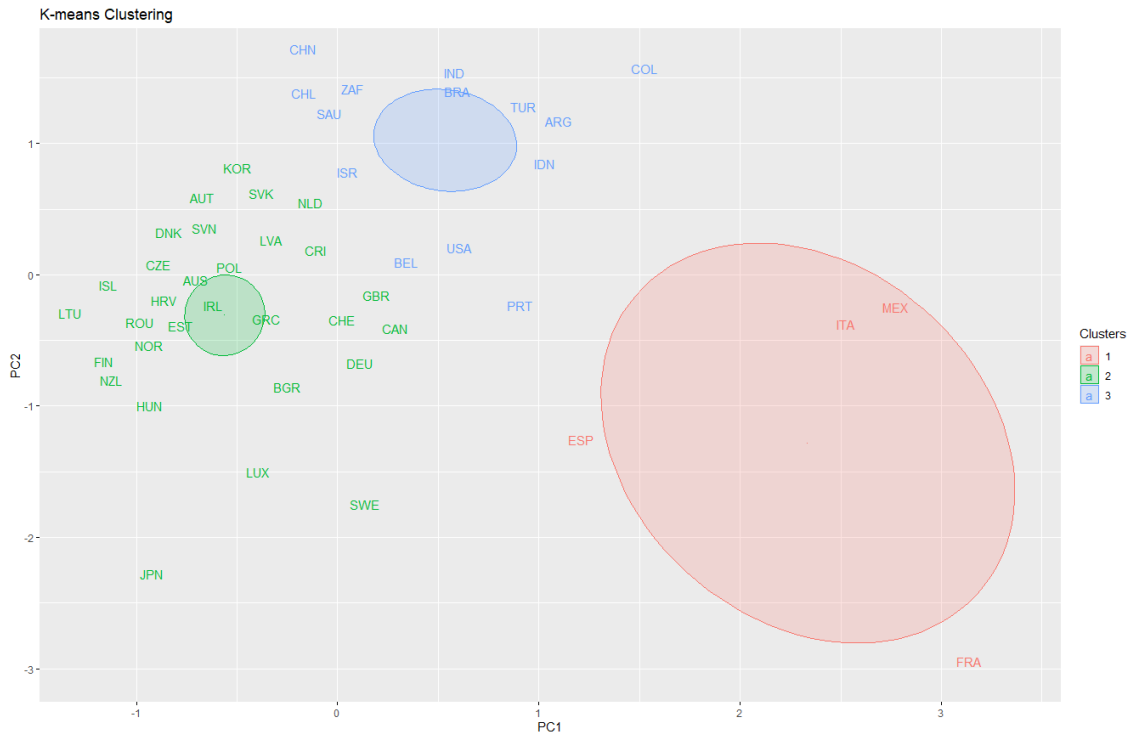


Figure 3- Cluster Plot

The cluster analysis result in three distinct clusters:

Cluster 1	ESP, MEX, ITA, FRA
Cluster 2	KOR, AUS, GBR, EST, DNK, JPN, HUN, CAN, SVN, FIN, NLD, SVK, LVA, CZE, POL, DEU, AUT, CHE, NZL, SWE, GRC, LTU, BGR, ROU, CRI, IRL, ISL, NOR, HRV, LUX
Cluster 3	ARG, BRA, USA, BEL, ISR, IND, IDN, ZAF, PRT, CHL, COL, TUR, CHN, SAU

Table 13- Clusters

The first Cluster's countries have two or more breaks and more restrict responses to covid, with Mexico being the only one with less than three breaks while having had a more restrict response, specially, regarding facial coverings and the stringency index. The second cluster is characterized by countries with a low number of breaks, less restrictive policy measures and more developed nations. Most of Europe, alongside Japan, New Zealand, South Korea, and Costa Rica are part of this group. The 3<sup>rd</sup> Cluster is formed by countries with a low number of breaks, a higher stringency index and more restrictive measures, particularly, facial covering mandates. Apart from Portugal and Belgium, it is comprised of American, Asian, and Arabian countries.

To complement the interpretation of the clustering analysis and to evaluate the quality and effectiveness of the solution, the silhouette score and inertia were calculated. Lower values of inertia indicate that the datapoints are closer to the center of the cluster indicating a well-defined cluster, and a silhouette score closer to one indicates that the datapoint is well matched to its own cluster, while values closer to zero indicate that the datapoint is closer to the edge of the cluster.

Silhouette_Score	Cluster	Neighbor	Silhouette_Score
ESP	1	2	0,045
MEX	1	3	0,420
ITA	1	3	0,427
FRA	1	3	0,458
KOR	2	3	0,091
AUS	2	3	0,619
GBR	2	3	0,272
EST	2	3	0,641
DNK	2	3	0,521
JPN	2	3	0,418
HUN	2	3	0,599
CAN	2	3	0,124
SVN	2	3	0,506
FIN	2	3	0,617
NLD	2	3	0,128
SVK	2	3	0,264
LVA	2	3	0,445
CZE	2	3	0,554
POL	2	3	0,489
DEU	2	3	0,325
AUT	2	3	0,350
CHE	2	3	0,433
NZL	2	3	0,585
SWE	2	1	0,363
GRC	2	3	0,583
LTU	2	3	0,580
BGR	2	3	0,502
ROU	2	3	0,638
CRI	2	3	0,116
IRL	2	3	0,632
ISL	2	3	0,581
NOR	2	3	0,631
HRV	2	3	0,633
LUX	2	3	0,484
ARG	3	2	0,589
BRA	3	2	0,595
USA	3	2	0,347
BEL	3	2	0,158
ISR	3	2	0,169
IND	3	2	0,602
IDN	3	2	0,564
ZAF	3	2	0,516
PRT	3	2	0,094
CHL	3	2	0,404
COL	3	2	0,541
TUR	3	2	0,609
CHN	3	2	0,354
SAU	3	2	0,341

Table 14- Silhouette Score

Country	Squared Distances
KOR	166,879
AUS	176,456
GBR	125,185
EST	189,805
DNK	174,061
ESP	410,545
JPN	656,026
HUN	258,507
CAN	145,288
ARG	384,857
SVN	172,295
FIN	264,001
BRA	271,532
NLD	132,907
USA	177,121
SVK	152,749
MEX	928,598
BEL	140,173
ISR	148,808
IND	340,789
LVA	132,052
CZE	180,670
POL	135,580
DEU	153,920
IDN	314,442
ZAF	278,793
PRT	207,215
ITA	803,959
AUT	165,263
CHE	133,509
NZL	318,189
CHL	236,108
SWE	385,989
FRA	1865,163
GRC	149,235
COL	513,042
LTU	277,178
BGR	169,787
ROU	204,197
CRI	119,908
IRL	171,324
ISL	264,901
TUR	362,319
CHN	313,177
SAU	208,524
NOR	235,820
HRV	195,825
LUX	289,484

Table 15- Inertia

In the cluster analysis, countries demonstrated varying degrees of alignment with their designated clusters, as indicated by silhouette scores and inertia values. Spain, Korea, and Portugal exhibited low silhouette scores, implying their proximity to the boundary between neighboring clusters. Moreover, Portugal and Korea displayed lower inertia, suggesting that their data points are closely concentrated around the cluster centers. These observations hint at potential similarities between clusters 2 and 3. Additionally, Belgium, Israel, Canada, Netherlands, and Croatia showed both low inertia and low silhouette scores, further underscoring shared characteristics within clusters 2 and 3. Conversely, Mexico, Italy, Japan, and France had medium silhouette scores and high inertia, implying their outlier status within the analysis, as they don't align entirely with their designated clusters. This analysis unveils nuances in cluster distinctions, with some countries being more adaptable to transitions between clusters, while others exhibiting unique characteristics that set them apart.

## CONCLUSIONS

This study successfully achieved its objective. Break points were identified during the pandemic period, most commonly the 3<sup>rd</sup> and 4<sup>th</sup> quarters of 2020. These breakpoints have been shown to be statistically significant, showing evidence of rejecting the null hypothesis of no break, in the recursive estimates and Moving Estimates test, but not for Recursive and OLS MOSUM and CUSUM tests. This indicates that there is a shift in the mean and variance for all variables with breaks.

As for the variables that experienced breaks during this period: contrary to the first intuition, the pandemic effects did not spread to unemployment, share prices and producer prices during 2020. This might be because of a medium to long term effect in those markets or because the consequences are not felt in the period used in this analysis. For example, other studies that analyzed share prices or stock returns with more granularity (daily or weekly), found structural breaks present, while with quarterly data, this effect is not felt. Unemployment is another variable that was expected to show some structural breaks, especially in the countries with fewer government policies or less robust safety nets in place, such as stimulus packages and business support, but this effect was not felt as no country shows structural breaks for unemployment during Covid-19.

Regarding the cluster analysis, the clusters formed do not clearly separate countries with and without breaks, pointing to no clear correlation between the country's response to Covid-19 and the number of breaks experienced. Although there is some grouping of countries with low number of breaks and less restrict government's responses, that does not mean that a less restrictive response lead to less structural breaks in the economic variables, as there are other cases with more flexible responses and more breaks, as is the case of France, Spain and to some degree Italy. Other countries that weren't as restrict had no breaks, such as South Korea, Estonia and Finland, and Chile and Brazil showed a higher stringency index and no Breakpoints.

The findings of this research offer a valuable contribution to our understanding of the economic consequences of global health crises. The ability to pinpoint specific periods of structural change in various economic variables equips policymakers and economists with crucial information for crafting targeted and effective responses to mitigate the adverse effects of such crises in the future.

It is important to acknowledge that this study represents a snapshot of the pandemic's impact during a particular timeframe. As more data becomes available, future research can delve deeper into the dynamics of the identified breakpoints. Additionally, conducting more granular analyses for each country and exploring a wider range of time periods will yield further insights and help in better identifying the precise breaking points. The analysis on countries such as Russia, China, Argentina, India, Indonesia, South Africa, Bulgaria, Romania, Costa Rica, Croatia, and Saudi Arabia needs more data to have more robust conclusions. These countries stopped reporting some or all the data for the variables in the study during 2021, not giving enough timeline after the covid-19 pandemic to actuarially assess the presence of structural breaks during this period.

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## APPENDIX A – COUNTRY’S ACRONYMS AND VARIABLES’ DESCRIPTIVE STATISTICS

<b>ARG</b>	Argentina
<b>AUS</b>	Australia
<b>AUT</b>	Austria
<b>BEL</b>	Belgium
<b>BGR</b>	Bulgaria
<b>BRA</b>	Brazil
<b>CAN</b>	Canada
<b>CHE</b>	Switzerland
<b>CHL</b>	Chile
<b>CHN</b>	China
<b>COL</b>	Colombia
<b>CRI</b>	Costa Rica
<b>CZE</b>	Czech Republic
<b>DEU</b>	Germany
<b>DNK</b>	Denmark
<b>EA19</b>	Euro Area (group of 19 European Union member countries that use the Euro as their currency)
<b>ESP</b>	Spain
<b>EST</b>	Estonia
<b>EU27_2020</b>	European Union (27 member countries as of the year 2020)
<b>FIN</b>	Finland
<b>FRA</b>	France
<b>G-20</b>	Group of Twenty
<b>G-7</b>	Group of Seven
<b>GBR</b>	United Kingdom (Great Britain)
<b>GRC</b>	Greece
<b>HRV</b>	Croatia
<b>HUN</b>	Hungary
<b>IDN</b>	Indonesia
<b>IND</b>	India
<b>IRL</b>	Ireland
<b>ISR</b>	Israel
<b>ITA</b>	Italy
<b>JPN</b>	Japan
<b>LTA</b>	Latvia
<b>LTU</b>	Lithuania
<b>LUX</b>	Luxembourg
<b>MEX</b>	Mexico
<b>NLD</b>	Netherlands
<b>NOR</b>	Norway
<b>NZL</b>	New Zealand
<b>OECD</b>	Organization for Economic Co-operation and Development
<b>OECDE</b>	European countries of OECD
<b>POL</b>	Poland
<b>PRT</b>	Portugal
<b>ROU</b>	Romania
<b>RUS</b>	Russia
<b>SAU</b>	Saudi Arabia
<b>SVK</b>	Slovakia
<b>SVN</b>	Slovenia
<b>SWE</b>	Sweden
<b>TUR</b>	Turkey
<b>USA</b>	United States of America
<b>ZAF</b>	South Africa

Table 16- Country’s Acronyms

Variable	Obs	Mean	Std. Dev.	Median	Trimmed	Mad	Min	Max	Range	Skew	Kurtosis	Std. Error	IQR
AUS	52	2,42	1,49	2,04	2,20	1,05	-0,35	7,83	8,18	1,75	3,79	0,21	1,37
AUT	52	2,40	2,00	1,91	1,98	0,80	0,56	10,59	10,03	2,69	7,28	0,28	1,09
BEL	52	2,38	2,39	1,90	1,90	1,27	-0,48	11,08	11,56	2,14	4,52	0,33	1,64
CAN	52	2,18	1,61	1,80	1,87	0,77	0,02	7,55	7,52	1,87	3,17	0,22	1,01
CZE	52	3,00	3,78	2,20	2,11	1,37	0,10	17,58	17,48	2,70	6,75	0,52	1,70
DNK	52	1,71	2,01	0,87	1,28	0,74	0,10	9,24	9,14	2,43	5,97	0,28	1,69
FIN	52	1,73	1,93	1,09	1,40	1,05	-0,34	8,87	9,20	1,91	3,76	0,27	1,73
FRA	52	1,42	1,35	1,17	1,21	1,03	-0,24	6,07	6,31	1,82	3,66	0,19	1,30
DEU	52	1,80	1,77	1,48	1,49	0,75	-0,92	8,58	9,50	2,08	4,74	0,25	0,97
GRC	52	1,26	3,21	0,45	0,77	2,16	-2,38	11,68	14,06	1,49	1,99	0,45	3,07
HUN	52	3,68	4,04	3,15	3,05	2,61	-1,06	22,73	23,79	2,59	8,88	0,56	3,08
ISL	52	3,61	2,05	3,17	3,32	1,74	1,07	9,67	8,60	1,20	0,92	0,28	2,33
IRL	52	1,18	2,34	0,50	0,77	0,89	-3,39	8,77	12,16	1,78	3,38	0,32	1,44
ITA	52	1,67	2,27	1,13	1,23	1,42	-0,48	11,75	12,23	2,42	6,82	0,31	1,95
JPN	52	0,53	1,16	0,30	0,38	0,84	-1,17	3,83	5,00	1,18	0,86	0,16	1,12
KOR	52	1,95	1,42	1,52	1,79	1,20	0,01	5,88	5,87	0,98	0,19	0,20	1,81
LUX	52	2,01	1,61	1,72	1,78	1,23	-0,08	7,06	7,14	1,41	1,98	0,22	1,68
MEX	52	4,35	1,49	3,97	4,16	0,99	2,27	8,52	6,24	1,10	0,47	0,21	1,45
NLD	52	2,32	2,46	1,65	1,77	1,10	0,00	12,26	12,26	2,65	6,95	0,34	1,57
NZL	52	2,20	1,94	1,55	1,86	0,85	0,08	7,30	7,22	1,46	1,03	0,27	1,08
NOR	52	2,43	1,36	2,13	2,26	1,14	0,36	6,74	6,38	1,33	2,05	0,19	1,50
POL	52	2,97	3,90	2,27	2,25	2,40	-1,50	17,33	18,83	2,10	4,75	0,54	3,21
PRT	52	1,59	2,23	0,77	1,17	1,06	-0,54	9,89	10,42	2,17	4,73	0,31	1,75
SVK	52	2,56	3,39	1,88	1,89	2,08	-0,75	15,21	15,96	2,22	5,06	0,47	2,83
ESP	52	1,81	2,42	1,52	1,40	1,83	-1,02	10,06	11,08	1,59	2,61	0,34	2,55
SWE	52	1,71	2,29	1,46	1,27	1,22	-0,35	11,56	11,90	2,58	7,42	0,32	1,89
CHE	52	0,23	1,03	0,05	0,12	0,82	-1,37	3,38	4,75	1,03	1,29	0,14	1,09
TUR	52	15,54	17,23	9,41	11,07	3,19	4,34	81,10	76,76	2,88	7,32	2,39	5,57
GBR	52	2,46	1,90	2,20	2,14	0,89	0,30	9,40	9,10	2,00	4,39	0,26	1,23
USA	52	2,44	2,03	1,89	2,07	0,96	-0,06	8,64	8,70	1,72	2,30	0,28	1,30
BRA	52	6,08	2,40	5,82	5,95	2,28	2,14	11,92	9,78	0,49	-0,56	0,33	2,97
CHL	52	3,75	2,65	2,93	3,25	1,14	-0,26	13,65	13,91	2,25	5,33	0,37	1,88
CHN	52	2,41	1,31	2,12	2,25	0,85	-0,11	6,44	6,55	1,16	1,40	0,18	1,03
EST	52	3,61	5,20	3,10	2,52	2,93	-1,15	23,77	24,92	2,39	5,80	0,72	3,43
IND	52	6,91	2,84	6,44	6,77	2,46	1,46	15,32	13,86	0,65	0,31	0,39	3,85
IDN	52	4,25	1,80	3,96	4,20	1,45	1,20	7,87	6,67	0,34	-0,76	0,25	2,18
ISR	52	1,23	1,60	1,23	1,09	1,82	-1,12	5,20	6,32	0,61	-0,47	0,22	2,16
RUS	49	6,66	3,42	6,36	6,20	2,85	2,25	16,21	13,95	1,24	1,30	0,49	3,48
SVN	52	1,77	2,39	1,55	1,34	1,26	-0,92	10,67	11,59	2,14	5,09	0,33	1,67
ZAF	52	5,12	1,22	5,07	5,13	1,21	2,33	7,92	5,60	0,01	-0,52	0,17	1,67
OECD	52	2,61	2,24	2,03	2,10	0,77	0,63	10,39	9,77	2,38	5,02	0,31	1,05
OECD	52	3,11	3,34	2,37	2,31	1,28	0,42	15,99	15,57	2,77	7,09	0,46	1,60
G-7	52	2,05	1,75	1,62	1,70	0,56	0,23	7,55	7,32	1,94	3,22	0,24	0,80
COL	52	4,12	2,37	3,37	3,72	1,34	1,56	12,63	11,07	1,71	2,63	0,33	1,58
LVA	52	2,73	4,84	1,88	1,75	2,37	-3,75	21,75	25,50	2,64	7,32	0,67	3,12
SAU	52	2,44	2,36	2,39	2,51	1,93	-3,20	7,00	10,20	-0,20	-0,35	0,33	2,78
EA19	52	1,90	2,17	1,42	1,46	1,30	-0,32	9,97	10,30	2,24	5,05	0,30	1,73
ARG	20	49,78	15,36	50,92	48,36	9,19	25,28	91,82	66,53	0,88	1,01	3,43	12,67
LTU	52	3,38	5,19	2,40	2,19	2,38	-1,57	22,72	24,29	2,61	6,42	0,72	2,72
CRI	48	2,83	2,09	2,44	2,88	2,69	-0,96	6,15	7,11	-0,04	-1,28	0,30	3,53
G-20	52	3,53	1,66	3,14	3,16	0,96	2,14	9,30	7,17	2,25	4,72	0,23	1,27
EU27_2020	52	2,07	2,36	1,51	1,57	1,35	-0,35	11,00	11,35	2,34	5,51	0,33	1,85

Table 17- Descriptive statistics – CPI

Variable	Obs	Mean	Std. Dev.	Median	Trimmed	Mad	Min	Max	Range	Skew	Kurtosis	Std. Error	IQR
KOR	51	0,73	0,79	0,74	0,79	0,40	-3,03	2,35	5,37	-2,09	8,40	0,11	0,67
AUS	51	0,64	1,37	0,65	0,66	0,34	-6,70	3,88	10,58	-2,52	14,66	0,19	0,47
ISL	51	0,64	2,93	0,95	0,85	2,86	-6,67	6,64	13,31	-0,55	-0,09	0,41	3,89
GBR	51	0,46	3,94	0,56	0,51	0,45	-20,99	16,61	37,60	-1,75	19,79	0,55	0,59
EST	51	0,83	1,54	0,89	0,93	0,95	-6,73	4,67	11,40	-2,03	9,58	0,22	1,25
DNK	51	0,49	1,36	0,50	0,48	0,56	-6,02	5,67	11,69	-0,97	11,65	0,19	0,75
ESP	51	0,25	3,63	0,37	0,32	0,68	-17,83	16,64	34,46	-0,68	17,25	0,51	0,88
JPN	51	0,20	1,66	0,21	0,28	0,85	-7,97	5,67	13,63	-1,67	11,08	0,23	1,05
OECD	51	0,50	2,03	0,55	0,55	0,27	-10,33	9,44	19,77	-1,31	20,07	0,28	0,38
NOR	51	0,44	1,42	0,53	0,47	0,95	-5,45	4,21	9,66	-0,99	4,78	0,20	1,28
HUN	51	0,71	2,79	0,93	0,83	0,75	-14,60	11,87	26,47	-1,98	19,71	0,39	1,17
CAN	51	0,51	2,12	0,59	0,62	0,57	-10,93	9,02	19,95	-1,84	18,73	0,30	0,71
ARG	51	0,37	3,29	0,59	0,48	1,66	-14,96	11,71	26,67	-1,20	9,40	0,46	2,23
SVN	51	0,57	2,62	0,61	0,62	0,88	-9,74	12,98	22,71	0,72	11,88	0,37	1,24
FIN	51	0,30	1,36	0,16	0,30	0,66	-6,26	4,95	11,21	-1,26	10,58	0,19	1,11
BRA	51	0,32	1,99	0,46	0,39	0,89	-8,71	7,95	16,66	-0,77	9,88	0,28	1,22
NLD	51	0,39	1,63	0,41	0,39	0,51	-7,94	6,29	14,23	-1,54	14,35	0,23	0,66
USA	51	0,54	1,72	0,60	0,58	0,40	-8,48	7,85	16,34	-1,32	18,19	0,24	0,51
SVK	51	0,61	1,86	0,62	0,62	0,49	-7,46	9,69	17,15	0,54	15,42	0,26	0,66
MEX	51	0,52	3,24	0,66	0,62	0,63	-17,77	13,08	30,85	-2,35	21,29	0,45	0,83
BEL	51	0,40	2,41	0,43	0,42	0,28	-11,40	11,76	23,15	-0,29	18,15	0,34	0,36
ISR	51	1,05	2,02	1,06	1,04	0,75	-8,78	8,86	17,63	-1,01	12,70	0,28	1,03
TUR	51	1,45	3,04	1,52	1,53	1,28	-10,37	15,65	26,02	0,74	11,17	0,43	1,72
IND	51	1,59	4,92	1,63	1,63	0,66	-22,56	22,59	45,15	-0,83	15,27	0,69	0,90
LVA	51	0,62	1,72	0,51	0,60	1,05	-6,94	5,76	12,70	-0,77	7,14	0,24	1,43
CZE	51	0,50	1,81	0,67	0,60	0,70	-8,85	6,95	15,80	-1,94	14,42	0,25	0,83
POL	51	0,91	1,89	1,00	0,99	0,64	-9,18	6,75	15,93	-2,38	15,08	0,26	0,83
DEU	51	0,40	1,99	0,47	0,43	0,54	-9,48	9,00	18,49	-0,83	15,98	0,28	0,77
IDN	51	1,14	1,29	1,26	1,28	0,17	-6,93	3,31	10,24	-4,67	27,44	0,18	0,24
LUX	51	0,60	1,77	0,51	0,56	1,25	-5,77	8,39	14,16	0,77	8,01	0,25	1,48
ZAF	51	0,41	3,19	0,47	0,51	0,52	-17,09	13,76	30,86	-1,79	20,71	0,45	0,67
RUS	47	0,43	1,14	0,48	0,43	0,69	-4,49	3,19	7,68	-1,14	5,86	0,17	0,88
PRT	51	0,27	3,23	0,47	0,32	0,55	-15,12	14,59	29,71	-0,44	14,75	0,45	0,98
ITA	51	0,11	2,85	0,19	0,13	0,44	-12,04	14,20	26,24	0,70	15,61	0,40	0,61
AUT	51	0,39	2,52	0,41	0,35	0,62	-11,43	11,35	22,79	-0,32	13,81	0,35	0,86
IRL	51	1,93	4,41	1,36	1,42	2,38	-5,59	21,02	26,61	1,86	5,59	0,62	3,31
CHE	51	0,44	1,52	0,51	0,46	0,43	-7,06	7,27	14,33	-0,59	16,52	0,21	0,50
NZL	51	0,75	2,62	0,78	0,77	0,59	-10,27	13,86	24,13	0,89	15,60	0,37	0,78
CHN	47	1,63	2,45	1,70	1,71	0,30	-10,30	11,80	22,10	-1,00	15,47	0,36	0,30
CHL	51	0,78	2,61	0,83	0,86	0,90	-13,31	6,68	20,00	-2,78	14,71	0,37	1,15
SWE	51	0,61	1,73	0,62	0,65	0,70	-8,05	7,34	15,39	-1,30	13,99	0,24	1,08
FRA	51	0,34	3,38	0,34	0,32	0,43	-13,58	18,43	32,01	1,54	18,90	0,47	0,60
GRC	51	-0,40	2,73	-0,11	-0,18	1,33	-13,36	5,29	18,65	-2,01	8,18	0,38	1,70
OECD	51	0,49	2,54	0,53	0,50	0,38	-12,17	12,33	24,50	-0,46	18,51	0,36	0,51
G-7	51	0,42	2,03	0,48	0,47	0,27	-10,20	9,50	19,69	-1,07	19,52	0,28	0,40
G-20	51	0,81	1,55	0,84	0,87	0,21	-6,22	7,91	14,14	-0,26	14,66	0,22	0,31
COL	51	0,94	3,13	0,82	0,96	0,62	-16,04	9,76	25,80	-2,47	15,82	0,44	0,81
EA19	51	0,34	2,49	0,42	0,37	0,38	-11,46	12,36	23,83	0,06	17,65	0,35	0,61
LTU	51	0,88	1,27	0,86	0,89	0,62	-5,26	6,07	11,33	-0,87	13,13	0,18	0,83
SAU	50	0,94	1,89	1,18	1,03	1,38	-4,96	5,73	10,69	-0,49	1,17	0,27	1,81
BGR	51	0,58	1,24	0,68	0,67	0,50	-4,85	3,61	8,45	-2,07	8,22	0,17	0,72
ROU	51	0,75	1,99	0,95	0,98	0,78	-9,57	4,72	14,29	-2,90	12,91	0,28	1,02
EU27_2020	51	0,39	2,35	0,49	0,42	0,38	-11,08	11,49	22,57	-0,26	17,85	0,33	0,55
CRI	51	0,85	1,57	0,83	0,94	0,81	-7,80	3,67	11,47	-3,02	15,49	0,22	1,23
HRV	51	0,44	2,79	0,45	0,44	1,30	-14,77	7,16	21,93	-2,62	15,70	0,39	1,76

Table 18- Descriptive statistics – GDP

Variable	Obs	Mean	Std. Dev.	Median	Trimmed	Mad	Min	Max	Range	Skew	Kurtosis	Std. Error	IQR
AUS	50	0,31	1,31	0,17	0,24	0,79	-2,65	4,16	6,81	0,57	1,30	0,19	1,09
AUT	50	-0,09	1,96	0,01	-0,08	1,53	-4,32	5,93	10,25	0,19	0,98	0,28	1,92
BEL	50	0,10	1,57	0,15	0,06	1,22	-4,44	4,42	8,86	0,10	0,86	0,22	1,59
CAN	50	0,35	1,94	0,17	0,25	0,92	-4,81	10,36	15,17	2,31	12,59	0,27	1,23
CZE	50	0,37	1,65	0,51	0,44	1,19	-4,39	3,91	8,30	-0,51	0,69	0,23	1,64
DNK	50	0,28	2,44	0,47	0,22	1,97	-5,93	5,74	11,67	0,04	0,11	0,34	2,66
FIN	50	0,15	1,13	0,06	0,11	0,98	-2,67	2,94	5,61	0,30	0,26	0,16	1,32
FRA	50	0,10	0,92	0,20	0,12	0,53	-2,57	3,97	6,54	0,75	5,50	0,13	0,72
DEU	50	0,27	0,91	0,30	0,26	0,73	-3,23	3,06	6,29	-0,36	3,99	0,13	0,89
GRC	47	-0,51	3,64	-0,54	-0,59	3,93	-7,53	7,32	14,85	0,26	-0,77	0,53	5,66
HUN	50	0,89	2,76	0,82	0,77	2,19	-8,73	12,07	20,80	0,59	5,74	0,39	2,86
IRL	50	0,21	1,94	0,14	0,21	1,64	-4,33	6,35	10,68	0,29	0,80	0,27	2,18
ITA	50	-0,04	1,29	0,05	-0,03	0,65	-4,47	5,89	10,36	0,88	9,44	0,18	0,88
JPN	45	0,15	1,88	0,09	0,12	0,49	-7,19	9,65	16,84	1,52	16,78	0,28	0,59
MEX	50	0,19	2,51	0,06	0,32	1,76	-10,70	4,89	15,59	-1,35	5,20	0,36	2,42
NLD	50	0,16	1,37	0,28	0,15	0,82	-3,29	3,36	6,65	-0,06	0,55	0,19	1,54
NOR	48	0,46	1,66	0,44	0,48	1,62	-3,99	3,97	7,96	-0,16	-0,04	0,24	2,27
POL	50	0,66	1,64	0,81	0,65	1,11	-2,68	6,24	8,92	0,37	1,44	0,23	1,67
PRT	50	0,07	1,63	0,25	0,10	1,76	-4,03	3,97	8,00	-0,14	-0,05	0,23	2,02
ESP	50	-0,07	2,47	-0,22	-0,13	1,22	-8,08	10,48	18,56	0,86	6,35	0,35	2,00
SWE	50	0,37	1,73	0,31	0,34	0,79	-4,43	7,46	11,89	0,73	5,63	0,25	1,04
GBR	50	0,13	1,18	-0,02	0,11	0,91	-2,96	2,46	5,42	0,20	-0,09	0,17	1,35
USA	50	0,43	2,66	0,48	0,38	0,62	-7,90	10,83	18,73	1,34	7,54	0,38	0,83
G7M	50	0,31	1,65	0,30	0,30	0,50	-4,92	6,59	11,51	1,28	7,40	0,23	0,63
CHL	37	0,49	10,45	-0,31	-0,95	2,76	-11,73	49,92	61,65	3,13	11,86	1,72	3,20
SVN	50	0,40	1,53	0,29	0,33	1,28	-2,52	5,79	8,31	0,86	1,92	0,22	1,67
OECD	50	0,35	1,07	0,38	0,34	0,38	-3,54	4,92	8,46	0,97	8,93	0,15	0,46

Table 19- Descriptive statistics – HDI

Variable	Obs	Mean	Std. Dev.	Median	Trimmed	Mad	Min	Max	Range	Skew	Kurtosis	Std. Error	IQR
AUS	50	100,12	8,92	101,82	100,61	11,36	83,88	111,39	27,51	-0,34	-1,35	1,26	17,08
AUT	50	105,38	9,67	100,80	104,67	6,88	88,93	128,97	40,04	0,59	-0,67	1,37	15,11
BEL	50	106,88	9,44	103,07	105,40	6,05	94,49	132,16	37,66	1,23	0,70	1,33	9,63
CAN	50	100,47	6,13	100,69	100,57	8,08	87,21	110,83	23,62	-0,13	-1,09	0,87	10,47
CZE	50	101,66	9,98	101,95	101,93	14,48	82,89	115,05	32,16	-0,10	-1,56	1,41	19,55
DNK	50	104,79	7,09	102,75	103,70	5,71	96,63	130,70	34,07	1,51	2,51	1,00	8,18
FIN	50	107,55	5,12	107,64	107,31	5,61	98,97	120,48	21,50	0,31	-0,51	0,72	7,98
FRA	50	100,03	3,59	100,00	100,28	2,53	80,30	104,90	24,60	-3,12	15,56	0,51	3,52
DEU	50	98,44	4,97	98,94	98,90	2,89	80,14	106,51	26,37	-1,27	2,89	0,70	3,96
GRC	50	106,63	6,15	106,13	106,24	5,60	96,87	120,51	23,64	0,47	-0,66	0,87	7,37
HUN	50	100,40	13,33	100,46	99,99	19,32	78,04	125,18	47,14	0,16	-1,36	1,89	25,59
ISL	32	91,15	6,41	90,87	91,18	6,32	77,60	105,98	28,38	0,03	-0,42	1,13	8,97
IRL	50	94,96	32,07	97,07	90,75	34,61	59,78	178,70	118,92	0,82	-0,07	4,54	44,68
ITA	50	102,87	5,11	103,56	103,24	4,52	78,06	110,16	32,10	-2,18	8,67	0,72	6,24
JPN	50	99,67	4,11	100,51	100,21	3,57	82,49	104,59	22,10	-1,73	4,34	0,58	4,97
KOR	50	103,33	6,75	101,47	102,80	5,03	88,82	122,01	33,19	0,72	0,55	0,95	7,00
LUX	50	98,46	4,70	99,34	98,85	3,66	77,53	106,32	28,80	-1,71	5,70	0,67	5,22
MEX	32	106,62	3,37	107,12	107,03	3,49	98,37	110,35	11,98	-0,87	-0,40	0,60	4,24
NLD	50	102,73	2,39	102,57	102,85	1,58	94,59	107,66	13,07	-0,66	1,29	0,34	2,43
NZL	50	100,12	4,30	99,65	100,22	6,08	91,17	106,89	15,72	-0,17	-1,22	0,61	8,09
NOR	50	100,32	3,03	99,84	100,33	2,99	93,91	106,56	12,65	0,00	-0,41	0,43	3,09
POL	50	106,78	18,14	102,35	105,00	18,38	80,33	152,27	71,93	0,74	-0,28	2,56	28,23
PRT	50	100,97	4,74	101,68	101,27	4,28	79,04	109,75	30,71	-1,82	6,92	0,67	5,65
SVK	50	99,48	11,65	102,03	99,82	15,57	78,27	115,81	37,54	-0,18	-1,48	1,65	21,25
ESP	50	101,59	4,83	102,54	102,09	4,04	80,44	107,81	27,38	-1,72	4,97	0,68	6,80
SWE	50	105,13	5,75	104,51	105,10	6,67	95,19	115,09	19,90	0,08	-1,16	0,81	9,48
CHE	50	106,37	9,73	101,30	105,28	6,75	94,50	129,60	35,10	0,82	-0,57	1,38	15,35
TUR	50	102,86	20,21	101,86	102,06	20,80	64,99	146,89	81,89	0,28	-0,61	2,86	28,23
GBR	50	100,67	7,66	99,84	100,03	7,68	90,66	115,95	25,29	0,59	-0,75	1,08	10,13
USA	50	98,00	3,73	98,64	98,43	3,32	86,62	103,07	16,46	-1,02	0,63	0,53	4,33
BRA	50	101,81	8,58	98,36	101,79	7,07	77,53	114,40	36,87	-0,10	-0,76	1,21	16,14
CHL	50	98,05	3,77	99,55	98,60	2,75	86,00	102,06	16,06	-1,21	0,79	0,53	3,85
COL	50	102,56	8,40	101,33	101,58	6,07	82,56	127,67	45,11	1,03	1,70	1,19	7,95
EST	50	105,21	15,84	101,69	104,94	14,01	68,67	136,18	67,51	0,10	-0,39	2,24	21,29
IND	50	102,85	11,25	102,48	102,97	15,42	75,33	123,30	47,98	-0,10	-1,02	1,59	20,92
ISR	50	102,46	8,32	100,22	101,52	6,99	89,46	128,03	38,56	1,18	1,44	1,18	9,15
LVA	50	105,66	12,00	102,25	105,89	15,89	79,53	125,40	45,87	-0,08	-1,10	1,70	19,01
LTU	50	107,43	18,59	102,06	105,19	18,09	77,54	161,55	84,01	0,98	0,59	2,63	22,94
RUS	48	100,64	10,41	100,32	100,69	13,84	82,73	120,27	37,53	-0,02	-1,26	1,50	18,28
SVN	50	108,01	14,58	103,49	107,06	16,04	88,11	135,58	47,47	0,35	-1,44	2,06	27,39
OECD	50	99,99	4,30	99,98	100,24	5,29	88,20	106,75	18,55	-0,45	-0,36	0,61	7,22
OECD E	50	101,58	6,39	100,91	101,49	7,84	88,84	113,42	24,59	0,10	-1,18	0,90	11,31
G-7	50	99,09	3,36	99,49	99,34	2,60	85,02	104,25	19,22	-1,43	4,24	0,48	3,19
EA19	50	100,67	4,37	100,29	100,86	4,82	84,79	107,52	22,73	-0,76	1,44	0,62	7,31
EU27_2020	50	101,19	5,13	100,49	101,27	5,95	86,53	110,62	24,10	-0,20	-0,39	0,73	8,88
BGR	50	101,87	8,00	100,82	101,21	8,06	87,03	127,03	40,00	0,92	1,22	1,13	10,47
HRV	50	103,48	4,68	104,07	103,48	4,20	94,96	112,86	17,90	-0,14	-1,00	0,66	7,32
ROU	50	99,77	13,08	101,01	100,33	16,08	73,42	118,68	45,27	-0,35	-1,18	1,85	24,06

Table 20- Descriptive statistics – Industrial Production

Variable	Obs	Mean	Std. Dev.	Median	Trimmed	Mad	Min	Max	Range	Skew	Kurtosis	Std. Error	IQR
AUS	52	0,33	2,11	-0,09	0,16	1,23	-5,39	7,28	12,67	0,78	1,65	0,29	1,66
AUT	52	0,62	2,94	0,72	0,57	1,58	-11,55	12,91	24,46	0,05	8,99	0,41	2,09
BEL	52	0,54	4,57	0,49	0,49	1,89	-16,15	18,17	34,33	0,14	5,95	0,63	2,56
CAN	52	0,37	3,21	0,44	0,43	1,68	-13,28	14,28	27,56	0,03	10,29	0,45	2,11
CZE	52	0,53	1,74	0,60	0,62	1,74	-4,42	4,16	8,58	-0,47	0,06	0,24	2,25
DNK	52	1,23	3,76	1,14	1,09	2,64	-12,21	12,04	24,24	0,03	3,23	0,52	3,53
FIN	52	0,37	2,19	0,27	0,26	1,83	-4,34	6,88	11,22	0,49	0,28	0,30	2,42
FRA	52	0,57	4,24	0,57	0,53	0,74	-14,35	24,25	38,59	2,23	19,20	0,59	1,00
DEU	52	0,51	2,07	0,45	0,49	1,35	-6,81	6,07	12,88	-0,23	2,70	0,29	1,70
GRC	52	-0,38	11,80	-0,86	-1,07	8,53	-23,29	49,66	72,95	1,28	4,51	1,64	11,71
HUN	52	0,93	4,90	1,10	1,18	4,27	-19,79	8,95	28,75	-1,25	4,14	0,68	5,61
ISL	52	2,00	11,45	0,84	1,95	10,02	-24,69	29,50	54,19	0,07	-0,03	1,59	13,43
IRL	52	16,44	68,87	6,65	5,44	24,05	-77,41	300,17	377,58	2,25	5,95	9,55	30,55
ITA	52	0,34	4,90	0,13	0,23	1,66	-14,89	28,03	42,92	2,77	18,70	0,68	2,04
JPN	52	0,29	1,50	0,57	0,45	1,04	-4,96	3,08	8,04	-1,24	2,31	0,21	1,46
KOR	52	0,66	1,83	0,83	0,79	1,96	-3,86	3,98	7,84	-0,56	-0,32	0,25	2,69
LUX	52	0,95	9,37	1,38	0,53	7,44	-15,50	36,47	51,98	0,99	2,61	1,30	9,29
MEX	52	0,45	5,24	0,86	0,67	2,53	-27,91	19,16	47,07	-2,17	16,72	0,73	3,33
NLD	52	2,10	23,84	0,17	0,39	2,57	-47,05	161,14	208,20	5,51	35,44	3,31	2,93
NZL	52	1,36	5,13	1,46	1,21	2,41	-17,74	26,04	43,79	1,23	11,43	0,71	3,38
NOR	52	0,54	3,16	0,54	0,67	3,00	-10,58	5,97	16,56	-0,69	1,35	0,44	3,95
POL	52	0,94	3,20	1,43	1,31	2,11	-13,02	5,93	18,96	-1,92	5,72	0,44	3,09
PRT	52	0,20	3,58	0,87	0,42	2,98	-8,95	10,57	19,52	-0,40	1,01	0,50	3,97
SVK	52	1,05	6,82	1,35	0,95	4,50	-12,93	24,65	37,58	0,54	1,89	0,95	5,96
ESP	52	0,07	4,36	0,08	0,05	2,04	-19,24	20,25	39,49	0,24	13,39	0,60	2,54
SWE	52	0,93	2,47	1,26	0,99	2,01	-6,74	6,00	12,74	-0,46	0,45	0,34	3,17
CHE	52	0,50	2,06	0,60	0,58	1,11	-7,63	8,15	15,78	-0,43	6,19	0,29	1,50
TUR	52	1,72	6,00	2,16	1,54	3,44	-11,58	28,87	40,45	1,38	6,50	0,83	4,85
GBR	52	0,78	4,25	1,09	0,88	2,31	-18,60	15,73	34,33	-0,93	8,68	0,59	3,23
USA	52	0,82	1,58	0,90	0,82	0,92	-6,71	5,35	12,06	-1,46	8,73	0,22	1,40
ARG	52	0,94	9,30	0,64	0,62	5,17	-24,39	49,10	73,48	2,19	12,18	1,29	7,23
BRA	52	0,26	4,64	0,28	0,21	3,15	-15,83	16,25	32,08	0,07	3,45	0,64	4,04
CHL	52	0,96	4,54	0,82	0,98	3,23	-17,93	10,33	28,26	-0,92	4,15	0,63	4,08
COL	52	1,20	7,17	1,36	1,38	3,33	-33,21	27,79	61,00	-1,12	11,10	0,99	3,88
EST	52	2,32	11,63	0,37	1,25	9,14	-23,42	41,54	64,96	1,02	1,84	1,61	13,62
IND	52	2,08	11,72	1,36	1,63	2,71	-40,05	69,14	109,19	2,69	20,92	1,63	3,75
IDN	52	1,20	1,58	1,30	1,38	0,63	-8,96	2,96	11,92	-5,06	29,98	0,22	0,85
ISR	52	1,35	2,95	1,33	1,47	2,81	-7,98	10,46	18,44	-0,23	1,68	0,41	3,57
LVA	52	0,92	4,53	0,74	0,90	3,00	-12,29	11,94	24,23	-0,20	1,60	0,63	3,99
LTU	52	1,65	3,87	1,66	1,52	2,20	-10,44	15,12	25,56	0,41	3,34	0,54	3,45
RUS	47	0,47	3,03	0,86	0,55	2,73	-6,95	6,36	13,31	-0,34	-0,15	0,44	3,67
SVN	52	0,38	3,86	0,18	0,43	3,37	-10,87	12,05	22,92	-0,10	1,54	0,54	3,87
ZAF	52	0,01	4,40	-0,17	0,19	2,91	-22,14	14,09	36,23	-1,81	11,59	0,61	3,67
OECD	52	0,64	2,22	0,68	0,69	0,75	-11,25	9,00	20,25	-1,89	16,65	0,31	1,04
OECD	52	0,65	3,63	0,78	0,59	1,89	-15,81	14,83	30,63	-0,55	10,00	0,50	2,26
G-7	52	0,61	1,78	0,66	0,65	0,60	-8,34	7,80	16,13	-1,18	14,70	0,25	0,82
EA19	52	0,50	4,56	0,30	0,39	2,10	-18,99	15,67	34,67	-0,56	6,55	0,63	2,73
BGR	52	-0,11	3,42	0,21	-0,10	2,76	-7,74	10,40	18,14	0,16	0,80	0,47	3,54
ROU	52	1,16	5,09	0,60	0,97	3,96	-11,65	16,43	28,08	0,34	1,24	0,71	5,41
EU27_2020	52	0,54	4,00	0,38	0,46	1,94	-16,95	13,54	30,49	-0,72	6,88	0,55	2,44
CRI	52	0,82	5,11	0,75	0,83	4,46	-12,17	17,65	29,81	0,22	1,57	0,71	5,74
HRV	52	0,40	4,15	0,46	0,37	2,56	-11,13	13,81	24,93	0,20	1,61	0,58	3,46

Table 21- Descriptive statistics – Investment

Variable	Obs	Mean	Std. Dev.	Median	Trimmed	Mad	Min	Max	Range	Skew	Kurtosis	Std. Error	IQR
AUT	52	2,57	4,39	1,43	1,84	3,08	-2,30	16,69	18,99	1,46	1,70	0,61	4,35
BEL	52	4,18	8,62	3,14	3,21	6,26	-8,00	29,56	37,55	1,04	0,88	1,20	8,16
CZE	52	2,77	6,13	1,68	1,74	2,96	-4,80	24,24	29,04	1,71	2,85	0,85	3,84
DNK	52	2,72	4,13	1,96	1,89	2,74	-1,80	16,41	18,21	1,82	3,00	0,57	3,62
FIN	52	3,51	7,17	2,14	2,22	4,33	-5,03	28,98	34,01	1,73	2,70	0,99	5,62
FRA	52	2,25	5,30	1,34	1,32	3,37	-3,84	19,81	23,65	1,69	2,69	0,74	4,25
DEU	52	2,47	4,35	1,33	1,53	2,44	-1,48	17,27	18,74	1,97	3,34	0,60	3,14
GRC	52	2,87	9,10	2,05	2,00	7,95	-12,68	31,91	44,59	0,87	0,89	1,26	10,80
HUN	52	5,39	10,20	4,17	3,99	6,07	-11,26	37,82	49,08	1,46	2,51	1,41	7,99
ISL	52	4,32	9,08	3,33	3,80	8,06	-10,63	26,29	36,92	0,42	-0,34	1,26	10,86
IRL	52	1,36	3,36	1,07	1,16	2,64	-4,83	10,14	14,97	0,62	0,17	0,47	3,44
ITA	52	2,43	4,63	1,41	1,62	3,25	-2,83	17,49	20,31	1,56	2,04	0,64	4,27
JPN	52	0,93	3,01	0,51	0,67	2,22	-4,00	7,71	11,71	0,69	-0,03	0,42	2,97
KOR	52	1,79	6,08	0,30	1,36	5,61	-7,52	15,53	23,05	0,61	-0,54	0,84	7,55
LUX	52	4,56	7,65	1,25	3,01	3,17	-2,21	32,80	35,00	1,85	3,00	1,06	5,70
MEX	52	5,21	2,90	5,20	5,16	2,93	-0,54	12,97	13,52	0,25	-0,26	0,40	3,89
NLD	52	4,01	7,42	2,47	2,92	6,04	-5,00	26,51	31,51	1,25	0,93	1,03	8,37
NOR	52	4,25	5,34	2,58	3,28	2,36	-2,54	22,35	24,89	1,89	3,53	0,74	4,35
POL	52	4,07	7,62	2,09	2,61	4,72	-4,19	29,82	34,01	1,73	2,56	1,06	6,97
PRT	52	2,54	7,05	1,73	1,56	4,78	-7,86	24,96	32,82	1,44	2,22	0,98	6,21
SVK	52	1,94	5,78	1,28	0,85	4,07	-4,73	21,51	26,24	1,79	3,09	0,80	5,12
ESP	52	3,18	6,37	2,03	2,11	4,41	-5,41	24,05	29,46	1,51	1,94	0,88	5,68
CHE	52	0,30	2,26	-0,07	0,07	1,05	-3,86	7,26	11,12	1,21	2,12	0,31	1,67
TUR	52	21,58	28,63	10,60	14,50	8,89	1,53	124,97	123,44	2,36	4,81	3,97	15,33
GBR	52	3,09	4,93	2,08	2,40	3,21	-3,50	19,11	22,61	1,45	2,27	0,68	4,07
COL	52	4,15	4,66	2,89	3,33	2,73	-1,84	17,24	19,08	1,51	1,56	0,65	3,57
CRI	52	4,24	4,43	3,21	3,68	2,79	-1,86	16,62	18,47	1,18	0,73	0,61	3,46
EST	52	3,91	6,40	2,61	2,79	3,44	-3,31	26,70	30,00	1,73	2,67	0,89	4,72
ISR	52	1,93	5,76	1,06	1,65	5,38	-8,08	16,35	24,44	0,40	-0,47	0,80	7,00
LVA	52	4,16	7,40	1,74	2,64	4,03	-5,52	28,69	34,21	1,92	3,17	1,03	5,29
LTU	52	4,07	11,59	2,21	2,09	6,86	-11,50	44,32	55,83	1,70	3,03	1,61	9,38
RUS	48	8,04	6,86	6,43	7,63	6,11	-3,97	25,96	29,93	0,63	-0,08	0,99	8,62
SVN	52	2,67	4,96	1,01	1,51	1,81	-1,75	20,07	21,81	2,25	4,30	0,69	2,48
ZAF	52	5,93	3,18	5,63	5,57	1,98	-0,60	16,97	17,57	1,33	2,89	0,44	2,63
OECD	52	3,59	5,70	2,33	2,65	3,24	-2,96	21,52	24,48	1,49	1,76	0,79	4,33
OECD	52	4,45	7,17	2,46	2,93	3,41	-2,30	28,56	30,86	2,01	3,56	0,99	5,17
G-7	52	2,74	4,96	1,32	2,13	2,96	-3,88	17,45	21,33	1,15	0,89	0,69	3,97
EA19	52	2,65	5,22	1,50	1,70	3,33	-2,98	19,97	22,95	1,65	2,39	0,72	4,35
EU27_2020	52	2,81	5,41	1,60	1,80	3,39	-2,87	20,84	23,72	1,68	2,47	0,75	4,40

Table 22- Descriptive statistics – PPI

Variable	Obs	Mean	Std. Dev.	Median	Trimmed	Mad	Min	Max	Range	Skew	Kurtosis	Std. Error	IQR
AUS	52	102,60	16,52	101,16	102,12	17,66	76,12	135,08	58,97	0,24	-0,92	2,29	24,05
AUT	52	113,75	20,36	105,14	112,57	19,13	81,44	159,00	77,56	0,46	-1,06	2,82	31,74
BEL	52	84,76	14,27	89,41	85,65	13,79	56,30	103,49	47,19	-0,51	-1,22	1,98	25,62
CAN	52	105,42	18,12	103,85	103,63	15,85	81,55	148,52	66,97	0,75	-0,21	2,51	23,58
CZE	52	105,25	12,92	102,09	104,07	11,02	86,36	139,67	53,32	0,81	0,04	1,79	15,57
DNK	52	101,86	44,34	101,99	98,55	45,42	41,97	195,26	153,30	0,51	-0,71	6,15	58,09
FIN	52	100,68	22,80	100,98	99,89	21,39	62,57	152,81	90,24	0,22	-0,65	3,16	29,42
FRA	52	98,27	21,50	98,13	97,66	24,36	61,81	141,53	79,72	0,14	-0,98	2,98	34,95
DEU	52	92,77	18,84	96,76	93,03	17,08	58,32	126,44	68,12	-0,25	-1,01	2,61	30,04
GRC	52	122,37	42,77	111,44	115,08	24,75	72,93	276,62	203,69	1,62	2,38	5,93	31,95
HUN	52	142,42	51,33	129,06	139,19	64,02	81,19	250,03	168,84	0,32	-1,36	7,12	97,72
ISL	52	108,70	50,57	110,78	102,88	54,33	45,87	226,52	180,65	0,82	-0,18	7,01	59,39
IRL	52	88,59	27,78	98,65	88,86	21,13	42,33	137,22	94,89	-0,32	-1,18	3,85	47,02
ITA	52	94,59	16,70	93,72	94,31	15,31	62,01	131,17	69,16	0,09	-0,60	2,32	20,63
JPN	52	90,19	25,34	97,81	90,81	26,85	47,53	128,78	81,25	-0,29	-1,21	3,51	38,37
KOR	52	107,93	17,69	100,94	105,15	7,43	81,93	158,99	77,06	1,40	1,43	2,45	18,13
LUX	52	97,80	18,98	98,37	97,40	13,10	50,93	141,29	90,35	0,10	0,54	2,63	16,31
MEX	52	98,28	12,13	99,05	98,62	11,74	72,94	120,86	47,92	-0,25	-0,70	1,68	15,15
NLD	52	100,62	23,79	98,94	99,16	25,69	65,15	154,38	89,23	0,37	-0,79	3,30	36,74
NZL	52	116,23	39,66	113,39	114,56	55,37	62,61	183,82	121,22	0,23	-1,33	5,50	71,44
NOR	52	117,43	43,63	103,83	113,55	49,44	61,42	211,77	150,35	0,58	-0,75	6,05	68,04
POL	52	100,56	15,09	100,01	100,09	15,76	75,06	136,33	61,27	0,27	-0,65	2,09	21,82
PRT	52	116,90	25,03	111,38	113,95	19,68	79,92	185,88	105,96	1,03	0,41	3,47	27,58
SVK	52	110,01	25,81	119,77	109,93	34,18	70,76	153,44	82,68	-0,10	-1,57	3,58	46,96
ESP	52	86,07	11,23	83,54	86,45	13,80	64,13	106,46	42,33	-0,09	-0,96	1,56	17,17
SWE	52	104,01	35,70	100,50	100,42	37,41	57,22	191,42	134,21	0,72	-0,24	4,95	45,70
CHE	52	99,65	21,48	98,65	98,90	23,27	63,10	144,19	81,09	0,17	-0,80	2,98	29,31
TUR	52	129,43	83,20	103,39	111,77	33,90	66,12	558,36	492,24	3,24	12,28	11,54	42,17
GBR	52	100,04	10,37	101,86	100,59	13,37	80,61	114,44	33,83	-0,32	-1,21	1,44	19,43
USA	52	105,15	25,59	101,98	103,83	27,17	65,14	158,05	92,91	0,31	-0,75	3,55	34,39
BRA	52	150,43	47,44	131,96	147,04	40,72	86,85	247,99	161,15	0,58	-1,14	6,58	81,93
CHL	52	116,50	16,68	112,29	115,19	15,74	93,00	150,77	57,76	0,63	-0,84	2,31	24,73
CHN	52	78,76	13,78	79,39	78,79	14,08	55,43	121,04	65,62	0,15	0,08	1,91	18,76
COL	52	115,63	14,32	116,96	115,75	18,44	87,67	142,80	55,13	-0,04	-1,03	1,99	22,68
EST	52	122,40	45,24	114,81	117,94	41,97	61,51	229,34	167,82	0,72	-0,33	6,27	55,35
IND	52	114,11	47,24	101,69	108,60	47,89	60,35	221,79	161,44	0,83	-0,37	6,55	67,15
IDN	52	104,80	22,63	105,16	105,41	25,18	53,35	143,85	90,50	-0,23	-0,75	3,14	32,22
ISR	52	90,32	14,09	87,92	88,94	8,39	68,40	128,52	60,13	0,89	0,46	1,95	11,14
LVA	52	152,83	67,46	134,71	149,88	81,13	67,12	268,02	200,90	0,19	-1,69	9,36	127,38
RUS	52	123,85	41,90	114,24	117,89	41,21	81,14	238,69	157,56	1,03	0,22	5,81	55,28
SVN	52	109,56	22,34	108,15	107,70	17,85	69,82	164,94	95,12	0,68	0,09	3,10	22,66
ZAF	52	96,29	24,01	100,33	96,36	17,73	53,14	144,50	91,36	-0,17	-0,80	3,33	32,16
EA19	52	94,75	17,82	97,86	94,54	16,65	62,44	131,84	69,40	0,01	-0,83	2,47	27,75
BGR	52	105,70	22,70	104,46	106,01	25,76	63,05	148,98	85,93	-0,07	-1,02	3,15	33,83
ROU	52	106,01	32,02	99,69	102,89	30,92	60,99	178,40	117,40	0,71	-0,40	4,44	39,92
HRV	52	107,87	8,80	107,00	107,28	8,69	92,48	131,49	39,01	0,63	0,05	1,22	12,12

Table 23- Descriptive statistics – Share Prices

Variable	Obs	Mean	Std. Dev.	Median	Trimmed	Mad	Min	Max	Range	Skew	Kurtosis	Std. Error	IQR
AUS	52	5,41	0,72	5,39	5,45	0,49	3,47	7,11	3,63	-0,45	1,20	0,10	0,67
AUT	52	5,59	0,69	5,52	5,57	0,82	4,43	7,00	2,57	0,19	-0,96	0,10	1,06
BEL	52	7,14	1,26	7,25	7,18	1,83	5,10	8,83	3,73	-0,15	-1,49	0,18	2,59
CAN	52	7,06	1,34	7,08	6,94	0,89	5,10	13,37	8,27	2,01	7,50	0,19	1,24
CZE	52	4,47	2,06	4,00	4,42	2,74	1,87	7,80	5,93	0,18	-1,71	0,29	4,36
DNK	52	6,23	1,18	6,10	6,23	1,53	4,17	8,23	4,07	0,05	-1,34	0,16	2,31
FIN	52	8,06	0,87	8,15	8,07	0,77	6,43	9,57	3,13	-0,24	-1,03	0,12	1,25
FRA	52	9,17	1,00	9,27	9,25	1,31	7,20	10,47	3,27	-0,51	-0,94	0,14	1,69
DEU	52	4,24	1,05	3,95	4,13	1,21	2,90	6,97	4,07	0,69	-0,36	0,15	1,68
GRC	52	20,26	5,11	20,32	20,35	6,00	11,47	28,07	16,60	-0,11	-1,29	0,71	7,90
HUN	52	6,39	2,96	4,85	6,23	2,22	3,23	10,90	7,67	0,46	-1,52	0,41	6,09
ISL	52	5,27	1,74	5,08	5,14	2,10	3,10	8,57	5,47	0,40	-1,15	0,24	2,81
IRL	52	9,50	4,12	8,52	9,36	5,11	4,33	15,93	11,60	0,29	-1,55	0,57	8,25
ITA	52	10,44	1,56	10,43	10,44	1,95	7,90	12,93	5,03	-0,07	-1,35	0,22	2,68
JPN	52	3,37	0,86	3,10	3,30	0,84	2,30	5,13	2,83	0,59	-0,97	0,12	1,37
KOR	52	3,54	0,36	3,57	3,54	0,35	2,77	4,27	1,50	-0,05	-0,56	0,05	0,45
LUX	52	5,57	0,71	5,60	5,57	0,84	4,40	7,47	3,07	0,13	-0,66	0,10	1,06
MEX	52	4,28	0,77	4,33	4,27	1,05	3,05	5,50	2,45	-0,03	-1,53	0,11	1,47
NLD	52	6,02	1,56	6,07	6,02	2,05	3,30	8,67	5,37	0,06	-1,21	0,22	2,62
NZL	52	5,03	0,99	5,20	5,07	1,19	3,20	6,70	3,50	-0,27	-1,04	0,14	1,63
NOR	52	4,07	0,58	3,97	4,04	0,64	3,13	5,53	2,40	0,51	-0,61	0,08	0,92
POL	52	6,59	3,05	6,30	6,54	4,67	2,83	10,87	8,03	0,10	-1,73	0,42	6,38
PRT	52	10,90	3,91	11,38	10,70	6,05	5,70	18,20	12,50	0,20	-1,38	0,54	7,13
SVK	52	10,02	3,41	9,67	9,99	5,21	5,67	14,90	9,23	0,07	-1,76	0,47	7,07
ESP	52	19,10	4,37	19,28	18,99	5,81	12,73	26,33	13,60	0,17	-1,37	0,61	7,57
SWE	52	7,78	0,78	7,93	7,76	0,94	6,33	9,30	2,97	0,08	-0,94	0,11	1,20
CHE	52	4,70	0,32	4,75	4,70	0,32	4,10	5,60	1,50	0,11	-0,31	0,04	0,47
TUR	52	10,77	1,58	10,43	10,70	1,43	8,23	14,03	5,80	0,39	-0,78	0,22	2,09
GBR	52	5,62	1,67	5,00	5,54	1,56	3,60	8,40	4,80	0,43	-1,49	0,23	3,63
USA	52	6,10	2,25	5,48	5,90	2,47	3,57	12,97	9,40	0,74	-0,21	0,31	3,73
CHL	52	7,45	1,36	7,09	7,20	0,88	5,65	12,02	6,37	1,79	3,06	0,19	1,23
EST	52	7,86	3,36	6,70	7,28	1,80	4,17	18,87	14,70	1,60	2,06	0,47	3,10
ISR	52	5,09	1,08	5,09	5,06	1,41	3,51	7,08	3,57	0,23	-1,23	0,15	1,83
SVN	52	7,00	2,12	7,30	6,98	3,14	3,57	10,53	6,97	0,00	-1,47	0,29	3,79
OECD	52	6,83	1,20	6,76	6,83	1,89	4,90	8,68	3,77	-0,04	-1,50	0,17	2,52
G-7	52	5,94	1,38	5,72	5,90	1,89	3,99	8,56	4,57	0,20	-1,34	0,19	2,65
EA19	52	9,57	1,75	10,02	9,59	2,35	6,67	12,20	5,53	-0,09	-1,37	0,24	3,07
LVA	52	10,60	3,94	9,60	10,11	3,36	6,07	20,53	14,47	0,98	-0,14	0,55	4,58
LTU	52	9,80	3,72	8,70	9,33	3,66	5,57	18,20	12,63	0,85	-0,47	0,52	5,09
COL	52	10,81	2,16	10,42	10,39	1,58	8,86	19,09	10,24	1,89	3,74	0,30	2,06
EU27_2020	52	8,93	1,83	9,25	8,95	2,57	6,10	11,70	5,60	-0,07	-1,51	0,25	3,23
CRI	50	11,39	3,44	10,06	10,60	1,32	8,34	23,77	15,43	2,07	3,68	0,49	2,36

Table 24- Descriptive statistics – Unemployment

Variable	Obs	Mean	Std. Dev.	Median	Trimmed	Mad	Min	Max	Range	Skew	Kurtosis	Std. Error	IQR
AUS	52	5,41	0,72	5,39	5,45	0,49	3,47	7,11	3,63	-0,45	1,20	0,10	0,67
AUT	52	5,59	0,69	5,52	5,57	0,82	4,43	7,00	2,57	0,19	-0,96	0,10	1,06
BEL	52	7,14	1,26	7,25	7,18	1,83	5,10	8,83	3,73	-0,15	-1,49	0,18	2,59
CAN	52	7,06	1,34	7,08	6,94	0,89	5,10	13,37	8,27	2,01	7,50	0,19	1,24
CZE	52	4,47	2,06	4,00	4,42	2,74	1,87	7,80	5,93	0,18	-1,71	0,29	4,36
DNK	52	6,23	1,18	6,10	6,23	1,53	4,17	8,23	4,07	0,05	-1,34	0,16	2,31
FIN	52	8,06	0,87	8,15	8,07	0,77	6,43	9,57	3,13	-0,24	-1,03	0,12	1,25
FRA	52	9,17	1,00	9,27	9,25	1,31	7,20	10,47	3,27	-0,51	-0,94	0,14	1,69
DEU	52	4,24	1,05	3,95	4,13	1,21	2,90	6,97	4,07	0,69	-0,36	0,15	1,68
GRC	52	20,26	5,11	20,32	20,35	6,00	11,47	28,07	16,60	-0,11	-1,29	0,71	7,90
HUN	52	6,39	2,96	4,85	6,23	2,22	3,23	10,90	7,67	0,46	-1,52	0,41	6,09
ISL	52	5,27	1,74	5,08	5,14	2,10	3,10	8,57	5,47	0,40	-1,15	0,24	2,81
IRL	52	9,50	4,12	8,52	9,36	5,11	4,33	15,93	11,60	0,29	-1,55	0,57	8,25
ITA	52	10,44	1,56	10,43	10,44	1,95	7,90	12,93	5,03	-0,07	-1,35	0,22	2,68
JPN	52	3,37	0,86	3,10	3,30	0,84	2,30	5,13	2,83	0,59	-0,97	0,12	1,37
KOR	52	3,54	0,36	3,57	3,54	0,35	2,77	4,27	1,50	-0,05	-0,56	0,05	0,45
LUX	52	5,57	0,71	5,60	5,57	0,84	4,40	7,47	3,07	0,13	-0,66	0,10	1,06
MEX	52	4,28	0,77	4,33	4,27	1,05	3,05	5,50	2,45	-0,03	-1,53	0,11	1,47
NLD	52	6,02	1,56	6,07	6,02	2,05	3,30	8,67	5,37	0,06	-1,21	0,22	2,62
NZL	52	5,03	0,99	5,20	5,07	1,19	3,20	6,70	3,50	-0,27	-1,04	0,14	1,63
NOR	52	4,07	0,58	3,97	4,04	0,64	3,13	5,53	2,40	0,51	-0,61	0,08	0,92
POL	52	6,59	3,05	6,30	6,54	4,67	2,83	10,87	8,03	0,10	-1,73	0,42	6,38
PRT	52	10,90	3,91	11,38	10,70	6,05	5,70	18,20	12,50	0,20	-1,38	0,54	7,13
SVK	52	10,02	3,41	9,67	9,99	5,21	5,67	14,90	9,23	0,07	-1,76	0,47	7,07
ESP	52	19,10	4,37	19,28	18,99	5,81	12,73	26,33	13,60	0,17	-1,37	0,61	7,57
SWE	52	7,78	0,78	7,93	7,76	0,94	6,33	9,30	2,97	0,08	-0,94	0,11	1,20
CHE	52	4,70	0,32	4,75	4,70	0,32	4,10	5,60	1,50	0,11	-0,31	0,04	0,47
TUR	52	10,77	1,58	10,43	10,70	1,43	8,23	14,03	5,80	0,39	-0,78	0,22	2,09
GBR	52	5,62	1,67	5,00	5,54	1,56	3,60	8,40	4,80	0,43	-1,49	0,23	3,63
USA	52	6,10	2,25	5,48	5,90	2,47	3,57	12,97	9,40	0,74	-0,21	0,31	3,73
CHL	52	7,45	1,36	7,09	7,20	0,88	5,65	12,02	6,37	1,79	3,06	0,19	1,23
EST	52	7,86	3,36	6,70	7,28	1,80	4,17	18,87	14,70	1,60	2,06	0,47	3,10
ISR	52	5,09	1,08	5,09	5,06	1,41	3,51	7,08	3,57	0,23	-1,23	0,15	1,83
SVN	52	7,00	2,12	7,30	6,98	3,14	3,57	10,53	6,97	0,00	-1,47	0,29	3,79
OECD	52	6,83	1,20	6,76	6,83	1,89	4,90	8,68	3,77	-0,04	-1,50	0,17	2,52
G-7	52	5,94	1,38	5,72	5,90	1,89	3,99	8,56	4,57	0,20	-1,34	0,19	2,65
EA19	52	9,57	1,75	10,02	9,59	2,35	6,67	12,20	5,53	-0,09	-1,37	0,24	3,07
LVA	52	10,60	3,94	9,60	10,11	3,36	6,07	20,53	14,47	0,98	-0,14	0,55	4,58
LTU	52	9,80	3,72	8,70	9,33	3,66	5,57	18,20	12,63	0,85	-0,47	0,52	5,09
COL	52	10,81	2,16	10,42	10,39	1,58	8,86	19,09	10,24	1,89	3,74	0,30	2,06
EU27_2020	52	8,93	1,83	9,25	8,95	2,57	6,10	11,70	5,60	-0,07	-1,51	0,25	3,23
CRI	50	11,39	3,44	10,06	10,60	1,32	8,34	23,77	15,43	2,07	3,68	0,49	2,36

Table 25- Descriptive statistics – Unit Labor Costs